

THE MAGAZINE FOR INDUSTRIAL VEHICLE TECHNOLOGY, DESIGN & ENGINEERING

iVT Industrial Vehicle Technology International

OEM interview  
Paco Pérez Salinas,  
AUSA

MARCH 2016

# iVT

INTERNATIONAL  
INDUSTRIAL VEHICLE TECHNOLOGY

# Multi-axled machinery

Building the perfect driveline –  
for when two axles just won't do the job

**Case studies**

**Grove GMK5250L** five-axled mobile crane

**Vredo VT6018** tri-axled slurry spreader

**Scheuerle** 26-axled shipyard transporter

**PLUS**

**Huddig's** Tigon Technology backhoe loaders

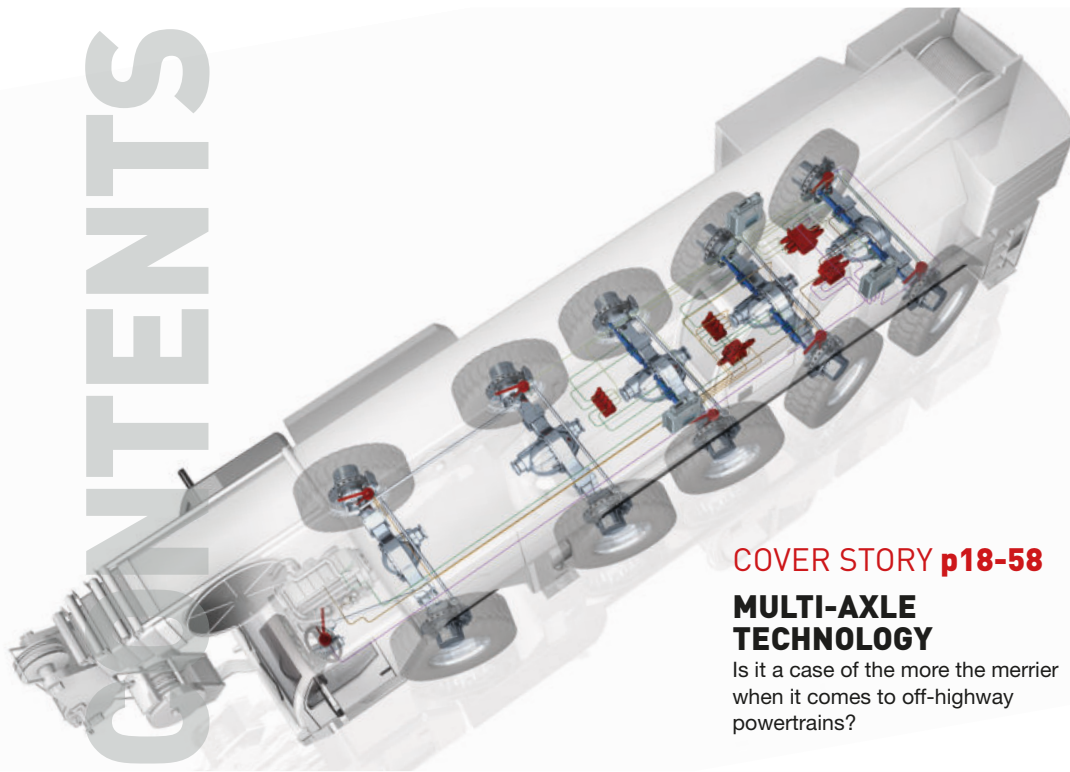
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**Bauma 2016**



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Is it a case of the more the merrier when it comes to off-highway powertrains?



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Picture: Amos Boaz

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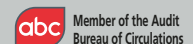
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# FOREWORD

Like 'smoothie', 'Brexit' is one of those new, trendy words to which I've taken an active dislike, despite being fairly ambivalent about what they're describing. That said, rather like 'flat white' – another hated word/phrase – I've no idea what it (a British exit from the European Union) *really* means. Unlike 'flat white', however, I do have an interest in finding out, because I feel I really should know where I stand on the subject.

The main problem is that the usual criteria don't apply when deciding which camp to join – you can't really make a decision based on the personalities involved, as most people do with an election. For every Michael Caine backing an exit, there's a Ukip (no affiliation to our company!) candidate saying the same, and you really don't want to share their views. On the other hand, that effectively means you're siding with the likes of UK Prime Minister David Cameron, and no one wants that either. So the issues have to be focused on exclusively.

Confusingly, better control of the economy, migration and enhanced trade are benefits that those on either side of the divide are claiming will result if the UK population votes their way on June 23. On the plus side, however, an exit would stem the powers of the TTIP – the trade agreement that would give big business the ability to sue governments should they have the temerity to pass legislation they deem unfair (for 'unfair' read 'safeguarding the environment/the public's health, at the expense of our massive profits'). So Starbucks, say, could take an elected government to court for having the cheek to impose a Sugar Tax – although no doubt they'd find a way of reducing that tax to minuscule levels before the need arose.

But what would this all mean for the off-highway industry? The UK Construction Equipment Association is now surveying its members to get their take on the issue. The main short-term effect,

says chief exec Rob Oliver, is the uncertainty that the referendum process is causing: "We have seen an initial sell-off of sterling, which helps our exporter members but penalizes our importer companies. If the people decide to ditch Europe, then there is further uncertainty around how long it would take to extricate the UK and set up alternative trading agreements. We have a strong record of inward investment in the UK from American, Japanese and, increasingly, Chinese companies, and this could be compromised by Brexit. The CEA, working through CECE, has met with some success in shaping European Directives affecting our members. The frustration, however, is that their implementation, covering areas such as machine noise, safety and emissions, has been uneven among Member States. This means that, in some respects, we still don't have a proper single market for our products. Generally this is the fault of national government agencies – so rather than seeing Brussels as the fount of unreason, sometimes we have to look closer to home to improve matters."

But is the rest of Europe bothered either way? Sascha Schmel, chairman of the Material Handling & Intralogistics Association within the VDMA, doesn't think that exports to the UK would be adversely affected. "A Brexit's effects on the German material handling industry will be much more determined by overall economic effects such as currency exchange rates than anything else," he told me. "And although the UK is our third-biggest export market, applying any other than the established EN or ISO standards is unlikely to be considered by German OEMs."

So, several hundred words later, I'm still none the wiser. Maybe a week spent in the hurly-burly of Bauma Munich will provide me with the answers I need – or at least offer one last chance to stock up on some very reasonably priced exceptional German beers...

*Richard Carr, editor, iVT International*

Coming up in the June issue of *iVT*

• The best of Bauma • OEM interviews: Putzmeister Underground & Corinsa • Electronics – condition monitoring • Mobile hydraulics • The latest vehicle case studies • IAA Preview

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# Ich Liebherr these



WHAT'S NEW

**MUNICH, GERMANY** – Having announced a host of spectacular new vehicles that *iVT* already loves, and with a few more under wraps until April, Liebherr looks set to steal the show at Bauma. However, it's the official market launch of a machine first seen as a prototype at the 2013 edition of the show that could well have the biggest impact on the industry, as the OEM makes six XPower (CVT) wheeled loaders available in the 12.2-21.6-metric ton and 140-260kW range.

Liebherr-Werk Bischofshofen worked as a development partner with ZF to ensure that the powersplit transmission, which will be installed as standard in the company's large wheeled loaders, has been optimized for the requirements of the new XPower drive system. It combines hydrostatic drive, for maximum efficiency in short loading cycles,

with mechanical drive, for long distances and tackling gradients, continuously adapting the mixing ratio of the two drive paths without any noticeable switching or interruption of traction. With the load being distributed over the two drive paths, this results in a much longer component lifespan.

Beefed up with robust components in an improved layout, these Tier 4F models have been put through more extensive testing than ever before, which has indicated that fuel savings of up to 30% are feasible.

Stronger axles (i.e. from the next model up in the previous range) have been fitted – for example, a new L 556 XPower is now equipped with the axles of an 'old' L 566, while larger bolt diameters and an optimized lever ratio have been introduced to increase the lift arm lifespan. The bucket structure

and bearings have also been reinforced, making it possible to increase the volume of the standard bucket by between 0.2-0.5m<sup>3</sup>.

There is little brake wear as the XPower drivetrain independently supports braking so that the operating brake has only a support function. Tire wear is reduced by up to 25% as the continuous force control, in combination with the automatic self-locking diff, prevents the wheels from slipping.

The stylish, tapered engine hood offers excellent visibility toward the back of the machine and increases safety immediately around it. Heavier components have been installed right at the back of the machine's rear section, shifting the CoG behind the back axle to remove the need for additional counterweight and creating the ideal weight distribution to enable higher tipping loads.



ABOVE: Along with the five-axled LTM 1250-5.1 and LR 1500 crawler cranes seen at a recent open day in Ehingen, Germany, Liebherr will fully unveil this eight-axled mobile crane with 'a very long telescopic boom'



The newly designed steel fabrication of the 230kW LR 1100 crawler provides optimum force transmission over short distances. The patented boom foot manipulator makes it easy for haulage contractors to move the crane.

The OEM has also developed a new type of high-strength fiber rope in association with Teufelberger, for use across its whole range. When the coating of the rope is clearly worn, the operator is able to easily identify when it needs to be changed. Its properties can also be assessed using condition monitoring



ABOVE: With a completely redesigned configuration, including angled 13m boom and straight 12m stick, the LH 110 C High Rise Port material handler features a hydraulic double-pivot cab with infinitely adjustable height and forward movement, and sliding doors with ground access. The patented energy recovery system (ERC) comes as standard



Liebherr will also unveil its largest dozer, the PR 776, at Bauma. The 565kW, 74t machine is said to be the first hydrostatic machine in this category and features on-demand hydraulic servo pressure and ROPS/FOPS integrated directly in the cab structure

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Matt Burton  
business operations and quality manager

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## CONSTRUCTION FOCUS



**JIM MANFREDI, MACHINERY OUTLOOK**

### NO BEEF WITH KOBE

The businesses of Kobelco Construction Machinery and Kobelco Cranes will merge as of April 1. Kobe Steel's construction equipment business saw Kobelco Construction Machinery spin off the crane business in 2004, since when the two companies have specialized in their respective fields in Japan and overseas.

Under its medium-term business plan covering FY 2013-2015, Kobe stated it would strategically expand its machinery-related businesses to accelerate global development.

### RECORD REVENUE

Liebherr Group has announced the highest revenue in its history – provisional figures for the full year 2015 put total sales revenues at €9.248bn. Year on year, this represents an increase of €425m or 4.8%.

In 2015, it enjoyed growth in construction machinery, mining and its divisions covering maritime cranes, aerospace and transportation systems, machine tools and automation systems, domestic appliances, components and hotels. Revenue from construction and mining increased by €337m, or 6.4%, to €5.631bn. This section includes the earthmoving, mining, mobile cranes, tower cranes and concrete technology divisions.

Although sales declined in Africa and Eastern Europe, increases were posted in the Middle East, the Far East, Australia and USA. In Western Europe – Liebherr's most important sales region – revenue remained largely unchanged.

### ASK THE EXPERTS

Exports of US-manufactured construction equipment

dropped 17.6% for the first three quarters of 2015 compared with Q1-3 2014, for a total US\$10.8bn shipped worldwide. Sales to all world regions dipped, led by Africa (-36%) and South and Central America (-28% and -21%), according to AEM. European and Asian sales came to US\$1.4bn each, dropping 11% and 10% respectively.

While it is hard to pinpoint the exact cause, some of the possible explanations for the decline may include the difficulties in exporting equipment with engines that require ultra-low-sulfur diesel, strengthening local manufacturing industries and a strong dollar making US manufacturers less competitive.

### CAT DRONES ON

Caterpillar has teamed up with Redbird, a leader in the acquisition and analysis of aerial data collected by UAVs.

Redbird collects and provides analysis of drone data using cloud-based, proprietary algorithms. This digital analytic data helps contractors become more productive, make better business decisions and optimize their operations.

The Caterpillar and Redbird agreement will operate in EAME.

### NEF FOR DIECI

FPT Industrial has signed a long-term supply agreement as the preferred powertrain supplier of Dieci, a producer of telescopic handlers and cement truck mixers. Their relationship began back in the 1980s.

Delivering power outputs from 92-125kW, its NEF 45 Stage IV engines will be used by Dieci alongside the NEF 45 Stage IIIA/Stage IIIB for lower emission territories outside of Europe.



## THE TOOL ON THE HILL

**BOPPARD, GERMANY** – Bomag's fifth generation of single-drum soil compactors covers the 11-26 metric ton weight class and includes a 12t model – a new addition to its earthworks portfolio.

Featuring rear axles with a no-spin diff and automatic lock-up to 100%, D-version models have a hill-climbing capability of 53%. Even if one wheel lifts, the other will still drive the roller forward.

But a special highlight of the high-gradeability DN models is a dual-pump system that supplies two motors to make the machine far more stable on slopes of up to 60%, which is constantly

attainable whether moving forward or backward.

Models BW 213, 219 and 226 feature Variocontrol (BVC), which is now even easier for the operator to use via a new operating concept: just one rotary switch integrated into the seat arm is needed to control all settings. Clear icons on the control panel make it obvious whether manual or automatic compaction mode has been selected, and also provide a clear indication when maximum compaction has been achieved. When automatic mode is being used, the operator specifies Evib values and Variocontrol then takes over control of the

amplitude, ensuring that the energy is transmitted at the optimum level.

Ease of operation and ergonomics were key factors during the design stage. The dashboard has a more user-friendly layout, the compact steering wheel and adjustable steering column aid a better view of the drum, and the cab features generously proportioned windows.

An Ecomode function has been shown to reduce fuel consumption by up to 30% without negatively impacting on performance, while the optional Ecostop not only saves fuel, but also reduces engine wear.

## URBAN WARRIOR

**ROCESTER, UK** – Designed to offer big machine performance on congested urban jobsites, JCB's 3CX Compact measures just 1.9m wide and 2.74m high and offers a turning circle of 5.8m (braked) to the outside of the wheels, or 6.7m unbraked. With equal-sized wheels, the backhoe loader has selectable two- and four-wheel steering.

Its 40km/h 3-speed hydrostatic transmission produces a 17% faster travel speed than the 2CX, as well as a creep mode that enables the use of high RPM – from the Tier 4F 55kW JCB Diesel by Kohler engine – to drive high-flow tools such as road planers at travel speeds of up to 3.5km/h.

Servo excavator levers contribute to a 19% increase in hydraulic flow, at 100 l/min.

Up to 75 l/min of bidirectional auxiliary flow caters to a wide range of attachments.

Two dipper lengths are offered, while a six-in-one shovel increases versatility at the front. A 2.98m load-over height, with a 1.11m forward reach, enables easy loading of high-sided haulage solutions. With a slim bonnet line, two

front and four rear halogen work lights and optional boom-mounted LEDs, visibility remains high.

With their optional limited-slip diff, heavy-duty JCB axles help reduce wheel slip in soft terrain, while an intelligent braking system disengages the transmission to reduce component wear.



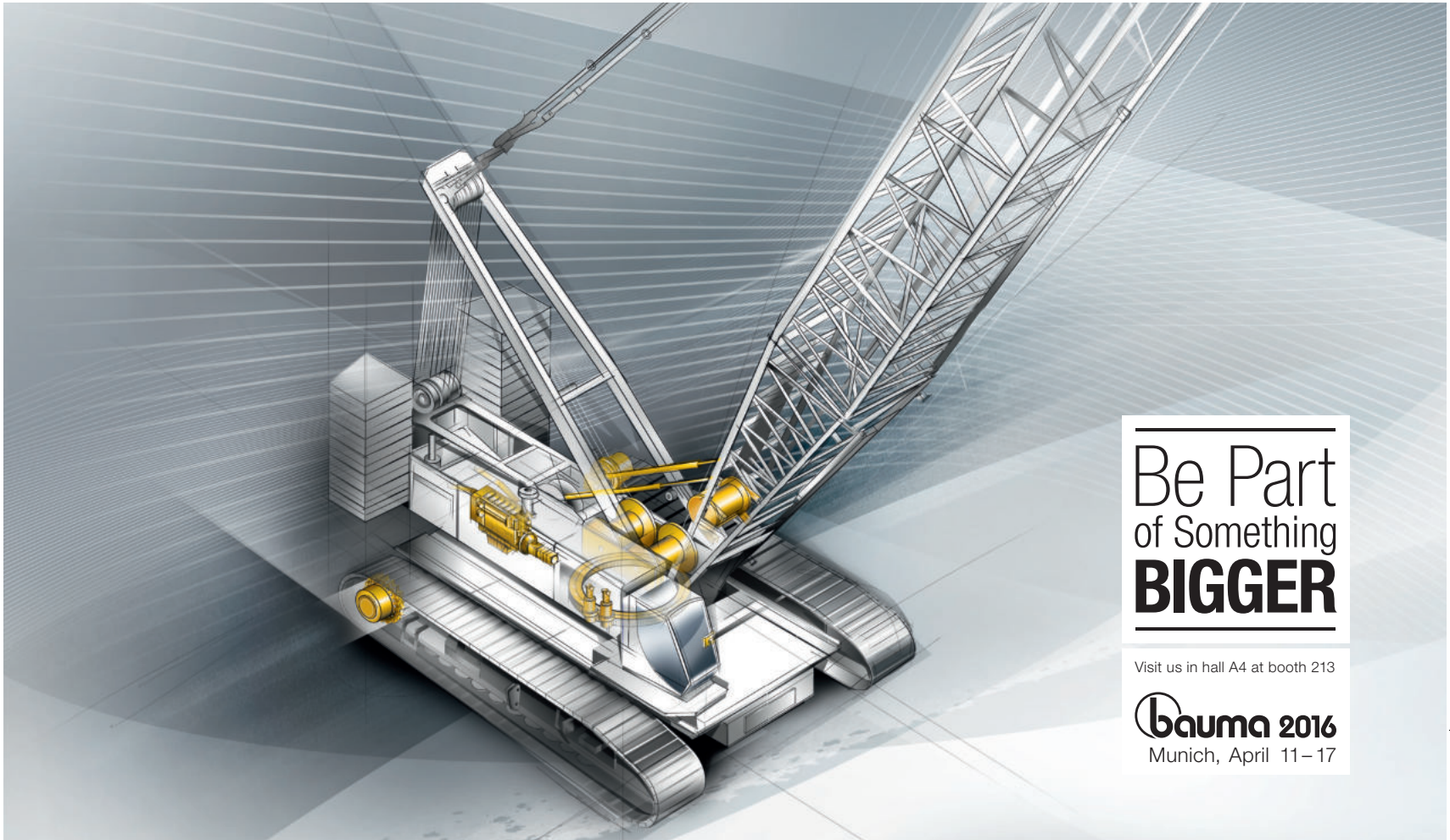
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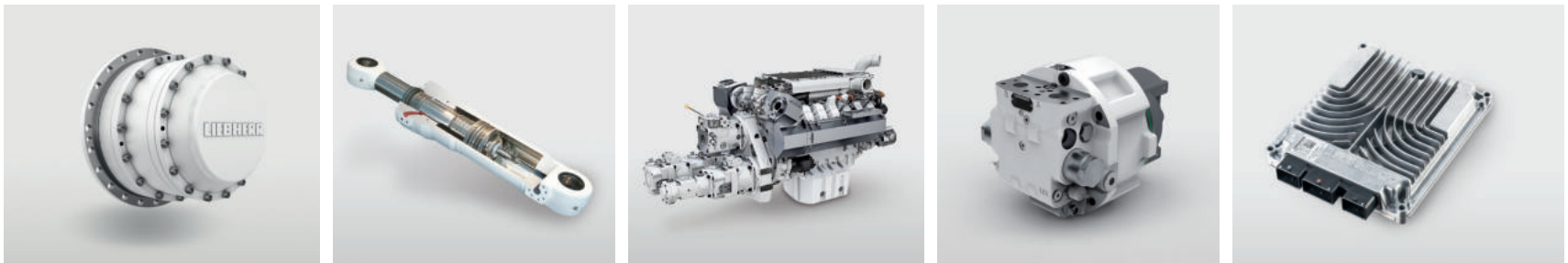
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## AGRICULTURAL FOCUS



**JIM MANFREDI, MACHINERY OUTLOOK**

### CHINESE EXPANSION

AGCO has opened a new factory in Changzhou, China. At almost 200,000m<sup>2</sup>, it will serve domestic and export markets. Established as an R&D and manufacturing base with state-of-the-art technology, it will gradually reach an annual capacity of 20,000 tractors, 30,000 engines, and 40,000 rear axles and transmissions.

According to the 'Made in China 2025' initiative, the ag machinery industry will come under the scope of support as part of the 'intelligent manufacturing' program, which involves a total approach to the production of agricultural machinery. The government has made it clear that it will prioritize investment in rural areas, develop the pilot financing and rental projects for large farm machinery, strongly encourage machinery leasing, and press forward with reforms to the rural financing systems.

AGCO has invested US\$300m in factories in China to date, and has four other manufacturing sites, in Changzhou, Shanghai, Daqing and Yanzhou.

### DISPUTE DIFFUSED

LightSquared and Deere & Co. have settled a legal fight over whether the wireless venture's GPS network had interfered with the global receivers made by Deere.

The new LightSquared, which recently emerged from bankruptcy after 3.5 years under court protection, says that the compromise sets the parameters on how the GPS and broadband industries can divvy up the spectrum – i.e. the limited pockets of airwaves that cell phone and internet companies use.

In 2013, Phil Falcone's Harbinger Capital, the hedge fund that then

controlled LightSquared, sued Deere, Garmin and Trimble Navigation, along with industry groups, in federal court, claiming their equipment interfered with the LightSquared network.

Under the agreement, LightSquared has agreed to forgo a portion of its spectrum nearest to the GPS signal and instead will use those frequencies that are further away. In return, Deere and Co. said it won't object to LightSquared's deployment of its wireless broadband network.

LightSquared will also adopt stringent handset and base station out-of-band emission and power levels, said Deere spokesman Ken Golden. Deere didn't make any payment to settle the litigation, he added.

### CLAAS APPOINTMENT

The president of Claas global sales Americas, Leif Magnusson, has been elected as 2016 Chair of the Association of Equipment Manufacturers (AEM). He succeeds John Patterson of JCB USA Group, and will serve a one-year term.

Serving as AEM chair, Magnusson will lead its board of directors and continue to share his expertise on a variety of topics including public policy, equipment statistics, market information, and business development.

### INTEL-LIGENT MOVE

Deere & Company has elected Brian M Krzanich, CEO of Intel Corporation, to its board of directors. "Brian's depth of leadership experience in technology, manufacturing and supply chain management is a valuable addition to the Deere & Company board of directors," commented Deere's chairman and CEO, Samuel R Allen.

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## HEAVY HANDLERS

BREGANZE, ITALY – Faresin Industries' new heavy-duty telehandlers have been specifically designed for working in the agricultural sector, with biogas a key application. Launched at Agritechnica last November, the range comprises two 9m (5.5t and 7t) and one 10m (6.5t) models.

Two transmission options are available, which can cut fuel consumption by as much as 20%. With a CVT system

developed in collaboration with Bosch-Rexroth, the VPSe Top (Variable Power System electronic) models feature two continuously variable hydrostatic motors fed by a continuously variable hydrostatic pump. The ECU manages motor and pump cylinder capacity, as well as the clutch that uncouples either motor and manages the gearbox. GLS versions incorporate a hydrostatic transmission with 2-speed

mechanical gearbox, offering four operating modes (Drive, Eco, Handling and Creeper).

The 152 l/min hydraulic system includes a variable displacement load-sensing pump, and a regenerative valve that enables maximum-speed boom lifting despite minimum engine RPM.

A reverse function has been incorporated into the electrohydraulic proportional joystick, while all setups have LED spotlights as standard.



## BACK ON TRACKS

HORICON, Wis, USA – In response to renewed dealer interest, John Deere has approved the use of Camso rubber tracks on its Gator utility vehicles for Europe, following their availability in the USA for several years.

Extending the versatility and year-round use of these all-terrain vehicles, the 318mm-wide front tracks and 356mm

rear tracks provide better weight distribution; a wider, longer stance; and maximum flotation on all types of off-road terrain. Ground pressure has been reduced by up to 75% (to under 1psi) while ground clearance has been increased by around 45% to 406mm.

Taking less than two hours to install, the tracks – which are made in Canada by the

same company that supplies Deere's 8R, 9R and 9RX large tractors – are steered, which further minimizes disruption of the soil surface. Total payload and towing capacity remain unchanged, at 635kg and 680kg respectively.

The standard wheeled 25hp XUV 855D Gator 4x4 has a top speed of 32mph, but this drops to around 25mph on tracks, as Chris Hardy, director of Camso's UK distributor, Supatracks, told iVT: "If the carrier vehicle is on 14in rims and has an effective tire thickness of 3in, then the effective rolling radius is 254mm. The drive sprocket on the tracks is 200mm rolling radius, so top speed will be reduced by 21%.

"This is, however, turned into greater torque available, which translates into better pulling and hill climbing capability, where it can easily climb steeper slopes without disrupting the terrain surface through spinning wheels."

## WHAT'S NEW

# HANDLING FOCUS

MICHAEL LEU, FORKLIFTACTION.COM

### RETRO APPEAL

The Kion Group and its Egemin Automation brand have extended their North American presence by signing an agreement to purchase Retrotech, which is valued at around US\$40m. Based in Rochester, New York state, it specializes in systems design, customized warehouse control software and stacker crane retrofits and modernization to ensure warehouse systems remain in good working order.

Retrotech will become part of Egemin Group Inc., based in Holland, Michigan, and be an operative part of Egemin Automation. The Retrotech brand will be retained and continue to be used in the USA to represent high-quality warehouse and distribution solutions.

"Retrotech is the perfect complement to strengthen the automation solutions currently being supplied by Egemin Automation in the USA," said Gordon Riske, CEO of the Kion Group. "This deal is an important step on our journey to becoming a leading player in the fast-growing market for automated logistics and material flow systems."

### SELF-GUIDED STUDY

Hyster-Yale Group has entered into a preferred vendor cooperation agreement with robotics specialist Balyo Inc. to market self-guided trucks in North America. Through this agreement, Hyster-Yale will broaden its capabilities by offering robotic high-productivity solutions for material handling, while Balyo aims to accelerate adoption of its innovative robotic solutions.

The Balyo technology enables trucks to navigate without the help of any wires, reflectors or magnets – instead using structural

elements of the facility to build a map.

Based in Massachusetts, Balyo is a 100%-owned subsidiary of Balyo SA, a French company specializing in the design, engineering and manufacturing of autonomous driving forklifts based on standard trucks.

### DEEP SEA DATA

Cargotec Corporation is to acquire Interschalt Maritime Systems AG, a specialist software and service provider to the maritime industry. Cargotec says this will complement its strategic aim of being a leader in intelligent cargo handling, through gaining more competence in the deployment of advanced software and service solutions, and having a global footprint with branch offices, service stations and partner representations.

The German company had sales of €42m in 2014. The parties declined to disclose the transaction value.

"During the last couple of years, we have been focusing on improving our profitability," stated Mika Vehviläinen, Cargotec's CEO.

"Now we are ready to take the next strategic step in implementing our strategy. Our target is to get 40% of sales from services and software in five years' time."

### UP TO LEXINGTON

Clark Material Handling has announced the expansion of its Lexington, Kentucky, USA manufacturing facility, which will see under-roof manufacturing increase by more than 200%. Beginning this May, Clark will begin production of its popular ECX (four-wheel electric) and TMX (three-wheel electric) models – which are currently produced in San Luis Potosi, Mexico – in Lexington.

# CeMAT



## CHARGING AHEAD

MJÖLBY, SWEDEN – Toyota will be displaying what it says is the widest range of lithium-ion material handling solutions in the industry – as well as a 'transparent' mast – at CeMat.

First launched in 2013, the Li-ion range included three warehouse trucks – the BT Levio LWE and LPE powered pallet trucks and BT Optio OSE order pickers. Five new series have now been added: BT Reflex RRE reach trucks, BT Movit TSE towing tractors, BT Staxio SPE and SWE

powered stackers, and the Traigo 48 counterbalanced truck. This effectively means all of the OEM's high-volume trucks are now available with advanced battery technology, leaving just its VNA products to follow suit – although there is no obstacle to this happening, iVT was told at Toyota's pre-CeMat event.

All of the trucks are ordinary lead-acid battery models that have been adapted to run on lithium-ion with the aid of additional counterweight in



the battery compartment to compensate for the lighter powerpacks. Once lithium-ion becomes more accepted, a purpose-designed range will likely become available.

Chairman of TMHE, Norio Wakabayashi, used the press conference to announce that BT trucks would switch to a Toyota badge later this year, with the BT name retained as a range identifier.

A new Traigo 48V electric forklift is also being launched, with enhanced electric power steering and force feedback to ensure accurate control at all driving speeds. The three-wheel models are available from 1.5-2.0 metric tons and are highly maneuverable in confined areas. The four-wheel models (1.6-2.0t), now feature an improved turning circle.

In other news, the OEM will also be highlighting what it says are 'the latest hydrogen fuel cell products'.

## STILL GOT IT

HAMBURG, GERMANY – Still has announced that 90% of its electric trucks will be offered with lithium-ion batteries by 2017. Its first Li-ion model, the pedestrian-operated EXU low-lift pallet truck with 1.6-2-metric ton capacities was unveiled in 2014, and now the OEM will present many more new models at CeMat.

These will include CX order pickers and tow trucks, new

low-lift pallet trucks, double-decker EXU-S and EXD-S high-lift pallet trucks, and the first counterbalance truck in the RX 20 model series, with a load-carrying capacity of 1.4-2t. All of these trucks will also be available in application-specific variants.

The battery is based on the latest lithium-iron phosphate technology, which ensures unimpeded service across the

# CeMAT

full temperature range (i.e. cold-store trucks). They are available with voltages of 24V and 48V and a power range of 1.9-49kWh.

The OEM cites Fraunhofer ISI's new *Product Roadmap, Lithium Ion Batteries 2030* report, which highlighted the lithium-ion battery to be the key technology for forward-looking drives for all types of electric trucks.

There is still potential for development in the coming two decades, with regard to both energy density and developments in pricing. The latter is already positive, with acquisition costs falling by around 50% since 2011, which experts had not expected to occur before 2020.



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# The Spanish Inquisition





WHEN HE VISITED AUSA'S FACILITY NEAR BARCELONA LAST SUMMER, *IVT*'S EDITOR HADN'T BEEN EXPECTING TO INTERVIEW A MEMBER OF ITS SENIOR MANAGEMENT TEAM. BUT WHEN THE CHANCE AROSE, HIS INITIAL FEAR AND SURPRISE WERE SOON SUPERSEDED BY A RUTHLESSLY EFFICIENT INTERROGATION

▷ As Northern Europe staggers virtually uninterrupted from one major storm to another, my short tour of Spanish construction equipment OEMs during last July's record-breaking heatwave could hardly seem further away. Organized by the country's ANMOPYC trade association, our small delegation's first port of call had been to AUSA's Manresa facility, near Barcelona, where during the factory tour I unexpectedly bumped into the familiar face of group commercial director Paco Pérez Salinas.

It seemed rude to refuse his invitation to a leisurely lunch, so after wriggling out of the not-so-relevant visit scheduled for that afternoon, I soon found myself wiling away the hours in the shady garden of a nearby rural restaurant-cum-car museum – before suddenly realizing I should make the most of this opportunity and ask him a few pertinent questions.

Luckily, that morning's company presentation had revealed several

areas ripe for further elaboration. In what would become a common theme during the rest of that week, the subject of exports had been a major topic, due to the devastation wrought by the 2008 financial crisis on the domestic off-highway equipment market calling for a huge rethink in terms of the business plan.

Seven years earlier, domestic sales had constituted 67% of this family-owned company's €150m revenue pre-crisis – now 87% of its compact vehicles for use in the construction, mining, agricultural and municipal sectors are exported and sold in over 80 countries through 450 dealers. Since 2010, its sales have increased by about 50% – in fact, AUSA's performance on this front had led to the company receiving a European Business Award two months prior to my visit.

"If you haven't done your homework before a crisis arrives, you are dead," Paco points out. "You can never just say, 'This is the strategy for the next two years'."

## OEM INTERVIEW

### Changing with the times

In fact, few companies are more aware of the need to adapt than AUSA, which was founded in 1956 as Automóviles Utilitarios S.A., a manufacturer of small PTV-250 series cars. But once Fiat and Seat had begun production in Madrid, competing on price soon became impossible. In 1961, therefore, its remaining stock of engines and drivelines was repurposed as, over the next two decades, it switched its attention to the manufacturing of site dumpers.

"To avoid the ups and downs of the market, companies need to be geographically spread," Paco continues. "It looks like China is slowing down, Brazil has stopped, and Russia is down too."

"In spite of all that, we are still growing a little bit in sales because we are spreading."

"Everything starts with hiring and retaining talented people, who are able to find distributors in our targeted sectors. Then our dealer

network becomes our ambassadors, guaranteeing best-in-class aftersales service to generate satisfied and loyal customers."

So a recently signed agreement with ZhongTong, a Chinese bus manufacturer, to distribute sweepers is already paying dividends, while Latin America is coming round to the use of site dumpers (and an unusual application for AUSA's self-loading concrete mixers – see *iVT* June 2012, p14), and there are plans to boost the site dumper's low profile in the USA.

"It's more sniper than scattergun," he clarifies. "We need to look for the niche and go in with the right machine as the solution."

"In Europe, they want quality products, they want to be efficient, and they'll say 'I want 20'. But in China they say, 'I want half price'. So we really need the people we're expecting to invest twice as much as they're comfortable with to truly understand the benefits of what they are purchasing."



ABOVE: For five years, AUSA was a manufacturer of tiny cars – then the drivelines used in the PTV-250 were built into site dumpers

OEMs have their green and yellow divisions, and we are going slowly in that direction as well. Nobody's been able to explain to me why construction and agriculture have an anti-cycle, but when one goes up, the other usually goes down!

"We are focused on niches, so we don't really compete with the big companies – and we are the only company that produces dumpers, forklifts and sweepers. Sweeping is a growing sector: it's large and is more stable than construction."

Those growing agricultural sales are largely spearheaded by AUSA's rough-terrain forklifts and compact telehandlers, which sell particularly well in Eastern Europe. But changes in demand since 2007 have led to sales of its smallest dumpers suffering as customers switch preferences to larger models. Whereas AUSA once produced up to 1,000 units annually, primarily consisting of 1.5- and 1.75 metric ton models, 3.5-, 6- and 10t are now the key capacities, restricting production to the low hundreds.

### Flexible approach

Given the company's emphasis on streamlining its product offering (see *Outsourcing pays*, right) does that mean we shouldn't expect any major departures from the norm in terms of new machines in future?

"We are thinking about that, but it's more about evolution of existing products. The shoemaker has to wear very good shoes, as we say in Spain! For example, one of our strongest products is the iLink system, which allows the same machine to be used as a sweeper or a washer or a snow plow. In Barcelona, we have two days of snow every two or three years – so if you have a machine that is mainly used as a sweeper/washer, but can be converted into a snow plow in under an hour, you don't need to buy another machine that will just sit unused for months at a time."

Does that approach apply equally to the components used in AUSA's diverse range then – is commonality at its maximum possible level?

"We are working on platforms now and trying to harmonize the components – this is an area where we have a lot of work to do," he

## "IF YOU HAVEN'T DONE YOUR HOMEWORK BEFORE A CRISIS ARRIVES, YOU ARE DEAD. YOU CAN NEVER SAY 'THIS IS THE STRATEGY FOR THE NEXT TWO YEARS'"



ABOVE: Paco (third from right) and Alberto Ortega, sales manager, urban, (second from right) at the signing of the sweeper distribution deal with China's ZhongTong

### Domestic bliss

Nevertheless, exporting is expensive, so the domestic market is well worth exploiting. "Spain is now growing – and it's cheaper and easier to sell here than it is in China, or even South America," he points out.

"The problem is that the prices of the rental companies are very low, which means they have to be even more efficient. So we have created a business unit for servicing, with extended warranties, and we're pushing maintenance kits and telematics. TCO will be the key driver for the developed countries."

Another way of expanding your sales, of course, is to diversify – or at least to better exploit alternative sectors with machines already at your disposal. "We're well known in construction, but now we're selling into agriculture much more," the director reveals. "Most of the major



### OUTSOURCING PAYS

AUSA's necessarily low-volume production has implications for the manufacturing process – while competitors such as Merlo take great pride in making as many components and sub-assemblies as possible in-house, AUSA takes a very different approach, outsourcing all of its fabrications and then assembling them in a very 'clean' factory. "It's because of economies of scale," Paco clarifies. **"We produce a lot of small batches, with very specific components, so external outsourcing makes us more flexible, more productive and more effective.** We are more like a workshop, so we use the Kawasaki system. In the same production line you can see a dumper, a forklift, a concrete mixer and a sweeper – and as our lines are flexible, we can be much more efficient.

"Imagine the problems if we had been responsible for the production of long batches of machines when the 2008 crisis arrived! We have such a wide portfolio as well, which can be a strength and a weakness."

In response to this conundrum, steps were taken to rationalize the product line-up, which stood at 89 models in 2010, and is now down to 61. "We are trying to harmonize the line-up and use the same type of platforms, etc," he says. "Some products were too out-of-date and we didn't want to invest in them because we had similar products to sell instead. So we've removed the ones that we were selling very few of, and we are still working on reductions – but without losing sales."





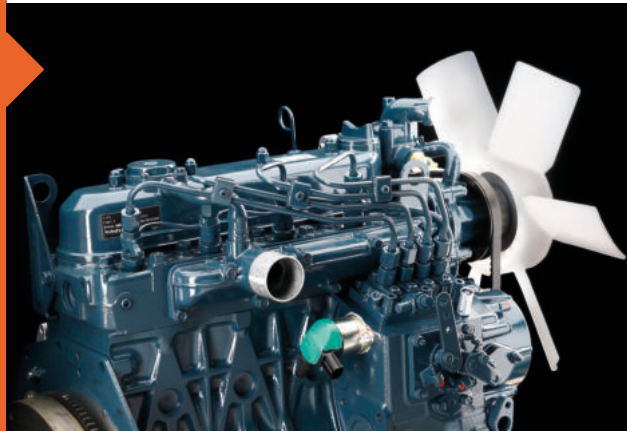
## OEM INTERVIEW

### THE SUM OF ITS PARTS

When it comes to choosing components, only the best will do for AUSA, says Paco. "I think the Kubota could be one of the best engines in the world – everybody says that. Whether I go to Germany, China, the States or Latin America, they all say, 'Kubota, it's a great engine!'"

"Bosch-Rexroth is one of the leading suppliers in the world, and Hansa-Flex is our hoses supplier. They are very good too – and because they have a facility on the same industrial estate as us, that is great for just-in-time delivery."

"When we are tendering against bigger players, we have to sell our competitive advantages. Yes, price is sensitive, but quality is extremely important in this sector. And delivery time is key nowadays too."



admits. "In the automotive sector they hold up the example of VW group using the same platforms in several models – and even between different brands that used the same chassis, such as Seat, Škoda and Audi."

There's no possibility of doing something similar with a modular build for dumpers, forklifts, sweepers and telehandlers, I suggest slightly desperately in the search for a provocative quote.

"No, that would be nice but not practical! Twenty or 30 years ago the automotive industry was talking about a car with 50 modules, and that still doesn't exist. But a way of harmonizing packages, for security, safety or comfort, etc, is possible and would reduce complexity."

#### Fast forward

Moving on to other contentious areas, I raise the subject of electric equipment, which had been in my thoughts since touching on the plans of Bomaq, a fellow Spanish manufacturer of rough-terrain forklifts, to develop a 2-ton AC-driven model, in an interview for 2015's *Advanced Lift-truck Technology Annual* (p34) carried out shortly before this discussion.

"I think we need to wait a little bit until the market is there – but when it happens, we will have to go that way or we will not sell. If it is forbidden to use a diesel engine in London in two or three years, for example, then we'll have to adapt!"

"I just hope that politicians will display some common sense – they always want everything green, but

**ABOVE: Kubota is a key, valued supplier for AUSA and its customers around the world**

the technology is not viable at the price point customers will accept. So it is an area where we can be fast followers, because if we want to offer enhanced total cost of ownership, we need to wait until the technology is really available. This is something we are looking into at every exhibition we go to.

"There are very good engineering companies that produce technology suitable for a fully electric sweeper, but not to the required extent. But in the next two years, things will happen and then we will go in that direction as well. After Euro 6, AdBlue and DPFs comes electric or hybrid!"

So are there any applications for hybrid technologies in AUSA models?

"Yes, there are several. For example, in the sweeper, to reduce noise, fuel consumption and pollution, you could use an IC engine when you're moving around the city, then when

you're working early in the morning or late at night, you switch back to electric. In greenhouses you could run a forklift

on electric until you go outside. It's the same with dumpers."

That sounds like an awful lot of extra technology to squeeze into a 1-ton dumper or forklift though, so would it actually be possible to adapt such compact machines?

"It would have to be! They're very small, so it's all about the level of batteries that you need. Of course, in many countries they are using [natural] gas as well, which is an alternative. So we are following the market – if the customer is ready to order that sort of technology, we will be glad to produce it. We are more concerned with satisfying customers and making a profit – sometimes being a trailblazer is more about winning innovation awards, but many of those awards are just given to prototypes that will never see the production line."

That's just one more challenge for AUSA to overcome as it adapts to meet new challenges. But given its successful transition from automotive to off-highway over 50 years ago, you feel it will be able to handle it. **ivT**



**ABOVE: AUSA is more of an assembler than a fabricator, although it does produce some of its own axles**

**RIGHT: The innovative iLink system enables one machine to do the work of several different models**



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**IF YOU'VE EVER WONDERED HOW ON EARTH IT'S POSSIBLE TO SAFELY TRANSPORT SHIP SECTIONS WEIGHING UP TO 820 TONS, THE ANSWER COULD BE THE 26-AXLED SCHEUERLE SHT 820.26.7**

▶ With 104 tires each supporting loads of up to 9.35 tons, in twin orientation in groups of four on each of 26 bogies distributed among 11 axle lines, each bogie supporting up to 38t, and with a 166t tare weight and 820t capacity, Scheuerle's SHT 820.26.7 ship section transporter is one of the heavier-duty specialist vehicles in the field of moving extremely heavy loads.

The specialist heavy-transport manufacturer, one of three companies in the TII Group, custom-built this formidable machine (dispatched to South Korea in November 2015) to meet the customer's requirements, modifying the design of its existing



# question

The SHT 820.26.7 used at the premises of the Sungdong Group in the South Korean coastal city of Tongyeong. Equipped with 26 axles, it moves large ship segments, positioning them for final assembly or moving them between different production facilities on the site

range of shipyard transporters for maneuvering sections of ship hull.

"This unit has a very strong frame – the maximum payload can be placed entirely onto the outer beams if required," explains Ralf Grützmacher, sales manager for Asia, based at Scheuerle's main facility in Pfedelbach, Germany. "On the other hand, because the customer requested a 7.5m maximum width, the space for design and installation was limited."

Seven of the bogies are driven, another 14 are braked, and the remaining five are idler bogies. In Scheuerle's type designation, the letters SHT are an abbreviation for Ship-section Hub Transporter, more

usually referred to as a shipyard transporter, and the digits 820.26.7 refer to the configuration in payload, the number of bogies and the number of driven bogies.

Grützmacher continues, "The number of driven bogies depends on the maximum slope that has to be traversed. The number of braked bogies is usually twice the number of driven bogies. It must be possible to brake the unit safely on the specified slope."

## Weighty issue

Shipyard transporters are not a new concept, as he points out: "The first shipyard transporters were produced

in the 1960s. At that time the payload was 50-100t and the units were equipped with mechanical steering. At the beginning of the 1970s the payload increased to about 400-500t and an electronic steering system was introduced.

"The main reason behind the request for transporters with a higher payload was the change in shipbuilding production technology," he continues. "The general target of shorter production time and greater efficiency led to bigger blocks [ship sections] being created – the purpose being to avoid lots of crane operations and welding inside the dry dock or at the slipway by handling large



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blocks instead of single steel plates. The welding and outfitting of a new vessel could then be done in parallel at several workshops simultaneously.”

As the company points out, “By combining several [SHT] vehicles to form one large unit, extreme loads of 6,000t or more can be transported...”

“Standardized equipment design offers the flexibility needed to satisfy most requirements. The transporters can be easily customized to meet specific needs.”

The first models in the 800-1,000t range were delivered in 2002, and many 800t SHTs have been supplied to customers since. Specifications of the platform, their coupling ability, and engines, etc, are all variable.

### Fearful symmetry

The SHT 820.26.7 is symmetrically oriented with 11 bogies along each side, and along the central axis between these are a cab at either end, two centrally mounted engines, and four more bogies distributed in the two vehicle halves between each cab and engine.

Powered by two 330kW (442hp) EPA Tier III Deutz water-cooled TCD 2015 V06 diesel engines, the SHT 820.26.7 produces a tractive force of approximately 770kN at 370 bar. The operational temperature range of -20° to 40°C permits extensive

global operational areas. Maximum gradient ability at 800t payload is rated at 5.4% or so, maximum unladen speed is approximately 15km/h, and the maximum speed with 800t load (at 0% inclination and rolling resistance of 25kg/t) is given as approximately 5km/h.

Grützmacher further explains that there are two hydraulic circuits – for the drive system (closed loop) and lifting/steering system (open loop) – and points out that while the hydraulic driving pressure is up to

**Even a transporter needs transporting: the Kübler Haulage Company took on the task of transporting the giant vehicle from the production site in Pfedelbach to the Heilbronn harbor facility on Scheuerle InterCombi trailers**


400 bar, the supporting and steering pressure is up to 250/300 bar.

Hydraulic components are supplied by Bosch-Rexroth for the hydrostatic drive system, gearbox, valves and steering motors, Hawe for valves and Neumeister for cylinders.

The machine is shod with 365/80 R20 tires on steel wheels. Rubber on Scheuerle’s various SHT configurations can be from a variety of suppliers, varying according to customer preference and the particular machine specification, but often



The transporter was first assembled on its back, before being rotated 180°. For turning and positioning the 165-ton construction, Wiesbauer used GHK500 and GHK700 cranes in a tandem configuration



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Continental is used. "One or two punctured tires will not stop certain transport. The relevant bogie may be taken out of operation, for repairs to be undertaken later," Grützmacher comments.

The loading platform has a length of approximately 28m and width of approximately 7.5m. While the vehicle is unladen, the platform is lowered to its base position, at a height of approximately 1.6m above ground level. If the load is resting on suitably positioned supports, the transporter will be slowly moved underneath and the platform then raised to engage and lift the load.

One hydraulic ram per bogie controls that bogie's axle position relative to the platform, according to the specific ground level and any slope. The bogie rams provide the platform with an elevation range of 0.7m to allow for raising the load from supports and lowering it again, and also for variations in ground level. When the vehicle is carrying a load, the platform is normally set at a height of 1.9m above ground level to allow for a deviation of up to 0.35m, both upward and downward, to help compensate for uneven ground.

### The even distribution of weight

The self-adjusting axles will also automatically compensate when on uneven ground to maintain evenly distributed load over all wheels, so the vehicle's platform is effectively self-leveling. Grützmacher provides some background: "Pendulum axles first appeared in approximately 1900. Willy Scheuerle introduced steerable bogies with pendulum axles and hydraulic lift/compensation in 1957 for payloads on trailers of up to 500t."

Scheuerle points out, "Depending on the application, the hydraulic support for the pendulum axles can be switched to three- or four-point suspension. This means that optimal axle compensation is available for

every transportation task. These adjustments ensure safe and careful transport for both vehicle and load."

Grützmacher elaborates, "The hydraulic axle load compensation ensures an equal axle load/wheel load on uneven ground within one supporting group. All bogies have been divided into either three or four supporting groups. The usual operation is four-point support, which provides the best stability. Uneven ground will deflect the frame within a certain range but not result in damage."

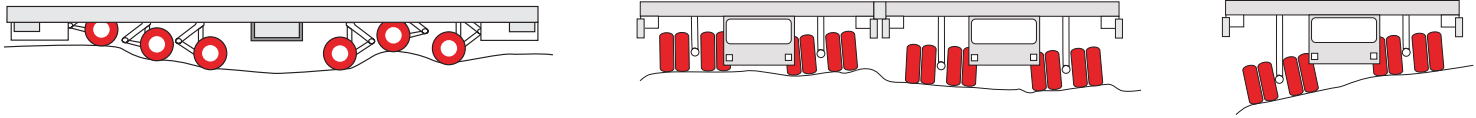
Hydrostatic motors are situated in the wheel hubs, along with an integrated reducer. Grützmacher explains, "There is a differential function – not mechanical but hydraulic, due to the hydrostatic drive system. Furthermore we have implemented ASC [anti-slip control] to avoid spinning bogies/wheels. The traction control system is by hydrostatic drive and ASC."

The pneumatic brake system consists of standard drive brake and park brake elements, incorporating components from Wabco. Scheuerle states its vehicles use 'off-the-shelf branded components for the drive, hydraulics and electronics'.

ABOVE & TOP: Not the SHT 820.26.7, but a couple of views showing Scheuerle transporters at work carrying extraordinary loads when operating in compound arrangement



## CASE STUDY



ABOVE: Scheuerle's pendulum axle technology sets benchmarks in this category. On uneven surfaces, the functional axle compensation automatically provides uniform distribution of the load to all the wheels

### Moving targets

The transporter has an outer turning radius of approximately 15.4m and features electronically controlled multidirectional steering, with a variety of modes: straight/circular; transversal; diagonal with all wheels parallel; circular around a set steering point, either within or outside the transporter's footprint; and carousel (circular around a central steering point). Additionally, if two or more transporters work together in a range of possible formations, the steering of each unit is coordinated and controlled by the transporter acting as master unit. Combined with a 165° steering angle in both directions from the base position, these precision steering modes make the transporter highly maneuverable even in tight spaces. The master cab is specified via the touchscreen panel in the cabs.

As Grützmacher describes, "If the operation is in closed compound [i.e. several transporters moving as one in a tightly arranged configuration] they are manually secured together. Alternatively they may operate in open compound [arranged at some distance from each other]. There are no proximity switches.

"In the case of coupled SHT units, communication is by CAN and the SHTs are connected by a cable," he continues. "The CANbus serves as a communication network between the installed hydraulic/electronic components, drive system, and the main controller. The operator enters the coordinates and angle via the touchscreen in the master SHT, and the compound group, separated at whatever distance they are, will then be operated as 'one transporter' from a cabin or by remote control. The speed and steering angle are fully synchronized. There are four potentiometers installed at the corner bogies, and proportional



Working in closed compound arrangement enables the transport of extreme loads, with communication between vehicles performed by CAN once they have been connected with a cable

valves will distribute the correct oil volume for each supporting group."

### Control center

Cabin controls include steering wheel, brake and drive pedals, joysticks for lifting/lowering and drive direction, a touchscreen monitor for steering programs and monitoring of the system (pressure, platform height, diagnosis, and more), a display of the weight and load center, and a multifunctional control system. The control systems also include GPS monitoring. External operation by remote control is also available.

Safety equipment includes amber flashing lights, under-run protection, hose fracture valve, emergency stops, and a CoG display. A safety valve is included for all hydraulic axle lines for the event of any hydraulic hose breakage to shut off the localized part of the system so that the vehicle can still function.

"There are pressure sensors in each supporting group," clarifies Grützmacher. "The hydraulic pressure

of each supporting group can be used to calculate the position of CoG, which is obviously very important, and also the approximate weight."

Each of the bogies along the vehicle sides, and also each engine bay, has a substantially sized cover enabling maintenance access from the top of the platform.

The cabins are located below the platform. Grützmacher comments, "There is a camera for driving backward ... camera systems are tailor-made and installed at each end, with two or three depending on the width of the transporter."

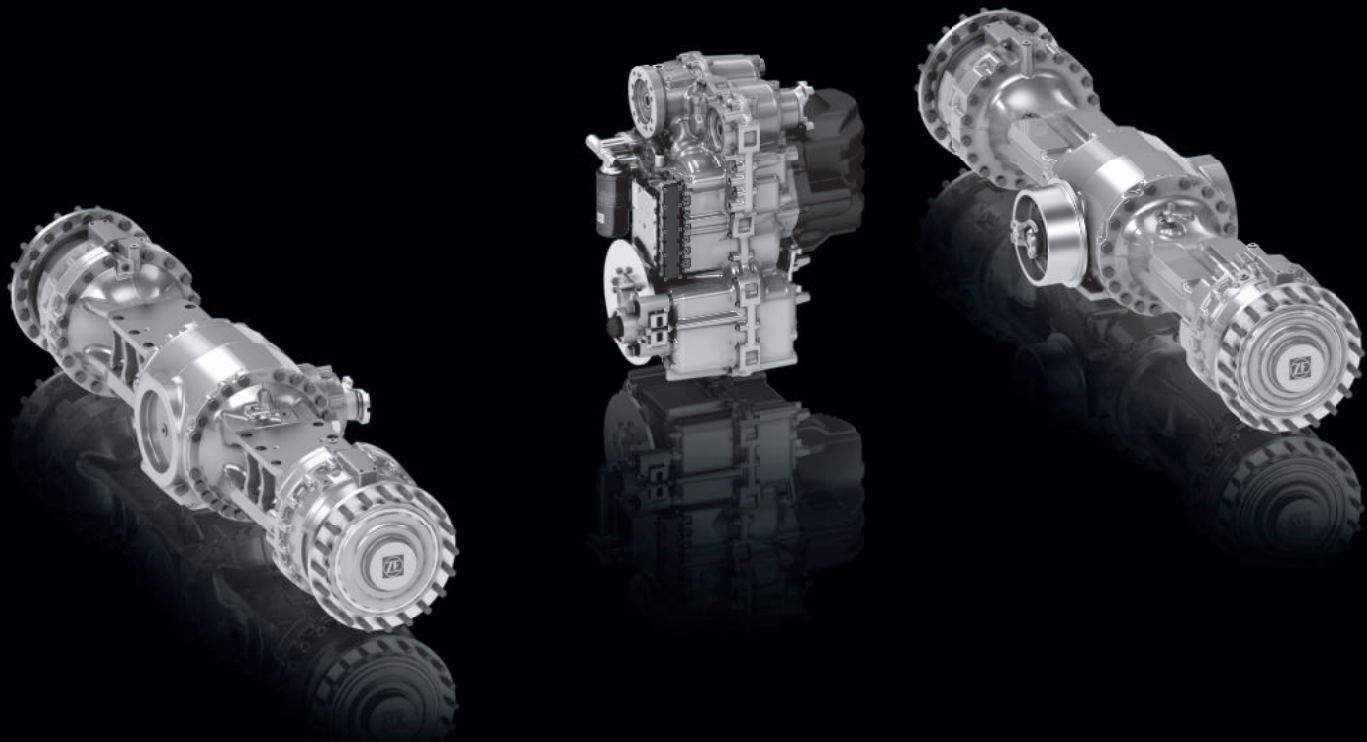
Looking ahead, he concludes, "I imagine the SHT will not have more payload than 1,200t [the biggest so far] due to its size. Heavier blocks will be moved by combined SHT or SPMT [self-propelled modular transporter, a different type of specialist heavy transport vehicle]. I don't expect automatic-guided SHTs due to less flexibility and high costs. An electric drive will come if suitable batteries become available." **IVT**

# ZF IS EFFICIENCY

In the context of a growing global consciousness to save energy there is a need to protect natural resources to guarantee a sustainable future for generations to come. Thus, lower fuel consumption and fewer CO<sub>2</sub> emissions are key drivers of development at ZF. The technology company is intensively researching concepts for future efficient mobility. Its current focus in this process is to optimize consumption in combustion engines through efficient transmission systems and driveline components that support the downsizing principle, as well as hybridization and electrification. Key features of this goal are the ZF Efficiency Package and the cPower. The fully powersplit CVT is a technological leap in construction machinery and allows fuel savings of up to 25% and an increase in efficiency of up to 20%. [www.zf.com](http://www.zf.com)



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Fitted with a hydraulic swing-away jib and extension, the GMK5250L's boom has a maximum length of 107m



A VOITH VIAB TURBO RETARDER  
CLUTCH AND THE LATEST STAGE IV ENGINE  
TECHNOLOGY ENABLES MANITOWOC TO  
BOAST A 30% REDUCTION IN FUEL CONSUMPTION  
FOR ITS GROVE GMK5250L FIVE-AXLE ALL-TERRAIN  
CRANE OVER THE MODEL IT REPLACES

# COMBINED EFFORT

## CASE STUDY

▶ When Manitowoc introduced the 250 metric ton capacity long-boom Grove GMK5250L all-terrain crane in April 2015 to replace the GMK5220, it proudly proclaimed it as the strongest long-boom five-axle machine on the market. In addition, its compact dimensions and maximum outrigger width of only 7.8m (25.6ft) mean that it can access the most confined work sites.

The 'L' designation indicates that the GMK5250L is classed as a long-boom all-terrain crane. The machine therefore features a main boom of 70m (230ft), and its overall reach is boosted by a 21m (69ft) hydraulic swing-away jib that can be extended with either an 8m (26ft) boom

extension, two 8m jib inserts, or a combination of the two for a total possible jib length of 37m (121.4ft). For optimum usage, the full jib can also be operated while the crane is working with its full 70m boom.

Another benefit is the ability to offset the jib by up to 50° compared with 40° on other Grove cranes – and an optional integrated heavy-duty jib is available.

### Rise to the challenge

According to Andreas Cremer, Manitowoc's global product director for all-terrain and truck-mounted cranes, there are multiple challenges that have to be confronted when it comes to the development of new

all-terrain cranes such as the 5250L. In general, where all-terrain cranes are concerned, on the one hand there is the task of designing the boom itself – while at the same time designing the vehicle that will carry it. Where the latter is concerned, it has to be good at on-road travel, while at the same time also being suitable for off-road use. A major challenge is in meeting the various national transport regulations.

"As a global manufacturer, we have to meet the various regulations that apply to our carriers around the world," explains Cremer. "However, we are used to doing this now, of course, so the challenge is not as great these days."

The GMK5250L was the first of Grove's five-axle all-terrain cranes to be fitted with a Mercedes driveline that incorporates the Voith VIAB turbo retarder clutch module



## SMOOTH RIDE

The GMK5250L features five axle lines, with lines two, four and five being both steered and driven. Axle lines one and three are also steered.

Suspension is provided through Manitowoc's MegaTrak system that provides all wheels with independent hydropneumatic suspension and a hydraulic lockout. The machine also features longitudinal and transverse level control with an automatic on-highway leveling system with a range of +170mm/-130mm.

There is also active suspension control on the outrigger control units. The MegaTrak system, based on the de Dion principle with the differentials connected directly to the chassis frame, ensures that all wheels remain in contact with the ground surface at all times, irrespective of the terrain over which the crane is traveling, and also ensures optimum driveline alignment under any conditions.

Suspension Mega struts are fixed to the chassis frame and consist of an

outer body with an inner strut leg with a 300mm stroke. An internal hydraulic cylinder connects the outer body and inner strut leg, which is interconnected with an accumulator for hydrogas ride quality. A drivehead is connected to the bottom of the inner strut and contains the reduction hub and brake assembly. The steering system is connected from the outer body to the drivehead via a wishbone linkage or internally via a top-steer suspension strut on certain crane models.

When compared with conventional systems, the use of an independent strut reduces the suspension system's weight and also allows for the use of a deeper carrier cross-section that improves the torsional strength of the crane.

Steering on the GMK5250L is via a dual-circuit, hydraulic power-assisted system with an emergency steering pump. Axle lines one, two, three and five steer when the machine is being driven on the highway (steer by wire).

There is a separate electronic hydraulic (steer by wire) steering system for the fourth and fifth axle line for all-wheel steering and crabbing.

Braking is provided by a service brake consisting of pneumatic dual-circuit disc brakes acting on all wheels, along with an air dryer. The permanent brake consists of an exhaust brake and constant throttle brake. The parking brake is a pneumatically operated spring-loaded brake acting on axle lines two, three, four and five.



With its 12t per axle configuration and dimensions well suited to global roading requirements, the compact Grove GMK5250L offers excellent roadability. Compared with the GMK5220, the gross vehicle weight has been reduced to give customers more transport options, including the ability to carry more equipment on the crane.

Special attention has also been given to the appropriate axle group spacing and specifically the fact that this exceeds 2.4m (8ft), which is a strict North American requirement for roading mobile cranes. There are additional design features that make the crane easier to move in countries that enforce stricter axle loading requirements, such as Canada, the USA, Norway, Australia and Japan.

Meanwhile, at the other end of the scale, in countries where the local requirement is for axle loadings of under 16.5t, such as the UK, the crane is able to move on the highway with up to 21t of counterweight. As most other cranes in this class are limited to 12t counterweight on the road in the UK, the GMK5250L therefore offers load chart advantages of up to 50%.

### Meeting the regs

However, the greatest challenge the company has had to face in recent years during new carrier design is one common to all construction equipment manufacturers, namely that of meeting new engine emission regulations. The step from Stage IIIA through IIIB to Stage IV created two main problems for Manitowoc.

The first of these was the space required for the various aftertreatment systems. "We had to find space for the AdBlue tank, the SCR system, and there were some restrictions on the exhaust piping in terms of how long it had to be straight to spray in the urea or AdBlue into the exhaust before it goes into the SCR," states Cremer. "As a result, a lot more components got onto the crane, for which we had to make additional space available."

"Where space was concerned, the other thing that happened was that when we moved from Stage IIIB to Stage IV, Mercedes-Benz also changed the engine generation and on the GMK5250L we had to go from a V8 engine to a straight V6 unit, which in terms of height, width and weight was very different."

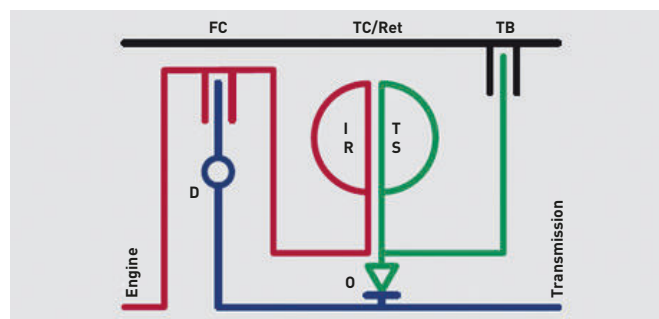
In fact, this change of engine was one of the main reasons behind the development of the GMK5250L, according to Cremer: "The previous model, the GMK5220, just required too much design work to change the engine. In addition, it was already very borderline in terms of weight – that's the other big challenge that we have when designing new machines. We had to achieve a weight of 12t per axle to achieve a global roading capability, so the engine change, plus the weight of the additional systems needed for that engine, just made achieving that with the 5220 too big a task."

### Flexible fit

Manitowoc was also aware that the VIAB turbo retarder clutch system

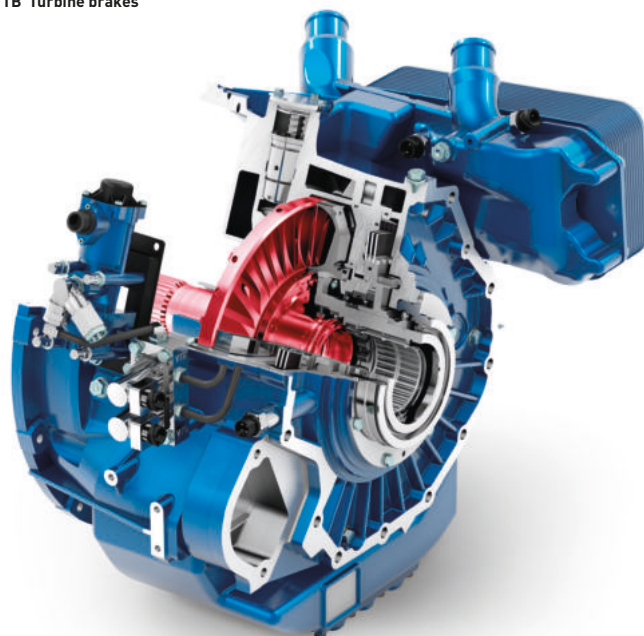
LEFT: As well as providing wear-free starting, the VIAB turbo retarder clutch enhances braking performance under tough conditions

BELOW: Schematic of the VIAB module



LEGEND

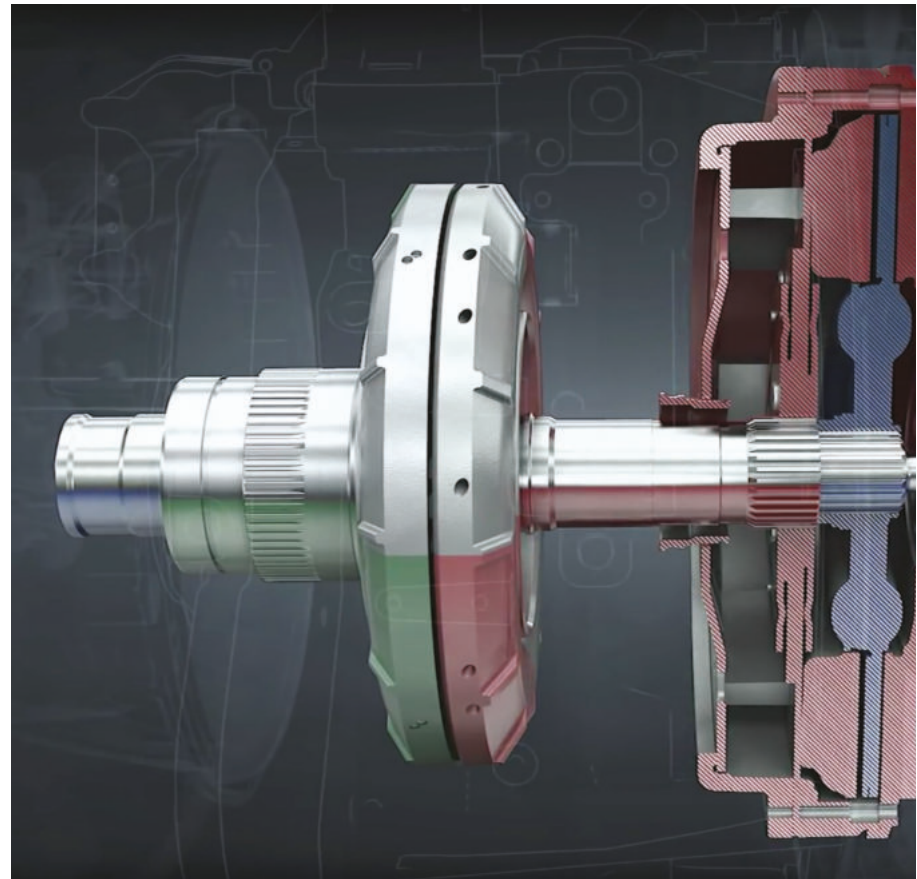
- FC Converter lockup clutch
- D Torsional vibration damper
- TC Fluid coupling
- I Impeller
- T Turbine wheel
- R Rotor
- S Stator
- O Free wheel coupling
- TB Turbine brakes



ABOVE: Using the VIAB module to produce a mechanical driveline when roading the crane results in a 30% reduction in fuel consumption

## CASE STUDY

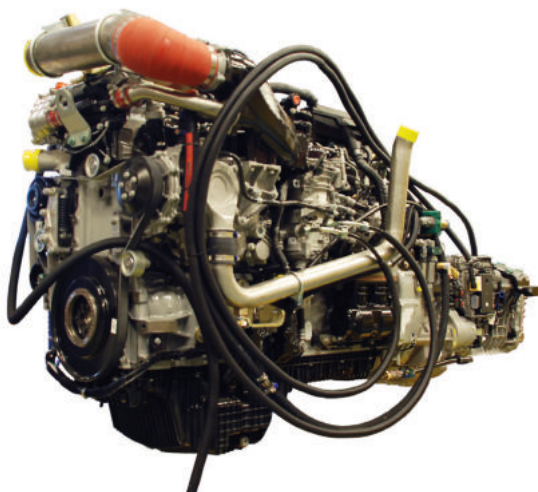
RIGHT & BELOW:  
**Enabling creep speeds to be undertaken without the risk of burning out the clutch, the VIAB turbo retarder clutch performs similarly to a torque converter**



### ONE'S ENOUGH

In the past, mobile cranes often featured two engines: a small unit in the superstructure to provide power for the hydraulics and electrical functions of the crane itself, and a larger unit for the carrier's motive power. Manitowoc, however, pioneered the use of a single-engined powerplant providing all the machine power requirements on its Grove GMK6400. It has again opted for this configuration on the GMK5250L, which uses the new Mercedes-Benz Tier IV Final/Stage 4 OM471LA six-cylinder diesel engine delivering 390kW (520hp). Other mobile crane manufacturers are also now increasingly moving to this configuration on their machines (see *iVT* Nov 2015, p48).

The main benefits this offers are obviously the reduction in weight, reduced expense as the latest emission-compliant engines along with their associated aftertreatment systems are costly, and the freeing up of extra space. "The only real benefit of using two engines comes if the crane spends considerable time operating in idle mode," says Cremer. "With a single engine, we are trying to reduce complexity, weight and cost."



from Voith was being used on the latest Mercedes-Benz Actros on-highway trucks.

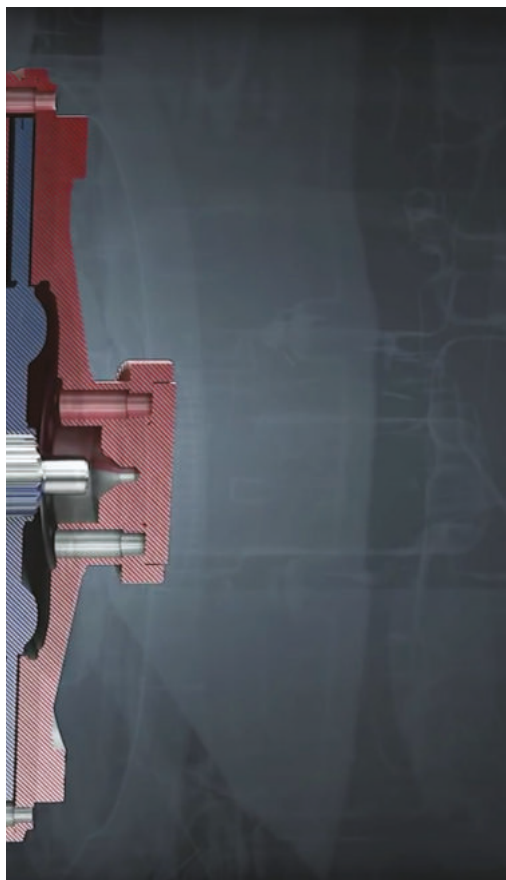
"We talked to Voith and thought it would make a good feature because it was available for the new engine. The previous model used an Allison transmission – but with the VIAB we found a solution that fits into two worlds because it performs very similarly to a torque converter transmission and allows you to maneuver very precisely at slow speed on rough terrain. So you can creep the machine into working position with full counterweight without risking burning out the clutch, while also benefitting from a mechanical driveline when on the road. The 5250L driveline therefore now consists of the Mercedes engine with the VIAB module sitting between it and a Mercedes electronic shift transmission," explains Cremer.

Combining the functions of wear-free starting and braking in a single component, the VIAB handles starting on uneven terrain, at high loads, maneuvering on gradients and low-speed ranges.

Startups using the system only require engine speeds of between 1,100-1,300rpm, the range in which the engine provides its maximum torque. During starting, the friction clutch is open, and the impeller is coupled with the engine – as is the turbine wheel with the turbine shaft. When the accelerator is depressed, oil flows between the two bladed wheels and torque is transmitted from the impeller to the turbine wheel via the oil, setting the turbine wheel, and hence the crane itself, in motion. The oil flow can be easily controlled and determines the torque.

The VIAB clutch reacts sensitively and dynamically to driver demands and driving conditions, and transmits the highest torques. It fully uses the available engine torque and offers maximum starting torque right up to the traction limit. At the same time, it is thermally stable and protects the driveline.

After startup is complete, the traditional friction clutch closes and transmits the torque, and the turbo retarder clutch is drained. This creates



a purely mechanical driveline with higher efficiencies and low fuel consumption.

“On the 5250L, we were able to achieve 30% lower fuel consumption over the previous model, and that is quite a lot on a big machine,” states Cramer. “Previously, the rule was that a crane of this size would consume 20 liters of fuel per axle per 100km, and in fact the 5220 did consume a total of 100 liters per 100km – but the 5250 is down to less than 70 liters per 100km.”

Most Stage IV engines are claimed by their manufacturers to offer lower fuel consumption than their predecessors but, according to Cramer, while the new engine itself does indeed have a lower fuel consumption, the main gain is a result of the switch from a torque convertor transmission to the mechanical transmission concept when the crane is on the road.

As a primary retarder, VIAB uses the transmission ratios. As a result, high braking torque is available even at low driving speeds. The operator activates the integrated retarder

either via the brake pedal or a five-stage multifunction lever. When the retarder is switched on, the turbine wheel is locked to the structure with the turbine brake. Oil flows between the two bladed wheels and creates braking torque at the impeller. This torque acts on the vehicle via the closed friction clutch and the transmission. The oil flow to the retarder can also be proportionally controlled and determines the braking torque.

The VIAB concept is also being adopted on the GMK5200-1 and the GMK5180-1. “Both of these five-axle machines use exactly the same driveline as the 5250L,” Cramer clarifies. “Currently, our smaller cranes use a different-size Mercedes-Benz engine, and a VIAB driveline incorporating that engine is not yet available – but if we could use VIAB on these machines, we would!”

“On our larger machines, such as the GMK6400, we are currently using a different technology that incorporates a hydrostatic drive system and that is likely to remain the future direction for these.” **IVT**



Grove GMK5250L - Turbo retarder clutch VIAB

A short video outlining the operation of the VIAB turbo retarder clutch as used on the Grove GMK5250L five-axle all-terrain crane can be viewed at: <https://youtu.be/0CJbAtAujk4>

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▷ They're not pleasant but they need a home, and they have a value. Natural solid and liquid wastes such as animal manures, treated sewage and even paper-processing waste are a good source of nutrients and organic matter for soils – but applying them without causing undue field damage is a challenge for farmers, agricultural contractors and manufacturers.

As farms have grown in size, the pressure has increased to apply wastes to post-crop stubbles faster and more accurately in what can often be a short window between harvest and cultivations for the next crop, or

THE TECHNOLOGY BEHIND MANURE SPREADING IS ADVANCING AT A RAPID RATE, AND IS INCREASINGLY A TASK FOR SELF-PROPELLED VEHICLES. DUTCH SPECIALIST VREDO HAS BEEN HARD AT WORK PRODUCING A SIX-WHEEL VARIANT, WITH AN IN-HOUSE-DEVELOPED CVT

# An exercise in fertility





TOP: In three-axle format, the VT6018 can accommodate a tanker of 32,000 liters, while a 21,000-liter unit is offered for the twin-axle machine

LEFT: Customers can choose the equipment they prefer for applying liquid from the rear of the tanker to the land, including dribble bars and injectors

INSET BELOW: Early drawings released of the machine's layout indicated how Vredo planned to boost capacity while continuing to use a rigid chassis and all-wheel steering

onto grassland at the end of a grazing or mowing season before the weather turns wet.

Meanwhile, environmental concerns mean such waste products must be incorporated quickly into the soil to prevent run-off and smell, while machine capacity has to be balanced against potential effects on soil structure, whether working on arable land that may subsequently be sown with a following crop, or on grassland where the land might be otherwise untouched year-on-year.

The Dutch have long been specialists in manure application machinery. A high number of pig and dairy farms means a large quantity of solid manure and liquid slurry needs to be incorporated into the soils of a country with a relatively small farmland surface area. And with much of the Netherlands at or below sea level, pollution of water presents a considerable risk without well-engineered application systems.

So it's no surprise the country is home to a number of specialists making this equipment and the high-horsepower, flotation-tired power units that have become necessary to power it as demands for greater capacity have grown. Technology on the spreader units themselves now commonly includes

variable-rate application software, allowing applied amounts to vary according to individual field areas via soil analysis maps, while boom systems create the ability to apply liquids directly to the ground over a wide span, and improved shredding and propelling rotors have raised the accuracy and evenness of application of solid spreading systems.

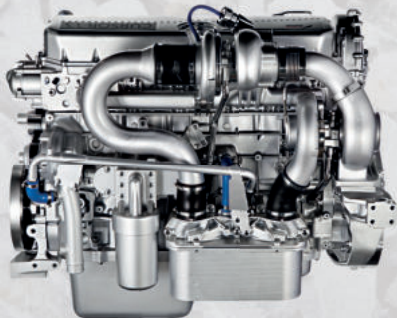
**Where there's muck...**

But the vehicles themselves have advanced too. Flotation-tired tool carriers – or 'floaters' as they're known in the USA – have been around since the early 1970s, mostly from either US or Dutch manufacturers, and built in either conventional four-wheeled format or as three-wheeled designs, with an out-front single front wheel for steering, spreading the machine's load over its full width. Latterly, twin rear axles to help raise carrying capacity have seen five-wheel variants of standard three-wheelers introduced.

But as advances in crab steering, automatic guidance and steerable linkages for following liquid-injector implements have been introduced, four-wheelers are now challenging three- and five-wheelers' full-width load spread benefit, via the ability to drive the machine at an angle and



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LEFT: A remote loading arm with gauge of 10in is positioned at the front of the machine, with material drawn in via a macerator-protected 12,000 l/min positive displacement pump

run each wheel in a different path. And with the introduction of Vredo's new six-wheeler with steering on all axles, including full 'crab' capability, capacity appears to have taken a big step forward, particularly for those preferring to fully mount tankers rather than trail a larger-capacity model via a fifth-wheel coupling.

What's even more interesting is that, despite being in such a niche and relatively low-volume market, Vredo has chosen to develop its own continuously-variable transmission for its triple- or dual-axle VT6018. The company has been producing its own design of flotation-tired self-propelled applicators since 1994, having previously specialized in manufacturing the application equipment to work on others' vehicles. Four-wheeled machines were its preference from the outset, focusing on a design comprising a front-mounted cab offering full forward vision, an engine located low between the axles, and front-wheel/four-wheel/crab steering.

**It's all gone pair-shaped**

The company has never ventured down the three- or five-wheel route with a machine of its own making, believing instead that wheel pairs, a front-mounted cab and a mid-mounted engine offer the optimum weight distribution. Now, though, to meet the demand for greater outputs, it has extended that thinking by adding a larger model, the Vredo Trac VT6018, to its line, with an optional third steerable axle at the rear. And while the OEM continues to source key components such as

axles and cabs from outside suppliers, for this machine it has developed its own transmission, a CVT unit, to be used in place of the hydrostatic system on its other models.

Vredo revealed details of the VT6018, featuring its VVT600 transmission, at Agritechnica 2013, when representatives of Vredo and of Sauer Bibus, which provided CVT expertise for the project, presented at the pre-show conference. Vredo is also working with Zuidberg on the CVT development, and the latter is manufacturing the unit, which will be available to external customers.

The fuel-efficiency benefits of a CVT, allowing engine and forward speeds to be varied independently of each other, were felt to be of greater value for a machine of this size and

weight than the hydrostatic drive that powers its smaller models.

When injecting slurry into the ground, implements such as deep leg cultivators on a rear linkage are often used to create pathways down which slurry can be fed, so tanker weight is not the only factor that makes this operation horsepower-hungry. Begun from scratch, the CVT project's aim was to create a transmission suited to machines of 440kW (600hp) and above, giving them high tractive ability as well as good travel speed.

Key components include a variable-displacement hydrostatic pump and a pair of 45° Sauer Bibus swivel motors, offering a combined displacement of 466cc. Angle sensors and a proportional valve provide precise pivot control, and power transmission to each wheel is via planetary gears. A mechanically engaged PTO is optional. Maximum permissible input torque is 2,650Nm, while the maximum input power is 440kW and maximum output torque is 13,500Nm.

The pump and motors are integral to the transmission housing, but in a departure from the norm, have been flange-mounted externally. Transmission control is by way of a SauerDanfoss Plus+1 controller, via software written by Vredo engineers.

There are two speed ranges, spanning 0-20km/h and 0-50km/h, which can be shifted under load on

Vredo is following the agricultural trend toward taller tires with a longer footprint to minimize trafficked soil area. Single options range from 1250/50 R32 to 800/70 R38





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the go, while the transmission also powers a shifttable mechanical PTO, capable of transferring full engine power, and three pump packs serve external hydraulic requirements.

**Axle folio**

On the VT6018, the transmission drives the Omsi-sourced heavy-duty axles of the machine, via planetary final drives. All steer, drive and are equipped with external disc brakes. A lockable longitudinal differential helps to maximize traction under difficult conditions, the 50km/h top travel speed is achievable at 1,350rpm, and towing capability is 28 metric tons.

The front axle is hydraulically suspended, and there is a walking beam arrangement cushioning the rear of the three-axle machines, and hydraulic suspension on the back end of two-axle models. Switchable steering modes include front-wheel, all-wheel and crab steering, with the third axle, where fitted, lifting during steering. Crab steering enables the machine to drive with all six tires creating their own path, for a full-width weight spread, and can be automatically switched over at each headland for four-wheel steer mode.

Meanwhile, in a departure from the usual squat-wheeled build of floaters, Vredo is following the trend for employing taller tires with a longer footprint to minimize trafficked soil area. The VT6018's design allows for the fitment of tires ranging from 1250/50 R32 (for an outside width

of 3.30m), 1050/50 R32 units through 900/60 R42 and 800/70 R38 rubber to 620/70 R38s for twin mounting.

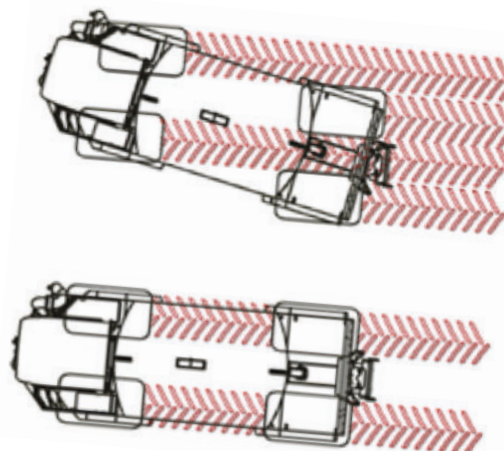
Powering all this is a mid-mounted Tier 4F Deutz TCD 16.0-liter V8 with modular exhaust aftertreatment and SCR, producing 600hp at 1,800rpm and 2,650Nm maximum torque. An Eaton EMR4 controller links engine to transmission.

**Claasy cab**

Vredo has stuck with long-term supplier Claas as its cab partner for the VT6018, with the latest Vista II unit customized internally to suit this machine. A large, 10.4in full-color touchscreen terminal shows all required operator information for both vehicle and implement, while two joysticks in close proximity to one another control all major implement operations. Operator comfort extends to luxuries such as an air-suspended Grammer Maximo Super-Comfort seat and Climatronic climate control.

Although the focus of the VT6018 is largely on manure application, its load platform can accommodate a variety of bodies, making it suitable not only for slurry tankers and muck-spreading units, but for possibilities including grain transfer hoppers, water bowsers and wood chippers.

Vredo claims that the low-down mid-mounting of the engine and transmission means it remains more stable in uneven terrain, while the VT6018 is claimed to have the lowest weight per tire of any machine of its type.



ABOVE: In crab steer mode, each wheel leaves its own track and the machine's weight is spread across its full width

BELOW LEFT: The VT6018's load platform can accommodate a variety of bodies, from slurry tankers and muck-spreading units to water bowsers, grain transfer hoppers and wood chippers

Details of the Vredo/Zuidberg/Sauer Bibus VVT600 two-range stepless CVT were first revealed at Agritechnica in 2013



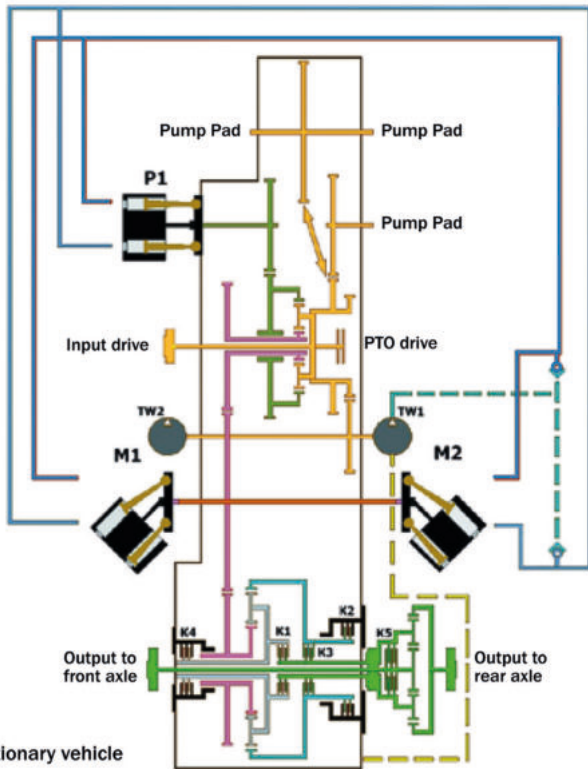
External power can be provided by the optional full-horsepower mechanical shifttable PTO at the rear of the machine (used to drive the Tebbe spreader box, for example), and/or an optional front PTO that is directly driven from the engine, offering the opportunity for out-of-season operation of equipment such as wood chippers. Vredo suggests customers may find further uses for the front linkage with, for example, a dozer blade on a silage clamp, where the low RPM/high traction capabilities of the CVT again come into their own.

But for applying slurry and other liquids – likely to be the VT6018's most common occupation – Vredo supplies a 21,000-liter polyester tanker for the twin-axle machine, and a 32,000-liter unit for the three-axle VT6018-3, capable of swallowing a full truck tanker in one go. A remote telescopic loading arm (optional) with gauge of 10in is positioned at the front of the machine, giving an unimpeded view when loading from a pit, container or tanker, drawing in material via a macerator-protected 12,000 l/min positive-displacement pump. Material is discharged via whatever type of applicator buyers choose to specify, with boom-type dribble bars, trailing shoe applicators or pipe-fed cultivator legs all being a possible match.

The heavy-duty three-point steerable rear hitch, which can be had with category 3N, 3 or 4N ball hooks, can be automatically steered accordingly when the machine is being operated in crab steer mode.



## CASE STUDY



Stationary vehicle

ABOVE: The CVT combines a variable displacement hydrostatic pump and a pair of 45° Sauer Bibus swivel motors. Power transmission to each wheel is via planetary gears

TOP RIGHT: Rear category 3N/3/4N three-point hitch offers hitch travel of 660mm and a lifting force of 80-105kN. It's steerable, to work with the machine's crab steering

### On the pull

Equipped with a CVT rather than a hydrostatic transmission that's less suited to draft work, the VT6018 also offers the possibility of use as a tractor for tasks such as cultivation, in suitable field circumstances. Vredo points out that the axles and transmission are capable of handling 600hp and 2,650Nm in continuous operation, suggesting this makes the machine extremely well suited to heavy pulling operations. The rear loading platform can be ballasted as required for such applications, while all-around suspension and lockable cross and longitudinal differentials help ensure power transmission with minimal slippage.

For spreading of solids, the two-axle VT6018 can be equipped with an 18m<sup>3</sup>/20t spreader body, with a 27m<sup>3</sup>/30t option for the three-axle version. The combination of CVT transmission and mechanical rear PTO means the slurry spreader can be driven in the most fuel-efficient way with a constant spreader drive RPM for an accurate distribution



### SPECIFICATIONS: Vredo VT6018

**Engine:** Deutz TCD Stage IV/Tier 4F 16.0-liter V8 producing 440kW/600hp @ 1,800rpm. Maximum torque 2,650Nm @ 1,250-1,450rpm. Fuel/DEF capacity 650/85 liters

**Transmission:** Vredo/Zuidberg/Sauer Bibus VVT600 two-range stepless CVT with 0-20km/h and 0-50km/h forward speed bands and 0-15km/h reverse speed band. Permanent all-wheel drive with lockable longitudinal differential

**Chassis construction:** Welded, formed of high-tensile steel

**Axles and suspension:** Two or three Omsi planetary steer axles equipped with dry disc brakes. Hydraulically suspended front axle. Walking beam rear axle suspension (on three-axle models) or hydraulic rear axle suspension on two-axle models. Two-wheel/four-wheel/crab steering modes. Third axle lifts during steering

**Brakes:** Spring-loaded dry disc brake on transmission output to front axle, hydraulically activated parking brake

**Tire options:** 1250/50 R32, 1050/50 R32, 900/60 R42, 800/70 R38, 620/70 R38s for twin mounting

**Implement hydraulics:** Danfoss load-sensing system, max flow and pressure 2x190 l/min at max. 200 bar. Five double-acting external valves with time, flow and pressure control. Closed loop maximum flow and pressure 260 l/min at max. 420 bar. Hydraulic oil capacity 170 liters

**Three point hitch:** Category 3N/3/4N. Hitch travel 660mm. Lifting force 80-105kN. Active controlled pressure/release system with free float and full depth control. Steerable left/right crab steering. Active contour control. Active hitch suspension during transport. Torsion suspension during fieldwork

**PTO (optional):** Front PTO direct drive from engine. Shiftable rear PTO

**Body mounting:** Four or six twistlock mounts. Loadcells installable

**Cab:** Claas Vista II with full pneumatic suspension. Air-suspended Grammer Maximo Super-Comfort seat. Passenger seat. Climatronic climate control. Electrically adjustable and heatable mirrors. Machine operation via twin joysticks and ISObus terminal including headland management. LCD color monitor for external camera feeds. Radio/CD player

**Lighting:** Bi-LED road lights, Xenon cab-mounted working lights, LED working lights elsewhere

**Slurry system:** 12,000 l/min Vogelsang positive-displacement pump with macerator. Vredo FT 6200 10in suction arm with 120° swivel capability. Rate control through ISObus terminal. Polyester tank with 21,000-liter (two-axle machine) or 32,000-liter (three-axle) capacity. Distribution options include Vogelsang SwingMax3 30m dribble bar with section switches on 27m and 24m and tramline shutdown, operated through Vredo ISObus terminal

**Dimensions:** Overall length for two-axle/three-axle machine 8.60/11.10m. Overall width 3.00m. Height (on 1050 tires) 3.80m. Ground clearance (on 1050 tires) 0.45m. Wheelbase for two-axle/three-axle machine 4.80m/7.30m. Outside turning circle for two-axle/three-axle machine 14.30m/19.20m (or 16.80m on three-axle models when third axle raised)

**Unladen weight including slurry installation:** 19,500kg (two-axle)/25,200kg (three-axle). (No implements/injectors included)

**Optional equipment:** Central tire inflation system with automatic control lowers chassis for field work and raises it for road travel, Trimble GPS RTK steering system, full power PTO at front and rear, front three-point hitch

pattern, claims the manufacturer. The mounting points are suitable for the installation of load cells between them and the body, for maximum spreading accuracy, control and work recording.

As farm businesses become ever fewer in number but larger in size, the future for the simple old task of muck spreading looks increasingly sophisticated. In terms of equipment,

with size and scale comes weight, but multiple-axle machines, crab-steering and auto-steer technology can help minimize this.

That's undoubtedly the thinking behind Vredo's six-wheel version of its VT6018. Putting such significant investment into its own CVT to propel it, though, takes the OEM's commitment to the contractor sector to new levels. **ivT**



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WHAT EFFECT WOULD ADDING AT LEAST ONE EXTRA AXLE TO A TRADITIONALLY TWO-AXLED MACHINE HAVE ON ITS DESIGN, DIMENSIONS AND PERFORMANCE?

## THE COLOSSUS



### Javier Gutiérrez Casal

A freelance mechanical design engineer based in Pontevedra, Spain, Javier has worked for many companies specialized in the development of industrial equipment

The front-loading dumper is a simple and basic vehicle designed to work in rough terrain, and is typically configured with an articulated chassis and two axles. Colossus, however, is a three-axled dumper, with all its components integrated on a rigid TUV-chassis that is capable of supporting a maximum load of 10 metric tons. The front and central steering axles are able to distribute most of the weight between those four wheels thanks to the double wishbone arm system regulated by hydraulic cylinders. The two wheels on either side have their hydraulic cylinders interconnected so that both wheels work as if they were part of a bogie axle. Maintaining the simplicity of the vehicle, the rear axle is a simple rigid unit with one hydraulic cylinder that can control that axle's reactions.

The hydraulic system, which controls the movement of all axles, offers two modes of operation: a Normal mode, wherein all axles operate freely; and an Active mode, where the movement of the axles is continuously regulated. The Active mode can reduce the vehicle's bank angle, adjusting the stroke of the interlinked hydraulic cylinders on either side of the central and frontal axles. It also acts on the rear axle, stopping or controlling its movements to increase the machine's stability.

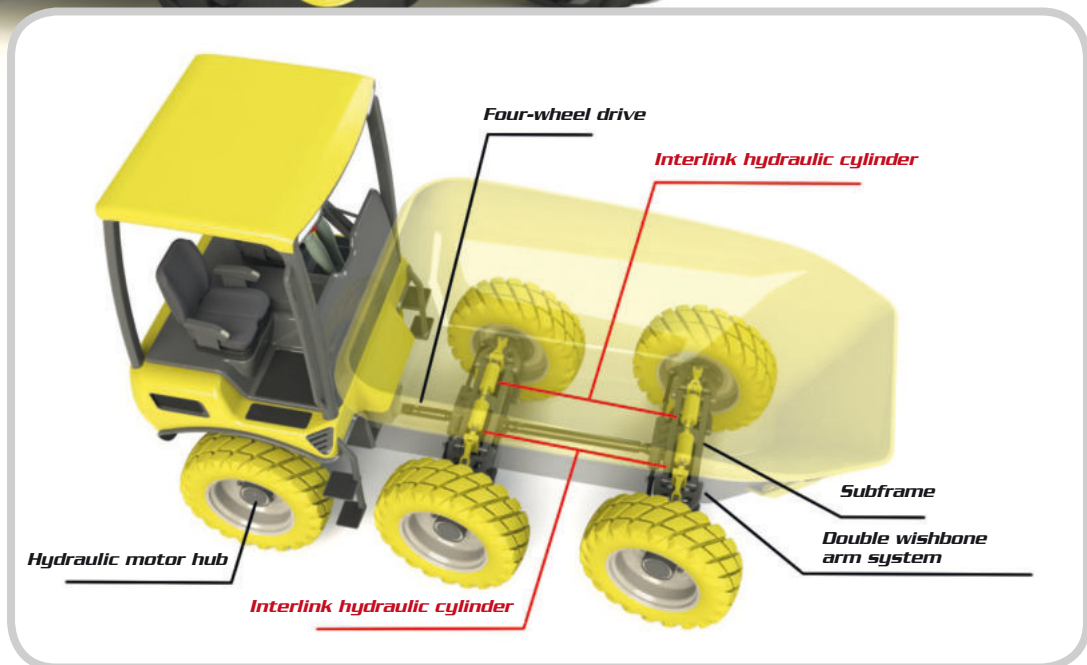
The dumper is powered by a conventional diesel engine, while an automatic five-speed gearbox transmits power only to the wheels of the central and front axles. Should the conditions be especially challenging, a hydraulic pump transmits energy to two hydraulic hub motors placed in the rigid rear axle.

To improve the comfort of the open cab, which is protected by a roll bar, the seats are attached to a platform mounted elastically on the bodywork and which isolates vibration and heat produced by the engine. The position of the driver and the shape of the skip improve visibility to the blind spot that is generated in front of the vehicle.

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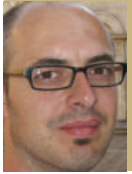


# CHALLENGE



## DESIGN CHALLENGE

# AJURIA HIGH-PERFORMANCE COMBINE HARVESTER



### Alberto Seco

Alberto has been involved in design projects from cell phones to heavy equipment. After a spell at an Italian design consultancy and as an industrial designer, he now works in the automotive sector

The addition of an extra pair of wheels to a conventional combine harvester would allow for the development of a higher-performance machine, even bigger than the currently available 500-550hp 10-class models. But while the trend for bigger tractors on a conventional frame seems to be working well, the combine size required for operating a 50ft header would require a new chassis. So could a six-wheel system provide the basis for an 850hp combine with a 16,500-liter grain tank and enable compatibility with headers from 50-60ft?

The front area of the machine would have to support massive loads due to the huge header, grain tank and threshing system, so adding an extra axle there seems to be a logical decision. A front bogie axle drive system would allow the use of wider tires than the dual combinations on a typical single front axle. The oscillating bogie would provide an even distribution of weight with reduced ground pressure and tractive effort on all four tires, while offering a more convenient frame when moving on tricky routes from one field to another.

This bogie configuration would also leave more room for the threshing mechanisms and make possible a longer system, ideal for effectively managing all the straw supplied by the wider header.

To complete the driveline, a rear drive/steering axle with bigger tires would add the rear traction required for this size of machine.

Enabling such a big header would increase productivity while lowering soil compaction through a reduction in the number of machines needed for harvesting, and also reducing the pass percentage on a field.

Transporting a high-performance harvester can be a problem. So to move the header easily when mounted (for travel between fields) or to transport the unmounted header, it would be foldable, ensuring it would be no wider/longer than 30ft. A greater width of the throat would be needed to control the torque of the header from side to side, so the vehicle is 4,300mm wide.

The threshing and separation system would be a hybrid system consisting of a set of transversal concave and threshing drums and two counter-rotating diameter rotors. The long (11,850mm) structure of the combine would therefore support twin rotors over 5m long to better manage the straw by offering a bigger separation area, especially where moisture could be a problem at the end of the working day.

By running two rotors, the machine's height can be restricted to 4,750mm, making better use of the width of the feeder throat by keeping the mat of material wider and thinner.

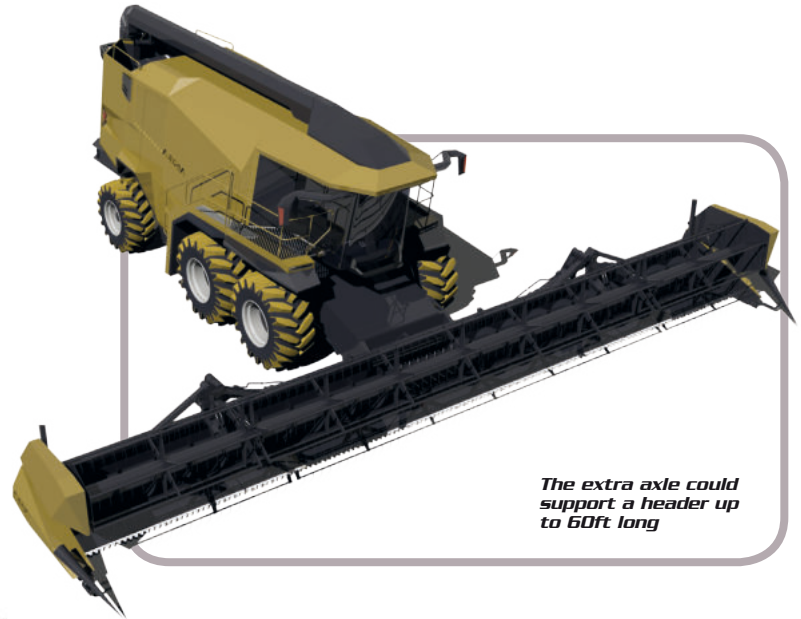
Instead of increasing the size of the grain tank upward, the body of the combine would open out toward both sides, resulting in a folding grain tank that grows wider instead of higher. A high-diameter unloading auger placed in the center of the machine, over the grain tank, would enable truly flexible grain unloading all around the combine. The wide header involves the use of a longer unloading tube, so this auger would be foldable in the rear section of the harvester, which would also shelter the straw chopper and the chaff spreader.

Convenient access to the cab is provided from both sides by means of dual ladders that wrap around the front wheels. Half of the ladder platform can be tilted for better access to the mechanisms during maintenance and cleaning operations.

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*Convenient access to the cab is provided via ladders that wrap around the front wheels*



*The extra axle could support a header up to 60ft long*

*The header would be foldable, halving its overall width to enable easier transport and maneuverability*



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LEFT: View of the vehicle with independent track systems turned



LEFT: The elevating cab provides an overview of the entire field

BELOW: Each track axle is independent, with full suspension to float over the ground and aid maneuverability

## MULTI-TRACKED SLURRY TANKER



### Soucy International

Soucy International designs and develops track systems, parts and accessories for powersports, agricultural, industrial and defense vehicles for reputed OEMs. Part of the Soucy Group, it employs over 1,500 employees in North America and Asia

The Multi-Track Slurry Tanker Spreader (MTSTS) is an advanced design concept based on the addition of several axles to optimize and reduce ground pressure. The negative impact of the massive weight of the payload in a spreader is eliminated by the addition of extra axles that will reduce soil compaction when the tank is at its maximum load capacity. In contrast to a deflated tire, the use of track systems on the field also greatly reduces compaction.

Each axle is independent and would be moveable to provide a greater turning radius to minimize impacts to the ground during a turn. Each axle has an independent suspension that will match the type of soil on which the MTSTS will be riding.

For enhanced visibility, the operator's cabin is mounted on a guided rail system, giving the driver a 360° field of view once it reaches its maximum height.

Furthermore, the MTSTS has the ability to receive an additional (trailed) tank to increase its autonomy in fields according to the operator's needs. The rear tank would also operate on multi-axis track systems to promote soil conservation in larger fields.

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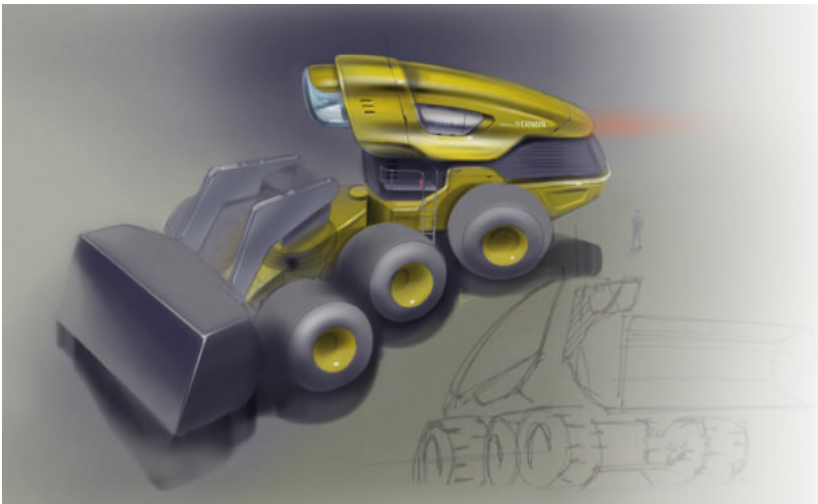


## MULTIFUNCTION WHEELED LOADER



### Amos Boaz

Amos is a specialist in industrial design and styling of high-performance vehicles. He also lectures at the Bezalel Academy of Art and Design, Jerusalem



*With wheels 4m high, the Orpela Vernon duo6 would be larger than any current wheeled loader and its greater stability could even allow for the loading of trucks in just one pass*

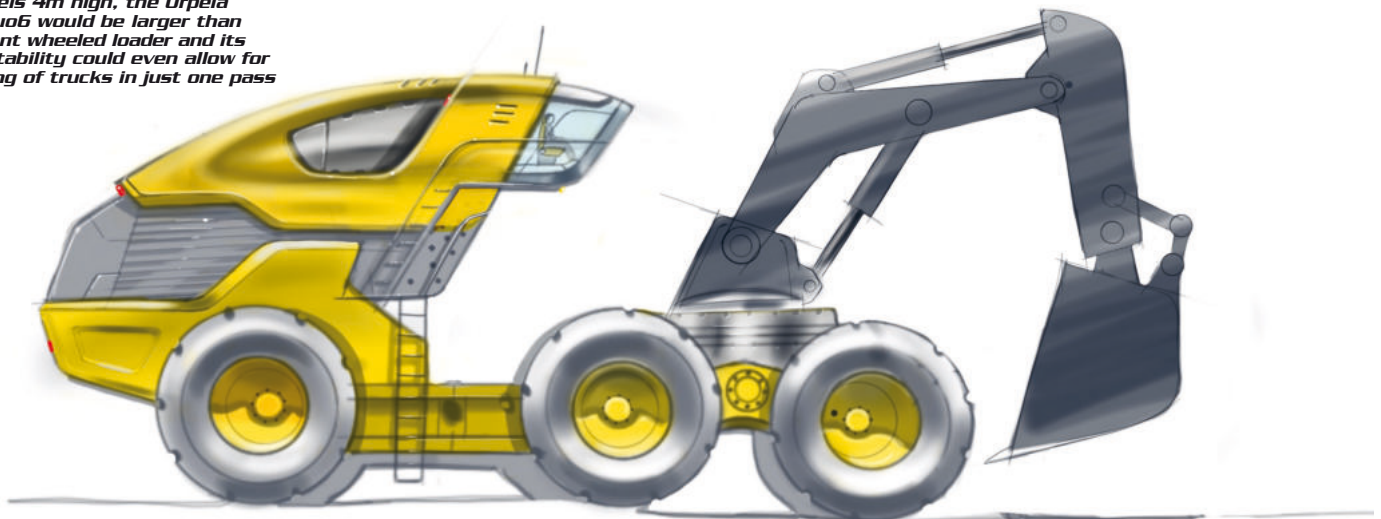
Adding another axle to a skid-steered machine really does change some key characteristics – as well as enhanced grip and greater stability, this results in better handling on rough terrain. The dual axle also provides the foundations for a much larger platform, on which can be attached a variety of tools.

By adding another axle at the front of a huge wheeled loader, the result is the Orpela Vernon duo6, a multifunction loader that is able to carry larger tools – and a greater variety of them – to tackle tougher jobs than a typical 4x4 system can cope with. In fact, this loader can carry a dozer blade as well as excavator tools, making it much more suitable for a variety of tasks around mines and quarries.

After the tool has been attached to the platform, the high stability of the machine means that it is safe to operate in the articulated position, enabling the Vernon duo6 to perform tasks such as loading trucks on either side without having to continually reposition the whole machine.

The tilting seat inside the cab provides a better view to any of the positions required.

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## FOUR-AXLED BACKHOE LOADER



### Pope Design

Jon Pope has designed heavy equipment for over 18 years. He has worked for a variety of off-highway OEMs, whether as an independent design consultant or employed by Teague

Dual bogie axles on a traditional backhoe loader would allow for far superior traction and flotation. Having two axles at the front and another two at the rear would provide more contact on the ground to create lower ground pressure. It would also distribute the weight better, which would be especially helpful when lifting heavy loads with the loader or backhoe.

The independent bogie system ensures that all eight wheels remain on the ground at the same time. It also jolts the machine less than a single oscillating axle when going over bumps, which makes it much more stable and effective during grading operations.

Another advantage of a bogie system on an articulating backhoe chassis is the longer wheelbase, which would help prevent the machine from 'bobbing' when driving at high speeds, especially with a load in the bucket.

And finally, the reduction in the diameter of the tires would provide better visibility of the bucket, create room for real all-wheel steering and even open up more room in the cab.

Although the backhoe is rigidly mounted to the turret, the operator's station, counterweight and the ROPS mounted to the top of this turret can rotate 360°. So when the cab is facing the backhoe, the counterweight opposes it.

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## DESIGN CHALLENGE

# CRANE CARRIER AND LIGHT TRUCKS



### Motive Power

As a director of Motive Power in Sydney, Australia, Lance Procter specializes in designing complex vehicles. Many have related to mining equipment, and he's designed towing tractors for heavy aircraft up to A380 size

Adding a third axle to just about any vehicle improves its 'cool' factor, but the addition can have a dramatic impact on the performance and applications for light trucks in particular.

Technically, a third axle will have an impact on three aspects of the vehicle in varying proportions:

- Payload mass;
- Mobility;
- Payload length.

The rated load for a light truck will double, and sometimes triple, as the result of the third axle, so it can carry substantially more, just like this crane carrier example. This vehicle is not one that would normally be considered as a crane carrier, but with a third axle it has the payload mass capability to carry a substantial crane, and even have a good pick and carry rating.

Combined with the knuckleboom crane, the small profile means it can operate in confined areas, making it useful for industrial equipment installations, for example. The use of a conventional on-highway chassis also means it can self-deploy at highway speeds, which is very useful in taxi crane applications.

The same approach can be used for any high-load, low-profile applications. Fire trucks are another example – for applications such as bushfire fighting, and fighting fires in parking lots, which need high water volumes, but low profiles.

Even smaller vehicles can benefit from a third axle, particularly if they are not intended to carry heavy loads. Our ambulance concept is a good example of where tray length is important, but the vehicle still requires good mobility. Depending on the application, 6x2, 6x4 and 6x6 configurations are possible. When a bogie drive is used at the rear, suspension and torque distribution issues need to be addressed, but solutions to these issues are now readily available.

The conversion of lighter vehicles into three-axle units often means that light, indigenous vehicles can be used for bigger jobs, and that the smaller profile permits access on narrow roads and thoroughfares.

There's no doubt that adding a third axle to a light truck confirms that good things can come in small packages. **ivT**

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*Big crane, small carrier - made possible by the third axle*



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*With the crane stowed, this three-axle unit is ready to deploy at highway speeds*

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IS IT A CASE OF 'THE MORE THE MERRIER'  
WHEN IT COMES TO WHEELS AND AXLES?  
OR DO THE ENGINEERING CHALLENGES  
MAKE THE INTEGRATION OF ALL THAT  
EXTRA TECHNOLOGY A REAL  
HEADACHE?

# Four wheels bad?

Nootboom's Manoevr Multi-PL semi low loader features a steering angle of 70° and up to 10 pendulum axles with 12 metric tons per line – unlike most semi-trailers with independent suspension which are often restricted to 9 metric tons per axle

Wheel and axle systems perform a crucial role in defining a vehicle's operational characteristics. All the associated components and their configuration not only assist operators, but also play a large part in safeguarding them and their payload.

Mobil Elektronik, for instance, provides a variety of electronic solutions for both commercial and specialist vehicles, such as steer-by-wire, control-by-wire, brake-by-wire, drive-by-wire, and automation of vehicle processes, depending on the application. The company offers

electronics, software, operation terminals, angle transducers, steering setpoint generators, remote control and more. Steering setpoint generators involve simulation of a mechanical linkage between the steering wheel and axle (force feedback), including mechanical end stop.

Bernd Sailer, the company's system architect, describes its activities using the example of a three-axle vehicle with six independently steered wheels without mechanical linkage. "Our steering systems can fulfill the necessary Ackerman geometry for all steered axles by using an individual

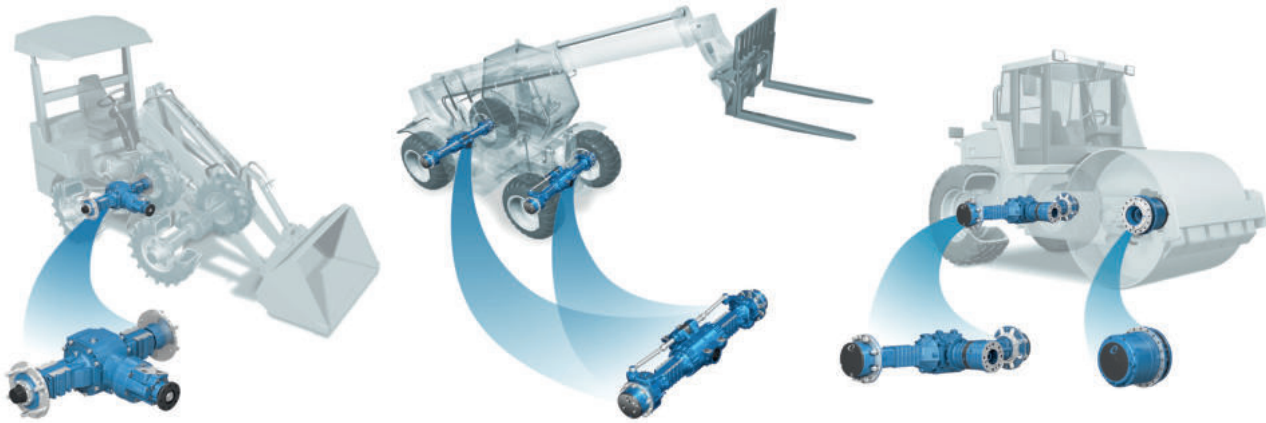
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algorithm. In different steering modes, such as all-wheel steering, or crab steering, the system is operated by electronic-hydraulic or purely electric controls.”

Regarding differentials for wheels, he adds, “Usually these components are not too relevant for us. Only on industrial vehicles do our products control the vehicle’s traction system, including its differential functions.

“On standard trucks and buses, we work with hydraulic pressures up to 180 bar, but with special industrial vehicles [Mobil Elektronik is a valued supplier to Scheuerle and several manufacturers of all-terrain cranes] pressures up to 300 bar are involved.”

Measurement and control are clearly essential for the reliability of vehicle systems, as Sailer points out: “We offer a large variety of safety angle transducers, safety control units, safety steering wheels and special proportional hydraulic valves. Each of our systems has been designed from our standard components, all of which have been tested internally as well as on-site over a long time. Also, most of our components are maintenance-free. We offer PC-based tools (e.g. WIN-PCS) for maintenance, configuration and commissioning of our systems.”

One development in high demand of late is a fail-operational steering system for applications such as all-terrain cranes, earthmoving, trucks and buses. “FailOp is a fully redundant steering system with two separate steering circuits,” he explains.

Regarding future developments, he concludes: “Steer-by-wire systems

for public road use will be important for commercial vehicles as they can offer so many advantages. The main tendency is that complete systems from one supplier are needed. The system architecture is the key, and this can be provided only by an expert. It does not make sense for a vehicle manufacturer to buy just the components without the architecture behind it.”

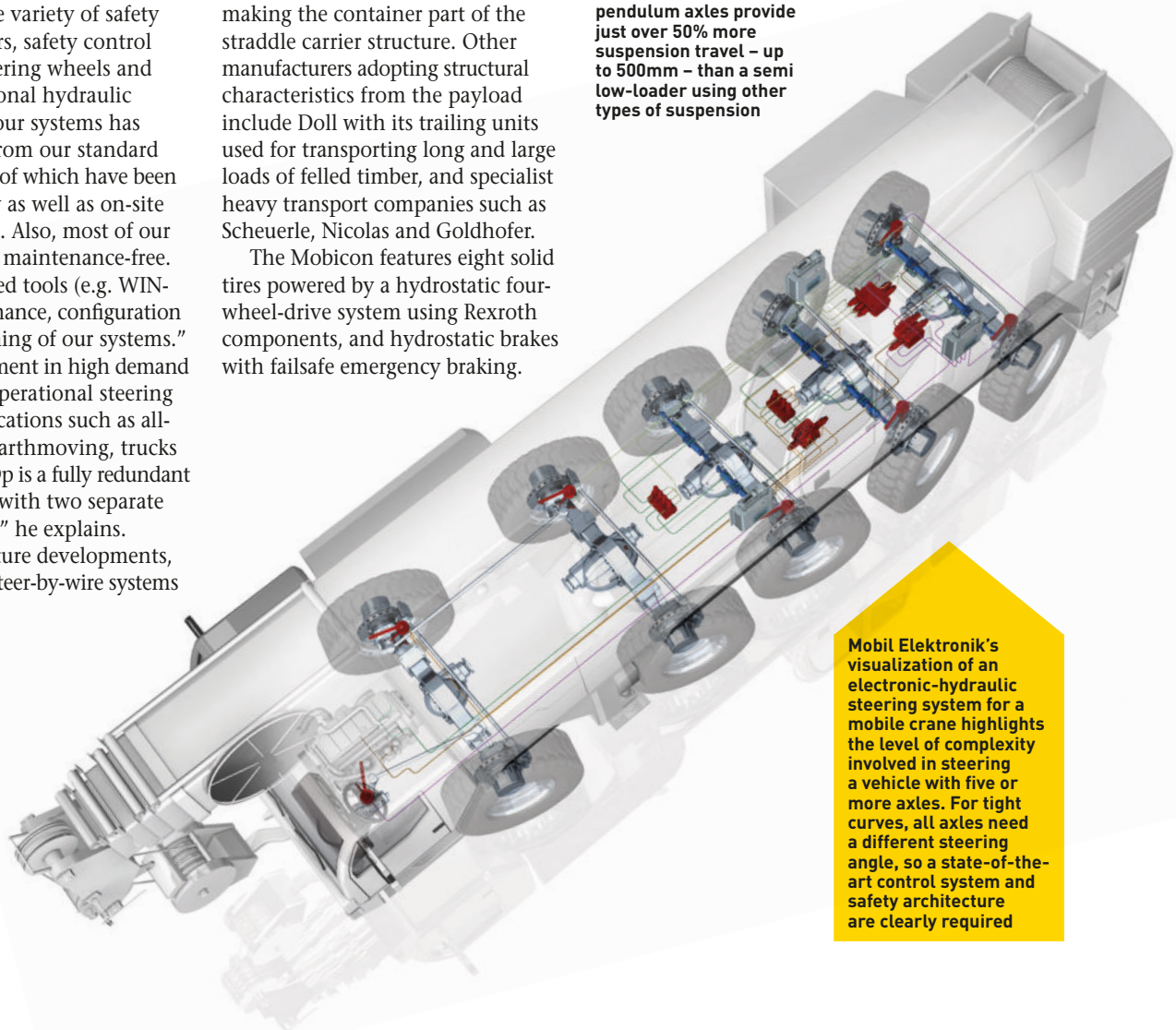
**Straddling the divide**

Australian company Mobicon manufactures several innovative ‘mini straddle carrier’ container-handling solutions. The rear tower of the Mobicon Two Tower, for instance, carries the rear of the container, while the front tower carries the front of it, effectively making the container part of the straddle carrier structure. Other manufacturers adopting structural characteristics from the payload include Doll with its trailing units used for transporting long and large loads of felled timber, and specialist heavy transport companies such as Scheuerle, Nicolas and Goldhofer.

The Mobicon features eight solid tires powered by a hydrostatic four-wheel-drive system using Rexroth components, and hydrostatic brakes with failsafe emergency braking.



ABOVE: Nootboom’s pendulum axles provide just over 50% more suspension travel – up to 500mm – than a semi low-loader using other types of suspension



Mobil Elektronik’s visualization of an electronic-hydraulic steering system for a mobile crane highlights the level of complexity involved in steering a vehicle with five or more axles. For tight curves, all axles need a different steering angle, so a state-of-the-art control system and safety architecture are clearly required



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## THE JOY OF SIX

By adding an extra axle, Fendt's fantastic Trisix Vario combined the advantages of tracked tractors with those of high-performance wheeled models – without either of their disadvantages. Displayed as a concept at Agritechnica 2007, it provoked great interest from larger farms, and was being touted as a possibility for the worldwide market within three years.

A completely new design from the ground up, rather than adapting an existing model, the Trisix featured three driven axles and two continually various Vario transmissions for better traction and a higher transfer of power. Potential production models might also have featured switchable 4WD, making them even more suitable for use across varying ground conditions.

Stability against sliding sideways on slopes was better than on standard tractors, even in poor ground conditions in which tracked vehicles would reach their limits. Tire contact area was of course also higher than that of standard tractors, and a tire-pressure control system was already being planned to optimize traction and reduce soil compaction.

Designed for use with heavy-duty implements, the TriSix also provided on-highway capability without the need for decoupling twin wheels. Dimensions of 7.61x2.75m would have allowed unrestricted use on the road. Stable straight-ahead driving and better tracking around curves would have been ensured at any speed for maximum driving safety. With 540hp supplied from an MAN engine, a high-performance braking system and optional ABS, transport speeds of over 60km/h were comfortably within reach.

Only the front and rear axles were steerable, with an automatic system locking the rear axle at speeds above 35km/h. The combination of such an innovative overall vehicle concept, along with the high potential payloads, offered superb transport capacities. The area behind the cab created additional options for mounting ballast weights, transport containers or articulated trailers.

A further benefit of the three-axle concept was the independent suspension on all six wheels – this delivered superior comfort and smooth driving performance.

Sadly, Fendt ultimately decided to stick with a more traditional large wheeled tractor layout – though this did ultimately result in the development of the spectacular Fendt 1000 Vario – which took more than a few cues, such as the huge engine, fan concept, variable 4WD and traction management, from the TriSix.



Mobicon's 2T (seen here transferring a container from a low loader) features four bogies that provide independent steering between front and rear

Tom Schults, Mobicon's MD, says, "We have delivered several machines to the US Navy that have eight-wheel steering and eight-wheel drive. Front and rear can steer separately, but the Ackermann principle was not used for this model.

"We are currently building a steering system for the Australian Defence with eight-wheel steering. This Mobicon will have front-wheel steering only, rear-wheel steering only, all-wheel steering, and crab steering. The front-wheel steering only and the rear-wheel steering only is to avoid the risk of a 40ft container 'swaying' when all-wheel steering is selected. The Ackermann principle will be applied, with one wheel as the 'master', and all other wheels commanded by a PLC to the correct angle.

"The hydraulic steering is combined with proportional valves. We have four bogies, each with two wheels – each of them has two wheels steering and one wheel driving.

"We do not have a problem with different RPM on each wheel, as all the wheels are parallel driven, and differences in oil flow are absorbed in the system."

### Moving mountains

According to Christopher Rimmel, press officer for TII Group, which comprises heavy transport specialist OEMs Scheuerle, Kamag and Nicolas, the self-propelled modular transporter (SPMT) was first created in 1983 and features hydrostatic motors in the wheel hubs. "Throughout the world, some 90% of movements above 5,000 metric tons are performed with Scheuerle vehicles. The heaviest move so far has been an oil platform weighing 15,000t."

Scheuerle's InterCombi SPE has a removable powerpack to enable a goose-neck trailer to be connected, offering considerable versatility. The powerpack can be set to start and provide additional power below 14km/h in steep areas to give a valuable boost, thereby avoiding the need for a second tractor.

Scheuerle also offers units with adjustable-width wheel combinations to cater for the array of differences in regional and international transport sizing requirements.

French specialist heavy transport manufacturer Nicolas describes its sizeable Tractomas as 'the most powerful prime mover in the world

## POWERTRAIN



– with up to 1,000t towing capacity'. Powered by a 27-liter C27 Caterpillar V12 engine, the Tractomas benefits from 663kW/900hp at 2,100rpm and 4,000Nm torque; features an Allison automatic transmission with a ZF transfer case; and includes PTO for up to two optional outputs.

The 12.5t-capacity front axle from Kessler includes Carlisle disc brakes and leaf-spring suspension with reaction bars. The 25t-capacity rear axle, also from Kessler, features Knott disc brakes and hydraulic suspension with reaction bars.

### Commercial considerations

Industrial vehicles built around a commercial chassis will often feature more than the 'normal' number of wheels. MAN offers a considerable range of axles and associated vehicle components, with drive formulae ranging from 4x2 to 8x8. Some models have a three-axle version with trailing axle, leading axle or tandem axle unit.

The company has also introduced HydroDrive, permanent or selectable all-wheel drive in 4x4, 6x6, 8x6 and 8x8 configurations.

"MAN is the first manufacturer of commercial vehicles to introduce selectable hydrostatic front-wheel drive... for more traction and safety when driving into or out of dirt roads and construction sites, on slopes and slippery roads," the company's website claims. "When HydroDrive is engaged while driving downhill, its sustained-action brake also acts on the front axle, helping stabilize the vehicle. Weighing only slightly more than a conventional rear-wheel drive, HydroDrive can also be engaged while driving and under load."

Available for its 6x4 and 8x4 vehicles with tandem axles, MAN's PriTarder features a highly efficient primary braking system – combining an EVBec engine brake and water retarder – that produces up to 600kW at low driving speeds. This is ideal for use on unpaved roads or off-road, where it acts on all driven wheels. With the steering brake function activated, the rear wheels on the inside of the bend are braked, depending on how far the steering wheel is turned, which considerably decreases the turning circle.

ABOVE: An unusual view of LinkBelt's RTC-80150 Series II six-wheel hydrostatic rough-terrain crane. Each wheel houses a Black Bruin hydraulic motor, creating fully hydrostatic drive with creep control – a suitably silent solution for US states where such cranes are allowed to drive only at night. The wheels remain compact, however, providing an overall height that is ideal for hauling, while enabling a short turning radius for enhanced jobsite maneuverability



MAN also supplies axles for special vehicles: front axles include straight axle beams (9.2t maximum load with disc or drum brakes) and dropped axle beams (for 3.4-9.2t maximum load with drum brakes). Planetary hub reduction front axles range from 6.3-9.5t with disc or drum brakes, extending exclusively to 10.5t for special application on airport fire-fighting vehicles.

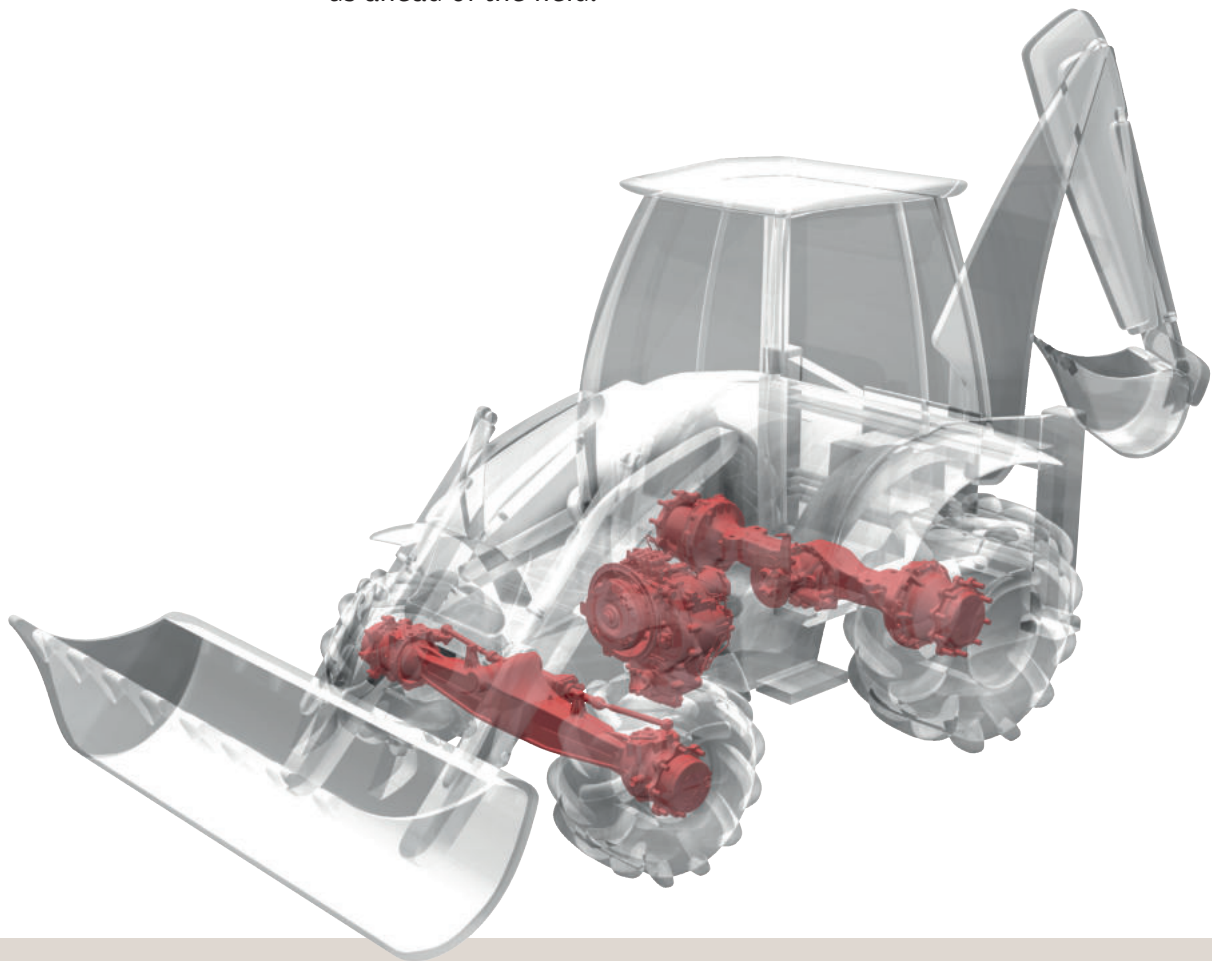
ABOVE: Featured in our November 2008 issue (p78), this is one of two Scheuerle heavy transporters designed to move 115-ton radio telescopes around the Atacama desert. A custom-designed Rexroth hydrostatic drive with 14 axial piston variable-displacement motors enables extremely precise maneuvering

"MAN planetary hub reduction front axles come as a single driven axle and as a drive-through axle for a tandem front axle, so that together with MAN planetary hub reduction rear axles – again with and without drive-through – an 8x8 all-wheel vehicle can be configured," the company says. "A differential lock plays its part whenever maximum traction is needed." iVT

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IVT'S RECENT VISIT TO BKT'S FLAGSHIP PRODUCTION FACILITY, AND A CHAT WITH ITS PRESIDENT OF TECHNOLOGY, REVEALED THAT PRODUCING INNOVATIONS IN TIRES REQUIRES SOME BRAVE NEW THINKING

# Revolutionary ideas

▷ Given that my visit to the inauguration of BKT's latest production facility in Bhuj, Gujarat, India, was my first ever tour around a tire factory – perhaps surprisingly after 14 years at *iVT* – I don't have much scope for comparisons. But to say that the story of its construction, not to mention its operations, is impressive is still an understatement.

The list of potential problems BKT would face following the decision to invest what was then its entire net worth in breaking ground on a 126ha desolate site in a state that is no stranger to natural disasters would have put off a more faint-hearted

company. The seismic risks called for a further US\$25m investment to ensure the US\$500m facility could withstand tremors reaching 9 on the Richter scale, while the unsuitability of the volcanic black soil required 7m of earth to be replaced with a variety more conducive to construction.

Rajiv Poddar, joint MD, described the other problems as including the lack of access roads and generally poor infrastructure, newly built roads flooding and preventing transportation, difficulties in finding and retaining manpower, extremely strong winds and, intriguingly, dangerous wild animals.

Construction began in January 2011, requiring an 8km pipeline for potable water and 13km of electricity lines to be laid. A thermoelectric power plant and rainwater harvesting system have enabled a degree of self-sufficiency. On the site, 6ha have been turned into a small town for the employees, including 406 flats, a mall, a green area and a recreation center, plus the on-site hospital and fire station that also serve the town a half-hour's drive away.

Having obtained ISO 9001:2000 certification for the self-contained production plant, BKT boasts that it represents the state-of-the-art in



## TRACTION TECHNOLOGY

terms of manufacturing and R&D. Built with the aim of redesigning the highly technical tire-manufacturing process to take full advantage of the latest generation of machinery, the main plant covers 29ha, and features 13 mixers and 65 tire-building machines.

A new R&D center is currently being built for research on new polymers and tread compounds. This will house an analytical lab, chemical and synthesis lab, sample preparation and compounding lab, physical lab for life prediction and compound development, an aging and life prediction lab containing an environmental aging oven, ozone chamber with low-temperature capability, and a microscopic lab for root cause and failure analysis.

Next to this is what BKT says is the only test track in India, consisting of three separate surfaces for testing tire performance and driving comfort: an outer, 776m concrete and asphalt oval, with a gradient; two inner tracks consisting of 280m of concrete and pavé; and 157m of circular concrete and asphalt. Several Indian OEMs

have already applied to use the track for their own tests.

The first tire rolled off the production line in March 2012, and after reaching a daily production of 150 tons – approximately 50% of its maximum production capacity – the Bhuj plant was inaugurated at the beginning of December 2015.

At just 60km from the Port of Mundra on the Arabian Sea, it offers huge advantages in terms of delivery times and opens up new avenues in the company's desire to achieve a 10% share of the off-highway tire market by 2018 (currently 6%). For instance, while BKT is most active in the ag sector, it expects 40-45% of its business to come from mining within the next three to four years – and the new facility has enabled it to produce OTR all-steel radials 2in larger than its previous 49in giants.

After traveling down to Mumbai for the subsequent press conference, *iVT* caught up with Dilip Vaidya, BKT's president of technology, to talk about what the future holds for the off-highway tire market (overleaf).



ABOVE: A scale model of the 126ha site in Bhuj

LEFT: Designed for loaders or dozers that operate in severe rocky conditions, and even in underground operations, the Earthmax SR 53 could play a key role in BKT's push into the mining sector

## HERE BE MONSTERS

Being rather dismissive of Monster Jam as a spectacle, *iVT* reluctantly agreed to ask Dilip Vaidya some questions on the topic on behalf of our sister title *Tire Technology International* – and then found the tale of how he developed a tire specifically for this application intriguing enough to include here (a more in-depth look at the subject can soon be seen in the March issue at [www.tiretechnologyinternational.com](http://www.tiretechnologyinternational.com)).

"In 2014, we were looking for the right platform for our branding, and as Monster Jam has a lot of followers in the USA, that's why we got involved," he begins. "I asked them about the problems with the existing tires and found they were taking a 66/43/25 trailer tire and then buffing off the lugs to reduce the weight, but they were not happy with that as they wanted to get it down to about 140kg.

"Then, when I observed the racing and the acrobatics, I understood their other requirements. They were jumping 30ft high, 30ft long, so the casing had to be strong enough to take that impact. The drivers told me that when they landed, it bounced, and while it does that they cannot move, so the sidewall shouldn't be too flexible – it had to absorb that shock quickly. And as they are crashing over old cars, it also had to have good cut resistance. Also, because they use jet engines, the right angle and depth of the lugs was vital to ensure the optimum traction. So considering this feedback, I developed this tire – in just four months we supplied the perfect product at the first attempt. They're very happy with the performance and the demand is growing. For the second generation we will reduce the dimensions of the cross-section as sometimes when the truck lands the tire belt can deflect and hit the shock absorbers.

"So we are seeing a great benefit from our sponsorship – many of the spectators are farmers, so when they see how the tires are still performing despite all that abuse, it's really good for our image!"



The days of buffing down the lugs of trailer tires are a distant memory after BKT unveiled a purpose-designed model for Monster Jam

### **iVT: What new challenges are modern industrial trends bringing to tire manufacturing and compounds?**

**Dilip Vaidya:** When you harvest genetically modified crops, such as maize or soya, the stubble that remains is harder, and that damages the tire. So we have had to develop a new compound stubble penetration resistance test to develop a cut- and chip-resistant compound for implement tires.

We are also developing compounds for tires especially for the North American and Northern European markets to help them perform better in low temperatures. In Bhuj, we now have an ozone chamber with a low temperature facility that goes down to -50°C.

Then there is our newly patented method for measuring a tire's footprint, by rolling it over sponge and then analyzing the footprint in 3D to measure the compression. It has been designed for tires running at low pressure, as soil compaction is very important in a flotation tire. It is not only the surface of such a tire that makes contact with the soil, but also each side, which you cannot measure using a normal flat surface.

Sometimes we may have to change the compound depending on the demand and the particular area. For example, when today's bigger dump trucks are going downhill when loaded, the weight goes on the front tire and because you also need to steer there is a lot of squirming, so sometimes you may get cracks on the base.

And for telescopic handlers in particular, tires need more stability due to the long reach of the boom. For JLG we have developed a tire with a 28in rim diameter rather than 24in, which provides higher stability.

### **In terms of R&D, is your key area for research the compounds, the profiles or other innovations?**

The major focus is new product development, then the development of new compounds, depending on the nature of the underfoot conditions. In agriculture, for instance, Spain has very different conditions to the UK, which is very different to Turkey. Sometimes when we check the properties of the raw materials, we can tell that the specifications may not be enough, so we are doing more research in that area to ensure we get the correct raw material with all the required properties.

### **What sort of R&D projects do you have going on at the moment?**

A lot! Development is a continuous process; every year we create about 120 new products. A lot of new compounds are being tested, such as for solid tires, with non-marking and anti-static properties.

### **How important is digital modeling and simulation in tire development?**

We are working in that direction, trying to simulate mainly for the OTR tire, but we'll also be doing it for some of our agricultural tires. We have Abaqus 3D modeling and checking, so we are on the way. The advantages are the shorter time to market due to reduced prototyping because we can predict some of the problems. With the biggest OTR tires, that will be critical – it's very expensive to make mistakes on those!

But tires are very complex – because they're formed of a composite mass of viscoelastic material and high-tensile steel gauze, it's very difficult to make the model. All the tire manufacturers are working in this direction, but no one so far has come up with a perfect model.

### **Have you implemented any innovations in terms of manufacturing in the new Bhuj plant?**

A lot of tires for large mining trucks are built with a two-stage machine, which isn't really good enough, so we have a three-stage machine. We make the band first and then consolidate it on the solid drum. This is something that I don't think any of our competitors do.

### **What about 'revolutionary' tire concepts such as the Pneutrac and the Tweel – is that something you would like to get into?**

Not at the moment. We've had a few opportunities to collaborate with others, but that is not our focus at the moment. Our primary aim is to develop the most complete range available anywhere in the world – there are sizes specific to certain countries, which other countries won't even use.

For example, we answered the demand of Indian dealers of Kubota machines for use in paddy fields. Normally you use a tire with a high lug for greater traction, but that high tread depth is not good on the road. So we have developed a tire that is good for the paddy field and also the road.

You will never see it in Europe, but there is very good demand for it in the Indian market – the dealer will replace the original tires before they've even been used, and the customers are very happy!

### **You're planning to increase OE sales from 15% to 25%. What can you offer the OEMs that some of your rivals might not be able to do?**

We are always open to make the tires suitable for their requirements, which we have been doing in India for a long time, so gradually we will be doing that in Europe in close association with them. For example, we are the largest supplier of tires to JCB in India and we are developing tires as per their requirement, which is not a common practice in the UK, but they need many different types of tires for the Indian market, considering all the different underfoot conditions.

One other thing is assembly, supplying the tire preassembled on the wheel. That's a service that no others are doing. We will be doing that from our Bhuj facility because we have ample space, so we can incorporate a mounting facility here.

### **Could a passenger car-style label ever become mandatory for off-road tires?**

There is no need and it's not going to happen. The noise levels and those other things do not actually matter, not even for the end user! **iVT**

**“WE ARE THE LARGEST SUPPLIER OF TIRES TO JCB IN INDIA AND WE ARE DEVELOPING TIRES AS PER THEIR REQUIREMENT, WHICH IS NOT A COMMON PRACTICE IN THE UK”**

**Dilip Vaidya,**  
BKT's president  
of technology, is  
responsible for creating  
about 120 new products  
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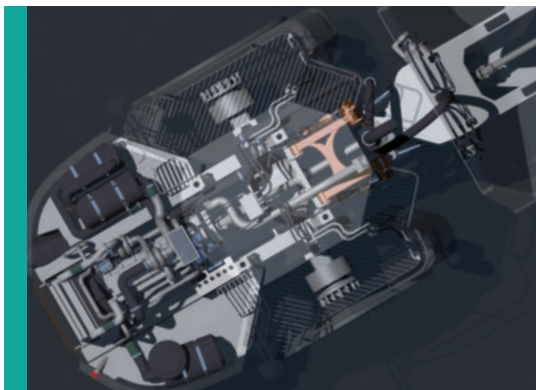
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# Plugging hybrids

HUDDIG IS UNDERSTANDABLY KEEN TO PROMOTE WHAT IT SAYS COULD BE AN INDUSTRY-CHANGING HYBRID TECHNOLOGY, BUT SOME OF ITS OTHER INNOVATIONS ARE WORTH SHOUTING ABOUT TOO

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Following the launch of Tigon Technology last year (see *iVT* June 2015, p4), Huddig is continuing to develop its revolutionary full hybrid technology, as well as create a number of new backhoe loader solutions that seem likely to change the work methodologies in several application segments.

Huddig is a fairly small Sweden-based manufacturer producing a niche, premium product that offers an impressive array of functions that its end customers can use in very effective ways. The company began manufacturing backhoe loaders in 1959, and in the early 1980s produced its first articulated model in the 10 metric ton class. Since then, constant research and development, combined with a close relationship with customers, distributors and suppliers has enabled the OEM to come up with original solutions that solve a variety of needs.

The OEM's aim is to innovatively increase safety and environmental sustainability to make both Huddig and its customers more effective in

the work that they carry out. As one of the first manufacturers of backhoe loaders to develop a hydrostatic transmission for smooth, consistent traction, the company claims to be a technology leader in its field. Now it has its sights set on revolutionizing the construction industry with its full hybrid technology solution, Tigon Technology.

Having researched a number of technical solutions, the Huddig team had seen the possibilities of building a hybrid machine concept combining diesel and electric power. Its solution generates and regenerates energy in a way that the OEM claims has never before been possible, with up to 30% more output than the diesel engine alone can produce.

Many would view it an ambitious venture for a small company in a big industry to implement this kind of advanced solution. However, it is part of Huddig's business strategy; breaking new ground with the aim of transforming the way that tasks with construction machines are performed is in its DNA.

The transmission consists of four two-speed planetary hub reduction gears, with EMGs on each wheel automatically transferring traction to the one with the best grip

### Transforming technology

The eventual implementation of full hybrid Tigon Technology is set to transform each of its City, Cable and Rail machines to further enhance sustainability and effectivity.

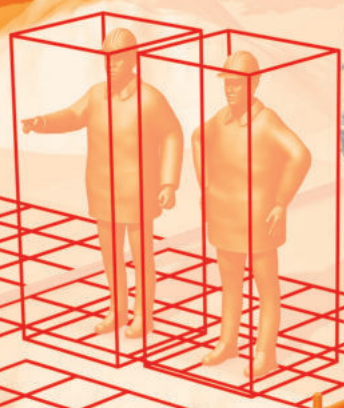
The Tigon Technology concept machine is powered by a Stage IV Cummins QSB 4.5-liter four-cylinder engine offering 104kW and driving seven electric motor generators (EMGs), each delivering 30kW to the hydraulics and transmission. Three EMGs and inverters are mounted on the diesel engine for start, stop and operating the two hydraulic pumps which generate energy for charging and operating the machine. Another EMG is located on each wheel hub to ensure full power and traction control on every wheel.

The hydraulics are operated by the diesel engine, the battery or an external electrical power source.

Huddig has designed the rear axle to accommodate a 25kWh lithium-iron phosphate battery that can fully operate both the transmission and the hydraulics. The diesel engine

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can be turned off completely for work in emission-free or silent mode for approximately two hours. When the vehicle is in stationary operation, an external power source can provide energy to charge the battery and give the machine the power needed. Any increase in power requirements of the vehicle results in the supply of more power from the battery. When a power surplus results from driving downhill, the battery is recharged in readiness for uphill propulsion. The battery pack incorporates a battery monitoring system in the back axle between the EMGs.

Conventional driveshafts and transmission components are not needed as the four wheel motors and EMGs control the speed and power of each wheel and can be adapted for any situation as the traction is automatically transferred to the wheel(s) with the best grip. The Tigon Technology concept machine controls the steering angle and updates the EMG parameters 100 times per second, with a dynamic and static steering compensation and the ability to adjust the speed accordingly. The control system has full control of the wheel slippage and adjusts the speed accordingly, so that the driver has full steering capabilities – even in the event of the front wheels losing ground contact.

Tigon Technology has been developed in close cooperation with world-class component suppliers. However, Huddig says it is not the individual components that make Tigon the technology it is – it's the way in which they are combined and controlled using their own control system that is the key, as the software allows the power, speed and torque at each wheel to be controlled. The speed of the hydraulic pumps is also measured by the control system to precisely match the hydraulic oil flow required to ensure the most efficient output for every work task.

### Charging forward

Since the concept's launch, further developments, evaluations and field tests have exceeded expectations. Performance improvements are just as essential as the environmental advantages the technology offers.

The prototype machine is also said to provide higher torque and 25% lower fuel consumption. The resulting improved propulsion and steering capabilities will be a huge benefit to the cable segment, and the ability to run in silent mode – with a lower emissions output – will greatly benefit operations in the city segment. In rail applications, the ability to carry out tasks powered purely by electric will not only



The steering system is a hydrostatic orbital control system with dual cylinders – digitally assisted by the wheels – in the center pivot with a steering angle of  $\pm 37^\circ$  and a frame oscillation of  $\pm 18^\circ$

minimize fuel consumption and environmental impact, but also reduce operational costs.

A few further modifications will be made before a preproduction series is created for evaluation by customers. Meanwhile, Huddig will demonstrate a concept model in an international arena, at Bauma 2016, with live demonstrations at booth 1309/4. "It will be a new experience for many to see a machine powered by either diesel or electricity, and also in combination with each other," states Lars Lindahl, Huddig CEO. There will also be a Huddig Cable machine fitted with the new Huddig Lift 2200 LWI on display.

Tigon Technology has earned the Swedish OEM a place in the finals of the Bauma Innovation Awards 2106, but Huddig's focus is also firmly on exporting into new markets. The US remains a priority and has gone from strength to strength since the first Huddig Rail was delivered in 2012. Technical development will be an ongoing process on several fronts, as well as widening the segments and customer categories, and finding new ways to make backhoe loaders more effective in terms of economy, fuel consumption and performance, to offer better overall economy for the end user.

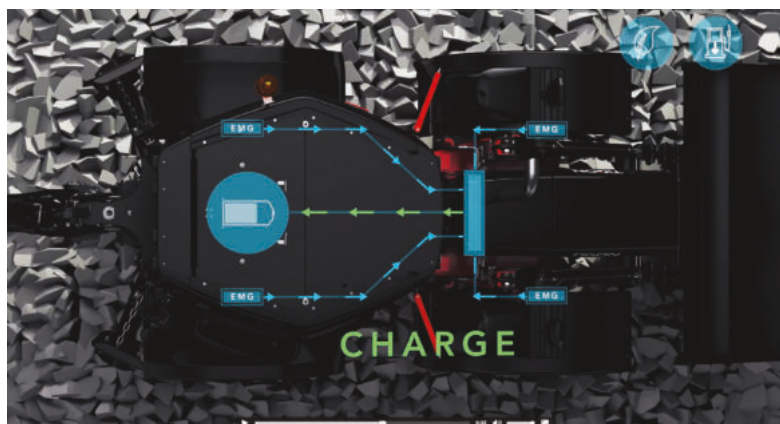
### Creating new industry segments

With their innovative combination of an articulating center pivot and hydrostatic transmission that enables maneuvering in almost any terrain, Huddig backhoe loaders reduce the need to use several machines and people for construction tasks.

The groundbreaking design is steadily making a huge impact in the city, cable and rail segments in

LEFT: The EMGs enable finer control of the working hydraulics, each delivering 30kW to enable silent operation when necessary

BELOW LEFT: When a power surplus results, such as from driving downhill, the power is sent to the 25kWh lithium-iron phosphate battery in the rear axle





## CASE STUDY

Europe and the USA. The machine is highly flexible, enabling it to work safely in tight, narrow spaces. As a multifunctional backhoe loader, the Huddig City has been constructed to be equipped with a variety of tools, so that the same machine can be used for several tasks, including excavating.

The City concept was born out of a need to be able to move in and between workplaces quickly and safely, even with heavy traffic and people close by. Enabling operators to have a good overview and total control of their machines ensures that safety is a high priority.

The Cable machine is a Huddig 1260C with Cummins turbocharged 116kW diesel engine. High hydraulic capacity gives it the strength required to carry out cable plowing, while its maneuverability means cables can be buried on the side of the road or in sensitive areas such as farmland.

The hydrostatic transmission provides smooth operation and constant traction, while the large wheels, high ground clearance and articulated center pivot facilitate off-highway operation in previously inaccessible terrain. The ability to lay cable parallel to the machine has proved to be essential in the roll-out of fiber-optic cable.

The Cable segment also includes the aptly named Muddy Mary, which is equipped with rubber tracks for

better grip and lower ground pressure. This makes it possible to maneuver in soft or snow-covered ground and was developed to facilitate work in areas with extremely low ground-bearing capacity.

Virtually all tasks in connection with line work can now be carried out with just one machine due to a combination of the backhoe and Huddig Lift, with man basket and pole grab. The off-road capabilities get the machine under any line or overhead power cable, regardless of whether they are over bogs, muddy ground or stony forest. It provides a safe platform to work on overhead lines, efficiently high off the ground, while the pole grab holds the pole in position and sets the backhoe free. The Huddig Lift with a man basket holds two people and can either be controlled from the basket or from the driver's seat.

Load-sensing hydraulics allow for high-precision tasks, such as erecting or removing a 25m pole that requires a secure grab and absolute control down to the last inch. The machine incorporates 60cc/rev and 100cc/rev variable axial piston pumps (though a stepped-up pump distribution box provides a total of 174cc/rev), with a nominal maximum flow of 352 l/min. The working pressure is 3,380psi.

The 1260C features low-pressure compressor valves for backfilling, a heating system (circuit pump system)



**ABOVE: The driver cab has been designed with enhanced ergonomics and increased safety in mind. The buttons are ergonomically positioned and the joystick has a turnable ring making it possible to operate four functions with one joystick. The joystick console is stepless and adjustable and the control knob can be used for a chosen function, for example adjusting the hydraulic flow**

for cold starts and an internal servo supply to the directional valve to return power for use in excavating functions. The hydraulic system is prepared for environmentally compatible hydraulic oils.

### Work the line

The Huddig Lift 2200 LWI (live-line work insulator) will be launched at Bauma. With a 22m working height, the lift can be equipped with a man basket and insulator for safe high-voltage, live-line work.

Combining a 1260C with railway wheels (hi-rail), the Huddig Rail is a system for railway maintenance that is also changing the way such work is carried out. Unusually, just one machine can complete several work phases. A railway line usually has to close down during maintenance but this machine can quickly and safely complete work tasks in the time gaps between passing trains.

The high flexibility and tool assortment means that one machine can carry out ballast regulation, snow management, utility work, vegetation management and material handling. The built-in safety feature of an RCI (rated capacity indicator) controls the lifting capacity to prevent tipovers.

The company has also recently launched a mobile loader crane attached to the front loader, which can reach 30m or so. This can be used for handling materials or fitted with a man basket for more effective and safer work on high-voltage power lines or construction sites. **ivT**



**ABOVE: The Huddig Rail can get on and off railway tracks at any location, making work much more efficient**



**BELOW: The Huddig Lift 2200 LWI was designed as a safe solution to meet current requirements and the increasing demand for service work on power lines to be performed with the power on (live line), which saves time, cost and inconvenience. However, the lift can also be used without the insulator and reach a height of 22m, which can facilitate work on bridges, in tunnels, façades on high buildings, and overhead railway lines**

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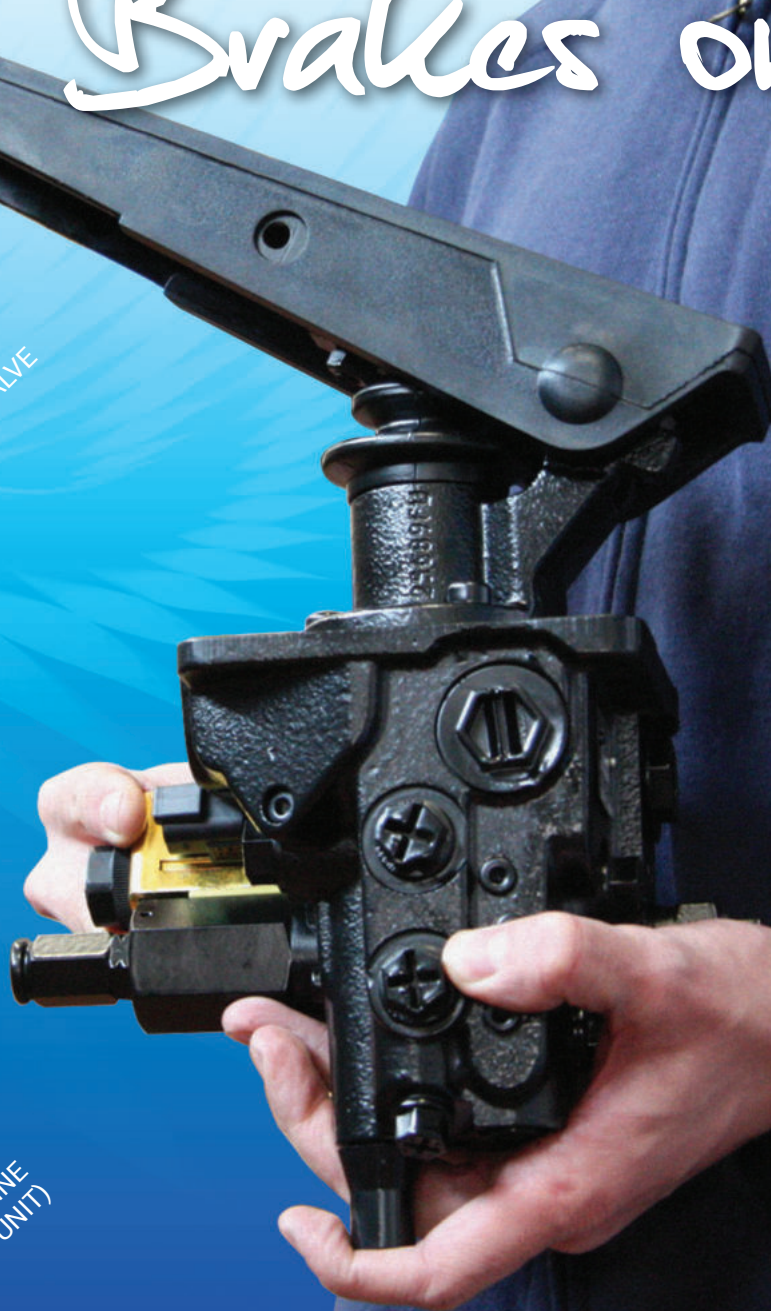
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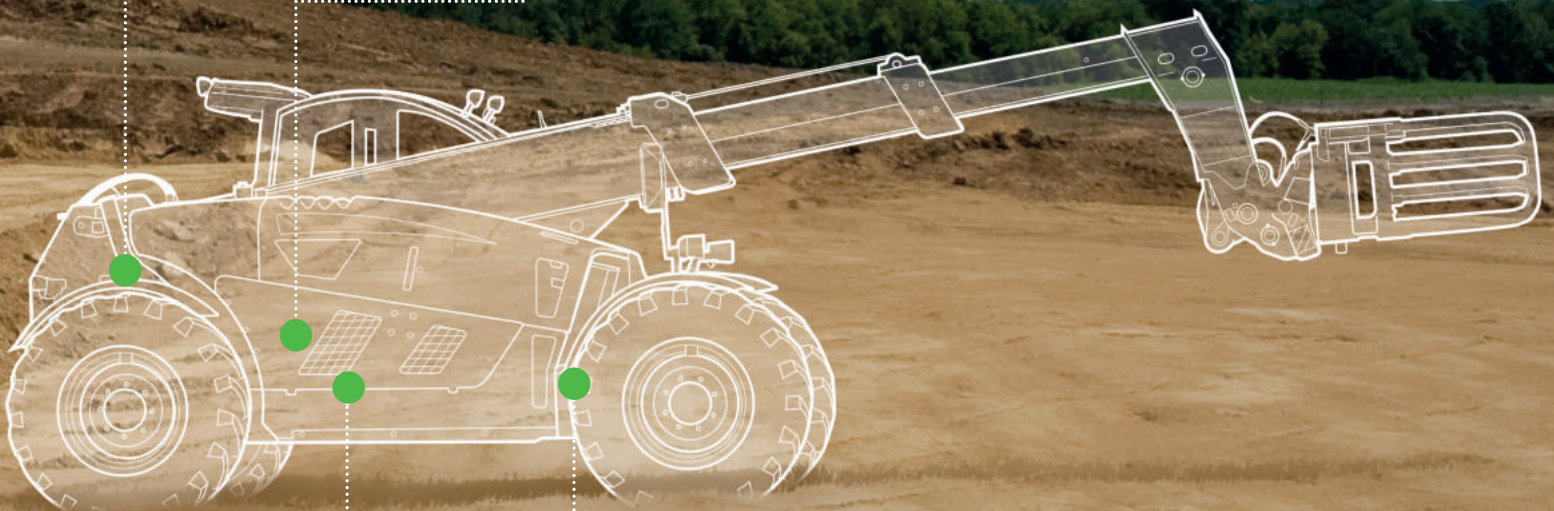
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# BAUMA MUNICH PREVIEW

THREE YEARS HAVE GONE BY IN THE BLINK OF AN EYE, BUT THE TECHNOLOGY HAS ALREADY MOVED FAR BEYOND WHAT WAS ON DISPLAY AT THE PREVIOUS EDITION OF BAUMA. HERE'S THE PICK OF THE INDUSTRIAL VEHICLE LAUNCHES AND NEW COMPONENTS THAT WILL BE ON SHOW IN MUNICH THIS APRIL

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ELECTRONICS

# NEW KIT'S ON THE BLOCK

■ Mecalac's new MWR concept was created after it identified a prime area for improving the operation of wheeled excavators. With the traditional design layout of those machines producing a high center of gravity that results in a lack of stability, inconvenient access to the high cab, and a frequently awkward diesel filling position, discomfort and security can often result. The OEM therefore looked at how it could lower the CoG, and hit upon the telehandler – for which stability is the prime consideration – as the solution, fusing that design with that of the wheeled excavator.

The goal was to fit the upper structure as low as possible between the wheels while retaining its full rotation. All the components in the superstructure have therefore been lowered as much as possible, with the shape of that and the undercarriage being completely redesigned around the oscillation of the wheels.

As well as anchoring the machine to the ground, this new design reduces the height that drivers must climb to access the cab, reducing the likelihood of falls, the most

common injury on industrial vehicles. Two handrails, left and right, can be gripped without needing to twist arms or wrists, while climbing down is also more ergonomic as the feet fall naturally into position on the steps.

The diesel tank has now been repositioned into the undercarriage, between the wheels, making refuelling simple, quick and safe.



**ON THE WEB**

Video content at:  
[www.iVTinternational.com](http://www.iVTinternational.com)



■ Volvo CE has provided plenty of pictures and details of its 16 new product launches but the one we're most eagerly awaiting a first glimpse of is the 55-tonne capacity A60H articulated hauler. With a 40% greater payload than that of its A40 models, it will offer a viable alternative to rigid dump trucks and construction trucks operating on soft, steep or uneven roads while lowering the cost per tonne ratio. The use of ADTs also reduces the level of maintenance required on haul roads, further improving profitability for mine operations.

Excellent stability and comfort during high-speed hauling are ensured by the matched drivetrain, automatic drive combinations (including 100% differential locks), all-terrain bogie, hydromechanical suspension and active suspension.

Intelligent monitoring systems such as MATRIS, CareTrack and the Volvo On Board Weighing System further optimize the high capacity of the A60H.

■ With a range of pave widths from 0.5 to 3.5m, Vögele's Super 800-3i mini paver may be compact but it is still capable of tackling a huge range of applications, such as minor roads, cycle paths, narrow farm tracks and between tram lines.

The well-conceived design and compact dimensions also make it an option for use inside buildings and paving to within 5cm of boundaries – with an overall height of less than 2m and clearance width of 1.4m, canopy roofs and narrow gates are no barrier to access.

The low outer track gauge of 1.14m enables the machine to pave in the milled strip of a small milling machine. With electronic control of the separate drives in the sprockets of the crawlers, the engine power is translated into pave speed with no loss of power.

The rubber pads on the 1500x180mm tracks ensure maximum traction for a constant forward speed.

With separately folding sides, the material hopper has been designed so the machine can be always be supplied with mix in the most effective way, whether from a lorry



The Super 800-3i also features the Niveltronic Basic automated grade and slope control system



at the front or from the side using a feeder with offset functionality. The push rollers can therefore be moved to the side, for instance when paving alongside walls.

Tailored specifically for Mini Class applications, its ErgoBasic operating system has been developed from the ErgoPlus concept proven on the OEM's large pavers, and offers similar levels of

intuitiveness in operation. The console's functions, controls and symbols were also inspired by ErgoPlus, though there is no need for a display as the status of all settings is indicated as a percentage on LED strips immediately next to the relevant function. These also indicate the set speed selected for the augers and compacting systems as well as fuel level.

■ Sennebogen will have at least three key new developments to show, the highlight being the 6300 duty-cycle crawler crane with an 80m main boom. Measuring 12m long, with tracks at 9.5m long and a width of 6.8m for stability and easy maneuverability, the machine posts an overall weight of 310 metric tons. Its uppercarriage alone weighs 100t.

"We are creating a duty-cycle crawler crane that will surpass everything that has come before it," says MD Erich Sennebogen. "Every part has been designed for maximum durability; the base frame is solid steel to ideally absorb forces during continuous use, and we spared no expense in high-quality components."

With hydraulic power up to 350 bar, oversized hydraulic lines and valves, and a 2,000-liter tank, it is well suited for demanding, dynamic use under extreme loads, for example in dredging and mining.

The OEM is also showing its new 730 E-Series pick & carry material handler. Driven by the 168kW Cummins Tier 4F engine, this mobile timber handling machine's 2-speed all-wheel drive enables travel speeds up to 20km/h and the towing of trailers up to 25t. Stacking heights of 10m and safe working loads of 4.2m at a working radius of 10.5m are all possible, with the fully rotating superstructure eliminating the need for complex maneuvering out of sorting lanes and simplifying the unloading of trucks.

The final machine of this trio is a specialized machine for removing hardened slag from blast furnace ladles. The SLC 4000 ladle cleaner uses the base of the 830 material handler, available in three undercarriage variants, with the addition of special-purpose telescopic attachments that can withstand temperatures of up to 1,000°C.



■ Introduced as a concept at Bauma Africa 2013, Bell's B60E will be shown in Munich, before full production begins in 2017. Its 60-ton ADT was designed in response to the greater use of rigid trucks in this size range, and is therefore built to a two-axle design, with a driven front axle and independent front and rear chassis.

"By combining the ADT concept as we know it with the single rear axle, we came up with a unique machine configuration – a 4x4 with full articulation steering and articulation joint and that gives us the ability to keep all four driving wheels on the ground and fully utilize the traction that's available," says product marketing manager Tristan du Pisanie. "This gives [it] more off-road capability than any conventional rigid truck." It also delivers lower fuel consumption, claims Bell.

Powered by the latest-generation Mercedes-Benz engine optimized for

off-highway use by MTU, the B60E will be available in regulated countries, extending its geographic reach. The rear axle is a dedicated 70t Kessler truck and haulage model, making the truck well suited to hard ground applications. "In these applications, you don't need the flotation of an ADT so the single rear axle can take the full load and deliver the benefits of having one less axle, such as no scuffing of tires and improved maneuverability," says du Pisanie. In wet weather, when rigid trucks would grind to a halt, this configuration proves its mettle as the truck can continue to operate. The rear chassis and suspension differ from the usual ADT technology – a cradle supports the rear axle, with struts providing shock absorption for a controlled ride.

The tighter turning circle and ability to negotiate steeper ramps are further advantages.



■ Hyundai will be launching its largest wheeled loader, the 23.5-tonne HL970, onto the European market. Powered by a 232kW Scania DC09 085A Stage IV engine, it's up to 10% more fuel efficient in truck loading than its predecessor, and has a top speed of 40km/h. It also features an Eco Pedal, which helps the operator to easily distinguish between economical and power operation. An Eco Gauge helps too, changing colour in response to engine torque and fuel efficiency, and displaying data such as average rate and total amount of fuel consumed. Hourly and daily use can be checked in detail.

Enabling operators to access accurate equipment data quickly, the infotainment system offers so much more. Similar to

a smartphone display, its 7in touch widescreen monitor is larger than in previous models and provides excellent legibility. Working via the wi-fi of the operator's phone, the Miracast system enables easy use of smartphone features on the big screen, including navigation, web surfing, watching videos or listening to music.

The audio system also has an integrated Bluetooth hands-free feature and built-in microphone that simplifies the making of phone calls.

This monitor also enables control of several new features such as Soft End Stop, which, in conjunction with the EH controls, reduces the speed of the attachment as it nears the end stroke to ensure shock-free operation.



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# A NEW POWER PACKAGE IN THE FAMILY

**World premiere at the bauma: H-Series Three-cylinder Hatz 3H50**

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## Multi-Wing puts MAX Pressure into off-highway applications

Multi-Wing's new axial fan - the PMAX3 - has already been taken up by key players in the market. The exceptionally high pressure rates have been tested and approved for customer projects in the off-highway industry. With a high-strength design the PMAX3 is built specifically for rugged Tier 4 applications. It has a very narrow axial depth and a minimum axial deflection which makes it a perfect fit for compact engine compartments. The hub parts are specifically designed to accommodate clutches to optimize fuel consumption.

The PMAX3 utilizes Multi-Wing's modular design giving 12 possible pitch angles to match a full range of duty points. It has an available diameter range of 445 to 640 millimetres and is moulded in glass-reinforced polyamide. PMAX3 is available in both L and R versions.

Meet Multi-Wing at BAUMA in Munich - Germany: Hall A6, Stand no. 230

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## POWERSIGHT TECHNOLOGY SOLUTION

**John Deere** will present its entire range of Tier 4 Final /Stage IV off-highway diesel engines and the PowerSight technology solution for its own off-highway engines installed in other OEMs' equipment.

Constantly striving to better meet its customers' needs, the manufacturer has developed a range that offers low cost of operation, optimal equipment performance and confidence, thanks to the proven reliability of its engines.

To meet Tier 4F/Stage IV emissions regulations, it has continued with its planned approach by developing an Integrated Emissions Control system, which encompasses a variety of aftertreatment and emissions-

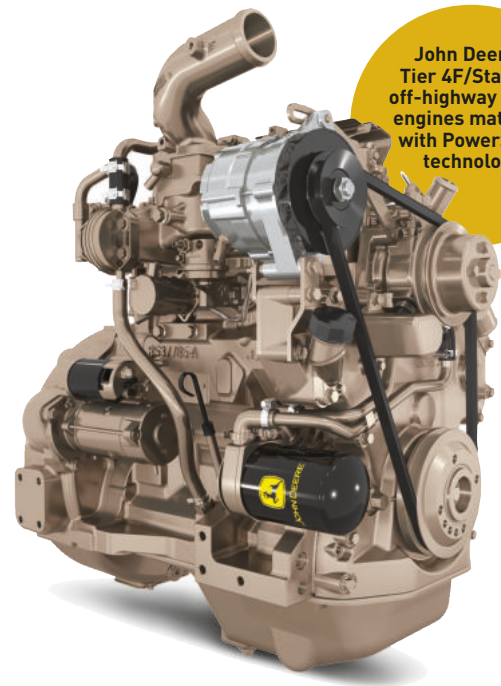
reduction component combinations. Integrated Emissions Control system technology configurations are tailored to meet regulations and customer needs in each power range.

John Deere PowerSight features four John Deere technologies – the JDLink machine monitoring system, machine health prognostics, remote diagnostics and programming, and the PowerAssist app – that integrate seamlessly to help customers manage their John Deere-powered OEM equipment.

The technology solution is being made available for John Deere Tier 4F/Stage IV, Tier 4i/Stage IIIB and Tier 3/Stage IIIA engines.

**John Deere Power Systems A5/227**

[www.ukipme.com/info/ivm](http://www.ukipme.com/info/ivm) Ref: 501



John Deere's Tier 4F/Stage IV off-highway diesel engines match up with PowerSight technology

## Specialist in engine cooling systems

**Radiadores Ordoñez** is a specialist in engine cooling systems and has worked with many leading companies in the automotive, motorcycle, agricultural and other industrial vehicle industries. In industrial vehicle applications in particular, the extreme working conditions demand the development of cooling solutions designed to withstand high vibrations, thermal conditions and dusty work environments.

The company will display its full product range at Bauma, with samples of the different individual products it manufactures (water radiators, intercoolers, oil coolers, fuel coolers, condensers, etc) and full assemblies for a variety of applications such as off-highway machinery, buses and motorbikes.

It boasts a highly qualified engineering team that is willing to collaborate with customers to design the best solution for their requirements. With a wide range of tubes and fins to choose from, the team can adjust the liquid and air pressure drop to match the working conditions and therefore optimize performance and maximize benefits to the clients.

The aim of Radiadores Ordoñez is to manufacture the highest-quality products from its +50,000m<sup>2</sup> Spanish facility that boasts the latest technologies in R&D, including complete testing facilities and a wind tunnel to develop and validate the coolers. Moreover, it has the experience and the means to design and manufacture its own tooling and machinery.

A wide range of tubes and fins makes custom cooling designs simple



**Radiadores Ordoñez A5/127**

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## SINGLE MODULE EXHAUST AFTERTREATMENT

The Single Module is ideal for use in space-constrained equipment



**Cummins** will present the next generation of ultra-clean engines designed to comply with the EU Stage V emissions regulations commencing in 2019 for construction, mining and material handling equipment. Across a broad 55-300kW output range (74-400hp), these engines will go beyond meeting Stage V near-zero emissions regulations, bringing an increase in power and torque of up to 10%.

The Stage V enhancements to engine performance have been achieved by taking an innovative approach to combustion, airflow and fuel-injection systems, enabling Cummins to realize the full potential of the four-cylinder QSF3.8 and QSB4.5, and the six-cylinder QSB6.7 and QSL9, without the need to increase displacement.

The Stage V engines will be supplied as an integrated system with the Single Module exhaust aftertreatment, newly developed in response to the needs of increasingly space-constrained equipment. This will provide up to 50% reduction in envelope size and 30% reduction in weight compared with the existing Stage IV and Tier 4 Final aftertreatment systems.

**Cummins A4/235**

[www.ukipme.com/info/ivm](http://www.ukipme.com/info/ivm) Ref: 502

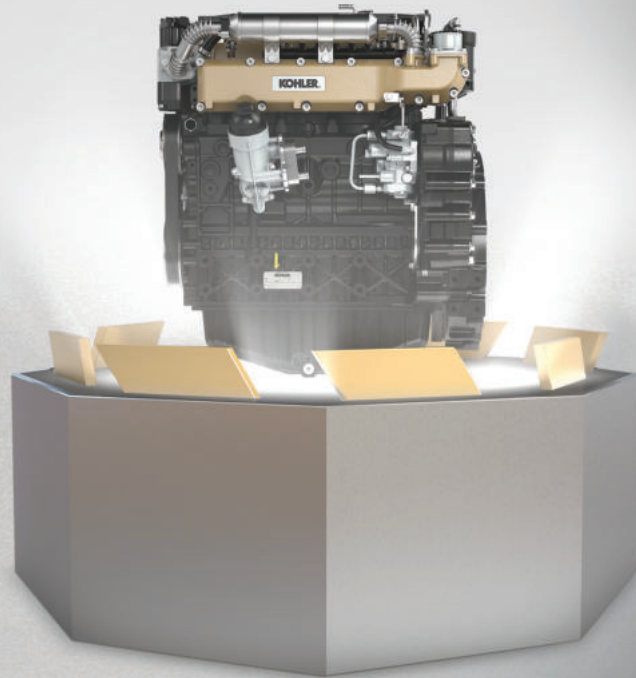
# KOHLER® Engines

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## Good News for Diesel Engines

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[www.ktr.com](http://www.ktr.com)



## New three-cylinder engines

A complete line-up of industrial engines up to 56kW will be presented by Hatz Diesel. For the first time, the company will show the three-cylinder models as a completion of the H series, solutions for the EU Stage V regulations, and generating sets and hydraulic power packs.

For an optimal combustion process, the best operating characteristics and reduced emissions, the three-cylinder models are also equipped with Bosch common-rail technology (maximum injection pressure 1,800 bar), similar to its successful four-cylinders. For the first time, this system is being used in a three-cylinder off-highway diesel engine. Thanks to the turbocharger and the intercooler, the engines have a maximum torque of 185Nm (at 1,600-2,000rpm) and a maximum power of 42kW. All of this requires an installation space of just a

quarter of a cubic meter. With a capacity of 1.5 liters and a maximum speed of 2,800rpm, this three-cylinder engine sets new standards. Furthermore, an additional power-take-off is added to the H family with this engine.

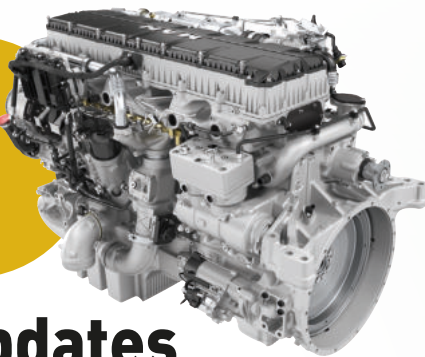
Following the family concepts, the various three-cylinder models are orientated on current and future emission standards. The Hatz 3H50TI requires no aftertreatment and meets Stage IIIA/Tier 4i in the 19-37kW power range. The 3H50TIC engine in particular is designed for the US market, Canada and some Asian countries. To comply with Tier 4F (19-56kW) and Stage IIIB (37-56kW), a combination of DOC and external EGR guarantees the necessary reduction of exhaust emissions. Both variants will extend the Hatz product range from 2018.

Common-rail technology from Hatz four-cylinder engines is being used



Hatz Diesel **A4/548 & 4-5A/9**  
www.ukipme.com/info/ivm Ref: 504

MAN's six-cylinder D3876 LE12x is even more compact than its predecessor



## MAN updates portfolio for T4F

MAN Engines will present the Tier 4F 12-cylinder D2862 LE13x and the six-cylinder D3876 LE12x engines, with improved performance characteristics. The former is available in 588, 650, 750 and 816kW versions, with 24.24-liter displacement. Wastegate charging gives a maximum torque of 3,750-5,000Nm at low speeds (1,300-1,400rpm). Its compact installation dimensions and SCR-only aftertreatment system give the engine a wide range of applications including wheeled loaders, crawler excavators and underground construction machinery.

The D3876 has proven to be an extremely flexible unit as a result of its compact and light design, and has a power range of 415, 450 and 485kW, and 15.26-liter displacement. The variable turbine geometry (VTG) provides a power plateau of 1,050-1,450rpm, with maximum torque of 2,700-3,000Nm. This gives enough charging pressure and dynamics even at low revs for heavy machinery such as wheeled loaders, excavators and mobile cranes. A CR system with an injection pressure of approx. 2,500 bar ensures optimal fuel consumption and reduces emissions, without compromising on efficiency or performance.

The latest EGR and SCR technology ensures it easily meets T4F standards, as well as EU Stage V. With 16 exhaust gas aftertreatment (AGN) variants, the modular exhaust gas aftertreatment with freely positionable individual components enables flexible system integration with a high degree of packing density.

MAN Engines **A5/325**

www.ukipme.com/info/ivm Ref: 505

## FULL RANGE FOR STAGE IV

Volvo Penta will demonstrate why it is more than just an engine supplier, by highlighting the best ways to optimize machine performance, including maximizing engine fuel economy and lowering exhaust emissions in line with regulations. Its full range of Stage IV/Tier 4 Final engines will be on display; these have been extremely well-received by OEMs for many factors, including reliability, robustness and the associated cost-effective maintenance.

The company has chosen an exhaust aftertreatment solution that requires only SCR technology, facilitating a simple and flexible installation for OEMs. As fewer components are used in the manufacturing process, there is less risk of malfunction, maximizing uptime and minimizing maintenance costs.

Further proof of the high quality of its engines is seen in the extended oil change intervals, with changes needed only after as much as 1,000 hours of use.

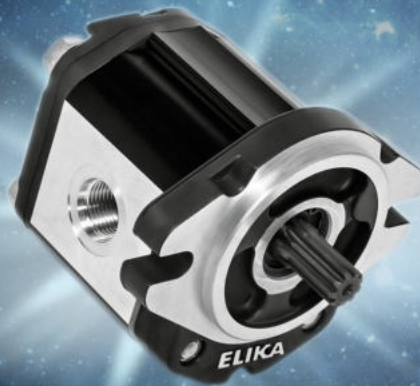
The full range of engines is available to meet Stage II/Tier 2, Stage IIIA/Tier 3 equivalent and Tier 4F/Stage IV emissions standards – meaning that no matter where an OEM exports its products, Volvo Penta has an engine to match the market's emission regulations. This ingenuity has been a hit with OEMs, who have praised the company for its ability to meet the requirements of differing regulatory standards.

Volvo Penta also offers a broad dealer network and access to a dedicated team of technical specialists to its customers, with 3,500 service points globally and 24/7 support in 18 different languages. This global service network helps the company to develop and maintain strong, valued and long-term relationships. Volvo Penta is working to expand its service network by partnering with Volvo CE dealers around the world.

Volvo Penta **C4/327**

www.ukipme.com/info/ivm Ref: 506





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Black Bruin wheel motors deliver torque just where it is needed – under the cargo

## ON-DEMAND WHEEL DRIVES

Sampo Hydraulics is now offering Black Bruin On-Demand Wheel Drives with novel, mechanical freewheeling – providing a practical and simple way to generate more pulling power for trailers or any towed-behind equipment. These wheel drives are extremely well suited for earthmoving applications, and fit perfectly into the wheel to deliver high torque just where it is needed – under the cargo. Therefore less tractive effort is needed, enabling a smaller prime mover to haul heavier loads for greater productivity and fuel savings.

On soft ground, a heavy vehicle is difficult to get or keep moving without on-demand wheel drive. But with Black Bruin-driven wheels, more tractive effort is generated when needed – or all the time if desired. Steerability of the driven wheels is also much easier: in fact, many operators keep the on-demand wheel drive on all the time, as torque is evenly split between the wheels, making driving effortless and economical.

When tractive effort is not required, the motors freewheel automatically, making driving at road speeds possible without active hydraulics. With Black Bruin motors, the freewheeling is safe and simple: mechanical springs in motors keep the stationary pistons secured in the cylinder block. With no overheating problems to consider, you need have no fear of failure!

Sampo Hydraulics **A5/502**  
[www.ukipme.com/info/ivm](http://www.ukipme.com/info/ivm) Ref: 507

## Take the pulse of your drivetrain

Dana's Spicer Smart Suite technology is a platform of fully integrated, connected-vehicle features that converts operating data from the drivetrain into actionable insights for enhancing productivity, improving operator and machine safety, and reducing TCO. The technology is an integrated system that collects, manages, analyzes, communicates, and acts on data sourced from the drivetrain, including torque management, condition monitoring, load monitoring, speed sensing and steering sensing.

It allows critical alerts and analyses to be shared on vehicle central display panels, via tablets, and in fleet management centers. It is also designed to take these insights a step further by performing key functions independent of operator intervention.

The solution includes:

- Sensors that capture data from key drivetrain operating processes;

- Computing capabilities that consolidate, manage and analyze data;
- Compatibility with common vehicle communication protocols and telematics systems.

Fully integrated into component housings, it ensures that sensitive mechatronic subsystems are protected from accidental damage and the impacts of typical operating environments.

The first application of the concept is a new intelligent load monitoring system (ILMS) for telehandlers. While traditional load monitoring technology collects measurements from a single remote-mounted or retrofitted load cell on the rear axle, Spicer ILMS uses data from across the vehicle to prevent tipovers more effectively, provide better estimates of static loads, and supply more intelligent calibration management. ILMS will be offered as an optional feature on all Spicer axles for telehandlers.

## Long live turbo brakes!

NAF's range of products includes planetary drives, gearboxes, differentials, planetary rigid axles, planetary steering axles and bogie axles – all developed and produced exclusively in Germany since 1960.

NAF products are offered to OEMs with application-specific designs, cast construction, a patented oil-immersed self-cooling disc brake, gear drive for high durability and long working life, an attached gearbox, and flexible adaptation due to the NAF Modular System.

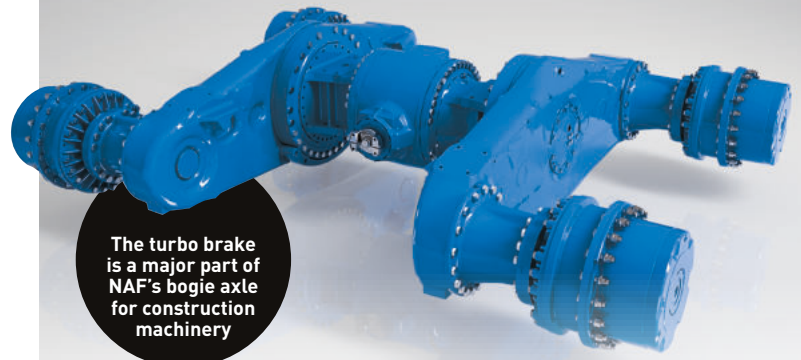
The patented NAF turbo brake – which is directly integrated in the wheel end and runs at wheel speeds up to 65km/h – has almost no wear over its lifetime, greatly reducing service effort. As an additional advantage, the turbo brake needs no external cooling as it offers a self-cooled system. Fully encapsulated by the wheel hub, the brake is completely protected against outside influences such as mud and water.

This brake system is one of the major components in the NAF Modular System, as a single wheel end or as a part of the company's rigid axles or bogie axles for use in different variations, sizes and ratios.

The design of all NAF drivelines is in accordance with the NAF Modular System, adapting existing parts of products in different combinations – with limited new developments or modifications required – to enable effective use, even in completely new applications. All individual parts have been long-term tested and can be variably combined to create an individual drive solution with substantial cost advantages.

### NAF A4/203

[www.ukipme.com/info/ivm](http://www.ukipme.com/info/ivm) Ref: 508



The turbo brake is a major part of NAF's bogie axle for construction machinery

Dana Spicer **A4/326**  
[www.ukipme.com/info/ivm](http://www.ukipme.com/info/ivm) Ref: 509



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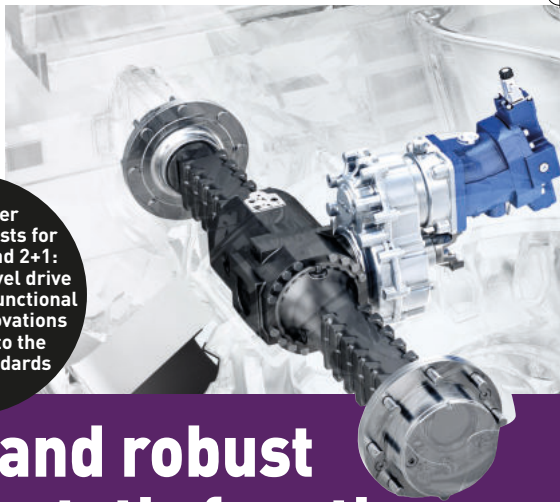
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**Professionals in motion**



Much lower integration costs for Shift on Fly and 2+1: hydrostatic travel drive solutions with functional safety and innovations conforming to the relevant standards



## Safe and robust hydrostatic functions

During the construction and configuration of hydrostatic travel drives, OEMs have to comply with the Machinery Directive as soon as they wish to market construction equipment in Europe. With function modules from Rexroth such as Shift on Fly SOF and 2+1, OEMs achieve considerably lower costs during the integration and application of hydrostatic travel drives. These combine innovative functions with standardized safety features that meet the requirements of the Machinery Directive. In addition, the Rexroth developers have examined all components and their interactions with each other, to further improve the robustness of the function modules. Both 2+1 and SOF cover a wide power variation through different combinations of various pump and motor sizes.

Shift on Fly enables safe, short and synchronized switching operations in different driving situations. In this way, comfort for the operator is increased too. The 2+1 travel drive module makes reductions in fuel consumption of up to 20% possible without tractive effort interruption during operation. It consists of an axial piston pump, which is connected to a variable motor and a fixed motor. The driving range changes automatically and travel speeds of up to 40km/h can be achieved.

Rexroth **A4/327**

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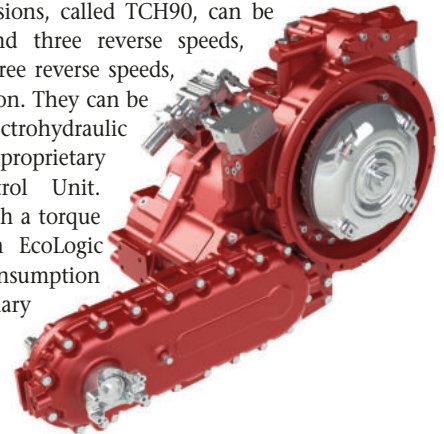
## TAILORED DRIVETRAIN SYSTEMS

**Carraro** has long-focused on offering competitive drivetrain systems for light and utility construction machinery, such as backhoe loaders, telescopic boom handlers, compact and small wheeled loaders, soil compactors, trenchers, wheeled excavators, and many others. In this regard, the company developed several drivetrain solutions for hydrostatic, torque converter and, more recently, electrically driven machines. All those solutions, entailing axles and transmissions with electrohydraulic controls have been tailored and optimized for each machine application. All Carraro drivetrain solutions have been designed to achieve the highest performance in terms of fuel efficiency and machine productivity, providing optimum levels of driver comfort at the same time.

Among the most recent evolutions in terms of the torque converter drivetrain is the new full powershift transmission range dedicated to machines with a side-mounted engine layout, such as many telescopic boom handlers. Those transmissions, called TCH90, can be configured in four forward and three reverse speeds, as well as in six forward and three reverse speeds, within the same overall dimension. They can be controlled both by a simple electrohydraulic controller or by the Carraro proprietary Transmission Electronic Control Unit. Those units can be equipped with a torque lock-up function and with an EcoLogic function to minimize fuel consumption both on the go and in stationary working conditions.

Carraro **A4/315**

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## Boosted efficiency and increased power

**Comer Industries'** integrated systems for major OEMs will be on display, featuring design solutions for boosted efficiency and increased power. On show at Thaler's booth will be the S-46 hydro axle (patent pending) for compact wheeled vehicles – this modified S-046 standard axle hosts a hydrostatic radial motor in line with the input shaft and allows 4WD connection while enabling improved driveline layout by reducing the installation room needed under the vehicle.

On show at Atlas Weyhausen's booth will be Comer's complete driveline system solution for single-drum soil compactors. This drive package incorporates a wheel drive for the front drum and a planetary drive combined with the rear axle to propel the wheels at the rear of the machine. The rear axle driveline assures a high reduction ratio combined with a low space impact under the vehicle. By using an available additional planetary stage on axle input, it is possible to provide proper torque to the axle, instead of using a drop box. Not having a drop box frees up room in the undercarriage and saves room in the vertical direction at the axle input. With a maximum dynamic load of 6.6 tons, coupled with a maximum output torque of 2,400 daNm, Comer Industries' F-128 axle is suitable for single-drum

rollers with an operating weight up to 9 tons. (For further details see *iVT Off-Highway Annual 2016*, p46).

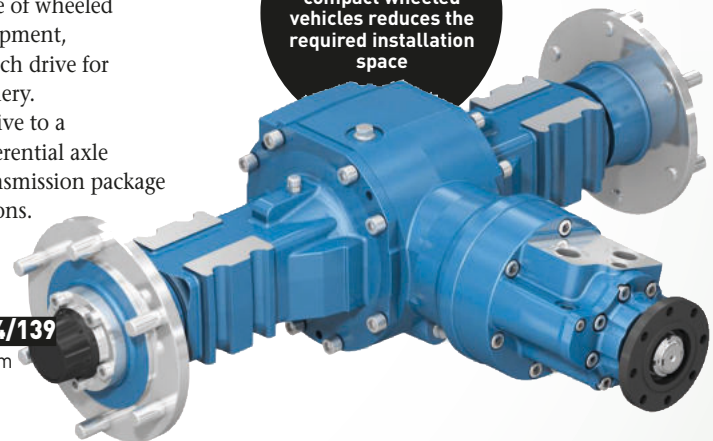
The company will also introduce the PGR-3600 rotating housing drive series – a compact and robust solution that features higher output torque and load capacity, along with increased reliability. It is the ideal choice for a wide range of wheeled or tracked mobile equipment, well as for use as a winch drive for cranes or fixed machinery.

Coupling such a drive to a Comer Industries' differential axle creates a complete transmission package compactors up to 15 tons.

Comer Industries' S-46 hydro axle for compact wheeled vehicles reduces the required installation space

Comer Industries **A4/139**

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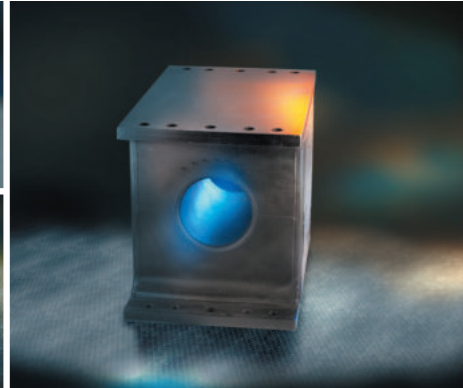
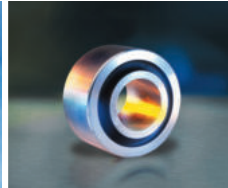




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**bauma 2016** HALL A4  
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[www.knott.de](http://www.knott.de)

## ZF'S GLIMPSE INTO THE FUTURE

ZF will present its latest product highlights including the Efficiency Package, the cPower CVT solution, as well as hybrid technology and electrification, to give a view into the future of industrial vehicles.

With the Efficiency Package, ZF has consolidated its competence in transmission, axle and software development to offer more than the sum of their individual advantages. This approach makes it possible to reconcile the frequently conflicting demands for enhanced comfort, greater productivity, and lower fuel consumption and component wear.

The fully powersplit, continuously variable cPower technology benefits from ZF's long-term off-highway experience and offers notable consumption benefits and productivity increases for the operator. It allows for completely new drive concepts, and enables up to 25% less consumption, as well as up to 20% more efficiency.

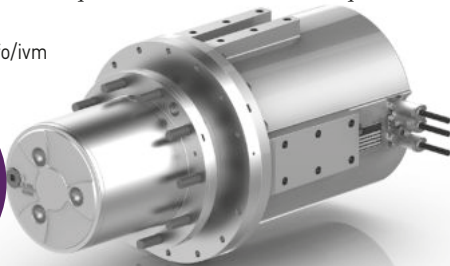
The ZF-hybrid system is suitable for all ZF transmission forms and can be implemented for direct or separate transmission mounting. This leads to a considerable reduction of consumption, an increase of work output, and a major reduction in exhaust emissions. Thanks to this innovation, operating costs can be notably reduced.

Electrification of attachments is another trend – ZF's electrical drive is provided by a fluid-cooled three-phase asynchronous motor with a high power density and a following transmission stage. The motor is integrated in the wheel hub unit to save space. The system can also be optionally fitted with a wheel brake. The rated voltage is 400V, so the motor power and drive torque are sufficient for most requirements.

### ZF A4/324

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Ref: 513

Integrated in the wheel hub to save space, ZF's electrical drive can be fitted with a wheel brake



## ONE-PIECE COUPLINGS FOR USE UP TO 250kW

In off-highway drive systems there is a trend toward single-piece coupling solutions. KTR's Monolastic coupling series is mainly used in hydrostatic drives and not only compensates for misalignment, but also allows for elastic damping of torsional vibrations.

The success of the series, which was initially only available for drive performances up to 120kW, made an extension appear logical – and KTR will therefore present Monolastic 75 with a permissible rated torque of 1,500Nm. It will be used on engines up to approximately 250kW, enabling compensation of high radial and angular displacements. As a consequence, the power packs of the drive are loaded less, which results in a longer service life.

The pre-assembled hub can immediately be provided with the requested spline. This allows for a simple axial plug-in assembly of the hydraulic pump without the need for any further tools and devices.

Monolastic couplings are available for torques from 40-1,500Nm and flange sizes up to ø395mm. Thanks to the simplified design of the coupling, special connections without complex adapters can be achieved at low costs. As a result, a perfectly adjusted, single-piece coupling system is now available for the connection of engine and hydraulic pump on higher-power mobile hydrostatic drives, and can be easily assembled by the plug-and-play procedure. The OEM merely has to fix the coupling to the engine flywheel and push the pump shaft into the coupling.



### KTR A4/537

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Ref: 514

## Tested, tailored brake solutions

Knott Brake and Trailer Technology's expertise lies in brake solutions tailored to the specific requirements of the most diverse industries. Its reputation is based on almost 80 years of experience and the world's largest portfolio of brake programs.

To do complete justice to its own motto – "We make your brake" – the company invests in state-of-the-art manufacturing, vocational training and continuous development. But a large part of its growing success is down to its in-house test rigs.

"Due to our independence, plus a large number of inspection and test facilities, we can perform all crucial preliminary investigations ourselves on-site, from initial prototypes to vehicle sign-off tests," says test supervisor Bernhard Klumpner.

The variety of test rigs alone is impressive, with fatigue endurance testing rigs, hydropulser, climatic chamber, corrosion and salt spray test, chassis dynamometer and flywheel test benches or lining

shear tests. Knott engineers have continuous access to all of this equipment.

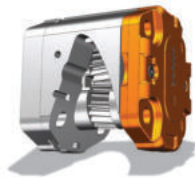
"We are particularly proud of our flywheel test dynamometers," reveals Klumpner. With driving motors of 160-500kW output and various flywheels, road test simulations can be performed here. "Of course we also develop our own test procedures and benches when needed for specific situations. It means that we have the facilities to perform tests for which external companies would otherwise have to be commissioned."

The advantages are clear, encompassing customized development options, a rapid response to all requirements, and in-house solutions that provide exactly what customers need: individually developed and optimized brake solutions.

### Knott A4/438

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# LoNoise.



**shhark** <sup>-=+</sup>  
when less is more eats decibels.

Turolla really cares about noise. We want to help our customers to be compliant with environmental legislation, enhance cabin comfort on their machines and get the most out of electric hybrid applications by eliminating noise in hydraulic components.

Thanks to its revolutionary patented design, not only does Turolla *shhark*<sup>®</sup> reduce pump noise emissions on average 4 to 6 dB(A), but above all, it makes the whole hydraulic system

quieter due to the reduced pressure pulsations through all the components, eliminating the need for expensive noise reduction devices. All this will improve installation and maintenance costs.

Turolla *shhark*<sup>®</sup> technology guarantees the same performance in terms of speed, pressure and lifetime as our performing standard gear units.



## Burnside Autocyl

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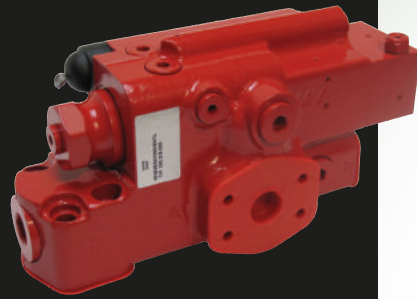
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◀ Hall A4 Stand 347

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## IMPROVING EFFICIENCY AT THE CYLINDER



With the Cindy-Reg, Bucher Hydraulics will be showcasing a solution that can result in up to 25% energy savings, while also increasing vehicle efficiency due to a significant increase in cycle rates.

The Cindy-Reg load-holding and load-control valve can save an astonishing amount of energy directly at the cylinder. The safety valve with the smart regeneration concept makes it possible to reuse part of the oil flow, which is fed directly into the opposite side of the cylinder, with the unused part going directly to the tank with no backpressure. The pump output flow is notably reduced during the lowering operation on mobile machines.

Depending on the system, there is the possibility that the pump output flow that has been saved can then be used for other functions. In addition to the main elements, such as the zero-leakage control assembly and the fast-acting, directly operated pressure-relief function, the safety valve includes an integral balance valve for tandem applications.

There are many other advantages of the system – its maintenance-free nature further enables a reduction in operating costs, while its leak-free load-holding function, a closing function assisted by the load pressure, and compliance with the requirements of ISO 8643/EN 474 ensure high functional safety.

Operating virtually independent of load pressure, it features a maximum working pressure of 420 bar and maximum flow rate of 400 l/min. Its load-control valve, check valve and pipe rupture valve are functionally combined in one coaxial valve assembly, and the system is unaffected by return-line pressure. It uses an SAE 1in flange-mounting (6000psi) and there are no dynamic seals.

**Bucher Hydraulics A4/103**  
www.ukipme.com/info/ivm Ref: 516

## PRECISION TUBE CONNECTOR ASSEMBLY

Stauff will present a machine for the pre-assembly and final assembly of cutting rings onto hydraulic tube ends. The SPS-PRC-POC was designed for the assembly of Stauff's Light and Heavy series of 24° metric tube connectors according to ISO 8434-1/DIN 2353 on tubes with outer diameters between 6-42mm.

The machine offers high precision, reliability and quality, which is mainly – but not entirely – due to the combined pressure and position control. Therefore, during the assembly process, the integrated PLC continuously controls the pre-programmed pressure and position of the tool and the tube. If any irregularity occurs, the assembly immediately stops and the operator receives an unambiguous text message at the machine display.

Flexibility is ensured by the choice between 50% pre-assembly and 100% final assembly.

The machine offers a high degree of automation (RFID detection of tools, integrated contact switch starting the assembly, and automated detection of tool wear), which enables consistent assembly results with a maximum degree of accuracy, reliability and process stability.

Stauff will also present its broad range of hydraulic tube fittings for the most challenging demands and rough conditions typically encountered by mobile construction equipment applications.

**Stauff A6/512**

www.ukipme.com/info/ivm  
Ref: 517

Consistent assembly results with a maximum degree of process stability



Stucchi's innovative multicoupling solution has been extended to cover 1in and 1½in flows

## MULTICOUPLINGS FOR LARGE FLOWS

In the world of hydraulic quick couplings, connecting and disconnecting lines above 1in has traditionally spelled trouble. The combination of weight, side load and other difficult conditions, such as environment and access, can make the couplings very complicated to operate. Once you add residual pressure to the equation, the situation becomes potentially unsafe for the equipment and, most importantly, for the operators.

With over 50 years of experience in the fluid power industry, Stucchi has provided an answer to all of these difficult challenges by extending its portfolio of multicoupling solutions to bigger dimensions. With the SV2GI and BM3IC, the company brings its innovative multicoupling solution to bigger-sized (1in and 1½in) flows.

**Stucchi A3/539**

www.ukipme.com/info/ivm Ref: 518

With the new SV2GI, the innovative plates are configured with two non-spill, flat-face hydraulic couplings (1in and 1½in or two 1½in) that can be simultaneously connected (or disconnected) in a quick and easy way, even with considerable pressure trapped in the circuit.

The lever/cam system minimizes the force required to connect, while the locking mechanism ensures a full connection and prevents the risk of any accidental disconnection. All these features are packed in a single compact and user-friendly system, that is specially designed to make every operation quick, easy, and safe. Parking station and cover plates are also available to protect the system from contamination and damage, as well as to provide a convenient stowage solution.



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 a Delta Power Company

### Electro-Hydraulic Components



Working out integration between related technologies

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# HIGHLY ACCURATE EH PROPORTIONAL ACTUATOR

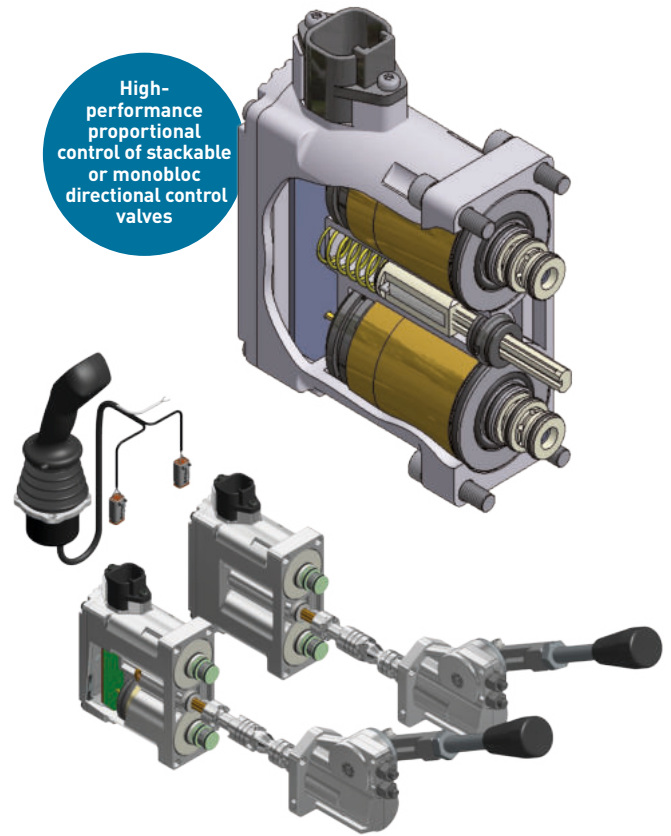
Tecnord's MLT-FD5/D electrohydraulic proportional actuator has been designed to shift a directional control valve spool either directly (FL version) or by means of a servo piston that is mechanically connected to it (SP version). The internal closed-loop position control of the MLT-FD5/D makes the valve spool achieve the desired position with accuracy levels approaching the performance of a servo valve, by continuously comparing the setpoint of a remote control device (e.g. potentiometer, joystick, machine management system) with the feedback signal generated by a high-precision Hall-effect position transducer.

Applications include the high-performance proportional control of stackable or monobloc directional control valves, as well as proportional control of variable displacement pumps and motors.

Two independent proportional valves provide a flow rate of 0.3 l/min, work pressure of 12-35 bar, and failsafe return to neutral in case of power loss. The Hall-effect contactless spool position sensor ensures excellent linear control on 100% of spool travel; 8mm standard control stroke from each side of Neutral/13mm for Float position in one direction only; and prevents 'cross-talking' between adjacent work sections.

The built-in electronics feature an analog operating mode with +5V supply to external potentiometers or joystick controllers – with position feedback through analog voltage. In the other operating mode, the remote control setpoint is provided via CANbus according to ISO 11898 at 250Kb/s or 500Kb/s by means of standard SAE J1939 messages. Diagnostic messages are also available from the MLT-FD5 actuator.

High-performance proportional control of stackable or monobloc directional control valves



**Tecnord A4/543**

[www.ukipme.com/info/ivm](http://www.ukipme.com/info/ivm) Ref: 519



The six-input, five-output, CAN-capable ECDR-0506A with the one- and two-input EVDR-0101A and EVDR-0201A



G3 drop-in hydraulic cartridge valves: on/off solenoid and proportional models are available

## ENHANCED ELECTROHYDRAULICS

HydraForce will feature a couple of electrohydraulic innovations for construction equipment applications – G3 drop-in cartridge valves and an expanded family of electronic controllers. Engineered for diesel engine, powertrain and pilot control applications, G3 drop-in valves operate with higher electromagnetic force, making them more responsive than previous generations of drop-in-style hydraulic cartridge valves. They have a special, top-mounted connector that is more compact and convenient for connecting electrical harnesses. G3 drop-in valves use less space and provide greater flexibility in application.

Based on the success of its EVDR one- and two-input electronic valve drivers, HydraForce has added a larger, CAN-capable model to the family – the ECDR-0506A. This new electronic controller has six inputs and five outputs and a 32-bit processor with high calculating power. It accepts input from analog or SAE J1939 CAN/CANopen operator interface devices (e.g. joysticks, potentiometers or sensors). The ECDR-0506A has a durable, IP69K-rated housing that is ideally suited for tough construction applications. This CAN-capable controller can enhance the electrohydraulics of a wide range of applications, including transmission controls, vehicle traction controls, and joystick controls. It also uses the same configuration software, HF-Impulse, as the other HydraForce EVDR controllers.

**HydraForce A4/550**

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# VEP-HD SERIES



- ◆ Connection/Disconnection with both side under pressure is allowed.
- ◆ Internal pressure release valve system allows an easy connection with high internal residual pressure.
- ◆ High resistance to impulse pressure.
- ◆ Flat face is easy to clean, reducing contamination in the hydraulic circuit.
- ◆ Minimal fluid spillage during disconnection.
- ◆ Minimal air inclusion during connection.
- ◆ Patented internal valve design creates minimal pressure drop.
- ◆ Modular design allows flexibility with a wide range of configurations (Flange code 62 included).
- ◆ Safe and simple to use.

a constant flow of solutions

## Steering safely

**Turolla** will highlight several solutions aimed to increase efficiency and safety on off-highway machinery. First is the Electro Hydraulic Power Steering system (EHPS): a solution that, even if using hydraulic power to accomplish the steering function, does it in a completely different way. The need to create a more efficient solution is fulfilled by an inverter that modulates the speed of an AC motor directly connected with steering hydraulic pump.

The advantages of this solution include power-on-demand and consequent downsizing of the system compared with the standard solution (pumps attached to the endothermic engine); a reduction of installation and maintenance costs; and an improvement in comfort during operation.

The second highlight is the DC Electro Hydraulic Pump (sometimes called emergency steering). This solution activates in the event of a failure in the primary steering – thanks to a pump driven by a small DC electric motor, the operator will be able to maneuver the machine to a safe area to park. This solution will improve the safety of both the driver and other machines on the road.

And, of course, the outstanding Turolla shark low-noise technology will be one of the key technologies on show.

### Turolla A5/219

[www.ukipme.com/info/ivm](http://www.ukipme.com/info/ivm) Ref: 522

Turolla will be shouting about its shark low-noise technology at Bauma



Temposonics magnetostrictive technology maintains the highest degrees of accuracy

## COMPACT POSITION-SENSING DEVICES

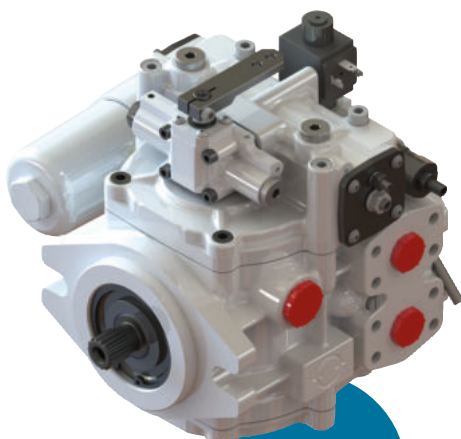
**MTS Sensors** will be showcasing its latest product innovations relating to the construction equipment market. Optimized for deployment inside space-constrained hydraulic cylinders, its compact position-sensing devices employ the company's proprietary Temposonics magnetostrictive technology. This ensures the highest degrees of accuracy are maintained, even in the most challenging of operational environments.

The position sensors that MTS manufactures can withstand shocks of up to 100g, as well as 20g vibration levels, without any compromise to their performance. Covering a measurement range from 50-2,500mm, the popular MH series has seen further expansion and now includes devices with Signal Integrity Level 2 (SIL 2) compliant functional safety, in accordance with IEC 61508. These sensors deliver a Safe Failure Fraction (SFF) of 95% at a hardware fault tolerance (HFT) of 0. Their average probability of failure (PFH) is  $\geq 10^{-7}$ .

### MTS Sensors A3/313

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The TPV 3600 – completely modular in both single and tandem versions



## Modular innovations

In collaboration with the University of Modena's Engineering Department, the **Hansa-TMP** Mechatronics Research Centre, based in Modena, Italy, has developed the innovative TPV 3600 axial-piston pump series. The company says this is the only pump on the market to be completely modular in both single and tandem versions.

The TPV 3600 series, with displacement of 25-38cc/rev and peak pressure of 450 bar, will be launched at Bauma 2016. The highlight of the pump is its complete modularity – just one body for all versions. On the standard body it is possible to integrate a multitude of controls, such as manual, hydraulic or electric, with or without feedback, and automotive. Moreover, a full range of onboard electronic sensors such

as pressure sensor, speed/RPM sensor, swash plate angle sensors, and man-on-board (MOB) sensors are compatible.

Furthermore, the pump can be mounted on the machine in any position, as the ports have been designed to be symmetrical on both sides, making it ideal for construction, agricultural, and material-handling vehicle applications.

Hansa-TMP works directly with the vehicle manufacturers to supply the overall electronics and programming for their machine functions and controls. This new Hansa-TMP offering, and its wide investment in the manufacturing process, demonstrates the company's huge commitment in the research and development of new products that deliver smart solutions to meet customers' needs.

### Hansa-TMP A4 439

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# ON THE MOVE

**bauma  
2016**

Hall A6, booth 349

GRAMMER is a system supplier of seating systems and vehicle control systems that improve the interface between vehicle, seat and user. We are the well-known innovation leader and trendsetter in ergonomics, safety and comfort.

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# OTTO

[www.ottoexcellence.com](http://www.ottoexcellence.com)

As an industry leader in the development and manufacture of control products such as switches, grips, joysticks and operator control modules, OTTO also offers value added products and services that help provide a more complete solution. OTTO is a fully-integrated manufacturing facility integrating *Design and Engineering Expertise – 3D Prototyping – Machining – Certified Lest Lab – Cable Assembly – and More!*

OTTO knows there is no standard, off-the-shelf solution to a complex customer requirement, so much of what we design and create is finely tuned and tailored into a customized solution. OTTO continues to develop its standard product lines, with over a dozen new products launched recently.



**bauma 2016**  
April 11–17, Munich

Hall A3, Booth 238

See OTTO's new products!

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## ENGINE-INDEPENDENT AIR-CON



For the efficient use of off-highway machinery during the warmer months, **Webasto** has developed an engine-independent A/C system.

At the start of each new development, Webasto joins its customers in analyzing the challenges in the field of air-conditioning. A requirement of many construction equipment manufacturers is to cool the cab independently of the engine over long periods, while consuming as little electrical energy as possible. When resting or taking a break, drivers often leave the engine idling to keep the cabin cool. But this has its price: the machine is not being used productively, but continues to consume fuel. This not only costs money but increases engine wear and servicing frequencies.

The company has developed the ideal solution for this challenge: the Polar Cab. The product uses cold-storage technology, which is already used as standard in trucks. During operation of the vehicle, a refrigerant is conducted over graphite plates in the storage core of the system. These plates are filled with water and vacuum-sealed in a film. As soon as the motor is switched off, the cold is then withdrawn from the graphite plates using a refrigerant and transported to the driver's cab via a heat exchanger. The advantage of the cold-storage technology is that it requires very little electrical energy; the batteries can be correspondingly small. The system can also be easily retrofitted.

**Webasto A4/343**

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## FOR TOURING CAR COMFORT, CALL KALORI

Enjoying the comfort of a touring car in an industrial vehicle is now possible through standard components. **Kalori** has developed the MultifluKs flap system, which is controlled by cable or electric actuators (the preferred option). These connectors can be piled up on top of one another, or be used separately. The MultifluKs system is small, maintaining the advantageous compactness of Kalori's HVAC technology.

Some of these fittings can be connected to the windshield's defrosting griddle, others to vents oriented toward the inside of cab and the operator, or to the lower part of the cab and the driver's feet.

The kit is customizable according to the cab's type and the area where the air needs to be diffused. The flaps can be fitted to different diameter connectors so as to use any type of protecting pipe or any air diffuser part.

Directional control is managed through a control panel integrating the air-conditioning setting, which can be automatic. This panel can also incorporate the pressurization control with configurable airflow and pressure.

The HVAC's sizing is determined by Simulka, a powerful calculation software, which precisely defines the required power to obtain the desired temperatures.

This is all part of an OEM system that benefits from a proven efficiency – most European manufacturers are already using Kalori's HVAC. Their vehicles are tested in Kalori's climatic chamber, to ensure compatibility with the expected conditions.

**Kalori A5/250**

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## USER-OPTIMIZED SEATING

At Bauma, **Grammer** will present the Dualmotion function for construction machinery seats and a seat for mid-sized construction equipment that integrates a new high-strength mechanical suspension.

The user-optimized Grammer seat for OEMs is equipped with the new MSG 285 suspension and delivers superb comfort and a safer, more back-friendly ride for drivers of mid-sized equipment such as excavators, wheeled loaders, compactors and backhoes. The high-strength mechanical scissors-type suspension can be combined with the proven S 700 upper seat top, which is available in a number of versions, to assemble a complete innovative seat.

Today, most construction machines are equipped with control carrier consoles that move with the seat, and this new seat includes an interface to meet all of the desired prerequisites for this application. Featuring 100mm stroke, the suspension effectively attenuates vibrations for smooth driving. The new model also features an easy-to-use, two-in-one mechanism for raising and lowering the seat (80mm) and adjusting it to the operator's weight.

The company will also exhibit its adaptive Dualmotion back support. The key feature of this innovation is that the upper backrest section automatically and intuitively fully adjusts to the driver's position when twisting around to face toward the rear, and thereby consistently provides optimal support.

Driver seat with seat top S 741 including Dualmotion function

**Grammer A6/349**

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## TURN A SEAT INTO A WORKSPACE

Creating an adjustable workspace in a vehicle with fixed mounted controls is a challenge, but with a few simple measures any ordinary baseline operator station can be enhanced into an ergonomically correct comfort zone. To meet the requests for such improvement, **Frameco** has developed the glassfiber-based 310 Armrest.

The product has an attachment system that adapts to all the major seat brands in a robust

way, meaning the 310 Armrest can be added anywhere, on any seat, in almost any machine. By combining an intelligent design with optimized material, the 310 Armrest can easily replace the regular standard arm delivered in off-highway machines.

This new product can be equipped with three different armpads in different sizes. Excavators and crane cabs are the primary customer group for this add-on to the cab interior.



With three available armpads, the 310 is particularly aimed at cranes and excavators

### Frameco A6/310

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## HEAVY-DUTY JOYSTICK PLATFORM

**Danfoss** will display its new JS1-H joystick family for heavy-duty applications. The JS1 platform is based on strong engineering experience and expertise with joystick functionality and user preferences. The family combines a professional look, touch and feel with superior quality, making them not only operationally and technically impressive, but also safe, reliable and effective.

The proven intelligent mobile control solutions can be customized for application needs in several ways, including button and switch placement, and selection between three different bases and five grip types that ensure smooth and comfortable operation. The design is easily integrated into existing development projects, removing the need for rework expense.

Customers can select from a standard portfolio consisting of three base options – single-axis with spring return or friction hold and dual-axis with spring return – and five ergonomically tested grip-type options. Push buttons, rollers and other controls on each can be custom-positioned. All JS1-H grip options are compatible with all base options, making upgrading as simple as swapping in a new component. Plus, there will be six standard electrical interfaces available for ease of configuration and selection.

Capable of being implemented on just about any machine requiring joystick control, the JS1-H joysticks enable full control and are Plus+1-compliant for added control based on data and programming. This simple development platform makes building and implementing software fast and easy – reducing the cost associated with custom-built code while maintaining quality performance.

### Danfoss A5/115

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## TAILORED JOYSTICK GRIP SOLUTIONS

**SVAB** will launch an innovative technology platform for its joystick grip, the SVAB Grip L8. As construction machines are becoming more sophisticated, with more functions and higher demands on the human-machine interface, the need for multifunctional joystick grips grows.

With years of experience managing complex requests on the SVAB Grip L8, the company has realized the importance of making its offer flexible and solution-focused. To handle all these requirements without lots of engineering hours that generate long-term projects, SVAB has created a technology platform for the L8 that has accumulated several years of special solutions and adaptations and made them into a configurable and quality-assured standard range. The grip can be configured very freely based on component placement, color, functionality and interface with the machine.

SVAB will also launch a newly developed online web configurator, a tool created for OEM design engineers to enable them to easily customize their own L8 grip configuration.

“Our goal is to make the purchase process simple for our customers,” says Fredrik Eriksson, marketing and sales manager. “With this concept, we can provide OEM customers with tailored joystick grip solutions, with delivery within a week of the first order. I’d like to claim we are alone in the world to be able to pull this off!”

SVAB Hydraulik will demonstrate the platform at its booth, where it will be co-exhibiting with Tenstar Simulation.

### SVAB A3/312

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SVAB's L8 grip offers highly flexible levels of configuration





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 Hall A5, Booth 125



Hannover Messe, Hanover  
 25.04. – 29.04.2016  
 Hall 11, Booth F43 und  
 Hall 13, Booth C16

## You can put this LED anywhere

**Nordic Lights** will show the new Nordic Pictor LED N7301, a low and compact work light for surface mounting on the application body. Offering good illumination and shock resistance, it has been especially developed for mounting on the sides of the boom to provide extremely good illumination of the bucket's working area. The Pictor is also very suitable for mounting on top of or below cabins, with different light patterns available for standard or upside-down mounting.

The work lamp is available with a floodlight pattern and has an operational light output of 2,600 lm. It has a sturdy aluminum housing (188x153x55mm) and a weight of 1.6kg. Among other features, this 12-24V multivoltage, waterproof lamp has an optically even distribution of light pattern, has a long lifetime, and requires minimum

**Nordic Lights A5/402**

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maintenance due to its heavy-duty construction. With extensive EMC, it is protected against load dumps, over voltage, reverse voltage and overheating. Its IP rating covers IP68, IP6K9K as well as SAE J1455 and it withstands salt mist according to ISO 9227 for over 240 hours.

The Nordic Gemini LED N4701 fulfills EMC standards of ISO 13766, ISO 14982 and ISO 7637-2 and CISPR 25 Class 3. The use of Nordic Lights products ensures that darkness, vibration, shock, dust and humidity will not affect visibility when successful work and safety depend on effective lighting.

The new Nordic Pictor LED N7301 is a low and compact work light, and is especially suitable for the sides of booms on excavators



## PROFINET-ENABLED JOYSTICKS

Safety is the most important new requirement for bus communication in most applications. As a result, CANopen Safety and ProfiNet Safe are the communication buses of the future. Both interfaces are now available for the latest joysticks from **W Gessmann**.

To be kicked by worker's boots may well be the worst treatment a controller can experience, and it is exactly to cope with this abuse that the new pedal controller P20 has been developed. While using only half the space of its predecessor, robustness has improved a great deal. With its new Hall-effect sensors, there is no more wear-out and the protection class IP 67 is achieved by complete over-molding of the electronics. Indeed all interfaces already known from the V25 joystick are also available, including voltage or current output, CANopen or CANopen Safety.

While most crane control units are either comfortable with lots of ergonomic adjustments or large enough to accept lots of command and indicating devices, the new KST 30 Wing Commander brings it all together. With the widely adjustable armrests, including the joysticks and other important controls, it is highly ergonomic. With the separate side boxes in various sizes allowing for dozens of additional devices including monitors or touchscreens, the KST 30 Wing Commander can grow with the customer's requirements.

**W Gessmann A3/303**

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## Cloud solutions for construction equipment



**Sensor-Technik Wiedemann (STW)** will not only present the interaction of single components, but also cloud solutions tuned to the special requirements of the construction industry, at its booth with two interactive towers.

Among its established solutions to enable the automation, connection and electrification of mobile working machines, STW will display product highlights such as the latest member from the ESX control unit family, the ESX-3CM, and the new V-series display and operator terminal generation, both supporting safety-relevant applications at the automation tower. Here, visitors

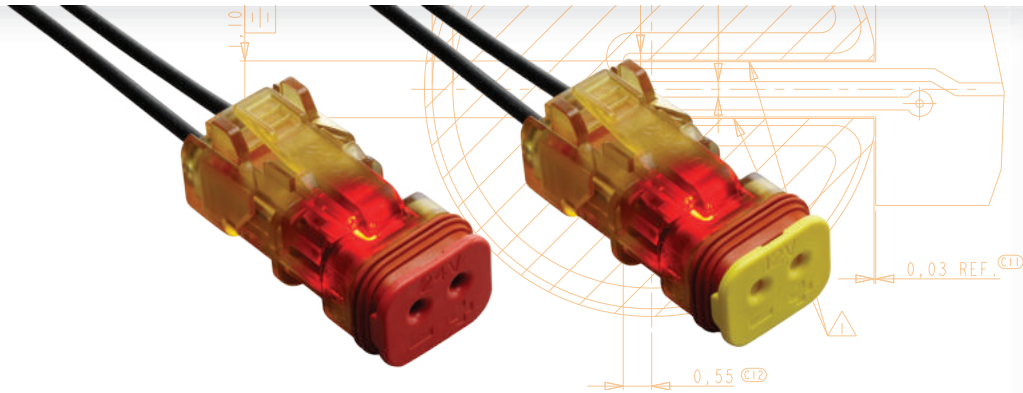
**Sensor-Technik Wiedemann A5/125**

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can also interactively experience the world of digiSENS measurement systems and sensors.

Above all, the data management and connectivity display tower is dedicated to the handling of information, recognizing the growing importance of this topic. Supplied with live data, applications for machine monitoring, such as the Vehicle Data System (VDS), and for data and process management, can be tested.

Based on Cumulocity's technology, STW's cloud solution gathers data from all other entities, offers seamless vertical and horizontal integration, and enables a real 'construction 4.0' experience.



## THE BRIGHTEST IDEA IN DIAGNOSTICS

The new Detector connector simplifies troubleshooting by producing a distinct glow when power is present. It is part of the rugged DEUTSCH DT connector series. At TE Industrial & Commercial Transportation, we are dedicated to providing you with innovative components to solve your biggest harsh environment challenges. Together, we can create something brilliant.

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## Best things, small package

TE Connectivity (TE) Industrial & Commercial Transportation's new compact two-position mini fuse holder (TE part number 2066046-1) stands up to the extreme conditions of the agricultural, construction, trucking and marine industries.

Part of TE's extensive portfolio of harsh-environment connectivity products, the new environmentally sealed fuse holder has an IP 67 rating and protects connections from dirt, dust, and water immersion up to one meter. The new mini fuse holder can be designed into an electrical system to provide protection for a vehicle's wiring and electrical equipment.

The fuse holder can also be easily retrofitted into an off-highway vehicle's existing electrical system to provide extra protection.

The new mini fuse holder features an integrated mounting feature, allowing it to be mounted almost

anywhere. It can accommodate any standard ATM mini fuse. Identification caps are currently available for two arrangements, 25A & 15A (TE part number 2066502-1) and 25A & 10A (TE part number 2066502-2). Additional identification caps will be available based upon demand.

The new mini fuse holder can accommodate two active fuses and two spares. It utilizes TE's robust and dependable AMP MCP 2.8 contacts, which feature multiple points of contact on each ATM mini fuse blade terminal. The AMP MCP 2.8 contacts provide stable electrical connections and solid fuse retention performance. TE's three-gland wire seals provide redundant, environmental sealing between the wires and plastic housing.

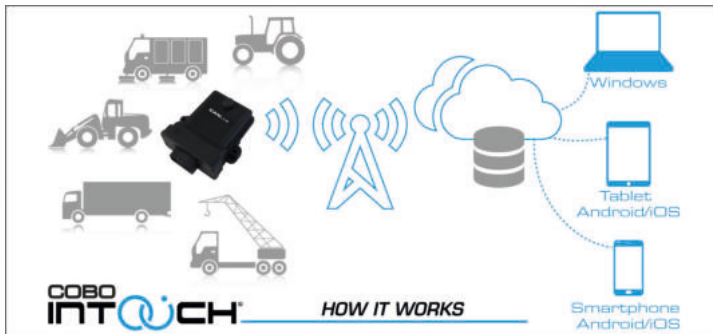
**TE Connectivity C4/615**

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IP 67 rated, this compact two-position fuse holder withstands water immersion to 1m

## BRINGING THE IoT TO OFF-HIGHWAY VEHICLES



As machine-to-machine connectivity is growing faster than just about any other telecommunications sector, **Cobo Group** has accepted the challenge of the Internet of Things by launching a flexible server-based architecture named Cobo InTouch, which enables an improvement in cost savings and productivity in the aftersales assistance of the off-highway vehicle market.

A Cobo onboard unit (such as CAN Live) equipped with multiple integrated sensors and communication devices assures the following main functionalities: geolocalization (internal GPS); 2G/3G communication (internal modem); machine relative remote position (internal 3D accelerometer); short-distance communication (wi-fi connection); remote software update; and datalogger.

Cobo InTouch connects Cobo devices with a web-server interface. Data is stored in a database and provided to customers via internet access (by smartphone, tablet and computer), whenever they need and wherever they are. The customer interface is attractive and dynamic, multilanguage, and customized with colors and logos. In addition, a responsive design both for laptop, smartphone and tablet makes the user experience very simple.

Applications include agriculture, earthmoving and lifting machines, transport, logistics and municipal vehicles. Cobo is also able to provide OEMs with telematics integration for their remote assistance services, providing the possibility of competing with the major market players.

**Cobo Group A5/412**

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## Remote-viewing from NBB

**NBB Controls + Components** has implemented a camera video system in its Nano-M SMJ transmitter. This extension enlarges the safety function of the remote system generally. As a result of the precise display of the live camera pictures on the control, the user can always – at any location – be aware of the situation round the machine and prevent accidents in the working area.

The camera system is a multiplexing principle that means that a connection with up to eight cameras is possible. The cameras can be installed at different places in the working area with a cable connection to the receiver, to a maximum distance of 40m. Via a switch on the transmitter, the selection of an individual camera or data display is possible. This system is designed as a single-cable solution that requires only one common connection cable for power supply and video signal.

The complete system is supplied by NBB and is available with 5.8GHz.

**NBB A6/151**

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With up to eight camera inputs, the operator has never had such a good view around the machine





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## The LinX effect

**maximatecc's** LinX Software Suite is an open and modular software platform for realizing both basic and advanced HMI and vehicle control functionality. At Bauma, the company will launch the next extension to the platform – Enterprise Connect, a fully fledged telematics system with onboard data collection, wireless communication, cloud hosting and back office web clients for big data analysis and reporting.

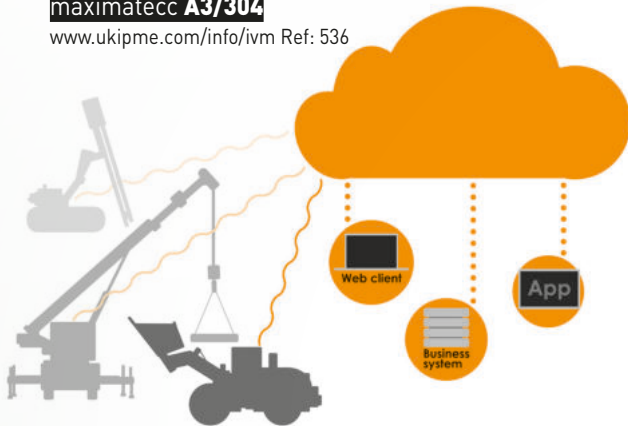
One of the key features of LinX Software Suite is that all signals and data in the equipment control system are easily available to any software system running on the equipment. For Enterprise Connect, this brings tremendous advantages. There is virtually no limit to the data that can be retrieved. Another benefit is in terms of aftermarket and service – all operator interaction with the equipment control system can be tracked. It enables tracking of not only alarm error codes, but also data on maintenance-prone parts, making it easy to detect misuse and offer preventive maintenance plans.

In terms of operative data – such as fuel consumption, production data and geographical info – LinX Software Suite's easy access to onboard data makes it possible to follow not only the obvious KPIs, but also more elaborate performance indicators, such as operator behaviors.

Enterprise Connect is a pre-packaged telematics solution, with all the infrastructure available out of the box. The choice of what data to collect is easily configured in the onboard system as well as in the back office client software. It offers equipment telematics at your fingertips.

**maximatecc A3/304**

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## Two-step buttons to efficiency

**Scanreco** has announced the launch of the Rocket Flex, a handheld transmitter designed to provide users with operational efficiencies through special two-step buttons based on proprietary, patent-pending technology; a large labeling area enabling large and visible icons for easy and safe operation; ergonomic and rugged design; E-stop functionality; and a long operating range.

The Rocket Flex has 14 push buttons, with single- or dual-speed steps and comes with two-way communication, enabling machine feedback to the operator via a graphic display and light-emitting diodes. With very low power consumption, it gives up to 120 hours of continuous operation on a single charge. Being subject to Scanreco's rigorous

testing protocols ensures a safe and reliable product over a long period, even in harsh working conditions.

"The transmitter operates in the worldwide license-free 2.4GHz frequency band and has an operating range of up to 300m. If an extended operating range is required, an extra transmitter can act as a repeater for the radio link," explains Claes Ulvefeldt, VP marketing and sales at Scanreco.

The transmitter communicates with the corresponding receiver using a Scanreco protocol and a unique identity code, guaranteeing that no other Scanreco transmitter or product can ever activate the machine unintentionally. The Stop function conforms to performance level 'd' as per EN ISO 13849-1.

**Scanreco A3/423**

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## REMOTE MANAGEMENT SOLUTION

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**Epec GlobE** is a new remote management service that allows OEMs and machine/fleet owners to remotely access machine data. GlobE back-end service and web portal are provided as a cloud service, which makes it flexible, reliable and cost effective. GlobE, along with Epec's 6000 series product family, offers machine manufacturers an easy and affordable way to connect their machines to the industrial internet.

The company says this is the most robust, reliable, fast and easy-to-use remote management solution in the industry. Being able to offer a total solution from one provider makes it possible for Epec to take the overall responsibility of the system from sensor to cloud and to the remote users. This complete remote management package cloud service combines:

- Robust 6000 series products with built-in 2G/3G/GPS, as well as a wide selection of high-performance control units for the entire control system;
- Application libraries and software tools;

- Training and project services;
- Support and maintenance;
- Pre-installed global M2M SIM card.

Advanced features help to maximize the profit for OEMs and end-customers alike, enabling them to monitor and log machine data, alarms and events; adjust machine settings; update the control system software; monitor control system I/O; provide email or SMS notifications; enable machine tracking and geo-fencing; and create reports based on the machine data.

The advantages include reduced travel costs due to remote diagnostics and SW updates; increased productivity through minimizing machine downtime via faster service; analysis of the collected data to predict service needs before they occur and to improve machine design in future updates; and optimized use of resources on the work site by adjusting machine settings and improving operator working methods.

**Epec A5/313**

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## WANDFLUH JOINS FORCES WITH HED

As a developer and manufacturer of high-precision hydraulic valves with the corresponding electronics, Wandfluh was keen to find an innovative partner in the field of custom-specific electronic control solutions. Therefore, at the start of this year, a partnership agreement between Wandfluh and HED, an American designer and manufacturer of vehicle electronics, was signed.

Initial projects have already been successfully implemented; this has led to a reciprocal transfer of expertise and trust in the technology of the partner company. For example, one of the applications is a trailer for transporting wood with a load of 10 tons which, on rough terrain, can be hydraulically accelerated or braked from the tractor vehicle using the display. At the same time, Wandfluh defined the entire concept and programmed the HED components in-house. The HED electronics are also designed for controlling the in-house amplifier so that the HED components are

optimally integrated into the Wandfluh product portfolio.

The product segment that has been expanded with HED makes Wandfluh a competent partner, particularly in the field of customer-specific, highly complex hydraulic solutions in the mobile or stationary sector. In agreement with HED, the components integrated in this way are given the label 'Wandfluh powered by HED'. Through this partnership, Wandfluh can now offer a total vehicle control solution, in addition to its strong platform of hydraulic systems.



Display of the Wandfluh control powered by HED

Wandfluh **A5/350**

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## High-grade encoders and systems

**Wachendorff Automation** develops and manufactures industrial-grade and automotive-grade encoders and systems. Developing accompanying and extensive design tests ensures the reliable and long-lasting application (as can be proved) in many industrial branches and mobile working machines in the roughest environmental conditions.

This guarantees reliable and long-lasting applications under the most exacting on-site conditions. More than 1,500 individual serial solutions are in use around the world.

At Bauma, Wachendorff Automation is going to show:

- Sensors for angle, route, engine speed, length, position, etc.
- CANopen, SAE J1939, RS485, Profibus, etc.

Wachendorff Automation **A5/339**

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## Smart 3D sensors



Collision warning and obstacle detection during the everyday operation of mobile machines make a decisive contribution to driver assistance and help considerably increase machine uptime. The smart 3D sensors of the O3M series from **ifm electronic** enable fast collision warning thanks to three-dimensional detection of the machine environment, actively supporting the driver and preventing accidents and damage.

Similar to the comfort and safety functions in modern motor vehicles such as distance warning, rear-view camera or emergency brakes assist, the new powerful sensor also provides automatic object recognition. It can record more than 1,000 distance values synchronously, and reliably detect and follow up to 20 objects. Functions for region and distance monitoring are available to solve even complex applications. They can detect up to 64 three-dimensional individual segments of the sensor's visible area independently of each other and supply abstract values to the machine controller. Setting is made via easy-to-operate PC software containing templates for many applications.

The heart of the new unit is the robust and reliable PMD 3D sensor patented by ifm. Even interference caused by changing environmental conditions such as sunlight or rain or materials with different reflective characteristics, does not influence the repeatability of the measured data. High vibration and shock resistance and protection ratings of IP 67 and IP 69K are ensured.

ifm electronic **A3/203**

[www.ukipme.com/info/ivm](http://www.ukipme.com/info/ivm) Ref: 541



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[www.motometer.de](http://www.motometer.de)

## RUGGED RELIABILITY FOR THE TOUGHEST CONDITIONS

Today's commercial and industrial vehicles require more connectors and communication than ever before. Environmental sealing and signal integrity within the harsh environments is critical – if one of these areas is compromised it can result in partial or complete failure of an entire system.

Molex's ML-XT sealed connection system utilizes both cutting-edge sealing technology and advanced manufacturing techniques to permanently bond the front seal, creating a one-piece plug housing. Rated IP 68, IP 6k9k and J2030 power-wash capable, the ML-XT is suitable for up to 18 circuits. For up to 84 circuits, the SRC family offers a rugged, sealed, wire-to-wire panel mount, hybrid connection system for signal and power. The primary location for this

system is as the firewall connector, but SRC can also replace existing connectors in a variety of in-vehicle applications.

Applications in construction and mining can be extremely exposed and require sealing on the bulkhead when unmated. Heavy-duty connectors from Molex effortlessly meet these demands and are UL/CSA approved.

Molex offers a range of communication solutions suitable for harsh environments (IP 67 and IP 69k) and carrying data rates up to 5Gb/s, from connectors and cables to Ethernet switches and solutions. Their state-of-the-art shielding technologies ensure signal integrity, system functionality and reliability within the commercial vehicle environment.

**Molex E0E100**

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## Displays for data connectivity

With Bauser's latest display solutions, extensive data connectivity can now be enabled via CAN 2.0B, USB, Ethernet or PAL/NTSC video (in response to custom requests), while J1939, CANopen, TCP/IP, and OEM proprietary protocols are also available. To enhance Stage IIIB/IV and Tier 4 emission standards compliance, compatible DPF and SCR functions can be incorporated.

Installation can be achieved with a jointed arm (surface mounted) or integrated, while up to 12 tactile buttons and an optional rotary encoder can be incorporated.

Bauser offers a wide range of display sizes, i.e. 3.5in (320x240) to 7in (1024x600) color transmissive TFT displays with LED backlight between 350-1,000cd/m<sup>2</sup> over a lifetime of up to 50,000 hours. The displays can be incorporated in a panel/cockpit, or even mounted on a surface by using the jointed arm. The displays are compatible with CAN J1939 engine data and can even be used as virtual terminals in an ISObus application to control the accessory equipment of machines. The optional rotary encoder enables the easy setting of a wide variety of machine and accessory equipment parameters.

Standard displays include up to 21 warning lamps (LED) and up to 26 pins for several I/Os, such as analog, digital or frequency inputs, as well as FET outputs (switching capacity 24V, 500mA). Finally, a rugged design means applications can withstand rough environments with high levels of shock and vibration over a wide ambient range.

**Bauser A5/232**

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Standard displays include up to 21 LED warning lamps and up to 26 pins for I/Os

## Tailor-made joysticks with IP 67

Makersan, an innovative manufacturer of sensors, engine throttles and motion controllers, has now widened its product range, using the latest technology sensors manufactured at its integrated factory in Turkey, with inclination and acceleration sensors, capacitive level sensors, thumb rollers, push buttons and IP 67-rated joysticks.

In addition to electronic pedals designed for harsh environment applications with customizable lever arm, treadle plate, mounting plate and configurable sensor outputs including CAN ability, and its hand throttles with similar options, Makersan will introduce a joystick that will take the industrial standards of Ingress Protection and configurational flexibility to new levels.

Offering submersible operational capabilities, the joystick's grip comes with extensive configuration possibilities using buttons, switches and thumb rollers that Makersan has produced from contactless full redundant Hall-effect technology. Furthermore, the joystick can be fitted with an internal vibrator and capacitive sensor. The new illuminated push buttons and thumb rollers can transform the grip into a feedback display.

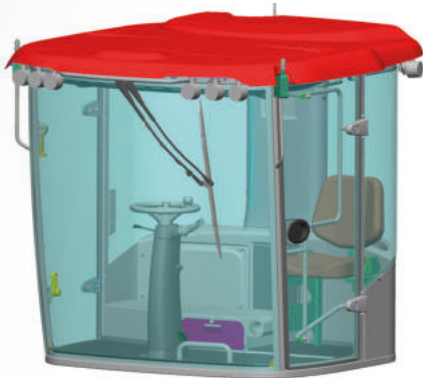
The pictured joystick is a new concept, designed by Hidromek, and built around Makersan's joystick base featuring CAN ability and IP 67 protection level. The grip has been designed with Makersan's thumb rollers, FNR Switch, Hall-effect push buttons, and capacitive deadman switch, to meet Hidromek's high quality and endurance standards.

**Makersan A3/408**

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## HOW TO BREATHE MORE EASILY



Siac, with its 50-year-long experience in the off-highway cab manufacturing market, has always been very attentive to the comfort and safety of operators. As a result of this expertise, the company has succeeded in applying specific safety norms to its cabs dedicated to the agricultural market, with the aim of preventing the inhalation of the chemical products during plant-protection treatments.

European Standard EN 15695-1; -2:2009, which regulates the level of exposure of the operator to dangerous substances such as pesticides and liquid fertilizers, is strictly applied by Siac engineers

### Siac EOE21

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during the design and development of cabs for agricultural, forestry tractors and self-propelled machines:

These standards concern:

- Cat 1: Cab not providing a specified level of protection against hazardous substances;
- Cat 2: Cab providing protection against dusts;
- Cat 3: Cab providing protection against dusts and aerosols;
- Cat 4: Cab providing protection against dusts, aerosols and vapors and three categories of filters:

Cat 2: Dust filters;

Cat 3: Dust and aerosol filters;

Cat 4: Dust, aerosol and vapor filters tested with cyclohexane method.

Siac developed and manufactured its first EN 15695 Category 4 cab in 2012, for Hardi Evrard's EVO XL 01 sprayer. This cab completely complies with the characteristics stated by the norm for Category 4 cabs, such as internal pressurization of the cab  $\geq 20\text{Pa}$  with respect to an exterior, fresh air intake system able to filter dust, aerosols, vapors and fresh filtered airflow rate  $\geq 30\text{m}^3/\text{h}$ .



With over 21,000,000 article numbers and 600,000 stock items, TVH can get its hands on parts for just about any vehicle

## Source material

Ever since 1969, the **TVH Group** has been passionate about parts and machines. The company is constantly growing in markets related to material handling, industrial and agricultural equipment. With activity in over 170 countries and affiliates all over the world, TVH tries to be close to its 20,000+ customers, to ensure it is able to offer the best-possible services and solutions.

TVH Group has been divided into two business units: Parts and Equipment. The know-how of TVH's Parts division is reflected by a database of more than 21,000,000 article numbers and 600,000 stock items. TVH's electronics department is Europe's largest, best-equipped center for repair of electronic parts. The company is also an ideal partner for sourcing spare parts for small earthmoving machinery, telescopic lift-trucks, and aerial work platforms (AWPs).

TVH Equipment is a specialist in new and second-hand lift-trucks and aerial work platforms, with more than 1,750 second-hand machines in stock, all subjected to a strict inspection.

TVH Group is also offering, under its own brand CAM System, a wide range of hydraulic and mechanical attachments and forks for industrial and agricultural machines as forklifts and telehandlers. Most of its products, such as sideshifters, forkpositioners, rotators, clamps, skips, snowplows and scoops are available from stock.

### TVH A6/207

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## Cutting noise and vibration

GMT supplies rubber and rubber-to-metal bonded elements to reduce and eliminate unwanted vibration and noise in all kinds of construction equipment. High-frequency loads require elastomer qualities specially adapted to this application.

These applications typically have very high levels of mechanically induced vibration and impact stresses which have to be isolated. The large product range of GMT mountings, which have been especially developed for this purpose, include:

- Elastomers for vibratory hammers;
- Buffers and rails for vibrating drum-rollers and vibration compaction plates;
- Buffers for hand grip;
- Cab suspension elements;
- Engine bearings/aggregate bearings;
- Axle bearings.

The GMT Group is a privately owned specialist company for the development and manufacture of rubber-to-metal-bonded elements and molded rubber parts. Its long expertise and extensive know-how



ensure an efficient and reliable processing of orders.

More than 930 employees in its companies worldwide are dedicated to providing the off-highway market with high-quality products.

Production plants are located in Germany, China, India, Ireland, Malaysia, Switzerland and the USA, and it operates sales and engineering offices in the UK, Austria, and France.

### GMT A5/503

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# Hard-working switch module

Otto's new TC-5 is a one-, two-, three-, four- or five-position cost-effective integrated switch module suitable for use in demanding applications.

The TC-5 is approximately 1in in diameter and can be front-mounted or rear-mounted either in a grip or front panel. It can be used to control many different functions, for example, cursor control of a navigation display.

The TC-5 can incorporate standard or custom legends, and can be LED backlit with a variety of colors. Standard termination options include FFC, flying leads, and ribbon cable (with or without AMP connector). Tested to 1,000,000 cycles, the TC-5's operating temperature range is -40° to 85°C and the module is sealed to IP 68S.



Otto **A3/238**

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# HIGH-PERFORMANCE HVAC SYSTEMS

Mobile Climate Control's Off Road division develops high-performance HVAC systems for vehicles and machinery in construction, agriculture, forestry, mining and material handling, and help make the driest or wettest surroundings, and the most extreme hot or cold weather, unnoticeable.

MCC has become a market leader in custom-designing HVAC units for the extremely small spaces available in compact vehicles. All these specialized HVAC units are designed and tested in the company's climate chambers to provide operators with the best possible comfort.

For material handling vehicles, the company custom-designs and manufactures electric heaters and air-conditioning systems for forklifts, utility trucks, and all kind of electrical vehicles – a complete range from 12-650V DC units used around the world. All products are custom-



designed for specific vehicles and tested in the company's climate chamber to make sure that the customer's expectations of a perfect climate will be realized.

MCC has opened its own state-of-the-art facility for manufacturing microchannel heat exchangers. This will enable the company to move the technology forward and to maximize the performance of the products.

MCC **A6/401**

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# Orchestral maneuvers

FOR SUCH A HUGE MACHINE, TADANO FAUN'S EIGHT-AXLED FLAGSHIP ALL-TERRAIN CRANE DISPLAYS STARTLINGLY BALLETTIC AGILITY. THE RIGHT STEERING STRATEGY IS THE KEY

▶ Set to attract the visitors at Bauma 2016, the flagship of Tadano Faun's all-terrain cranes is impressive. With eight axles, the ATF600G-8 has a maximum lifting capacity of 600 tons, and is equipped with the new Triple Boom System, which does not require a boom suspension system.

And thanks to Mobil Elektronik's EHLA steering technology – which will also be presented at Bauma, along with the required system components and various other technologies – this giant vehicle can be maneuvered easily and safely. EHLA steering systems are not only being used in all-terrain cranes but also in complex construction vehicles such as trucks, dumpers or trailers. The design of Tadano Faun's ATF600G-8 steering system is a prime example of the benefits it offers.

The development of this eight-axle crane, which can be driven with a maximum load of 12 tons per axle on the highway, made high demands on the designers and engineers of Tadano Faun, as well as on their involved suppliers. A central requirement was: how can this colossal vehicle be maneuvered precisely and safely in public traffic, as well as around the construction site?

A customer-specific steering strategy was needed for the ATF600G-8, which enables this 21.7m-long, 3m-wide crane to move from one place to the other. The two axles at the front are steered mechanically – but for the remaining six axles, a much higher flexibility was needed. The requirement was therefore for an electronic-hydraulic steering system.

This was the ideal task for Mobil Elektronik, a global market leader in steer-by-wire technology and a key supplier to Tadano Faun for many years.

"This is our core competence – we develop customized solutions out of our standard components, fulfilling the strong regulations and safety standards," says managing director and owner of Mobil Elektronik, Klaus Klugesherz.

Out of the principles of the well-known EHLA systems, the Mobil Elektronik engineers developed the most suitable solution for the steering technology of the ATF600G-8. Three independent steering circuits have been applied, so that each steering circuit controls two axles.

For safety reasons, each steering circuit is equipped with its own electric and hydraulic power supply.



ABOVE: Tadano's ATF600G-8 – at 21.7m long, 3m in width and with eight axles, it has some demanding requirements in relation to maneuverability



ABOVE: All eight axles are steered – two of them mechanically, and the other six via the electronic-hydraulic EHLA system

Their steering programs are synchronized, enabling them to support each other, or even make corrections if required.

## Improved functionality

Different steering programs – balanced with the vehicle's geometry – enable the ATF600G-8 to offer exceptional maneuverability in spite of its enormous dimensions. With the manual steering program, for example, the rear axle can be steered completely

independently of the steering angle of the front axles. The EHLA technology also enables the individual positioning of each single axle. This way, any steering error of the middle axles can be minimized, reducing the tire wear significantly.

Another technology highlight is the rear-swing-out suppression. A complex algorithm controls the steering of the rear axles in relation to steering angle, vehicle geometry, speed and distance. Using this steering program, the driver can follow tight curves and perform maneuvers close to buildings or barriers with much higher safety. With the ATF600G-8, this functionality has been realized for the first time in an all-terrain crane for public road use.

As usual in EHLA steering systems, all axles can be activated for on-road use from any position just by pushing a button. To improve the controllability of the Tadano Faun ATF600G-8 on public roads, the steering angles of the rear axles are automatically reduced at higher speed.

Of course, Mobil Elektronik designs the EHLA steering systems for compliance with the most recent standards of functional safety. Having introduced its first steer-by-wire application for heavy-load vehicles as early as 1973, the company has long been a pioneer in providing system technology for mobile automation. **IVT**

*Bernd Sailer is Mobil Elektronik's functional safety manager and system architect. He's worked there for 25 years*



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# V for victory

DESPITE STAGE V LEGISLATION STILL BEING A FEW YEARS OFF, A NEW THREE-PLATFORM RANGE THAT OFFERS COMPLIANCE FOR MACHINES FROM 202-566kW COULD PROVIDE OEMs WITH A WINNING SOLUTION

Although Stage V emission standards will not come into force until 2019, Scania's renowned modular product system and its famed excellence in engineering mean that the company is able to offer compliant engines well in advance of the deadline. To enable customers to meet the proposed timeframe with a mature OEM product, Scania is offering prototype Stage V engines for installation well in advance. Its new range combines outstanding performance and total operating economy, and features engine-management and emission-control systems developed in-house.

The new Stage V engine is based on state-of-the-art technology, with three platforms – 9-liter, 13-liter and 16-liter – producing output from 202-566kW. The new range is based on the same platform as earlier versions – which Scania uses for all its trucks and buses – minimizing the investment required by OEMs transitioning to Stage V.

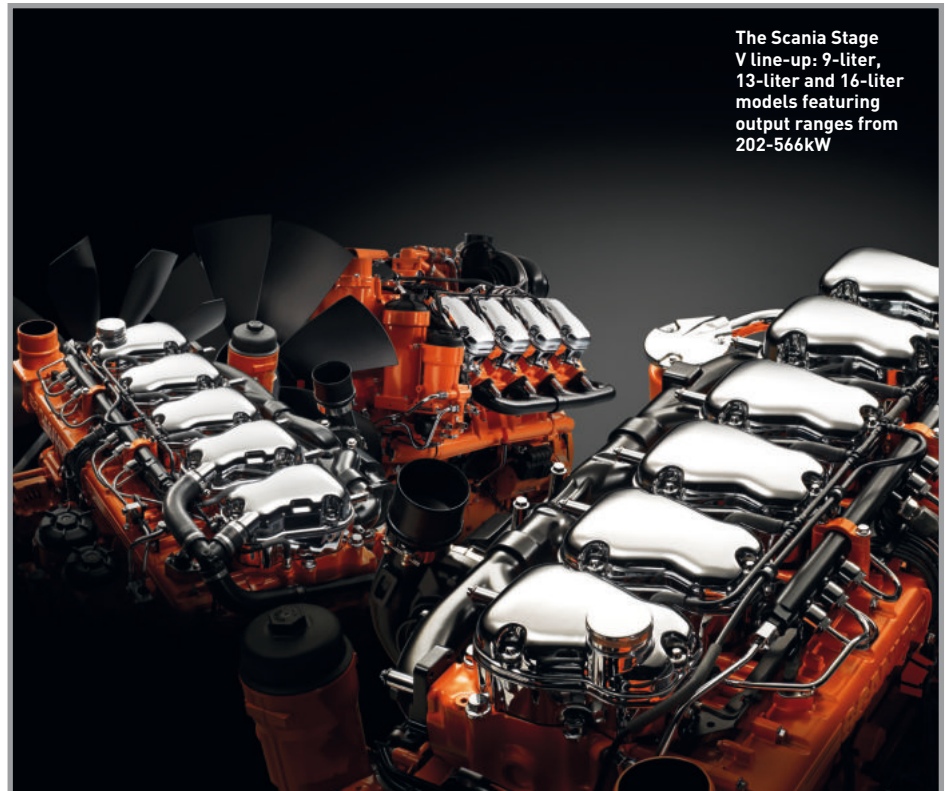
Advanced engineering lies at their heart, delivering vital characteristics such as robustness, excellent fuel-efficiency, and optimal convenience for operators.

"Scania's industrial engines are based on our successful Euro 6 engines for on road applications," says Anders Liss, VP sales at Scania Engines. "Our first Euro 6 truck engines were introduced in 2012, and we now have a proven track record in this area.

"Because Scania is a market leader in developing power solutions for use in both off- and on-highway transportation, we can ensure that the new Stage V engines meet all requirements," he continues. "This includes everything from performance and fuel economy, to outstanding environmental performance, robustness, and convenience of operation."

Important requirements for the industrial engine segment are high uptime, generous torque at low revs, excellent fuel economy, and prompt engine response. These demands are all met by the new Scania engine range. The company has carefully overseen all strategic steps from basic engine development to manufacturing, with the development of the engine-management, fuel-injection and emission-control systems all carried out in-house.

To ensure full control of all aspects of engine performance, Scania has developed a new generation of engine-management systems. The multitude of functions controlled includes fuel injection, exhaust



The Scania Stage V line-up: 9-liter, 13-liter and 16-liter models featuring output ranges from 202-566kW

aftertreatment, charge air, and engine operating temperature. The control unit is mounted on the cool side of the engine.

Key characteristics of the new engine ranges are:

- Easy-to-service, featuring modular architecture with individual cylinder heads;

- Scania XPI common-rail fuel injection;
- Scania SCR and DPF exhaust aftertreatment;
- Scania Engine Management system;
- Scraper ring to prevent carbon build-up at the top of the piston. This is extremely useful in low-load applications.

## SCR-only approach

For several years, Scania has used selective catalytic reduction (SCR) technology for aftertreatment on

trucks and buses. Now it is moving toward an SCR-only approach, in combination with diesel particulate filters for Scania trucks. The SCR-only solution is now being made available for industrial applications where features such as prompt engine response, generous torque at low revs, and fuel economy are in demand.

The normal maintenance and oil-change interval for the new engine range is 500 hours. Shared components between the different engine series lowers the costs of stocking parts and maximizes availability. The training of staff is also simplified as a result of the commonality between the different engine ranges. **ivT**

Ann-Helen Tolleman is editor-in-chief for Scania corporate communications



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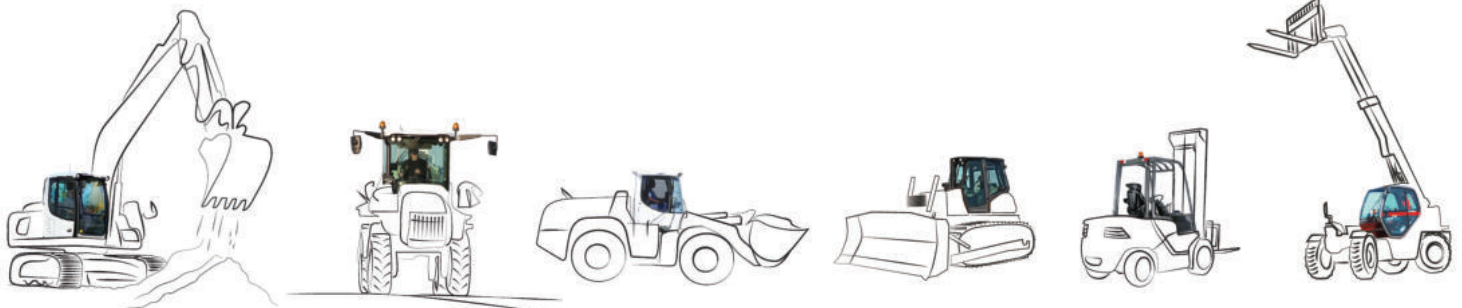
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# Three's a charm

YOU CAN'T RELY ON CHANCE WHEN DEVELOPING A TRIO OF NEW ENGINES THAT ALREADY MEET THE DEMANDS OF STAGE V. BUT THE PACKAGE SIZE AND DURABILITY OF THEIR AFTERTREATMENT SYSTEM IS CERTAINLY A LUCKY BREAK FOR OEMs AND END USERS

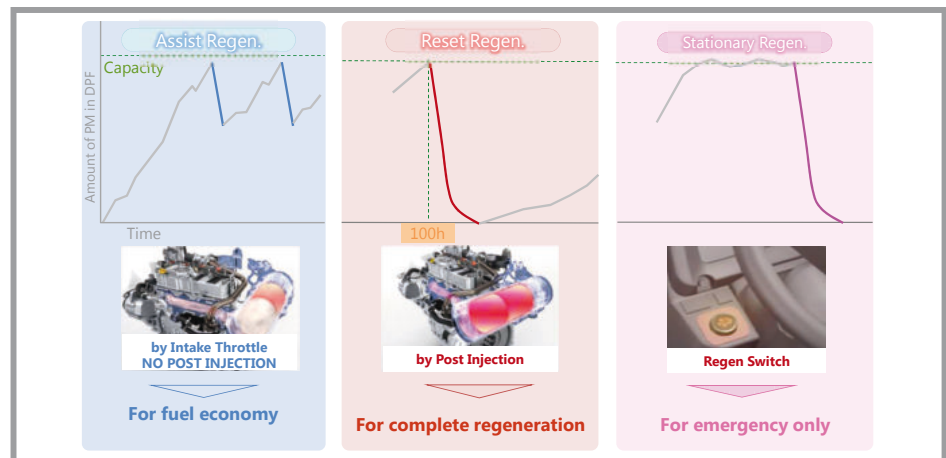
▶ Yanmar is adding three new engines to its evergreen TNV line. Ranging in power from 33.3kW to 88.4kW, the units will be displayed publicly for the first time at Bauma in April. All three feature turbochargers and intercooling, accompanied by the manufacturer's innovative three-mode aftertreatment system, which offers a minimum working life of 6,000 hours and is therefore practically maintenance-free during its entire lifetime.

The smallest of the new trio, dubbed 3TNV86CHT, is a three-cylinder 1.6-liter unit producing 33.3kW. Although it has been designed to take up far less space in the engine bay, it retains the same mountings as its predecessor so machine manufacturers won't need to redesign the whole installation. The 2.1-liter four-cylinder 4TNV86CHT produces 48.5kW, while the larger 3.1-liter 4TNV94FHT can be ordered in differing rates of tune, from 69.8kW to 88.4kW.

"We are one of the few suppliers that are ready now for Stage V," explains Gert Maris, senior area manager at Yanmar Europe's industrial powertrain department. "This is important for our customers, as



Yanmar's 4TNV86CHT – a four-cylinder engine with turbocharger and intercooling



The three-mode regeneration process of Yanmar's DPF

the new regulations are very stringent, and we have gone to great lengths to comply early."

## Power play

The company has a specific philosophy based on three principles: environmental responsibility, product quality and user-friendliness. Maris notes, "This is deeply embedded in Yanmar's corporate culture. It's about much more than just the engine's emissions; it's about looking at every stage of the process including sustainable manufacturing, cutting back on waste and even energy use in the factory."

A lot of the company's efforts have gone into improvements in power density, enabling the fitting of smaller engines that outperform their predecessors in terms of economy and power. Maris observes, "For emissions reduction, we worked hard on combustion chamber design back in the early 2000s, so we had a good platform to start with. Further improvements were achieved by adding in modern turbocharger design and common-rail injection. Also, the way the aftertreatment system is packaged has become crucial to a successful engine installation."

This is keenly felt in one of Yanmar's key markets for these engines – mini excavators. Maris continues, "As a rule of thumb, we generally like to install the aftertreatment in a space no larger than a silencer.

Excavators and wheeled loaders benefit greatly from having a smaller, lighter but more powerful engine."

It's the performance of the aftertreatment system that Maris feels make these engines stand out from the crowd. "There is always a discussion about DPF systems, with those who have DOC-only solutions scaremongering about the high temperatures or operators having to stop the machine to regenerate. It's just not a problem – our DPFs run no hotter than a silencer and they sometimes outlast the rest of the machine anyway. In fact, these things are essentially maintenance-free. What's more, there are more than 120,000 of our engines out there with this technology and we have not had a single problem reported."

Maris keeps in close contact with the equipment makers, and he knows how much they appreciate the lack of zero hours issues. "We also consider the next stage – the operator experience – very carefully. We want them to have absolute faith that a Yanmar engine under the hood will give the durability they need without the hassle of stopping to regenerate."

"The 4TNV94FHT is already gaining interest in the off-highway market, and Bauma is the ideal venue to showcase it to the construction sector." **IVT**

Gert Maris is sales manager for industrial engines at Yanmar

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# World service

AS ENGINES BECOME EVERMORE TECHNOLOGICALLY ADVANCED, THE LEVEL OF TECHNICAL SUPPORT BEING OFFERED MUST KEEP PACE – SUCH AS MODERN METHODS AND NEW DIGITAL TOOLS FOR PROVIDING TRAINING AND TECHNICAL SUPPORT ANYWHERE ON THE PLANET



▶ The introduction of the KDI power plant family – Kohler Engines' crown jewel in the diesel engine market segment – has not only represented a radical leap forward in technology, but has triggered a corresponding evolution in other departments too, including services and technical assistance. Given the considerable investment, this evolution was natural and vital for providing users of the new KDI engines with support that meets their expectations and is in line with the sophistication of the products.

With this step, a radically innovative approach was taken by Kohler Engines. In addition to providing traditional training to the technical staff, a decision was made to adopt a new philosophy that led to the development of supplementary services and resulted in an upsurge in quality thanks to the enhanced technical support offered to dealers, workshops and OEMs. This has been achieved by introducing innovative digital learning and training tools that offer the remarkable advantages of teleworking.

The new approach is based on a solid foundation: an organizational framework in which assistance with diesel engines is coordinated from the group's HQ in Reggio Emilia, Italy, and offered by a worldwide service network supported by European branch offices (in France, Spain, Germany and the UK) and service departments in North America (Kohler, Wisconsin), China and Pacific Asia (Shanghai), and Central and South America (Mexico City).

For the KDI line – the first industrial diesel engines to use a 2,000 bar common-rail injection system – the Technical Assistance and Replacement Parts division has drawn up a series of requirements for workshops that wish to join the network of KDI qualified service centers, whose technical personnel receive training that is specifically targeted for this line.

From its Reggio Emilia HQ in particular, the division provides documentation, initial training and technical support to all branches around the world, which in turn cover their specific territories and create networks of dealers and authorized workshops. In doing so, they directly supervise OEMs that intend to perform repairs and service on KDI engines directly through their own dealer networks. This highly structured service organization includes 1,500 service locations in Europe, which are flanked by those OEM dealers that directly service the engines in their machines.



ABOVE LEFT: The iService multimedia platform is easy to access and navigate  
ABOVE RIGHT: The concept of training is at the heart of the service philosophy

## The training now arriving...

At the heart of this new service philosophy is the concept of training, whether carried out in traditional form or with modern digital tools. The former includes courses offered not only to the service network, branches, distributors and authorized workshop networks, but also to trainers at dealers and authorized OEM workshops. Courses are available at the group's Reggio Emilia HQ as well as at distributors' locations. They consist of a technical unit and a practice section that involves installation/removal and dynamic testing. Traditional classroom-based courses are accompanied by an innovative Distance Learning section – a remote training tool included in the iService multimedia platform. It combines traditional viewing of technical manuals with the enhanced usability offered by advanced digital technology.

Initially created exclusively to support the KDI product line, but gradually extended to all families of diesel and petrol engines produced by Kohler Engines, iService is designed to meet the needs of the service network and of end users, as it contains user-friendly interactive content that is easy to access and navigate on PCs, smartphones and tablets. This novel platform contains the entire gamut of aftersale materials offered by Kohler Engines, such as operation and

maintenance manuals, workshop manuals, parts catalogs and warranty programs. Most importantly, it provides the opportunity to take advantage of the Distance Learning online training tool.

The Distance Learning section can be accessed at [www.lombardingroup.it](http://www.lombardingroup.it), specifically in the iService section of the Service menu, where users can choose from a number of training programs, according to the engine in question (Academy section). Training is subdivided into seven sections: introduction, safety, cleanliness, maintenance, systems, operational groups, and checks. Each chapter includes an online final test, which must be passed before access to subsequent chapters is allowed, so the user can easily determine the level of skill acquired from each chapter.

Of course, the iService Academy has been created specifically for the Kohler Engines qualified service network. End users, on the other hand, can take advantage of the network of Kohler Engines dealers and authorized workshops. Their locations in local areas can now be found using a new app for mobile devices. **ivT**

*Nino De Giglio is senior manager – brand and communication at Kohler Engines, where he has worked for 10 years*

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# All mod cons

**THIS NEW PAIR OF CONVENIENTLY MODULAR CONCEPTS FOR EXHAUST AFTERTREATMENT AND ENERGY STORAGE COULD HARDLY BE MORE DIFFERENT – BUT WILL MAKE THE LIFE OF OFF-HIGHWAY DESIGNERS AND OPERATORS ALIKE FAR EASIER**

▶ The regulations for exhaust gases from mobile machinery will be further tightened in the EU from 2019 with the arrival of Stage V. Very similar strict emissions regulations already apply to tunneling applications in the EU and for off-highway machines in Switzerland, so Liebherr fitted its first machines with its SCRFilter system in 2014. Since mid-2015 the system has been installed in its engines as standard, making a tried and tested exhaust gas aftertreatment system available to customers.

The SCRFilter system comprises a DOC catalytic converter, an SCR catalytic converter and an SCR-coated particulate filter. The DOC is maintenance-free and the passive regeneration of the coated particulate filter makes the system reliable and easy to operate. The combustion process was optimized so that only a few particles must be captured by the SCRFilter. As a result, the maintenance intervals can be stretched to more than 4,500 operating hours. With the in-house development of engines, injection systems, engine controls and exhaust gas aftertreatment solutions, Liebherr is enabling high system integration. High efficiency can be achieved with simultaneous low fuel consumption. As an all-in-one solution, the further developed ECU3 engine control unit comprises all control functions for engines up to 560kW and also for exhaust gas aftertreatment.

The SCRFilter is a part of the Liebherr modular system for engines and is, therefore, compatible with all engines in the D93, D94 and D95 series. These models have identical performances, machine cooling system requirements and the same interfaces during installation in terms of Stage IIIA, IV and V emission standards, meaning the customer can use the same machine design for various emission standards.

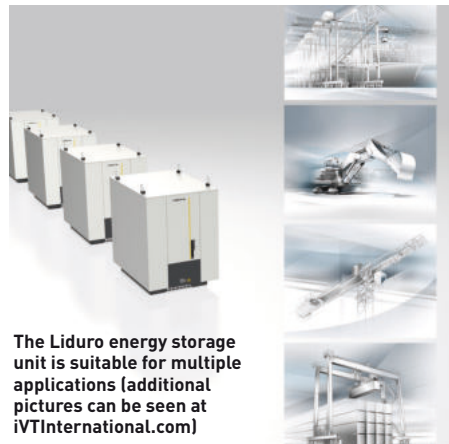
## Liduro debut

At Bauma 2016, Liebherr will also present its in-house developed Liduro energy storage system for the first time. This powerful and flexible system for electric drive systems is based on double-layer capacitors. The compact, liquid-cooled complete system comprises all of the necessary individual systems and assemblies, thereby making integration in suitable applications much easier. As such, the new energy storage system is a cost-effective and sustainable system for increasing the productivity of electric drive systems and facilities.

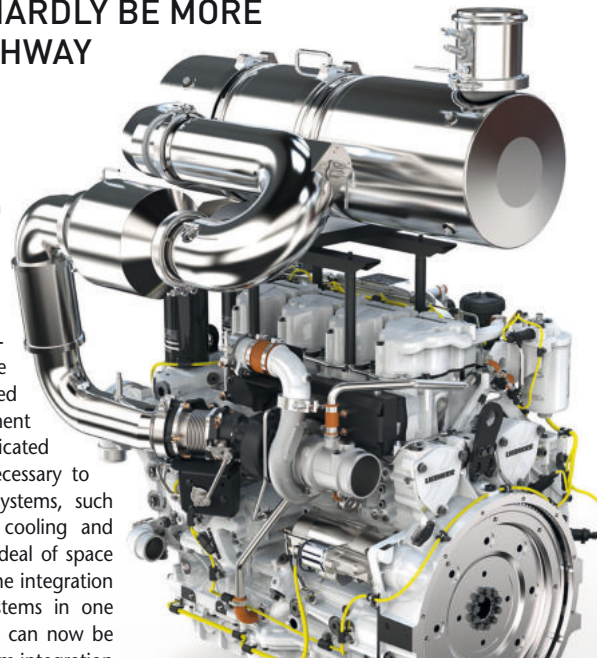
Liduro is a complete system with 1.5MJ of energy, which enables the accumulation and supply of 100kW within 15 seconds with a reaction time of 500µs.

Until now, the integration of energy-storage units in new and existing mobile and stationary applications has required extensive measures in terms of development and installation. Aside from the complicated mechanical implementation, it was necessary to bring together numerous individual systems, such as DC/DC controllers, storage cells, cooling and management, which required a great deal of space and resulted in high costs. Thanks to the integration of all individual components and systems in one energy storage unit, considerable time can now be saved along with material costs for system integration and installation. The 'connect and use' system makes simple installation and operation possible – the user only has to make arrangements for the mechanical attachment and electrical wiring. There is the option of connecting the storage unit as a purely two-pin device directly to a DC link of 530-850V, as well as accumulating a defined amount of energy or supplying it again by using an additional communication interface. It is also possible to exchange all of the processing data via this interface.

Up to 10 units can be connected in parallel to enable an increase in storage capacity, not only



The Liduro energy storage unit is suitable for multiple applications (additional pictures can be seen at [ivtinternational.com](http://ivtinternational.com))



Liebherr six-cylinder in-line engine with the SCRFilter exhaust gas aftertreatment system

providing more power but also ensuring excess energy can be used for subsequent work, and that no additional supply is required.

The Liduro basic system has already been installed and tested on a mobile, diesel-electric gantry crane. A fuel reduction of up to 40% was recorded, equating to a saving of 700 liters per week or up to €18,000 per year. Among the other advantages is the ability to use a smaller diesel engine – this no longer has to cover load peaks and can be maintained at an optimized operating point, notably reducing the emission of harmful substances.

For applications associated with a high number of dis/charging cycles, where high load peaks temporarily occur and long service life is essential, double-layer capacitor energy storage units offer many advantages over battery-type accumulators, e.g. in the area of electromobility and also during lifting operations, such as with cranes, forklift trucks and elevators. The new energy storage system is, therefore, a cost-effective and sustainable system for increasing the productivity of electric drive systems and facilities. **ivT**

*François Jaussi is head of product management and sales diesel engines at Liebherr Machines Bulle; Daniel Ried is head of product management control technology at Liebherr-Components Biberach*



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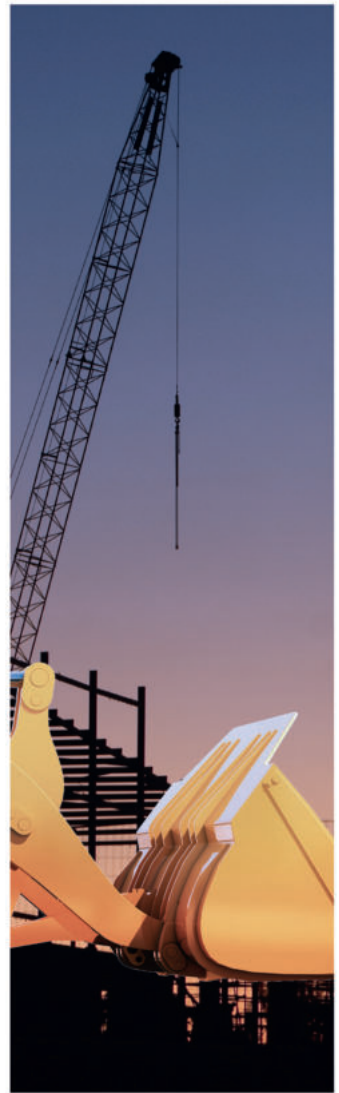
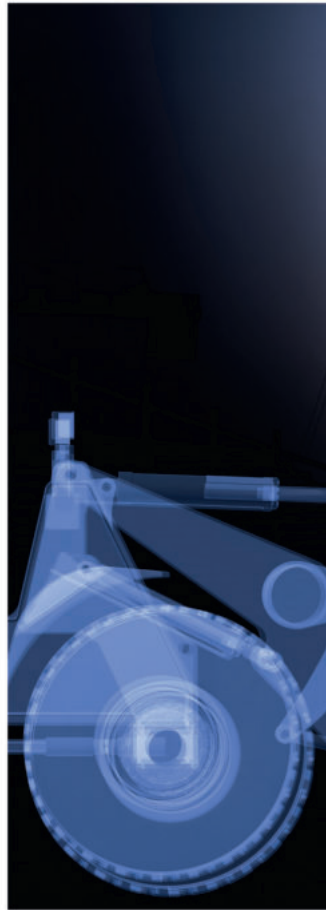
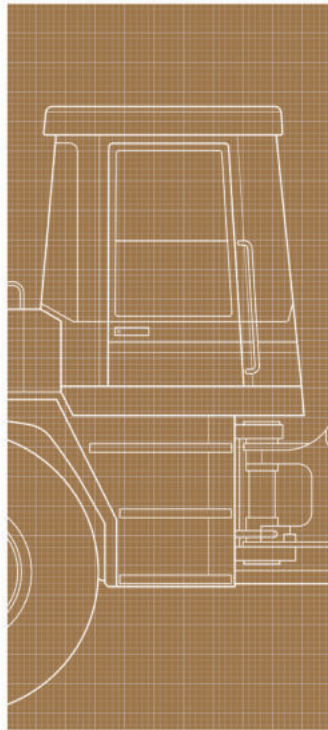
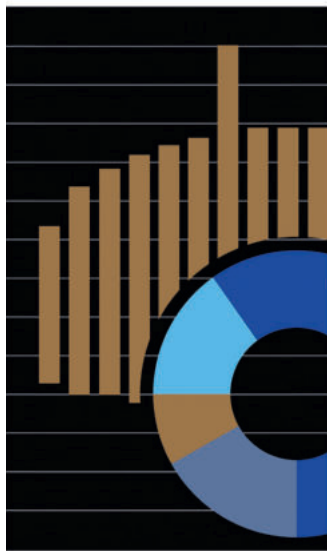
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# Air aces

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Technologies for commercial and industrial vehicles and engines have to operate reliably even under high loads and in tough environments. For this reason, the cutting-edge solutions (Figure 1) offered by BorgWarner, such as the Visctronic fan drive, the Compact Variable Coolant Pump (CVCP), the award-winning regulated two-stage (R2S) turbocharging technology, and its innovative exhaust gas recirculation (EGR) modules are designed to meet the highest standards and enable reliable and trouble-free operation.

The company's extensive product portfolio includes numerous air- and coolant-flow solutions, such as the Visctronic fan drive and the CVCP, which provide superior air and coolant control for precise and reliable thermal management of the engine and auxiliary components. Its Visctronic variable-speed fan drives feature an accurate temperature input to enable precise cooling and energy management. Communicating with the engine's control unit via specially calibrated software, the fan drive directly responds to the engine's needs based on engine temperature, engine speed, vehicle speed and engine load. Even under dynamic conditions, the company's electronically controlled fan drive technology only operates when needed, thereby reducing the average fan speed in any given duty cycle and making more power available. Compared with conventional fan drives, the Visctronic technology improves fuel economy by up to 1.4%, and even by up to 4% in comparison with fixed fans.

BorgWarner's CVCP (see Figure 2) combines the capabilities of a highly efficient conventional fixed pump with the ability to fully control the coolant flow. Responding very quickly to the engine operating conditions, the CVCP provides the required coolant flow through precise impeller speed control and diagnostics as well as reduced parasitic losses for improved fuel savings of up to 1.5%.

## Boosting power for engines and vehicles

BorgWarner also supplies a broad range of wastegate, VTG and R2S turbocharging solutions for commercial and industrial vehicles and engines. The company's proven wastegate turbochargers combine the highest efficiencies with excellent durability. Its BV range includes pioneering turbocharging systems featuring



FIGURE 1: BorgWarner's highly efficient technologies for commercial and industrial vehicles and engines help manufacturers to comply with challenging emissions regulations

VTG, which facilitate precise adjustment to the respective engine operating point for optimum power output with the greatest fuel efficiency.

With many years of experience in the use of VTG technology in the commercial vehicle and off-highway segment, BorgWarner is able to offer a finely staggered portfolio of units – from the BV55, right up to the BV86 – that enable optimum coordination and matching of the turbocharging system with the requirements of its customers. The BV series covers diesel engines with displacements from 4-16 liters. A robust VTG mechanism enables efficient and reliable operation of the BV turbochargers even under the toughest conditions. This efficiency is being achieved through a CFD-optimized vane design in connection with specially developed turbine wheels.

The company's renowned R2S turbocharging concept provides excellent efficiency and broad flow compressor wheel characteristics through dynamic response as well as flexible and precise regulation. The R2S turbocharging concept meets the demands of modern engine concepts by providing maximum exhaust gas recirculation rates, even under full-load conditions, while considerably reducing emissions.



FIGURE 2: The Compact Variable Coolant Pump combines the characteristics of a conventional coolant pump with the capability to fully control the coolant flow

## A breath of fresh air

BorgWarner's state-of-the-art EGR technologies cool and recirculate exhaust gases and are a well-proven approach to reducing combustion temperatures and nitrogen oxide (NOx) emissions with the aim of helping vehicle manufacturers to meet demanding emissions regulations. The EGR modules, designed for high durability, provide tailor-made solutions for numerous powertrain applications, including low-pressure and high-pressure EGR systems.

Incorporating its EGR cooler, EGR valve and bypass valve into one compact package, BorgWarner's EGR modules are highly efficient and reliable. The EGR cooler optimizes heat transfer by using highly corrosion-resistant stainless-steel hybrid or corrugated tubes. The EGR valves and actuator technologies provide precise and responsive control combined with high flow capability, excellent sealing, and resistance to corrosion and heat for reliable operation, even under challenging conditions.

All BorgWarner technologies for commercial and industrial vehicles and engines are designed to meet the highest requirements, by offering long-term durability, reduced emissions and advantages in terms of fuel consumption. **ivT**

*Paulo Aguiar is European sales and application engineering senior manager at BorgWarner Thermal Systems*



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# The odd couple?

GIVEN THEIR ABILITY TO DECOUPLE WHEN HYDRAULIC POWER ISN'T NEEDED, A PUMP AND CLUTCH COMBINATION ISN'T REALLY THAT STRANGE – AS THE ENERGY SAVINGS AND LOW WEAR WILL TESTIFY

Concentric uses elements of its core technology building blocks to aid the design and development of unique solutions that answer a variety of key industry market drivers, namely energy savings and power density combined with lower noise. The company's most recent development is an integrated combination of its patented dual cone clutch (DCC) and its Ferra series pumps.

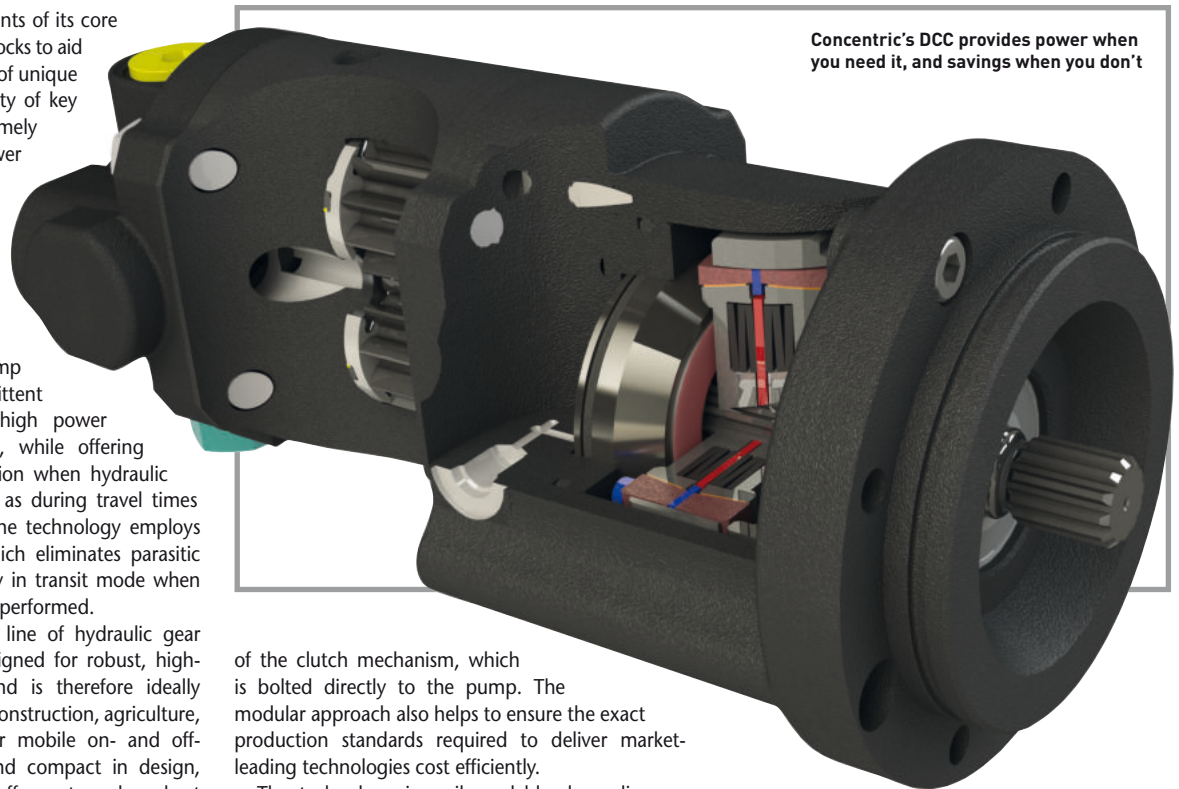
The Concentric DCC pump is designed to suit intermittent applications that demand high power density during work cycles, while offering savings in energy consumption when hydraulic power is not required, such as during travel times between operating cycles. The technology employs power-on-demand logic, which eliminates parasitic losses, thereby saving energy in transit mode when work functions are not being performed.

The Ferra series cast-iron line of hydraulic gear pumps and motors was designed for robust, high-performance duty cycles and is therefore ideally suited for applications in the construction, agriculture, material handling and other mobile on- and off-highway sectors. Rugged and compact in design, the Ferra series products offer extremely robust performance across a broad range of pressure and temperature requirements.

## Technology boost

Following the acquisition of LICOS Trucktec GmbH in 2013, a variety of new technologies became available to Concentric. The patented DCC is compact in design and, with extremely low wear at the friction interfaces, is virtually maintenance free. Actuation of the clutch can occur either hydraulically or pneumatically and can be designed to include fail-safe modes of operation depending upon the application requirements.

Like many other products in the Concentric offering, the integrated DCC pump product is modular in design, which allows for easy substitution of standard pump components as well as the addition



Concentric's DCC provides power when you need it, and savings when you don't

of the clutch mechanism, which is bolted directly to the pump. The modular approach also helps to ensure the exact production standards required to deliver market-leading technologies cost efficiently.

The technology is easily scalable depending on the torque loads required by the application. Recent testing has yielded positive results in transmitting up to 140Nm of torque and power savings up to 3kW. Prototype units are available that can be customized to meet specific application requirements.

There are many advantages associated with the integrated power-on-demand DCC product – not least the compact design that offers vehicle and system designers greater flexibility when competing for the ever-decreasing available space within the latest machines. Through its very nature of possessing the ability to be decoupled when not performing work, the resulting reduction of parasitic losses directly correlates to a drop in fuel consumption.

The power-on-demand logic allows for additional benefits by decoupling auxiliary pumps to deliver improved start-up capability, particularly in cold

weather conditions, thereby requiring reduced cranking power. This opportunity may also allow for an overall reduction in engine size as a result of not having to overcome these parasitic loads at startup.

In addition to these benefits, improved pump reliability is anticipated through extended pump life, which is accomplished by only running the unit when the work cycle requires. Furthermore, a reduction in environmental noise emission is also accomplished by turning the pump off when it is not being used. In fact, whatever the application might be, this new technology being offered by Concentric can be easily adapted to suit the demands of almost any vehicle. **ivT**

*William Pizzo is global vice president of engineering/hydraulics at Concentric*



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# Driving school

ALL YOU EVER NEEDED TO KNOW ABOUT DRIVELINES, AXLES, TRANSMISSIONS AND TRANSFER GEARBOXES CAN BE LEARNED AT THE BOOTH OF JUST ONE SUPPLIER AT BAUMA THIS YEAR

▶ Global manufacturer JCB Drivetrain Systems (JCB DSL) will be once again showcasing part of its ever-increasing range of products, including axles, transmissions, transfer gearboxes and drivelines, at the Bauma show in Munich this April.

The company is looking forward to welcoming new and existing customers to its stand – particularly OEMs that are planning and building new machines and looking for a world-class componentry supplier with decades of engineering expertise.

Over the last 30 years, JCB DSL has partnered a wide range of OEM machinery manufacturers in the construction, mining, industrial, material handling, agricultural, GSE and other sectors, to supply some 500,000 transmission components. This includes steer-drive and rigid-drive axles, hydrodynamic, powershift and synchromesh transmissions, and transfer boxes.

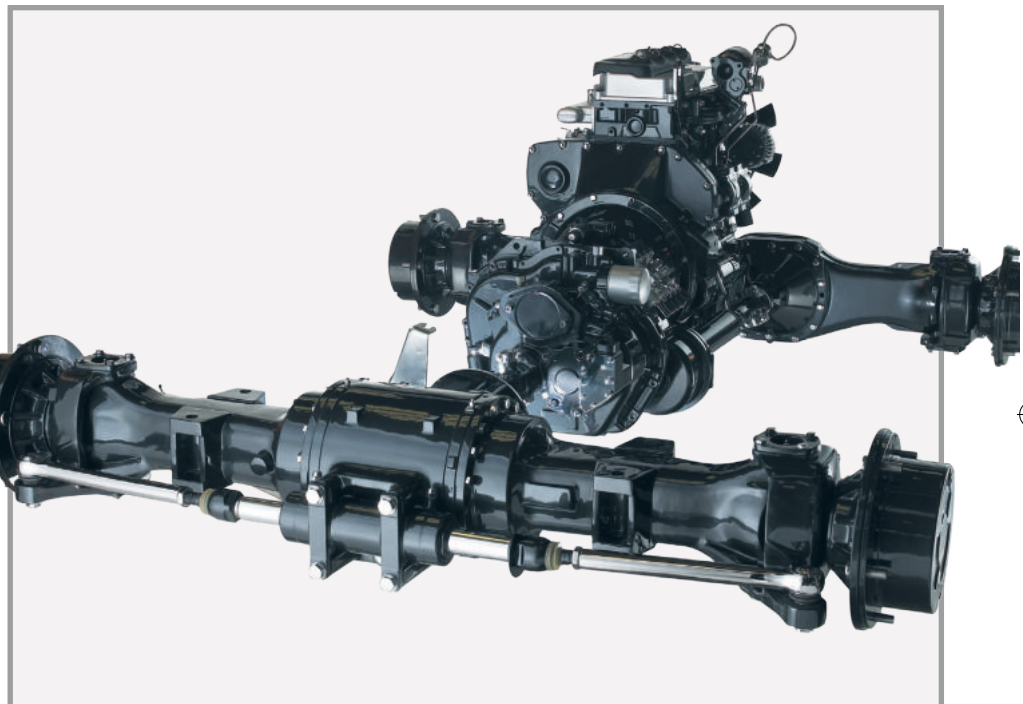
Innovation is at the heart of the business, with patented products including the novel, low-cost JCB Torquelock locking torque converter, the Max Trac torque proportioning differential, and variants such as limited-slip and soft-engage locking differentials, all available to OEMs for use within their own products.

The hugely successful launch of JCB's own engine in 2004 has enabled JCB DSL to supply fuel-efficient four- and six- cylinder engines at the required levels of emissions control; and also to produce full driveline systems for OEMs' systems that have been engineered, tested and proven globally within the company's own machines, as well as with a growing range of OEMs.

JCB's longstanding policy of vertically integrating its manufacturing processes has also enabled JCB DSL to incorporate the company's own precisely manufactured hydraulic cylinders into its systems and provided the potential to offer JCB cabs; components that are used every single day in tough operating environments around the world.

## Global makeover

The JCB DSL business was re-branded in 2012 to leverage use of the renowned JCB name, and this has enabled it to draw on the group's global presence, reputation and experience. Access to research and testing facilities, real-time operating data, and application experience directly benefits the JCB DSL business, ensuring that components offer the right



ABOVE: JCB 4WS drivetrain, including SD80 low-cost driven/steering axles with oil-immersed service brakes, P5760 6x4 automatic powershift transmission with coaxial pump drive, locking torque converter, integral park brake and the JCB Ecomax Stage IV engine

performance, productivity and durability. The rebrand has led to significant growth in new territories, with hundreds of customers across six continents now sourcing components from the supplier.

OEM customers are able to select individual components or a modular suite of components from the company's portfolio, safe in the knowledge that they will save valuable engineering, purchasing and management time, thanks to years of tried-and-tested experience out in the field.

Alternatively, should a bespoke solution be required to meet a particular need, the team at JCB DSL has built up vast experience as a result of many years of supplying customized and tailored products, as well as specific industry solutions, to a wide range of customers. All products are backed up with renowned industry-leading support, service and aftercare.

Manufactured in the UK and India, JCB engines, axles and transmissions are supported with highly experienced engineering and design capacity in both locations, and the same proven production processes. This approach is designed to satisfy cost and logistical requirements of its customers in all corners of the world, but can also assist them with future strategies for legislative changes and emissions compliance – areas in which JCB as a group has huge expertise.

Fully ISO accredited across the group – including ISO9001, ISO14001 and ISO 18001 – and with numerous gold standard safety awards to its name, JCB DSL is looking forward to taking part once again at one of the world's premier exhibitions. **ivT**

*Nigel Harding is general manager of JCB Drivetrain Systems Ltd*



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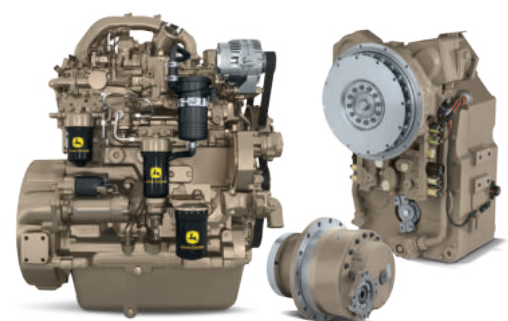
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# The way of the Ninja

THE SAME ENGINEERS BEHIND ONE OF THE WORLD'S MOST POWERFUL PRODUCTION MOTORCYCLES HAVE ALSO PLAYED A KEY ROLE IN THE DEVELOPMENT OF A RANGE OF HYDRAULIC COMPONENTS FOR THE OFF-HIGHWAY INDUSTRY

▶ The name Kawasaki instantly summons up the image of a powerful motorbike, speeding down a clear, open highway. Not surprising given the recent launch of the Ninja H2R – one of the world's fastest motorbikes – which grabbed headlines the world over.

Situated in Japan's Nishi-Akashi (close to Kobe, where the company was founded) is the Kawasaki Development Centre, where the same engineers behind this mechanical marvel have applied their expertise and R&D techniques to the development of a new range of off-highway machinery components.

Even when used alone, these new pumps, motors and control valves offer several notable efficiency and controllability improvements. But, when combined, they provide clients with even more effectiveness and reliability, saving valuable time and resources during procurement, development and maintenance.

The products have built on Kawasaki Precision Machinery's expertise in creating hydraulic systems for excavators and are ideal for almost any off-highway machinery, including telehandlers, backhoe loaders and wheeled loaders.

## What's new?

While most variable-displacement axial piston pumps suffer from a dramatic drop in efficiency at lower displacements, Kawasaki's K3VLS axial piston pump demonstrates best-in-class efficiency across the full operating range.

Available in frame sizes 50, 65, 85, 105, 125 and 150cc/rev, the K3VLS features load-sensing, electronic displacement, torque-limiting and variable horsepower controls. The pump features a 280 bar maximum operating pressure and 350 bar peak pressure rating. It is proven to lower fuel consumption, even while idling. Lighter and more compact than competitor products, the K3VLS has been developed for machines and equipment that use load-sensing or electronic control systems.

Kawasaki's M7V high-speed variable-displacement swash plate axial piston motor is one of the quietest on the market, thanks largely to its newly developed rotating group. Available in displacements of 85, 112 and 160cc with 400 bar continuous pressure rating, it is ideal for hydrostatic transmissions, drill rigs and crane winch systems.



The K3VLS pump was developed in the same R&D center as the Kawasaki Ninja H2R motorbike

Available in 71, 90 and 125cc displacements with a 400 continuous pressure rating, the K8V series of closed-loop axial piston pumps features electric and hydraulic proportional controls with through-drive and tandem versions available.

And finally, the KLSV load-sensing main control valve series for multifunction off-highway machinery offers the benefits of post-compensated flow-sharing architecture, 400 bar continuous pressure rating, and 180, 250 and 400 l/min sectional flow rates.

## Behind every good product is...

Behind these products is Kawasaki's 450-strong team of development engineers, 110 of whom specialize in hydraulics. But it's not all down to the people; it's also thanks to the high-quality manufacturing equipment and testing processes they have at their fingertips.

Rigorous testing is undertaken throughout the design process including CFD (computational fluid dynamics). This is used to maximize component

efficiency by optimizing the path the fluid takes through the component to reduce pressure drops.

Kawasaki has invested heavily in technology to decrease friction losses, developing a process to minimize metal-to-metal contact and designing and building custom heat-treatment machinery that is now used in the component manufacturing process.

Another core area focused on during research and development was noise reduction. Kawasaki's on-site anechoic chamber enabled the team to accurately determine the sound pressure levels created by each machinery component. With noise levels an important deciding factor for off-highway vehicle manufacturers, this was a vital stage in the development of both the K3VLS pump and the M7V motor.

These are just some of the techniques deployed in the development of the new product range. **ivT**

*John Boote is the business development manager for Kawasaki Precision Machinery UK*



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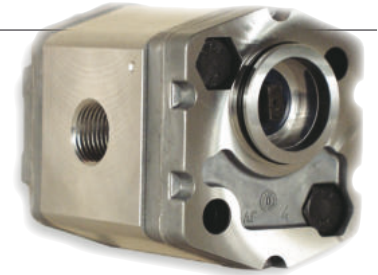
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# Pump and dump

**A COMPACT, ROBUST GEAR PUMP AT THE HEART OF MESSERSÌ MINI-DUMPERS IS KEY TO ENSURING THESE MACHINES RISE ABOVE EVERY CHALLENGE THAT COMES THEIR WAY**



By virtue of its continuous cooperation with many of the leading off-highway equipment manufacturers, Marzocchi Pompe is an ideal partner for the development of machinery for the earthmoving and other industrial vehicle sectors.

Take Messersì, a first-class manufacturer of compact equipment, for example. Established in Italy in 1957, it has now become a world leader in the manufacture of tracked mini-dumpers and boasts a wide range of models, from 0.5t to 2.5t in payload.

Through the use of the most up-to-date design technologies and high-quality components and materials, these Messersì machines can meet every type of challenge with the guarantee of high performance and superb durability. The tracked mini-dumpers' main advantage of allowing one worker to carry out a number of jobs at one time means a saving in time and labor for the building company, while helping to maintain the optimum safety and working conditions inside the building yard.

The power and torque of the engine, rapidity of movement and compatibility with a wide range of accessories make its mini-transporter an ideal solution to meet materials handling needs, even in confined spaces, as well as many other jobs inside the building yard. With its hydrostatically driven and patented track layout, the TCH-R812D in particular delivers a larger footprint on the ground, providing superb stability and enhanced driving comfort during all loading conditions.

At the heart of the power unit is the 1BK7 gear pump, which Marzocchi supplies to Messersì in several different displacements. This is housed in the main hydraulic circuit and, together with the small main engine, generates the hydraulic power required to operate the motors and the cylinders. The Marzocchi pumps were chosen as they were of the correct displacement to obtain optimum performance from the engine used. Tests carried out by Messersì also highlighted the good behavior of the pump in terms of low rotational speed and exceptional ability to maintain pressure.

Belying their compact dimensions, Marzocchi BK7 gear pumps are extremely robust and available in aluminum (ALP) and cast iron (GHP) versions, in displacements between 1.4cc/rev and 35.2cc/rev. The spheroid cast-iron flange and cover construction



allows the GHP pumps to easily handle peak pressure up to 310 bar and rotational velocity up to 6,000rpm. The optimized design provides the operator with outstanding volumetric and mechanical efficiency over most working conditions with maximum values that reach 98%. Those high values of efficiency offer improved autonomy and economy of the platform.

The use of hydraulic equipment in this kind of small earthmoving and material handling machinery offers numerous advantages. Chief among these is the installation versatility – the mounting of the pump, and of the hydraulic motors, is no longer constrained by the position of the PTO, as this can now be positioned freely to meet application requirements. Pumps and gear motors are also very compact power units, and their speed of operation depends on the oil flow in the circuit rather than being dependent on the speed of the combustion engine. The rotation speed can also be hydraulically increased in order to obtain values of speed or torque much higher than what is being currently produced. And finally, any repairs and replacement of different hydraulic components are simple and fast.

## Production range

To satisfy the demands of off-highway equipment manufacturers, Marzocchi Pompe has developed a number of specific pump and motor products that integrate anti-cavitation, electroproportional, priority

ABOVE: Marzocchi 1BK7 gear pump, as used in the Messersì tracked undercarriage model TCH-R812D (previously TCH-R16D)

and relief valves, and high-low systems. The current Marzocchi production range varies between 0.19cc/rev and 200.3cc/rev and it is divided into eight groups according to gear size. Within each group, different displacements are obtained by changing the gear width. A wide range of flange, shaft and coupling configurations is available; in fact, these components can also be designed to meet customer specifications. The cast-iron versions exist in groups 1, 2 and 3.

Maximum operating pressure depends on pump displacement and type, varying on average from 230 bar on aluminium models to 280 bar for cast-iron versions. All products can also be supplied with Viton seals, while special versions are available for use in temperatures between -40°C and +120°C. Mono-directional and bidirectional motors are divided into three families (1, 2 and 3) that cover a range of displacements between 2.8cc/rev and 87cc/rev. The maximum working pressures for the motors are similar to those established for the pumps and they can deliver torque up to 250Nm and power up to 60kW. **ivt**

Daniilo Persici works in the R&D department at Marzocchi Pompe SpA, where he leads test, FEA and CFD analysis

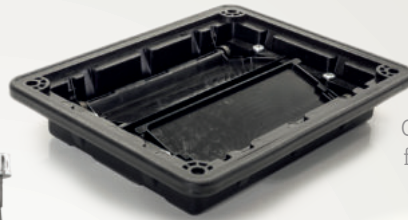


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# Faster, higher, safer

ASSEMBLING AND OPERATING 14M LIFT-HEIGHT ORDER PICKERS MAY NOT QUITE BE AN OLYMPIC SPORT, BUT PRODUCING SHORT RUNS IN RECORD TIME CALLS FOR A FOOLPROOF FITTINGS SYSTEM

Founded back in 1953, and headquartered in Hamburg, Germany, Jungheinrich's history is closely associated with the development of innovative vehicle solutions for in-plant logistics. Its aim has always been to support businesses in deploying their workforce more efficiently, to speed up in-plant material flows and thereby reduce costs. This was certainly the case in the OEM's foundation year when it developed the Ameise 55, the first electric forklift to be equipped with a driver seat.

Since December 2015, the company has been offering the latest generation of the EKX electric order picker. The EKX III offers an innovation whereby the operator can oversee the handling of the load from within the driver's compartment, up to a lift height of 14m. This gives rise to greater flexibility for the user and, above all, an increase in safety during the loading and unloading of full pallets. Other EKX III technical highlights include new vibration damping for better performance and safe transportation even on bumpy floors. There is also a novel electric drive that enables the EKX III to work up to two shifts without changing batteries. Also, due to the use of lightweight materials and high-strength steels, it was possible to increase the load capacity by about 100kg.

The new lift-truck integrates as seamlessly as possible – just like its predecessors – with all the requirements of the warehouse, such as aisle width and rack heights. It is by no means uncommon for Jungheinrich to produce a lift-truck version in a batch size of one – and to do so with a comparatively short delivery time. Responding to this challenge requires everything to run like clockwork on the assembly line.

The stackers are fully assembled in the factory and tested, prior to the mast being disassembled before transportation and finally assembled at the customer's workplace, as it is not possible to transport these large machines in one piece.

## Fit for purpose

From this, it is apparent that Jungheinrich places a high priority on the safe and reliable functioning of each individual component. This is one of the reasons why the OEM decided to use the Parker EO-3 fittings series on the EKX III series. EO-3 stands apart from other fittings due to its connection system for both tubes and hoses, which at a glance shows visually



ABOVE: EO-3 is an innovative fittings system that features visual assembly recognition for tube and hose applications

from the outside whether or not the assembly is correct. If the yellow marking is in the viewing field of the externally located indicator ring, assemblers and quality inspectors know that as far as assembly is concerned, everything is in order and that leakage – in the worst case occurring during a customer's operations – will be avoided.

Moreover, Parker's EO-3 system delivers quicker assembly with the help of new technology. Unlike previous standard connectors, EO-3 is based on an internal cone with integrated soft sealing and a tapered thread, so positioning the tube and hose line during installation is simplified and crossed threads are prevented.

In the past, the commissioning of high-pressure hydraulic systems – both at Jungheinrich's facilities and those of its customers – called for a high level of time and effort with, of course, a corresponding cost burden. All of the connections previously had to be tightened using torque control, but in the assembly of EO-3, neither a torque wrench nor an extension are



ABOVE: The EKX III offers the ability for the operator to control the load from the driver's cab up to a lift height of 14m

required because of the low tightening torque – a standard jaw wrench is sufficient. From tube size 25mm upward, an octagonal nut is used instead of the standard hexagonal type, providing additional processing convenience that is positively regarded during installation in tight access spaces, as well as in often-used overhead forklift truck assembly.

The performance benefits for the EO-3 fittings series are completed by their Cr(VI)-free surfaces, which on average provide a corrosion resistance of 500 hours against white rust, thereby increasing the endurance of the fitting, as well as of the complete hydraulic system.

And finally, because EO-3 is a fittings system for use with both tubing and hose lines, there are further advantages for the assembler in terms of logistics and stockholding, which results from the delivery of components from a single source. **ivt**

*Georg Kälble, manager marketing service, has worked for Parker tube fittings division Europe for 20 years*



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# Making the braid

THE ADOPTION OF A PLASTIC TEXTILE BRAID THAT REDUCES THE WEIGHT OF HEAVY-DUTY, HIGH-TEMPERATURE HOSES ENSURES THEY PROVIDE EXACTLY THE RIGHT CHARACTERISTICS FOR USE IN VERY TIGHT PACKAGE SPACES

▶ ContiTech has developed an extremely flexible high-temperature hose that features external reinforcement for truck and off-highway applications, yet also reduces weight to help provide lower fuel consumption. Klaus Brühne, who is responsible for hose developments for these applications, and Thorben Pilzecker, head of key account management, Industrial Vehicles, discuss the benefits of this latest development for the customers.

## Why did you develop this hose?

**Thorben Pilzecker:** The market is demanding ever more efficient engines. This can be summed up as more power for lower consumption and pollutant emissions. This results in our customers having to deal with rising temperatures in the engine compartment, and conventional hoses are now reaching their limits. This prompted us to find a solution that meets the increased temperature requirements and therefore enables our customers to continue to increase the efficiency of their engines.

## Where can the hose be used?

**Klaus Brühne:** Its flexibility means it can be used even in especially tight and complex installation situations – and that even includes where extremely high temperatures are commonly encountered. Depending on the particular finish, the new hose can withstand temperatures of up to 250°C – at operating pressures of up to 15 bar. But the hose's properties mean that its use is not just restricted to applications in very hot environments – it can also be used, for instance, for turbocharger lubrication, control and cooling. Other uses include cooling water applications with high radiant heat levels.

## Where does the hose's extreme flexibility come from?

**KB:** It gets its flexibility from a special braid made of a plastic textile that is resistant to high temperatures and chemicals. This encloses the highly stretchable inner-lining made of a rubber that is specially adapted for the application. Thanks to the bending radii that this makes possible, the hose can also be used in the extremely tight installation spaces that are becoming increasingly common in engines, given the trend toward downsizing.



TOP: Klaus Brühne  
ABOVE: Thorben Pilzecker



ABOVE: ContiTech's externally reinforced hose is extremely flexible and, if required, also kink-resistant

**“DEPENDING ON THE PARTICULAR FINISH, THE HOSE CAN WITHSTAND TEMPERATURES OF UP TO 250°C – AT OPERATING PRESSURES OF UP TO 15 BAR”**

**As well as downsizing, reduced weight and the associated fuel savings are major issues in the truck and off-highway sector. Can the new development also play a role here?**

**TP:** As a result of its rigorously lightweight design, this hose solution offers a significant weight advantage over the PTFE pipes enclosed in a stainless-steel braid used hitherto for these tasks. The new hose therefore also contributes to reducing fuel consumption and cutting the associated CO<sub>2</sub> emissions.

**Can the hose be adapted to special customer requirements?**

**KB:** It can also be manufactured as a molded hose or can be sold by the meter. In addition, a kink-resistant version is also offered. Another advantage for the customer is that the hose is part of a modular package from which the user can select the right product for the particular application. This yields further cost benefits.

**Can you give us some application examples?**

**TP:** Our externally reinforced hose has already proved itself in a number of applications in practice. For instance, it is in operation in the commercial vehicle sector, while in the off-highway market the hose is being used by engine and compressor manufacturers. Furthermore, it has also already been taken up by major German auto makers to lubricate turbochargers.

**Ever higher temperatures and pressures in ever tighter installation spaces at the same time – how much further can we go?**

**KB:** This trend will continue. Our task in this is to enable our customers to follow this trend and to continue jointly driving developments with them. I am absolutely convinced that we will find the appropriate solutions for future requirements, too. **ivT**

*Peter Abbes is director of communications at ContiTech Fluid Technology*



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# Conception to delivery

THE ABILITY TO EFFORTLESSLY LEVERAGE A HUGE AMOUNT OF EXPERIENCE GAINED IN THE OFF-HIGHWAY SECTOR – TO HELP ‘GIVE BIRTH’ TO ELECTRIC BUSES AND MILITARY VEHICLES – IS THE MARK OF A TRUE ONE-STOP SHOP

Boasting strengths encompassing complete machine assembly, operator cabins, machining services and welded steel components, Fortaco manufactures in 10 business sites across Eastern Europe and Finland, providing its customers with industry best value. The company aims to be the most professional and reliable partner, with total commitment to safety, quality and operational excellence.

Its customers benefit from comprehensive project work for complete one-stop shop service solutions for steel fabrications, operator cabins and assembly. Fortaco's services offer tremendous benefits for the outsourcing of small and medium series, or by providing an external production satellite option. The cabin business, in particular, from simple overhead guards up to full plug-and-play cabins, is one of the key success factors.

Two recent success stories are noteworthy. One is the cooperation with the Finnish bus maker Linkker to manufacture a fully electrically driven city bus, based on Linkker's design and technology. The other is the BAE Systems all-terrain vehicle, Beowulf, presented at the Defence Exhibition in London, UK, last September. Both projects serve to demonstrate the company's enormous experience in cabin development and manufacturing, as well as assembly services.

For Linkker, the cooperation started with a joint workshop defining the project target, content and timeline. This was new ground for both parties, as Fortaco's experience was acquired in the off-highway market, though the principles in the planning of the manufacturing processes and tools, to identify and align suppliers, to define QHSE rules and prepare staffing models based on project progress and expected ramp-up, are common.

The cooperation included a full-scale content model for Fortaco, which was given full responsibility for sourcing, logistics management and ownership of material and assembly. The project was started in May



ABOVE: Side view of the new BAE BV510 Beowulf all-terrain vehicle

RIGHT: FEM analysis sketch of the front car of the BAE Beowulf

BELOW: Linkker electric city bus at a loading bay in Finland during the trial period

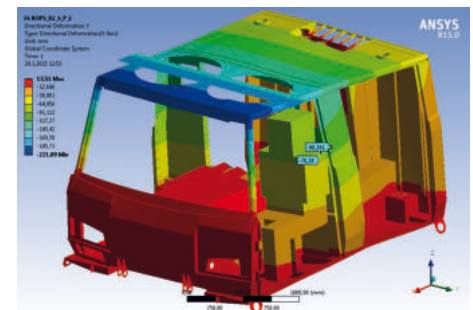
2015 and the first bus will be delivered in May 2016, marking a tremendous effort by both teams.

Kimmo Erkkilä, CEO of Linkker, described it in a nutshell: "With an electric bus we are building the solution of the future, so to bring our ideas into reality, we needed a manufacturing partner who redefines its field too. The broad spectrum of expertise at Fortaco brings new ideas, increased efficiency and quality into the process."

## Combined effort

The Beowulf project with BAE was a completely different task – but just as demanding. The design emerged by combining the ideas and requirements of BAE with the experience of Fortaco's CabTech team. The vehicle serves multiple purposes, so the design and interior, as well as the exterior concept, needed to consider not only military, but also civilian requirements.

The result was a 'poetry in motion' appearance of the new BAE BV510 Beowulf all-terrain vehicle. Intensive industrial design, 3D modeling, FEM analysis of the HVAC system and cabin frame strength, as well as the design of the electrics and CANbus control system for the full vehicle, were part of the project tasks that Fortaco provided as a service to BAE.



Building the first prototype of both the front and rear cabins was a challenge. With no room for delay, BAE provided certain parts of the vehicle to Fortaco's prototype workshop in its Kurikka, Finland, facility, while Fortaco had to line up its suppliers to be ready when needed. The result was rewarding – both teams presented a product to the market that is not only an eye-catching design reference, but also a technical highlight with unique features addressing the purpose for which it was designed.

Fortaco had once again proved to be a reliable partner, with the expertise to support its customers on the spot and with a total commitment to safety, quality and operational excellence. **IVT**

Jochen Adam-Mueller is VP Sales Central Europe & Business Unit Assembly within Fortaco Group and has over 15 years' experience in the off-highway market



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# Unbreakable?

## MEETING THE CHALLENGE OF DEVELOPING THE WORLD'S MOST ROBUST COMPACT JOYSTICK CALLED FOR GREAT STRIDES IN TERMS OF DESIGN, ELECTRONICS AND MATERIAL SPECIFICATION

▶ A diminutive joystick possesses the power to control the multimillion-dollar machines used by mining and demolition companies. So when a joystick failure occurs, no work can be achieved until it's replaced. But what if an unbreakable joystick could be incorporated – then operations would be safer, more efficient and provide increased profitability!

The Swedish company Caldaro, known for its high-quality OEM products, tackled this special challenge faced by mining and heavy equipment operations. The result was the C15, a joystick that can be used across the application spectrum, from the toughest working environments to exquisitely high-precision fine-tuned medical equipment.

Claudio Talamo, the company's managing director, initiated the challenge and had a few thoughts about how to construct this new joystick, according to Erik Kauppi, sales engineer at Caldaro. "We have been working together with two customers from heavy industry, with a focus on creating the world's most robust compact joystick," he says. "A crucial part of this new joystick is an axis manufactured as a single piece and with double-diameter dimensions. This makes it practically impossible to bend."



Under a stripped-down C15 you'll find the extremely strong shaft and electronics potted with a protective compound

Another important constituent is that the circuit board and electronics are potted in a protective compound after mounting under the base of the axis. This completely protects the circuit board, enabling it to become impervious to degradation and short circuits from threats such as salt mist, water, lubricants and virtually all chemicals.

The C15 joystick offers single, double or double-independent signals, with the double-independent variant meeting the most safety demands.

"As we developed the C15," Kauppi elaborates, "we thought of the many different kinds of electronic specifications we get and said: 'Let's create one electrical solution and solve them all!' So we did just that. It's even possible to replace older joysticks with the superior C15."

The third factor that makes the C15 a masterpiece of construction is the selection of materials. "Our ambition was to create the best joystick, bar none," he continues. "We ignored the cost of materials early on to enhance engineering creativity, and therefore incorporated only the very best materials available. Surprisingly it turned out that ultimate production costs are still lower than that of earlier joystick models. This is due to an interaction of our superior concept and materials with manufacturing excellence."

Caldaro uses a rubber mixture that endures the toughest conditions encountered in both mining and demolition. When underground, salts, minerals and water create mixtures that can be very dangerous for any machine. Above ground, sunlight brings UV light that dries and cracks many rubber compounds. A rubber blending that tolerates oil well is often sensitive to low temperatures and results in the rubber being too hard. With this in mind, the company therefore carefully incorporated planned testing, resulting in a rubber compound that tolerates all these challenges over widely ranging temperatures.

### Can anything break the C15?

All the work from development through production is done in Sweden. "We cooperate with people from heavy industries who know what it means to use a joystick," says Kauppi, "and combine their experience with handpicked experts from all over our nation."

Early test results are extremely impressive. The actual break point has been a very important part of



C15 joystick fitted with a compact and ergonomic multifunctional grip – one of many alternative grips

the development – if the C15 breaks, it must break in such a way that it is still functional enough to bring the machine to a safe state. "We call this safety feature 'graceful dead'," Kauppi concludes. "In all mechanical evaluated fail modes, we have repeatedly confirmed this graceful dead state, maintaining functionality well within the original specification. We have succeeded in this challenge and believe that we have now developed the most robust joystick in the world. We're proud to present the C15!" **ivT**

Åsa Stenström is a copywriter and marketing consultant with a special interest in the interaction between humans and technology



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# UNBREAKABLE

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# Linked in

## ERGONOMIC TRENDS AND GROWING OPERATOR HEALTH AWARENESS HAVE SPARKED THE OEM FOCUS ON FACELIFTING NOT ONLY THE SEAT BUT ALSO THE CONNECTION IT PROVIDES TO THE HUMAN-MACHINE INTERFACE

Major developments in HMI (human-machine interaction) components have resulted in a huge amount of available joystick handles, fingertip controls and silicone button sets. Cab interior designers can now optimize the human interface in all aspects regarding the controls – and seat manufacturers have also picked up on the modern trend for an increased focus on comfort, styling and setting features.

The magic link between an excellent seat and a futuristic high-tech arm pad is the Sittab Flex system. This family of armrest brackets is now widening its scope toward segments outside its traditional heavy-duty area. The system primarily includes the Armflex (horizontal) and Vertiflex (vertical design) arm types, both of which can be presented in a wide range of shapes and versions. According to the vehicle type and joystick size, its construction material can also be altered between aluminum or glass fiber.

As a result of its 25-year history of developing and producing armrests attached to the seat suspension to carry joystick controls, Sittab can today present a 'Lego box' of superb functionality. The modular concept provides the all-important and intelligent attachment between a comfort/lifecycle-optimized seat suspension and an efficiency-oriented/ergonomically shaped armrest. Building on cornerstones such as robustness, the possibility for infinite adjustment, and an attractive, modern design have ensured the Flex arm systems enjoy unbeatable popularity in machines where long operator hours are common.

By employing a design where the friction joints are supported by gas spring technology, Sittab has been able to generate not only superior functional capability but also a sophisticated feeling when using the product. Sensors to indicate driving position or entry position form part of an integrated design controlled by a double micro-switch system. Robustness is achieved by the use of cast steel components in combination with machined aluminum profiles. Armrest pad development is currently on a course toward wider designs to meet the increasing variations in operator size.

### Looking ahead

Future cab developments will in most cases be reliant on consideration of the global market and an operator group that displays very pronounced differences.



ABOVE: A Vertiflex armrest with K-pad and a TG joystick box provides a firm yet comfortable feeling in a machine operated under rough conditions

RIGHT: Armflex armrest with K-pad and Exicidor lever steering joystick box for greater comfort and increased efficiency



Accordingly, an additional design feature to the multiple settings is the ability of the Sittab Flex system to be adapted to a variety of seat types, which opens the possibility for an OEM to launch a machine with different seats for different markets, without having to redesign the control set.

The production method used for the Sittab Flex system is optimized to meet factory option program start-up requirements. Small initial volumes, produced with high attention to detail, have helped the product to practically reach levels of perfection in terms of quality. Cable routing on an adjustable flip-up armrest is traditionally a weak point, making it a major design

challenge. The Sittab Flex system employs a pre-determined routing of the control cable and is protected by ABS covers all the way back to the rear end of the pad of the armrest. Metal inserts are recommended and used in all new arm pad designs to secure a firm link to the joystick box arrangement. As an alternative to a single-unit control pad with integrated arm support, the Sittab Flex system can also take advantage of a double ball clamping system to attach the joystick box to the armrest pad. **ivT**

*Anders Claesson has been managing director at Sittab in Gustafs, Sweden, since 2006*



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# Pillar talk

## WHEN GETTING TO GRIPS WITH THE SMOOTH OPERATION OF OFF-HIGHWAY VEHICLES AND THEIR VAST RANGE OF ATTACHMENTS, SMART CONTROLS FOUNDED ON THREE PILLARS HAVE A MAJOR ROLE TO PLAY IN ENHANCING THE HANDS-ON EXPERIENCE

Thanks to the latest individualized platform-based controls, the challenging handling of excavators, graders, wheeled loaders and agricultural and municipal machinery is systematically simplified. Operators can therefore work more safely, rapidly and precisely with their machines.

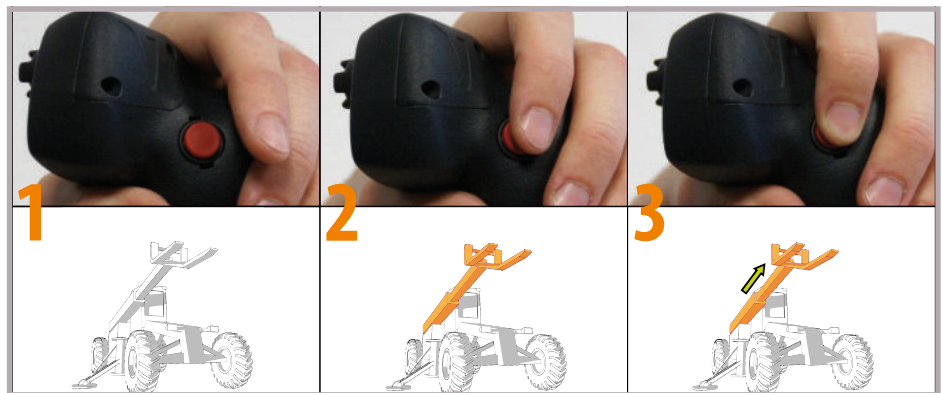
In association with its OEM customers, Vemcon develops and realizes simplified operating concepts based on a control system platform. The application process is optimized with respect to time and cost. The motivation is clear – operating companies expect their drivers to exploit the full potential of their mobile machines. Over the past few years, however, there has been a significant growth in machine complexity: industrial vehicles often carry several different types of attachments, with a range of buttons and control elements placed inside the cabin. And finally, in times of gamification, young drivers in particular request intuitive and ergonomic machine handling. To meet these market needs, Vemcon joystick solutions are therefore founded on three pillars.

### Taking control

The first pillar concerns smart controls inside the joystick that ‘train’ the operator. Discovering or allocating which operating elements control the corresponding movement can be a difficult task for the driver in a machine that provides a plethora of functions and carries different attachments. Buttons, for example, often drive totally different functions of the different attachments. Furthermore, a number of control patterns are used in many machines to control either undercarriage movements, tool movements or auxiliary functions. The function of a button is not clearly defined, although the driver has to go through a learning process – in some cases, several times a day if he changes between machines or attachments.

To learn, a human being has to make mistakes. The principle of trial and error is the only practical way to learn how to control a machine. The goal is therefore to make this learning process as safe and time-efficient as possible – making mistakes regarding machine control translates into faulty operations, and this can result in dangerous situations or expensive damage.

Smart control training of the driver is a simple and efficient way to solve this problem and save time and money for companies operating complex machines. If



ABOVE: 1) With the operator's finger not on the Smart Button, nothing happens; 2) With finger on the Smart Button, the display shows the resulting movement; 3) When the Smart Button is pushed, the tool moves



ABOVE: The Unigrip multi-axis joystick simplifies control of the notoriously difficult motorgrader

the driver wants to rotate a gripper, for example, he does not need to try all buttons before pushing the correct one: the Smart Button recognizes his finger on its surface and shows the resulting movement on the cabin display – without the button being pushed. If the operator places his finger on the wrong button, it is possible to test another one, have a quick look at the display and make sure that he now touches the correct one. Only then does he push the button and drive the function. Due to the combination of multiple senses of the driver, this has proven to be an efficient online training method. Moreover, it represents a reliable way to prevent faulty operations.

To achieve intuitive ergonomics, the second pillar relies on robust and precise mechanics to realize handles with up to 6DOF. As a result, every movement can be logically mapped to the joystick handle.

The third pillar is the standardized service to tailor joystick ergonomics to the specific needs of the machine and its specific working process. The system platform is individualized at crucial points to develop optimized operating concepts in a timely and cost-efficient manner. The most important steps in this process are:

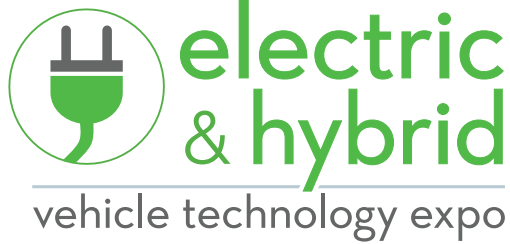
- Analyzing working process and operator's workflow;
- Analyzing machine dynamics;
- Establishing the requirements for every machine function;
- Developing the intuitive ergonomics of the operating concept and the smart controls training concept;
- Providing a functional sample to obtain the driver's feedback at an early stage; and
- Developing of serial parts and software.

This unique combination of driver assistance and intuitive ergonomics means considerable benefits for operating companies. Coupled with platform-based technology, its standardized customizing method makes Vemcon the perfect OEM partner to increase machine productivity through simplified handling. **ivT**

Jan Rotard, co-founder & CEO of Vemcon GmbH, has worked in the off-highway industry for over 10 years

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# Stroke of genius

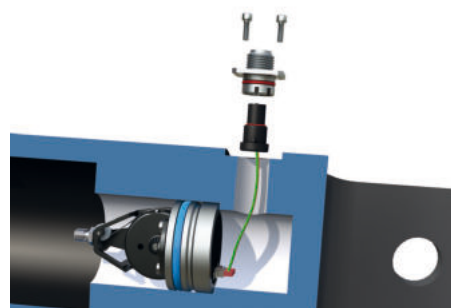
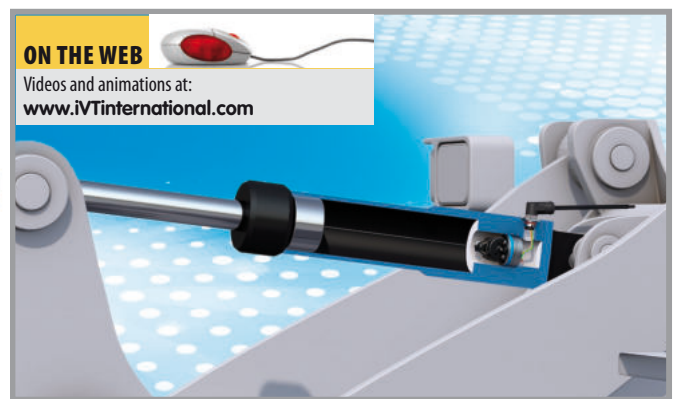
THIS CLEVER HYDRAULIC CYLINDER STROKE-MEASURING SYSTEM BOASTS SEVERAL INGENUOUS INNOVATIONS, ELIMINATING THE NEED TO DRILL PISTONS AND EVEN ALLOWING FOR USE IN TELESCOPIC CYLINDERS

Whether they're inside agricultural machinery, construction equipment or municipal vehicles, intelligent sensors have now become indispensable throughout the mobile machinery market. Accurately recording paths and angles is an integral component of intelligent operating concepts and functions. These functions improve not only the convenience, but also the safety of industrial vehicles. Using intelligent sensors also increases performance and efficiency, enabling repetitive work processes to be automated and therefore reducing the workload of machine operators at the same time.

## Stroke measurement in cylinders

Because most motion sequences for mobile machines rely on hydraulic cylinders, one of the most important measurement tasks for sensor technology is precisely determining the stroke of the cylinder to enable measurement and monitoring of the motions to be carried out. This is why both machine and sensor manufacturers are always looking for new innovations in stroke measurement for hydraulic cylinders. Germany-based Siko has therefore developed its new and innovative SGH10 measuring system for direct stroke measurement following close collaboration and dialog with its customers and using its many years of experience in the area of path measurement technology. The cylinder stroke is measured precisely utilizing wire-actuated sensor technology installed directly in the cylinder. The high-quality plug ensures the system fulfills protection class IP69K.

Technologically speaking, the innovative SGH10 cylinder stroke measuring system pursues an entirely different technological approach. In contrast to other common measuring systems on the market, a wire-actuated mechanism installed directly in the cylinder is used to measure the stroke. The wire is mounted in the piston head. If the cylinder is extended, the wire, which is wound up in a wire drum, is pulled out. The rotation of the wire drum that is thereby created is detected without contact by the sensor electronics and used to calculate the linear travel. This makes it possible to detect the position of the cylinder precisely and completely at all times. The magnets that are used to detect the rotation are scanned by the electronics through the pressure-resistant base plate of the SGH10. The electronics are fully encapsulated



Sensor integration made easy and cost effective with protection class IP69K

on the unpressurized side of the system. This means the entire measuring system is built into the cylinder and is optimally protected from external environmental conditions. This offers a clear advantage: in contrast to an externally mounted measuring system, the sensor system cannot be influenced or damaged by loose parts or by environmental influences.

## Revolutionary further

Another revolutionary aspect is the reduction of costs for integrating the system into the cylinder. This is because in previous measuring systems, the sensor rods had to be integrated into the piston over the entire measuring path; this often required long and highly precise bore holes in the piston. This is not only

expensive, but also weakens its structure. In the SGH10 stroke measuring system, just one small thread is needed in the piston to mount the cable. This enables the system to offer major potential cost savings, which affects production times and, ultimately, overall costs for hydraulic cylinders. The greater the stroke length, the greater the potential for monetary savings. Cylinder manufacturers, mechanical engineers and end-use customers benefit equally from this – a real win-win situation on all sides.


Another highlight is that, in contrast to the alternative measuring systems mentioned earlier, the SGH measuring technology can even be used in telescopic cylinders. It provides design engineers with entirely new options when developing forward-thinking assistance systems and supplemental functions in industrial vehicles.

At the SPS IPC Drives fair in November 2015, the company presented its wire-actuated encoder SGH10, a global Siko innovation. With its innovative technology and the new function, the encoder attracted a great deal of attention. And this wasn't all – it also received the i-NOVO Tech Award, presented by the DirectIndustry online industry portal at the fair. This is given for products that stand out due to their innovative applications, for example, the development of a new technology, or a technological innovation in the manufacturing process. **iVT**

*Mathias Roth is branch manager of mobile automation for Siko GmbH*

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# The mate tricks

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ABOVE: Precision ISO 11783-2 interconnect systems for CANbus architecture in agricultural machinery  
BELOW: Powell IBIC offers improved functionality, is field repairable and has more accessories than any other ISObus solution

▶ Powell Electronics has long played a leading role in providing many of the electronic and electromechanical components needed to create the agricultural industry's next-generation technology. As the demand for more advanced electronic systems and equipment increases, the company has been there, every step of the way, providing the high-performance solutions and support needed to build the systems that will give modern farming enterprises the biggest competitive advantage.

Powell provides components for ISO 11783-2 and SAE J1939 applications, including related products such as sensors, switches, connectors, circuit breakers, solenoids, lighting and value-added assemblies. Its ISObus products have become the new standard for connecting and transmitting power and signals between agricultural tractors and their implements.

The IBBC (ISO Bus Breakaway Connector) is an ISO 11783-2 standardized connector receptacle that incorporates integrated electronics along with its patented breakaway latching system. This breakaway system does not rely on bayonet pins but instead uses an engineered quick-release latching system that provides substantially improved latching, breakaway action and longevity. This system is fully intermateable

and interchangeable with the previous products on the market and has superseded those in the designs of most of the major tractor OEMs.

## IBIC – the game changer

Powell's IBIC (ISO Bus Implement Connector) is the perfect solution for connecting implements to the tractor in the ISO 11783-2 protocol for the electrical connection of agricultural vehicles. The Powell IBIC should be used for any application that requires both



power and CANbus communication. Made from the best quality non-corrosive materials, the IBIC's special design ensures its survival in the harshest environments. This best-in-class connector offers fast and easy assembly, and is field repairable.

The outstanding strain relief with integrated cable clamp means no more wear and tear on your hands from the screws and tabs that the old-style connectors use. When mated with the IBBC, it will survive many disconnects, but even with previous designs it will break away correctly. If there is any damage to the bayonet due to the old design, spares will be available. These rings are extremely easy to replace – a job that can even be done in the field by the tractor operator with basic tooling. It is also simple to populate the IBIC breakaway connector with standard crimp tooling, which saves labor time over the old design. This IP67-rated connector can be used in combination with a protective cap, will not deform when dropped, and also has an improved grip position marker.

The IBIC waterproof cap is specifically designed to be used with the Powell IBIC. It shows a clear mating location, has a firm grip diameter and a lanyard to attach to the back end of the connector. The IBIC adapter and conduit provide a quick push-in connection for corrugated conduits and allow for an IP67 rating if discreet wires are used for the CAN in place of jacketed cable, available in conduit size NW17 and NW23.

## Solution TBC

Powell's Terminating Bias Circuit (TBC) is a cost-effective solution for providing active termination for CANbus vehicle networks. The TBC Terminator is compatible with ISO 11783-2 as well as SAE J1939 specifications, and is an inexpensive alternative that provides the correct electrical bias and termination at each end of a CANbus segment and suppresses reflections on the CANbus system. The device's rugged design protects the PCB with an over-mold of tough polypropylene that ensures continuous operation in rough conditions. The Powell TBC plugs directly into the harness on the vehicle so no other enclosure or hardware is required. **ivt**

Ryan Milligan is business development manager at Powell Electronics in New Jersey, USA

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# BULLETIN BOARD



## Close call

With cabs becoming increasingly watertight, it's becoming difficult – sometimes impossible – to fully close the door of many new vehicles. This is due to over-pressurization created by the sudden, often violent, closure of the door. This pressure must be drained through a valve, which has been developed by Kalori's R&D department.

This valve opens when the door is being closed in order to let the inconvenient pressure escape, but closes instantly to keep the outside air and dust from entering.

A differential valve also exists, developed for pressurized cabins. This allows a correct closure of the door, but also resists an inner pressure up to 100Pa, which allows for cabin pressurization without creating a leak.

The frame of these two valves is fitted with a seal that facilitates a high-quality application in the cabin bulkhead.

An ingenious leak generator complements the equipment. This enables a sufficient leakage rate when the cab is too tight to have 30m<sup>3</sup>/h, as the regulatory standard EN15695 calls for.

With Kalori's pressurization system, Kprotec soft, it is very easy to set the cab to 22Pa pressurization and the 30m<sup>3</sup>/h outdoor air supply, or any other values the OEM requires. This setting, executed at the end of manufacturing, ensures excellent production quality.

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## Under control

Custom solenoids for off-highway applications are vital when it comes to meeting system demands for better performance, safety, lower emissions and greater fuel efficiency. TLX Technologies' fluid control valve is an example of a custom valve that has been designed to provide exceptional durability and repeatability for the challenging demands of off-highway system applications.

Rugged construction, low-to-high temperature tolerance and fast response ensure consistent performance over the valve's entire lifespan. Designed for operating in ambient temperatures ranging from -40° to 125°C, this field-proven control valve can be used for a variety of mediums including coolant, water and chemicals.

Available in both a submersible or non-submersible version, the valve is



easily configurable to a customer's application requirements.

Designed to offer precise fluid control in on- and off-highway vehicles with typical applications that include coolant control, water shut-off, fill and drain requirements, the valve can handle flow rates up to 0.5 l/sec and a maximum fluid pressure of 500kPa. TLX partners with OEMs and Tier 1

system suppliers to meet the challenge of developing technologies for current and emerging vehicle architectures by delivering efficient, cost-effective solenoid and solenoid valve solutions.

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## And the rest

Product development tailored exactly to the user's needs is the key to HMI design – and therefore to successful products. With the presentation of a fingertip-controlled armrest for Mitsubishi's forklift trucks, Frei has again proved its advanced knowledge in the design and manufacture of bespoke HMIs.

At CeMAT 2016, the company will present a new generation of multifunctional armrest based on an innovative modular design. This armrest takes all ergonomic aspects into consideration to overcome any physical fatigue of the truck driver. The armrest functions are designed for harsh ambient conditions using non-contacting Hall-effect sensors.

Frei's multifunctional armrest will be available in several different configurations, allowing it to be used in forklift trucks, construction machinery and agricultural machinery.

The concept consists of a control pad with fingertip or dual joystick control, optional arm support, as well as an optional height adjustment unit. Hence, the multifunctional armrest offers great flexibility for a huge variety of applications.

"Frei carries out the engineering tasks such as mechanical design, electronic hardware and software development in-house. We are convinced that this is the only way to develop an optimum product and to provide support during its entire product cycle," states Jürgen Schwarz, head of the Control Systems division at Frei.



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Hall 026, booth G31

## Cost-effective pedal boosts ergonomics

 Curtiss-Wright's Industrial division has announced the launch of the WM-554, a lightweight, compact and cost-effective electronic suspended pedal from the corporation's brand family of Williams Controls.

Featuring a non-contact, Hall-effect sensor that can be factory-programmed for dual analog output (APS), the WM-554 suspended pedal provides smooth driver operation and is available with a standard pedal travel of 19°. The WM-554's lever arm and mounting bracket can be customized to assist installation and optimize driver ergonomics in the vehicle cab environment.

Key features of the WM-554 include:

- A product life of 3 million travel cycles;
- Operating force between 17N (idle) and 35N (full travel);
- Robust, durable design enables high static load capability and environmental protection to IP67 – suitable for exposed operator cabs;
- Lever arm and bracket can be customized to suit specific vehicle designs.

The WM-554 is being launched with a 5V DC supply voltage, including electronics that are fully compliant with industry-standard electromagnetic emission regulations (SAE J1113).

The new pedal assembly employs a corrosion-resistant, coated steel mounting bracket and high-strength composite plastics for the body and pedal arm. This makes possible a highly ruggedized and lightweight construction, making the WM-554 ideal for industrial and commercial on- and off-highway applications, including medium-duty trucks and vans, buses, recreational ATVs, military and construction vehicles.

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## Empire of the (mission-critical) sensors

 Sensata Technologies is a global leader and early innovator of mission-critical sensors for engines, chassis, transmission and hydraulic circuits, as well as operator controls such as joysticks, multifunction grips, and armrest control assemblies.

These products are customized for those equipment manufacturers active in industrial vehicle markets such as agriculture, construction and material handling.

Sensata Technologies designs and develops solutions that not only improve the productivity and reliability of many off-road vehicles, but simultaneously make them easier to operate, even under functional safety conditions.

The company also supports OEM customers with an industrial design capability that aims to achieve a distinctive look and appearance of the cabin interior while maximizing the human-machine interface.

Its product portfolio is complemented with complete

armrest solutions, representing total cost reductions due to less internal complexity related to the purchase, assembly and testing of cabin interior modules for OEMs.

Sensata also supports machine development teams covering critical aspects such as co-development of the detailed application specification,


the specification of the functional requirements of the machine controllers, hardware and software development, integration, and functional and compliance testing of the provided solution.

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## Time for HVT

 Dana Rexroth Transmission Systems has completed final validation testing of the fuel-efficient R3 hydromechanical variable transmission (HVT), with the start of production expected in Q3 of this year.

In addition, the HVT R2 platform has now entered production.

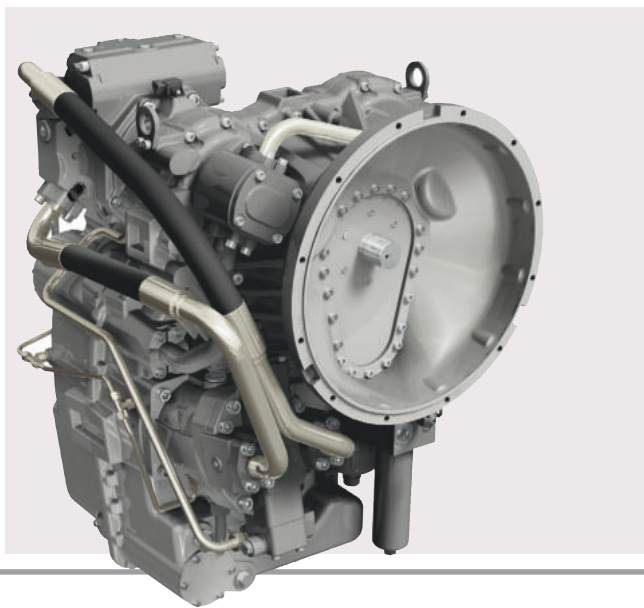
Both versions feature a modular design that can be adapted for a variety of applications, including wheeled loaders, motor graders, lift-trucks, reach stackers and forestry skidders. The HVT R3 has been designed for applications with net input power from 200-270kW (268-362hp).

In production since late 2015, the HVT R2 supports power outputs from 135-195kW (180-260hp), and it is now featured on Kalmar's new Gloria generation of reach stackers as part of the highly efficient Kalmar K-Motion drivetrain. Developed in association with Volvo Penta, the solution for 45-ton Gloria reach stackers has been shown to reduce fuel consumption by up to 40%.

A product of the joint venture between Dana Holding Corporation and Bosch Rexroth, HVTs from Dana Rexroth reduce fuel consumption considerably by decreasing engine speeds throughout the duty cycle and at idle, where speeds can be dropped to as low as 650rpm. Application analysis demonstrates the possibility of further savings without compromising performance through engine downsizing.

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## IT MAY HAVE BEEN INVOLVED IN SOME SURPRISING BEHAVIOR OF LATE, BUT DOES VOLKSWAGEN REALLY DESERVE TO BE TREATED AS THOUGH IT'S THE WORLD'S WORST ENVIRONMENTAL CRIMINAL?

▷ The recent Volkswagen diesel debacle must leave many of us with a feeling of remorse in that a company that has done so much to champion the adoption of highly developed diesel engines can be publicly pilloried by the world's leading governments, even though the basic principles of progress are still being upheld.

The predictable knee-jerk media reaction in the UK was that diesel engines are now the spawn of the devil – and presumably prompted by media pressure, some well-intentioned, if somewhat short-sighted and ill-informed 'world experts' stated that the anomaly that led to VW's misrepresentation is costing lives.

Most people who have been involved with the manufacture of engines will appreciate how difficult it is to ensure conformity to emissions legislation 'as laid down' and the fact that we remove cooling fans, optimize the air and fuel temperature, pre-run, break in, and verify engine performance before the prepared engine even gets a sniff of the test cell, attests to the idea that conformity exists as a principle rather than a fact.

Once the design is homologated, engineering and production tolerances dictate that – even in this age of Six Sigma manufacturing – the reality is that no two engines will perform in exactly the same way and produce exactly the same emissions, while the performance of those lying in the proverbial three in 1,000 could be way off base.

Does this cost people's lives? I suppose you could construct a convoluted argument to draw a projection between a world without any pollutants versus the world in which we live, but is that in any way realistic? What is clear is that emissions of engines manufactured under the auspices of western companies have been systematically reducing since the end of the 1960s, which is generally a good thing as, at least for the foreseeable future, our business will be reliant on the diesel for motive power.



Illustration: Julie Welby

Now, I am not saying in any way that our manufacturers should be falsifying results, but let's get things into perspective. The issue that VW is fighting over is the emission of microscopic amounts of a gas that only exists within the products of combustion because we have almost eliminated what would otherwise be substantial quantities of other, more damaging, gases. So, it isn't that the engines are not clean; it is just that they are not as clean as we are saying they should be.

Should we be concerned? Well, in principle I think so – clearly we have an obligation to build engines that conform, and if they don't conform we should be clear about it. The problem is that, as far as the customer is concerned, emissions regs have little impact in the western world and virtually none in the developing countries where the supposedly new world markets exist.

So again I ask, have we got this right? Should a European company have to shoulder the burden of development of these types of engines when eastern counterparts are seemingly exempt? Should there be a more realistic level of emission established in consideration of mass production shortcomings? And, ultimately, does it actually matter a damn when most of the world simply ignores the targets anyway?

We have to accept that the IC engine will continue to play a major

role in our lives for the foreseeable future. Certainly in our sector it will remain pivotal – there is currently no viable technology to replace it in off-highway applications. Until somebody realizes that the electricity used in a hybrid is generated by an engine and starts working on viable and inexhaustible sources of electricity, this sector will not be able to put into serious use any of those developments that are being trumpeted in the automotive sector. Are we convinced, for instance, that the reciprocating engine is the ultimate configuration, or has the rotary engine concept such as the Doyle or Wankel configuration still got something to contribute?

Whatever we think on this matter, one thing is very clear: this is going to cost VW a great deal of money. Tragically, there will be endless reworks of perfectly viable engines, seminars to examine the future viability of diesels as a prime mover, a handful of world summits, and the inevitable parasitic loss (and I use that word selectively) that will be awarded in compensation and legal costs. And at the end of that, the world will keep on turning, farmers and constructors will continue to use their equipment, everyone will get on with their lives, and VW will be short of a few billion dollars.

Call me old fashioned if you will, but wouldn't you rather see that money put into development? **iVT**  
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