

# iVT

INTERNATIONAL  
INDUSTRIAL VEHICLE TECHNOLOGY

Case studies  
**Albach Diamant 2000**  
self-propelled woodchipper  
**Hidromek HMK Vision Compactor**

OEM Interviews  
Putzmeister Underground & Corinsa

**PLUS**  
Latest advances in heavy-duty  
on-highway truck transmissions  
Mobile hydraulics  
Condition monitoring



# Reinventing the wheel -ed excavator

JCB turns rubber duck design on  
its head with the Hydradig

**iVT electric & hybrid**  
industrial vehicle technology  
SYMPOSIUM 2016  
The path to increased electrification and  
hybridization of industrial vehicles  
**DETAILS INSIDE!**

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Construction sites ain't what they used to be – in fact they have prompted the most radical rethink in wheeled excavator design in history



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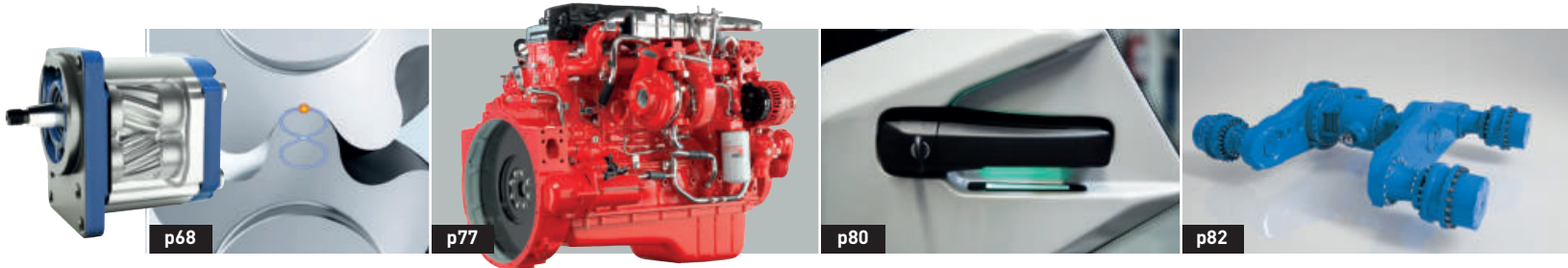
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## FOREWORD

△ Last month's news that the long-running Terex/Konecranes/Zoomlion love triangle has finally come to an end (well, more or less) is almost as surprising as some of the dramatic twists and turns that this on/off saga has contained. For those who've managed to miss the story so far, it all began in August last year, when the two western players began a courtship with a view to a financially advantageous marriage of convenience, potentially making them a US\$10bn force in lifting and materials handling, not to mention various construction sectors.

But then, this January, a glamorous Chinese temptress (oh, I've been there – tell me about it...) came along and understandably turned Terex's head with an initial offer of US\$30 per share that it couldn't (but ultimately did) refuse. Poor old Konecranes was left on the shelf, feeling unloved and taken for granted, while Terex lapped up the attention of this exotic rival for its affections. By late April, Konecranes still forlornly hoped for a reconciliation, but then, just like in all the most clichéd soap operas, the spurned lover decided to seize life by the throat, embrace its independence and head out on its own three weeks later – taking one of Terex's most prized possessions with it. (Although, of course, it *will* be paying US\$1.3bn for the privilege of acquiring the Terex Material Handling and Port Solutions business.)

Not that Terex had too long to get attached to Port Solutions (TPS) – its integration of the previous Gottwald, Noell and Fantuzzi acquisitions was only formalized in 2012. In fact, the ink is barely dry on April's agreement with ManiTex to transfer the intellectual property and manufacturing rights of its CVS Ferrari

operation's terminal tractor and RoRo tractor product lines to the TPS portfolio – who will receive custody of those now, I wonder?

All this notwithstanding, Terex seemingly came to its senses and ended its dalliance with its Asian suitor just two weeks after the Konecranes offer. As far as we're aware, it has made no trip to the all-night garage looking for a box of chocs and some flowers in a doomed attempt to woo back its former Finnish fling...

However, this all reinforces a conclusion I formed a couple of years ago, before cowardly backing out of cornering the then-Terex chairman and CEO on the subject at a press conference. My question would have gone along the lines of, "Ron, given that you keep selling off all your most interesting lines to other OEMs, I'm concerned that by the time Bauma 2019 rolls around, all you'll have left is a handful of crushers, scissor lifts and woodchippers. Will there be any point in the editor of a magazine only concerned with vehicles attending your conferences in the future?"

Well, come to think of it (he said, in a tenuous attempt to link this story to the contents of this issue), if Terex gets back into the habit of making vehicle acquisitions again, it could do worse than take a look at Albach. The chippers it produces are indeed of great interest to such an editor (hence why there's a major feature on its Diamant 2000 on page 44). Said to be the world's first self-propelled chipper and capable of 70km/h on-road speeds, this huge beast certainly attracted my attention on the Ropa stand at Agritechnica. Oh yes, and the Hidromek HMK Vision Compactor (p34) and JCB HydraDig (p38) are pretty cool too!

*Richard Carr, editor, iVT International*

Coming up in the September issue of iVT

• EIMA Preview • OEM interview • Ergonomics: the user experience/designing for an aging operator population • Weycor wheeled loaders • Look out for the Lift-truck Annual in August!

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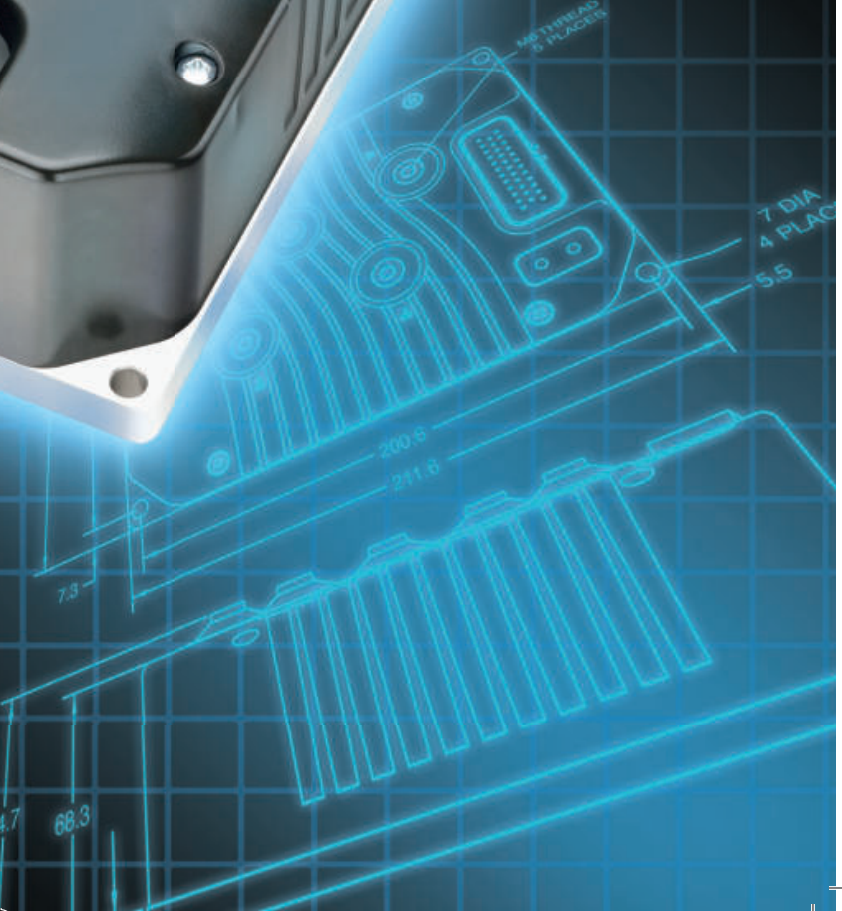
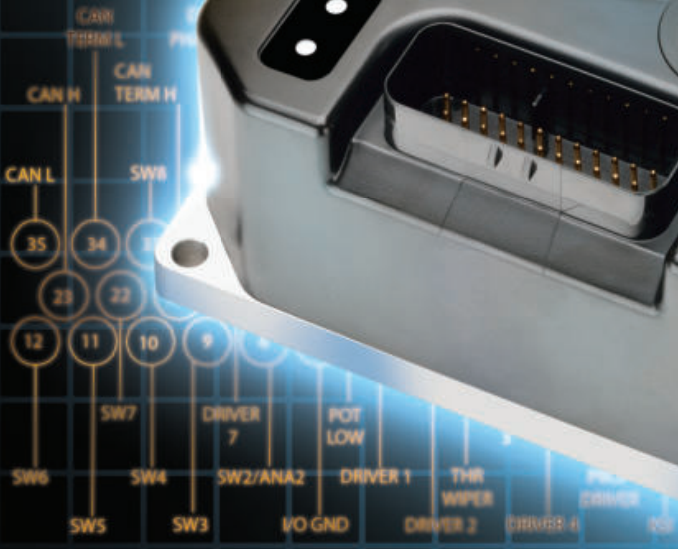


**CURTIS**

# WIRING 1234 SE Induction Motor



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# From 0-60 in 50 years



JUST OVER HALF A CENTURY AGO THERE WAS NO SUCH THING AS AN ARTICULATED HAULER. NOW THEY CAN MOVE LOADS OF 60 TONS

**BRAÅS, SWEDEN** Offering 40% greater productivity than Volvo's previous largest articulated hauler, its 60-ton (55 metric ton) A60H really shows its mettle when performing heavy hauling in severe off-road operations. Featuring the latest Volvo drivetrain innovations, its higher hauling speeds combine with optimized stability and operator comfort to enable more material to be moved in less time.

In a combination exclusive to the A60H, the active hydraulic front suspension system used on Volvo's full suspension (FS) haulers is matched with the proven, maintenance-free, rear bogie concept of the A40G. As well as 100% diff locks and hydromechanical steering, it features Hill Assist as standard, providing more control over the machine on steep gradients.

So given the concerns over stability that prevented any OEM from offering even a 50-ton ADT for years, how has Volvo managed to hit 60? "We invented

the articulated hauler concept," Mats Karlsson, global director of Volvo CE's hauler platform told *iVT*. "Over the last 50 years, we've built up a vast amount of knowledge and experience connected to this product and we've created the ideal configurations and specifications relating to machine proportions, weight and load distribution, and the ideal balance between beneficial features and machine stability.

"This knowledge was used to develop the new 60-ton class A60H. Focusing on full suspension, on the active leveling system the leveling sensors monitor the axle's position and the full suspension system adjusts the hydraulic cylinders to keep the machine level."

Powered by a 16.1-liter Volvo D16J engine delivering 495kW maximum power and 3,200Nm of torque, fuel efficiency has been improved while capacity increases, resulting in a reduced cost per ton ratio. Matched with a fully automatic

Allison planetary transmission with six forward and two reverse gears, it enables a top speed of 54.9km/h.

With an unladen weight of 43,750kg, it can be filled in just four passes by Volvo's L350G wheeled loader, or approximately six from its new 90 metric ton excavator. A dump support system, which tracks lateral inclination to help prevent unsafe tipping, comes as standard and the load and dump brake ensures the operator stays in control at all times.

One key benefit of the as-standard onboard weighing system, combining load cells mounted in the bogie with the active front suspension to measure the payload, is that it enables on-the-go changes to be made to the gearshifting strategy, according to how much payload the machine is carrying.

Engineered to increase uptime with its heavy-duty front and rear frames, hitch and wet disc brakes, it also offers superb



The A60H features an exclusive electrically controlled hydraulic belly plate to simplify service access to the engine

servicing access. The front grille swings down, acting as a service platform with its anti-slip steps, while the electrically controlled hood opens hydraulically to 90°. When combined with the belly plate that operates using the same system (standard and unique to the A60H), this provides full and safe access to the engine compartment, removing the need for manual operation.



Another of Volvo's Bauma 2016 highlights, the 90t EC950E is a vital counterpart to the A60H, being able to provide maximum payload in approximately six passes







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## CONSTRUCTION FOCUS



JIM MANFREDI, MACHINERY OUTLOOK

## CRANES ON HOLD

**Manitowoc** has suspended operations at its Brazilian facility, which opened in March 2012 to assemble Grove, telescopic and RT cranes. In January, suppliers received a letter from operations director Pedro Oliveira: "Today, Manitowoc Cranes announced its intentions to suspend production operations at Passo Fundo plant with immediate effect ... our partnership with you ... also needs to be suspended temporarily as a result..."

Oliveira said this was due to "depressing market conditions in our region as well as political, social and economical issues ... these operational changes compensate the decline in the demand of our products and help us to measure correctly our business and put us in a better position to compete in the global cranes market".

Production will be suspended for an undetermined period of time, but the company intends to re-establish operations when conditions allow.

## WHERE ARE THEY NOW?

Ron DeFeo, chairman and CEO of Terex Corporation until his retirement from the company at the end of 2015, has been appointed president and CEO of **Kennametal**. He has been a board member there since 2001.

Barry L Pennypacker has been appointed president and CEO of **Manitowoc Cranes**. Larry J Weyers, the previous president of Manitowoc Cranes, will continue as EVP of the Cranes group.

**Caterpillar Inc** made the following officer changes effective March 1, 2016: Doug Hoerr, vice president of the Wear, Components & Aftermarket division, became VP of the Material Handling & Underground division, replacing Denise Johnson who was recently named group

president with responsibility for Resource Industries. Greg Folley, VP with responsibility for the Sustainable Solutions division, will also assume responsibility for Hoerr's previous division. The reman business will transfer to Tana Utley, VP of the Large Power Systems division.

## ONLY IN AMERICA

**Atlas Copco** is breaking ground on a new 180,000ft<sup>2</sup> facility in Rock Hill, South Carolina. The US\$20m project will serve as the production and assembly facility for its North American Construction Technique division. Once completed, the facility will produce portable generators and compressors as well as other construction equipment. It is expected to open in April 2017.

Construction of the future home of **Hydrema US** has begun on a 1.6ha parcel of land in Cumming, Georgia, USA. This first structure will be a 1,207m<sup>2</sup> facility, which will be phase one of a planned two-structure 'campus'. About 929m<sup>2</sup> is to be designated as shop and warehouse space, with the remainder being a two-story office space area with mezzanine.

**Caterpillar** is to close five plants and trim about 670 jobs in the latest phase of a larger cost-cutting campaign that was announced last year. The company will cut about 230 jobs for office and production workers at a major manufacturing campus in East Peoria, Illinois, where the OEM is consolidating some manufacturing and transferring some work to outside contractors.

Other consolidation efforts will add some jobs in Pontiac, Illinois, while cutting positions in Thomasville, Georgia; Santa Fe, New Mexico; Prentice, Wisconsin; and other sites.

**Caterpillar is to close five plants and trim about 670 jobs**



## CONCRETE EVIDENCE

**NOVENTA DI PIAVE, ITALY** One of the hidden gems to be launched at Bauma was the Carmix 3.500 TC mobile batching plant. "This will change the minds of contractors who think the quality of [mobile] concrete isn't as good as that from a batching plant," said company president Rino Liborio Galante, speaking at a small gathering to celebrate 40 years of manufacturing.

The 3.500 TC therefore features world-class components, with a choice of rear-mounted water-cooled engines according to geographic use: a six-cylinder, 117kW Perkins 1106D E66TA turbo diesel for the EU and USA; or a 112kW Cummins B5.9 TAA turbo-diesel for elsewhere. These drive a 4WD/4WS Bosch Rexroth hydrostatic transmission, with the pump and motor connected to the differentials through a two-speed reducer. Dana Spicer axles with oil-immersed disc brakes and planetary reducers contribute to working speeds of 0-10km/h, and 0-30km/h roading speeds. Even with a fully loaded drum (maximum capacity is 7,600 liters for a 3.5m<sup>3</sup> yield) – the machine can tackle slopes up to 30%.

It also features a double mixing blade, mixing and jet speeds independent of engine RPM, and a joystick-controlled 600-liter loading bucket with hydraulic-commanded opening to load sand and gravel directly into the drum.

Electronics play a key role in achieving the mixing performance that will tempt contractors. The new Concrete-Mate feature enables the mix to be weighed directly inside the drum, rather than hydraulically on the shovel, to ensure highly reliable data on concrete quality control. In addition, removing the need to use an Abrams Cone to measure slump, the Promix digital stainless-steel probe provides details of temperature, moisture and rotational speed of the mix, and is powered by a real innovation – a drum-mounted small solar panel. This hasn't been fitted for ecological reasons, though – it's the only way the sensor can have a power supply due to the complexities of attaching external cabling to a rotating drum. Although jobsite conditions will mean that the panel rarely stays clean, once the battery pack is fully charged, it can keep the sensor fully operational for several days (or nights).

This constantly uploads real-time data every 10 seconds to an easy-to-read display in the cab, ensuring the operator is always aware of the parameters of the concrete being prepared. The data can be stored in an external computer or sent to other mobile devices via wireless networks.



**iVT's favorite innovation at Bauma – a solar panel provides power to an otherwise inaccessible place**

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## WHAT'S NEW

# AGRICULTURAL FOCUS



**JIM MANFREDI, MACHINERY OUTLOOK**

### DOWNER ON THE FARM

Commodity prices are hitting farmers in the USA and India hard, according to reports.

US net cash farm income (NCFI) is expected to have dropped by US\$35.6bn (28%) to US\$93bn in 2015 – the second consecutive year of decline. This would be the lowest since 2009, and US\$14.7bn (in real terms) below the previous 10-year average. Crop receipts are expected to decrease by US\$18.2bn, led by projected declines in corn (US\$8.6bn), while livestock receipts are expected to decline by US\$25.4bn (dairy by US\$13.9bn, hogs by US\$6.6bn and broilers by US\$4.4bn).

A report from **NITI Aayog**, the government of India policy think-tank, has warned that the Indian farm sector crisis is expected to deepen further if the trend of falling global commodities prices is not reversed. It recommended more private sector involvement, reforms in land lease policies and easy market access, while emphasizing the need to train farmers in non-farming skills to tide them over the agricultural crisis.

### SALES SLUMP AT BÜHLER

**Bühler Industries'** figures took a hit for the year ending Sept 30, 2015, with revenues down by US\$79.8m (from US\$325.5m in 2014) contributing to a net loss of US\$5.3m (2014 saw profit of US\$12.5m). Weak commodity prices and the unstable political environment in Eastern Europe continued to have an affect: sales in Canada were flat over 2014, while sales to the USA and Eastern Europe declined. The decrease in margin was a key driver, along with lower gains in foreign exchange and higher selling and admin costs.

Weaker demand as a result of lower commodity prices are set to have an unfavorable impact on Bühler sales and profitability in 2016.

### COMBINED GROWTH

US retail sales of self-propelled combines jumped in January, showing a YoY increase of 21.4%, according to **AEM**. In addition, sales of sub-40hp tractors showed positive growth with 5,354 units sold in January, an increase of 13% YoY. Conversely, sales of 40-100hp tractors decreased for the third consecutive month, and sales of +100hp 2WD tractors and 4WD tractors also decreased.

### GOING FOR GAS

By 2025, according to Texas A&M University projections, 40% of the US population will be driving vehicles powered by CNG. It says the first spike will come from local delivery truck fleets, taxis and municipal government vehicles because there will only need to be one refueling site rather than roadside infrastructure.

### CHALLENGE REJECTED

New Hampshire's Supreme Court rejected most challenges to the state's Auto Dealers Bill of Rights law, which was expanded to include OEMs of tractors and yard and garden equipment. **John Deere** said that being looped into protections designed for car and truck dealers interfered unconstitutionally with their contracts. The state argued the law is a merger of regulations dealing separately with auto OEMs and ag OEMs. It bars them from terminating contracts with dealers without just cause, limits mandatory upgrades to facilities, and requires proper reimbursement for dealers' warranty work.

US retail sales of combines up **21.4%** in January

**40%** of US population will drive CNG vehicles by 2025

# GET A LOAD OF THESE

**AHOGHILL, UK** Two new concepts for the wheeled and telescopic loader market have been unveiled by Northern Irish OEM Blaney Motor Company. Part of the Blaney Group, which has focused primarily on manufacturing attachments for UTV/ATV vehicles, the company is making its first official foray into self-propelled machinery and plans a full range of these loaders for use in the agricultural and construction industries ahead of a full product launch later this year.

"We have identified a number of requirements from operators centering around a range of smaller wheeled loaders that are compact yet powerful, efficient and reliable," said Alison Duncan, dealer development manager. "The machines we wish to develop will have specific focus on the under 2 metric ton lift capacity."

The key theme is therefore compact design, with weight of under 3.5t and featuring compact dimensions that enable them to be transported between sites on a small trailer. This makes them ideal for many applications, including amenities, equestrian, landscaping, self-build and road works.

While specifications are subject to change as the designs are fine-tuned in the coming months in response to feedback and field trials, a choice of engines is likely to be offered. The TH1 15-48 telehandler is currently powered by a 50hp engine that provides a lifting capacity of 1.5t and a reach of 4.8m. It will have a hydrostatic transmission with a four-wheel-drive lockable differential if required. The L1 10-27 is a compact wheeled loader with 1t of lifting capacity and a reach of 2.7m. It will also feature a hydrostatic transmission with a four-wheel-drive limited-slip differential, although it will be powered by a 40hp engine. Extra versatility will be provided as a result of Blaney's attachment expertise, with a focus on more niche attachments – such as mowers and side-discharge cement mixers – ensuring suitability for a wide range of applications.

### On the web

More info, images and videos online at: [www.iviinternational.com](http://www.iviinternational.com)

Final specifications have not yet been decided for the new compact loaders from Blaney Motor



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## WHAT'S NEW

# HANDLING FOCUS



MICHAEL LEU, FORKLIFTACTION.COM

### XIEXIE, BUT NO XIEXIE

Ending months of speculation, **Terex** has rejected a takeover bid from Zoomlion. Terex Cranes president Ken Lousberg confirmed that "discussions with Zoomlion regarding the potential purchase of Terex Corporation have been terminated."

He also confirmed that the recently announced sale of Terex's Material Handling and Port Solutions business segment to Konecranes is proceeding as planned, subject to regulatory and Konecranes shareholder approval.

"We are pleased that this announcement brings several months of uncertainty to an end for our customers, our team members and our shareholders," he continued.

According to the statement, "The favorable impact of the MHPS sale will enhance our financial position, enabling us to invest in new products and services to serve [customers] even better in the future."

### KEEP ON KEEPIN' ON

On the back of a successful 2015, **Jungheinrich** is off to a strong start in 2016, with incoming orders up 12.2% on the same time last year to reach 27,500 units. In Q1 2016, the value of incoming orders amounted to €755m, up 13.4% year on year. All business fields contributed to its net sales growth, with sales in the new truck business including €72m from the Logistics Systems division (up from €67m last year) and €16m from the Mail Order division.

Jungheinrich notes that the global materials handling equipment market expanded by 3.7% on Q1 2015. The driving force was the European market, which posted a gain of 12%. Russia showed clear signs of stabilizing (-1.5%), after having slumped in 2015 (-39.4%).

The warehousing equipment product segment posted the strongest rise, expanding by 10.2%, boosted mostly by Europe (up 15.2%) and Asia (up 10.0%). The battery-powered CB truck market gained 7.3% in volume globally and 10.6% in Europe. Worldwide demand for IC trucks declined by 4.3% – primarily due to the contraction

of the markets in North America and Asia, although there was positive development in demand in China, (climbing by 7%).

Demand in this product segment in China had decreased by 17.9% over the course of 2015. In Europe, Q1 sales in this segment rose 1.9%.

### TERMINAL VELOCITY

**Kalmar** has broken ground on an expansion project for the Kalmar Ottawa terminal tractor manufacturing plant in Kansas, Missouri. Key improvements will include the refurbishment and expansion of the facilities to improve employee safety, security, efficiency and well-being. Additionally, Kalmar will construct a test track for testing and on-site customer events.

### MAGNUM OPUS

Construction has begun on an 11,000m<sup>2</sup> **Sellick** facility in Harrow, Ontario, Canada. "In order to compete on a global scale, we needed to expand and build a state-of-the-art plant," said company president Howard Sellick.

Sellick Equipment has manufactured RT and truck-mounted forklifts since 1969, when the Sellicks converted a Ford 4500 tractor into a forklift for outdoor use.

Sellick Equipment escalated with the development of the integral one-piece frame. The design could accommodate various industrial powertrains, and led to brand manufacturing for OEMs such as John Deere and International Harvester.

European market up 12% in Q1 2016

# RIISING TO THE CHALLENGE



**CRAIGAVON, UK** Hyster has celebrated 35 years of manufacturing in Northern Ireland with the launch of the XT series of 2.0-3.0 metric ton four-wheeled forklifts designed to offer long and reliable performance. "We have to face new challenges, such as Japanese OEMs manufacturing in China," said product launch manager David Rowell, "so to make money in the middle sector of the market we have to be competitive, sourcing products worldwide. But there is a synergy building these with the [high-spec] FT models in Craigavon – there's approximately 50% parts commonality."

The Premium mast design, for instance, is taken from the FT and offers higher residual capacity for greater storage capability. With high rigidity and low settling times at elevation, faster lift-speeds than targeted competitors are being claimed. However, unlike the FT models, mechanical levers are in use, making the series ideal for rental and, ultimately, the second-hand market.

Engine options are also similar, covering diesel, LPG and dual-fuel, from 36kW and 45kW Yanmar and 46kW PSI models. The claimed diesel consumption of 3.1 l/hr is better than that of the FT series from just three years ago. Working on the basis that a vertical exhaust makes no sense as contaminants are heavier than air, exhaust gas is routed through the counterweight for maximum dispersal efficiency, achieving a 10:1 dilution just 2m behind the truck. An optional LPG presence system provides a 15-minute warning when the cylinder is at risk of becoming empty.

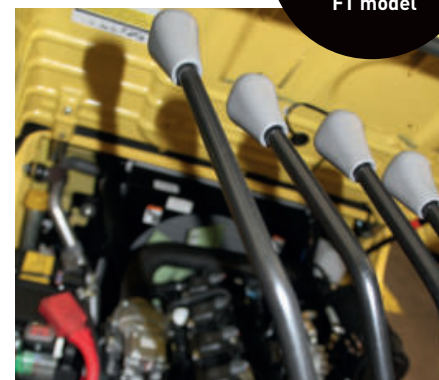
With an 86° steering angle provided by the rear axle, the new trucks can virtually rotate within their own length. Hyster says it is the only OEM that uses Trelleborg's innovative PitStop tires (where an orange band becomes visible when 100 hours of service life remain) as standard on all of its machines – but these will be an optional feature on the XT.

The hood opens to 63° to offer cowl to counterweight accessibility, with daily check items being color-coded. O-ring face seal fittings ensure that virtually zero leakage of hydraulic fluid can occur.

### On the web


More info, images and videos online at: [www.ivtinternational.com](http://www.ivtinternational.com)

Mechanical levers make the XT a lower-cost option than the premium FT model



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bauma 2016



# ELECTRIC MUD

A HOST OF EARTHMOVING AND CONSTRUCTION MACHINES APPEARED IN ELECTRIC AND HYBRID GUISE AT BAUMA THIS YEAR. WILL THIS MUDDY THE WATERS OR IS IT A SIGN OF THINGS TO COME?

Kramer's 5055e can provide five hours of autonomy from lead-acid batteries



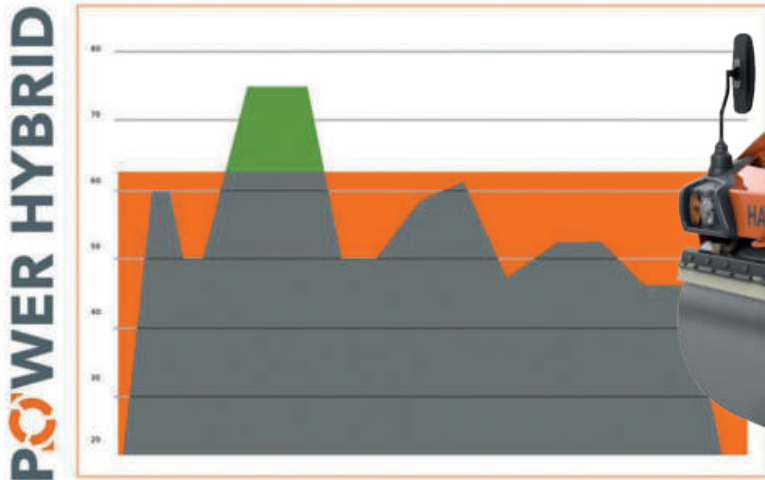
Now that compliance with what we all hope will be the final stage of engine emissions regulations has been largely achieved, or at least a course of action decided upon, it seems that we are at long last beginning to see a bit more 'real' innovation at exhibitions once again. And if Bauma 2016 was anything to go by, it seems that most of it took the form of electric and hybrid vehicles – some from OEMs with history in that sector, and some from very surprising sources indeed.

**Wacker Neuson** falls firmly into the first camp, having begun founding its 'e' (electric) range with the dual-power option for its 803 mini excavator at Bauma 2013. This was followed by two battery-powered rammers that reduce running costs by 55% or so, while the WL20e, a lead-acid battery-powered compact wheeled loader, was added in 2015, offering up to five hours of autonomy under full load.

WN subsidiary **Kramer** has now thrown its hat into the ring with some panache, as its fully electric 0.55m<sup>3</sup> bucket capacity wheeled loader, the 5055e, received this year's Bauma Innovation Award in the Machine category. Available this northern summer, it offers comparable performance, off-road capability and operating comfort to its 3,450kg, 35kW diesel equivalent, but with the benefit of zero emissions and extremely low noise levels.

Powered for up to five hours on one charge of its lead-acid batteries, which takes three to six hours depending on the options, it employs two electric motors, one for the work hydraulics and one for the drive system, with power being taken only when required by the specific application to reduce energy consumption.

Kramer admits the initial investment cost is high, but points out that this can be quickly amortized as a result of the much



Shown in green in the graph (left), peak loads can be managed with a hydraulic accumulator, enabling a huge reduction in the size of engine required for a 9t tandem roller

#### Hamm's hydraulic hybrid headliner

Perhaps the biggest hybrid surprise on show was Hamm's HD+ 90i PH prototype. The OEM has craftily employed hydraulic hybrid technology to enable a huge reduction in unnecessary engine power in this popular 9 metric ton tandem roller – dropping from 85kW to just 55.4kW, creating the additional benefit of removing the requirement for SCR aftertreatment technology.

However, crucially there is no loss in performance. When the OEM's development team examined the engine load of a standard model during compaction, it was clear that peak loads were needed only occasionally, and even then, just for a few seconds – usually on startup or when activating the vibration/oscillation.

These peak loads (seen in green in the above graph) can therefore be managed with a hydraulic accumulator that acts as an auxiliary drive to supply a short-term power boost of up to 20kW. During all other working situations, there is an adequate reserve of power (shown in orange) to replenish the accumulator via hydraulic pump until the next peak demand arises. In combination with the electric fan drives and a stop/start system, the technology could offer 15% fuel savings, while simultaneously reducing noise from the powertrain.

The system is now entering field trials but is said to be suitable for series production, in models with double vibration (VV), oscillation (VO) and combi rollers (VT).

Low-mounted lithium-iron batteries feed three electric motors



lower maintenance and running costs. With no engine to cater for, service times are shorter and therefore more price convenient, as is the cost of the power.

Not to be outdone, Kramer's parent group, Wacker Neuson, revealed the DT10e ride-on tracked dumper (above), claiming its power and stability is 'in no way inferior' to the original 9.7kW diesel-powered DT10. Its low-mounted lithium-iron phosphate batteries feed three electric motors, one for each track and one for the work hydraulics. These provide an average of eight hours' operation when fully charged, and even under maximum load the battery lasts for 3.5 hours. Maximum payload is 1,000kg, and gradeability with a loaded bucket reaches 36%, despite the slim machine width of just 80cm.

And at approximately €750 per 1,000 hours versus €2,500 for the DT10 diesel, operating costs are very attractive too.



#### Bobcat reveals E10 Electric excavator

Bobcat surprised many with the reveal of the E10 Electric micro-excavator prototype, developed at its Dobris Innovation Centre in conjunction with electric vehicle specialists. The factory-installed alternative powertrain option consists of an electric motor that can be powered by a Li-ion battery pack, or a 400V mains electric supply via a plug-in power cable. The batteries can be fully charged in under an hour to enable independent operation for two to three hours, although work can still be carried out while recharging.

As this zero-emissions version of one of Bobcat's most popular machines is designed for demanding indoor demolition work, it has also been equipped with auxiliary lines and an efficient oil cooler system for continuous hydraulic breaker operation.





**Komatsu's hybrid components are covered by a five-year or 10,000hr special warranty**

**Komatsu vs Kobelco in the electric hybrid excavator stakes**

Two Japanese OEMs came out with new electric hybrid takes on the excavator. Having logged more than 10,000,000 hours of operation on 3,500 units worldwide since it launched the PC200-8 Hybrid in 2008 (and as hinted at in our Intermat 2015 review in iVT, June 2015, p12) Komatsu extended that technology to a 36 metric ton machine, the HB365LC-3 (above). Said to offer 20% fuel savings over the standard PC360LC-11, it features the same 202kW SAA6D114E-6 Stage IV engine, but provides an extra 53kW of electric power from the ultracapacitor. This captures kinetic energy generated during the swing-braking phase before quickly discharging it on occasions of peak demand, such as rotation of the superstructure.

Meanwhile, Kobelco, which proclaims itself the "original hybrid pioneer of the construction industry", showed a Japanese version of its SK210LC Generation 10 hybrid. Offering expected savings of 15% over its conventional equivalent, this also electrically recovers energy from swing deceleration, but has now switched from the capacitor used on its -9 predecessor to lithium-ion batteries to retain a greater volume of energy for longer to support higher engine output.

Additional benefits include its ability to even out loading on the Stage IV four-cylinder engine, which in turn stores excess energy from light loads to assist when needed for a heavy load.



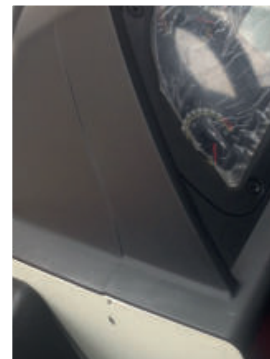
**Kobelco's SK210LC Gen 10 Hybrid will be available in Europe next year**



**Disappointed and disillusioned**

Having featured XCMG's new wheeled loader cabs in our November 2015 issue, we were keen to take a peek inside the finished product. But having lavished five pages on praising a cab design that sets new standards for Chinese equipment, it seems only fair to highlight our disappointment in its execution. From the outside, first impressions were undoubtedly good, but once inside the spacious cab, the shortcuts were very much in evidence, as the pictures below demonstrate.

If this is the standard to which the exhibition model is finished, do the production models really stand much chance of persuading western customers to abandon their tried-and-trusted brands?



Those scuffs could appear on just about any machine, but the poor joins should have been avoided



The fire extinguisher was originally intended to be fitted to the A-pillar, but this new location makes access to the AC filter impossible!



The bulging cabling behind this cover not only looks atrocious, but reduces visibility through the front windscreen. Another run of cable literally cut a corner and obscured the view to the ground at the left-hand side



The finish of this recess takes me back to my days as a trainee joiner, when we occasionally used the expression, "It'll do for the lads"

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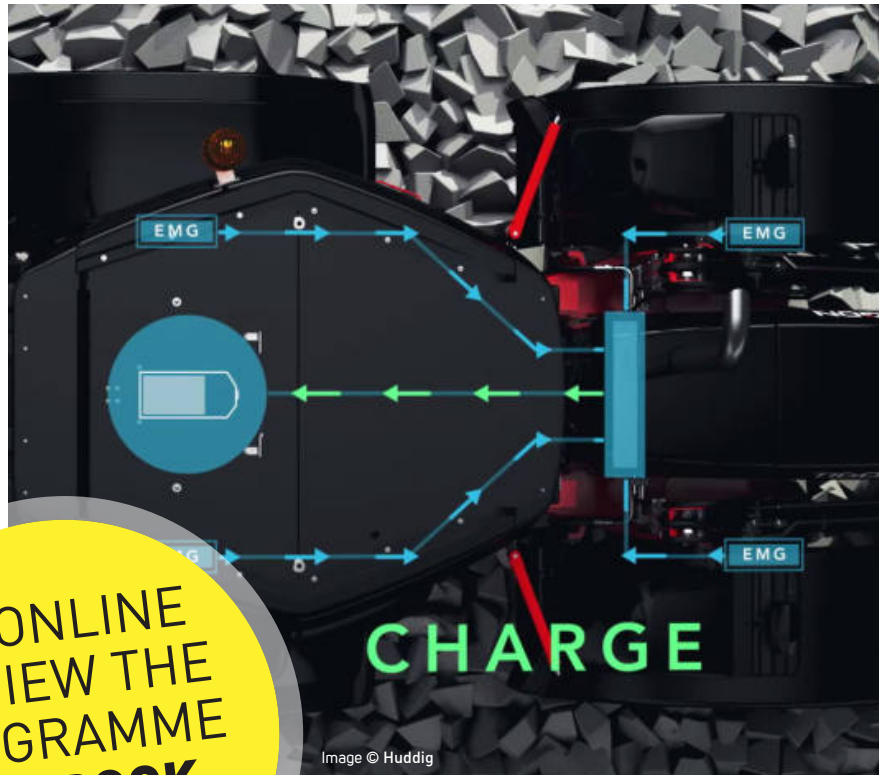
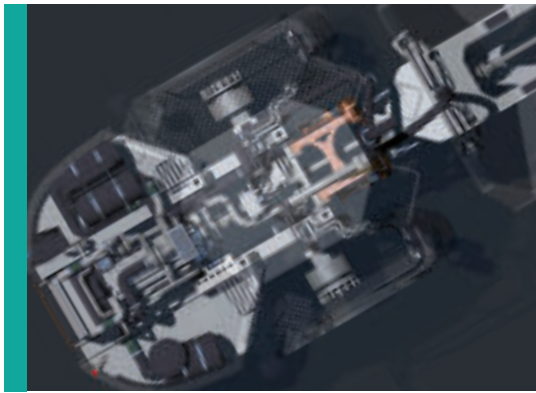


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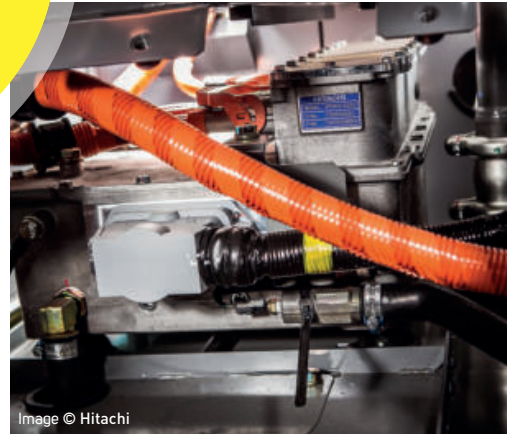
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For more information about the Electric & Hybrid Industrial Vehicle Technology Symposium 2016, please contact **Nick Moller, conference director:** [nick.moller@ukipme.com](mailto:nick.moller@ukipme.com)

# Electric & Hybrid Industrial Vehicle Technology Symposium

AS OUR BAUMA REVIEW SUGGESTS, THERE'S DEFINITELY A RENEWED BUZZ SURROUNDING HYBRID TECHNOLOGY – AND THERE'S ONE PLACE YOU CAN FIND OUT ALL YOU NEED TO KNOW ABOUT JOINING THE CLUB...

"I WOULD  
SUGGEST A FUEL  
REDUCTION OF  
**50%**  
IS AN ACHIEVABLE  
TARGET"



▷ To be held in Cologne, Germany, November 9-10, 2016, Electric & Hybrid Industrial Vehicle Technology Symposium will be the world's only conference exclusively dedicated to the design and development of electric and hybrid vehicle technology for the construction, agricultural, industrial and off-highway vehicle industry.

The symposium will bring together R&D engineers and heads of design and engineering from around the world to discuss, debate and analyze the growing possibilities and future developments for the hybridization and full electrification of off-highway vehicles.

Off-highway industrial vehicles pose their own specific design and development challenges. The Electric & Hybrid Industrial Vehicle Technology Symposium will discuss and debate the technological breakthroughs required for increased deployment. Electrification offers the potential to significantly reduce emissions and noise levels, cut fuel, lower maintenance costs and eliminate hydraulic systems, as well as a host of other benefits. So this conference is a must-attend event for all OEMs, Tier 1 and 2 suppliers, and anyone involved in the off-highway and industrial vehicle market.

*iVT* therefore caught up with a couple of the speakers scheduled to present at the Symposium to discuss some of the issues surrounding this exciting technology.



## SYMPOSIUM

Our interviewees provided so much information that we've had to put their responses to questions concerning automotive hybrid technology, government incentive schemes, take-up in the emerging markets and predictions about when all OEMs might have a selection of hybrids on sale, online due to the lack of space: visit [www.ivtinternational.com](http://www.ivtinternational.com) for more details



### PRESENTATION: HYDRAULIC HYBRID SYSTEMS FOR EXCAVATORS

**Milos Vukovic, team leader systems and controls, Institute for Fluid Power Drives and Control – RWTH Aachen, Germany**

*Concerns over global warming and depleting fossil fuel reserves are forcing manufacturers of mobile machinery to improve the efficiency of their products. The use of hydraulic hybrid architectures may be a possible way forward. This talk aims to illustrate the potential of such systems and the challenges facing their implementation. As an example, the STEAM system developed in Aachen will be presented and discussed in detail.*

#### Can you outline a few key points of your presentation?

Before designing a new architecture, it is first necessary to understand the problems with today's machines. Therefore, I'll start off by giving a brief overview of the major loss mechanisms in such machines and the potential they offer for energy recovery and hybridization. This will be followed by a discussion of some interesting hybrid solutions found in industry and academia. As a case study, I will go on to present the work we have done in the development of the STEAM system by focusing on the lessons we learned and the mistakes we made.

#### Can you tell us more about the STEAM system?

We have been working on it for the past four years. It represents the first holistic approach to designing such machines, as the hybrid technology not only allows more efficient engine operation, but also lowers hydraulic throttling losses and enables energy recovery from all the machine's actuators. A prototype has been built and tests show an average fuel consumption reduction of up to 30%.



"Any application in which power demand to the actuators fluctuates considerably is suited to hybridization"



### PRESENTATION: HYBRID POWERTRAIN FOR OFF-HIGHWAY APPLICATIONS

**Vern Caron, electric vehicle engineer, Oerlikon Fairfield**

*Off-highway applications can benefit from hybrid-electric drives. These systems can reduce fuel consumption by 30% in highly dynamic driving cycles with significant stop/start activity. Other benefits include downsized engines, reduced tire wear and longer TBO. Oerlikon Drive Systems provides a series-electric drive for off-highway and material handling vehicles. Its components are quickly connected via power and CAN-link cables, and are usable in a variety of applications.*

#### Can you outline a few key points of your presentation?

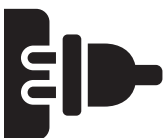
Fairfield has developed a high-power electric drive system that makes use of switched-reluctance motors with ultracapacitor-based energy storage. Its differentiating features are: electric drive axles with tightly integrated dual inverters; engine-mounted switched-reluctance generator with integrated inverter; and an ultracapacitor-based energy-storage unit that serves as the central connection point for all of the hybrid-electric components. A primary objective is to provide a system that can easily be engineered into existing vehicle architectures. This allows adoption by multiple OEMs in applications where volumes are insufficient to justify internal hybridization efforts. Fairfield is also interested in providing individual components for OEMs that prefer more internal involvement.

#### Can you tell us more about your hybrid developments?

Fairfield has been working on higher-power hybrid-electric drives for about four years and fielded a first prototype in June of 2015. The initial design is showing excellent performance but needs refinement, particularly in the area of cost reduction. We have had a number of inquiries – in some cases, we don't fully understand the business case, so it's always a learning experience.



"It may be possible to develop new vehicles that are difficult to implement using conventional powertrain technology"



**Why have so few of the hybrid prototypes launched over the past decade actually entered production?**

**Milos Vukovic:** Designing hybrid architectures for excavators, wheeled loaders and similar machines is far from simple. In contrast to a car – a vehicle with essentially only one actuator and task – mobile machines, especially excavators, have multiple actuators, which are used for a wide range of different applications, making the design and implementation of hybrid drivetrains far more complex.

Secondly, hybridization is not always the right choice. Depending on the application, there may be many other – simpler and more cost-effective – ways to reduce fuel consumption. I think that in the past some OEMs just chose the wrong machine for their hybrids. In these cases, the increase in cost was just not justified.

There are also a number of important factors to consider, not necessarily directly related to the hybrid technology as such. The introduction of more stringent emissions guidelines has probably been the major challenge during the past 10 to 15 years. This has left OEMs with little time to focus on other developments and has forced them to install expensive and space-consuming emissions systems in their machines, which has increased costs and affected their bottom lines.

The way in which emissions tests, for example the non-road transient cycle (NRTC), are conducted is also a problem, as such test procedures do not consider how the engine will actually operate when in the machine, giving OEMs no additional incentives to invest in hybrids. Coupled with the 2008 downturn, this has been a far from optimal period to launch a hybrid machine.

Finally, the construction and mining sectors are quite conservative in terms of innovation, making the introduction of new technologies even more difficult.

**Vern Caron:** Commercial products are successful when there is a good business case. Usually there is an upcharge to adopt new technology and so far end users have not seen an adequate payback to justify widespread adoption of hybrid technology. In particular, the business case for electric vehicles is very sensitive to fuel cost. This adds instability to the market; especially the case during the past year or two.

**But are things changing now?**

**MV:** I think they are changing slowly. First of all, our society is becoming ever more conscious of the threat posed by CO<sub>2</sub> emissions. People are realizing that new technologies such as hybrids are the only way toward a sustainable future.

Secondly, companies have started looking at things from a much broader point of view, meaning that concepts such as lifecycle costs are becoming more and more important. Introducing fuel-saving hybrid machinery is, therefore, becoming considerably easier.

Last of all, the younger generation that grew up with modern technologies, such as smartphones and tablets, and who are now entering the off-highway sector, will begin to demand the same sort of technological improvements from the machines they use at work. This will force OEMs to become more innovative and make it easier for them to launch new products.

**VC:** Things are changing incrementally, year-on-year. The cost of iron lamination and copper is unlikely to drop substantially, but ultracapacitors are becoming more capable (higher temperature, higher voltage and higher density) and lower in cost. Semiconductors (IGBTs) are also becoming lower in cost and more robust. High-voltage cables and connectors are more readily available.

**What's the perfect storm scenario that would make hybrids an operator's automatic choice?**

**MV:** That would be a rapid rise in fuel prices and legislation enforcing a CO<sub>2</sub> tax on mobile machinery.

**VC:** We would need to see a major increase in demand for equipment (e.g. due to need for infrastructure improvement) along with a sharp increase in fuel cost.

**What's the typical ROI timeframe of a hybrid machine – and how much does it need to improve to encourage wider adoption?**

**MV:** It will always depend on the type of application and the current fuel price, so it is not possible to be specific. Ultimately though, the goal should be around one year – this would really help to spread the technology.

**VC:** We generally assume that the end user requires a two-year ROI. We expect that many leading-edge users may accept a three-year ROI.

**Will construction equipment continue to be the main hybrid application or is there plenty of scope in agriculture and material handling too?**

**MV:** Any application in which power demand to the actuators fluctuates considerably is ideally suited for hybridization. On the other hand, applications where a constantly high power demand is required for long periods of time – as may be the case in many agricultural scenarios – are less suited.

Detailed knowledge of the typical duty cycles to which each machine is subjected is essential in deciding whether or not this is the case.

**VC:** Equipment with shorter useful life and fewer operating hours per year are more challenging applications. But the flexibility of electrically powered systems could lead to new equipment designs that would take advantage of that.

**Are there some off-highway machines (or some sizes of machines) that could never benefit? And is full electrification the answer in that case?**

**MV:** This might be true for smaller machines, with operating weights of up to 10 tonnes, used in and around city centers. Their fuel consumption is already relatively low, so the amounts of energy and costs that can be saved are therefore probably not that high. In the case of cities and governments striving for a zero emissions policy, full electrification may be the solution. At the end of the day, the customers that must pay for these machines will decide if full electrification is the answer.

**VC:** Smaller vehicles in rental applications are a case in point. They have low operating hours and the user is typically not focused on operating efficiency.

**How much potential is there for current levels of efficiency to improve? What type of technology enhancements might be required?**

**MV:** Once again, this all depends on the application and machine. For certain tasks there is still quite a bit of potential, for

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others not that much. For example, in the case of an excavator, used mainly for digging, I would suggest that a fuel reduction of 50% compared with today's non-hybrid machines is an achievable target.

But two big issues remain to be solved, namely reliability and costs. What engineers have to focus on is how to get the technology to function reliably for all possible duty cycles and operating conditions, while keeping costs low. This will be the major challenge.

**VC:** Over time it is likely that hybrid technology will move from use in large, expensive machines with high operating duty cycles to smaller machines with intermittent use. In many cases, ancillary benefits like extended rebuild life, improved tire wear and better operating efficiency may be a factor. Hybrid technology may also make it possible to develop new vehicles that are difficult to implement using only conventional powertrain technology.

**Parallel or series systems – will one of them dominate in the next 10 years?**

**MV:** This all depends on the application. In some cases a parallel system may be better than a series system and vice versa.

**VC:** Parallel hybrids are complex and contain many redundant components. They are easier to adapt to existing systems, but they are also constrained by the limitations of those systems. Conversely, series systems are simple and flexible. As an example, a very attractive approach would be a series hybrid powered by a multi-fuel turbine engine and high-speed generator.

**Do machines that offer the potential to recapture energy stand a better chance of success than those that rely on other methods, such as generators?**

**MV:** By using a hybrid system in an application with large energy recovery potential, the size and therefore cost of the diesel engine can be considerably reduced. As a result, such applications are destined for hybridization as it not only makes sense

from the energy perspective but also from the economic side, as a shorter ROI can be attained in such cases.

**VC:** There are many electric drive applications that are not hybrids, such as locomotives or very large wheeled loaders. In these cases, conventional mechanical powertrains are difficult to implement. The ability to recover energy normally lost in braking by use of a secondary storage unit (battery, ultracapacitor module, flywheel or hydro-pneumatic reservoir) can justify adoption of electric (or hydraulic) drivetrain systems in applications normally served well with conventional mechanical powertrains. This depends greatly on duty cycle and operating hours per year. For example, wheeled loaders have an ideal duty cycle for hybridization.

**Hydraulic versus electric hybrids: for machines such as excavators, where both solutions are currently offered, could one become the 'standard'?**

**MV:** That is an interesting question. I think each company has its own philosophy here and there will always be both solutions. But from a theoretical point of view, I would say the hydraulic hybrid is better suited for excavators. First of all, the actuator with the most energy recovery potential is the boom. Due to the cost-effectiveness and robustness of hydraulic cylinders I do not see an electric linear actuator replacing the boom cylinder any time soon. Additionally, this recoverable energy must be stored and reused in a relatively short amount of time, which calls for an energy-storage device with a high power density – namely a hydraulic accumulator. If you're already using a hydraulic hybrid boom it then also makes sense to extend the system to the swing, thereby keeping everything hydraulic and avoiding unnecessary power transformations.

An additional advantage is that it is cheaper than its electrical counterpart (supercaps and batteries), at least at these power ratings. Then there is maintenance: technicians and mechanics are already

familiar with hydraulics; this is not the case for high-voltage electric hybrid devices.

**VC:** At present, hydraulic hybrids are simpler and lower in cost. Electric systems are able to handle more energy with better efficiency, are more efficient and avoid the use of large partially oil-filled reservoirs. So electric is the better technology in the long term.

**Can hybrid machinery provide any other benefits outside of fuel consumption?**

**MV:** Hybrids can help reduce noise levels by allowing operation at lower and much quieter engine speeds. Operators can also expect faster operation as the additional energy storage device can provide a power boost for short periods of time.

**VC:** Torque vectoring at the wheel ends can reduce tire wear. Smart use of hybrid energy can improve operating efficiency. Many wear components can be eliminated, leading to longer overhaul intervals.

**What do you see as the long-term potential for hybrid machinery?**

**MV:** Until the majority of our electricity supply comes from renewable sources, hybrid machinery is the only really sustainable technology currently at our disposal. It provides a way to considerably improve the way in which we use fossil fuels in today's machines. By improving engine operation and making use of energy recovery from actuators, we can considerably lower fuel consumption and CO<sub>2</sub> emissions.

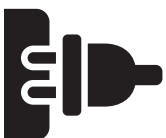
**VC:** For an application that currently provides 30% fuel savings, it may be possible to improve that to 40%. Things that will help include: higher operating voltage (1,200V or higher); lower internal impedance in energy-storage components; lower friction in mechanical components, allowing for more energy recovery; electrification and integration of more accessory components; and more sophisticated vehicle control algorithms. **iVT**

**The full symposium program and interviews with other presenters will appear in our September issue**

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JUST LIKE ANOTHER SPANISH MANUFACTURER WE FEATURED RECENTLY, CORINSA AND PUTZMEISTER UNDERGROUND TECHNOLOGY SELL RELATIVELY FEW MACHINES IN THEIR DOMESTIC MARKET. BUT THAT DOESN'T MEAN SALES ARE SLUMPING...

# No Spain, no gain?





After years of being rather cynical about the value of the obligatory factory tour during a visit to any off-highway OEM, by the end of last summer's ANMOPYC-organized tour of Spanish manufacturers I was beginning to really miss the smell of machine oil and burning flux.

Admittedly, on this particular day, as I was learning more about the operations of Corinsa and Putzmeister Underground Technology, I did walk around their production facilities – but just as at AUSA two days earlier, I discovered that neither of these relatively small manufacturers made their own fabrications.

The similarities didn't stop there either. As AUSA's Paco Pérez Salinas had told me, the company had been forced to turn to the export market to survive, having relied heavily on domestic success for many years (see *iVT* March, p12). This approach, I soon discovered while talking with commercial manager Sergio Gil Arias, was even more evident at Corinsa, a small company situated almost halfway between Madrid and Toledo. Founded in 1979, Corinsa began manufacturing (i.e., including fabrications) large pneumatic-tired rollers for France's Albaret, and while now fully independent, it remains a

specialist in this niche market but almost exclusively relies on sales outside of Europe. In 2015, it sold approximately 40 machines, each built to order over the space of two or three months, in addition to its healthy reman program.

"If we didn't export we would have to close because we hardly sell in Spain and France anymore," says Sergio, as we tour what is perhaps the smallest assembly area I've ever visited. "So we practically sell only to Africa now, though we are about to sell into UAE, Kuwait and elsewhere in the Middle East so it's an interesting time. And we have just signed an agreement to manufacture and sell directly in Algeria too – that's near to us, so it should be a good deal."

Nevertheless, a major part of those African sales are due in no small part to that French connection. "French contractors like these machines for use in their contracts in Africa," he continues. "France used to be our most important market after Spain;

**ABOVE: Corinsa's commercial director, Sergio Gil Arias: "If we didn't export we would have to close because we hardly sell in Spain and France anymore"**

we have had a dealer there for many years but now it's difficult and they don't sell many machines."

This is not only due to economic reasons – the changes in trends and machine preferences play a part too. Pneumatic-tired rollers, for instance, are often used as finishing machines that follow the tandem roller but, in Europe at least, often only tandem rollers, or smaller pneumatic models, up to 21 metric tons, are employed. Even an industry giant struggles to sell the biggest models: "We have made 35-tonne models under the Corinsa brand as the CCR 21.35 for about 38 years," he says, "even after Caterpillar bought Albaret, which is why our rollers are similar – but Cat doesn't manufacture this size model anymore, maybe because the volumes are low. More rollers are required for other kinds of jobs, and this one lasts for a long time, so you don't have to change it every three or four years!"

Has Corinsa considered targeting the European market with smaller



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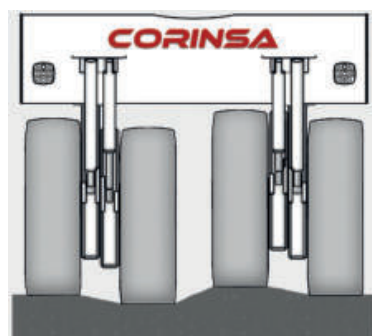
models then? “We do produce sub-21t models, with the same technology as our bigger machines. But we don’t sell them in Europe – we only use the highest technology so our machines are a little bit more expensive. People like the machine but when they see the price...” he tails off. “You can’t compare; the technology, the systems and the final results aren’t the same.”

### High-tech demand

It strikes me as unusual, however, that an OEM relying so heavily on sales to Africa would produce such advanced machines, and that the bulk of them would be sold with the cab option – not quite the sort of demand you’d usually expect from emerging markets, in other words.

“We sell to important major contractors – at first we only worked with French contractors out there, but now there are African customers who prefer our machines,” he clarifies. “I think we are definitely the market leader in Africa. It’s a big machine, quite expensive, but they like the technology, they know the machines intimately, and they look after them well. Our next Hercules C4 will have a new design, but the technology will remain the same – I think we have reached the limit in PTR technology.”

Corinsa currently produces three heroically named models – Ulises, in 8.5-21t capacities, the 21t Hercules C4, and the enormous Goliath CCR 21.35. “CCR 21.35 is the only 35t machine of this kind, the biggest in the world,” he boasts. “Some Chinese machines are 28t, but it’s the weight



per wheel that’s most important. Nine wheels on a 28t model don’t provide much weight – we only have seven wheels, three up front and four at the rear, but they each provide 5t. So although CCR 21.35 is a huge machine, it’s not actually oversized.”

It’s all about making the most of what you have: isostatic suspension at front and rear (though the Ulises’ rear wheels are rigid) ensures each wheel maintains constant contact – and therefore uniform pressure – on the ground for even compaction, full balance and a smooth surface finish regardless of the conditions. The three front wheels are mounted on independent hydraulic cylinders, with the four rear wheels mounted on final transmission housings; the outer wheels attached to the chassis and the inner wheels mounted on hydraulic cylinders that interconnect with the front wheels to ensure each wheel provides an equal load.

And of course, this arrangement also ensures a high level of stability, in association with the steel ballast that enables the CCR 21.35 to be offered in 21, 28 and 35t capacities.

**MAIN IMAGE: A choice of tire profiles make PTRs two machines in one – while the optional spare tire facility lends some useful weight**

**TOP RIGHT: There’s a touch of the ocean-going liner about PTRs when they’re fitted with tire windshields**

**ABOVE: Weights of 5t per wheel ensure the most efficient compaction, while hydraulic steering ensures smooth and low-effort handling**

**LEFT: Isostatic suspension ensures that all wheels maintain constant contact with the ground**

Pneumatic-tired rollers are just as at home on soil, however – although Sergio explains they may require a change in tire profile. “They are two machines in one, so most customers will buy a spare set of tires with the machine. But changing them is a workshop task; they can’t do it on site as they are big wheels and it’s a heavy machine.”

Some ad hoc maintenance of this sort is possible, though, as due to the downtime a puncture would create, many of these rollers optionally carry a spare tire, in a manner somehow more appropriate to an old 1930s coupé than an industrial vehicle. And as tire pressure has to be varied according to the task, this can be performed from within the cab, where the operating station rotates fully so that operators can always face the direction of travel – older models had two stations, with two seats and two sets of pedals, etc.

While larger models use a Clark powershift gearbox, the Ulises runs hydrostatically – a dual-body pump with four dual-displacement radial piston motors sends traction drive to the four rear wheels, as part of a three-speed forward and reverse propulsion system that offers high flexibility in terms of speed control (allowing travel speeds of up to 18km/h) and maneuvering.

So what’s next for Corinsa, I ask? “We are looking into producing two other models, but with eight and nine wheels,” Sergio reveals. “But we’re a small company, with 20 employees or so, so we have to take it slowly!”



(When it gets hot, we stay cool.)

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### Concrete jungle

Heading back to Madrid, my next port of call was operating in even more specialist circles – although could boast much larger facilities and, depending on production peaks, perhaps five or six times the number of employees.

That's perhaps not surprising, though, as Putzmeister Underground Technology is, of course, a division of the German concrete pump giant – and, by extension, owned by Sany – with the specific task of producing compact concrete spraying and transport equipment for use in mines and tunnels.

Having put down its roots in Germany in 1958, Putzmeister set up a Spanish subsidiary after merging with its former distributor during the 1980s. "About 14 years ago, we began to produce the SPM 500 Wetkret and given its success, we began to design and assemble other new products," says chief operating officer José Luis Castro. "Here we have the complete process, from design to production, global sales and marketing as well as after-sales and spare parts service."

The Spanish division models its production on that of the automotive

industry for a leaner, more time-responsive approach. For instance, due to the relatively low volumes involved, chassis are now welded by vetted group suppliers from across Europe. "Our philosophy is, we only assemble, not fabricate," José Luis continues. "Until three or four years ago, we had an important section for welding but changed our strategy to work alongside carefully selected external suppliers and produce those parts. It meant a big effort during the first year as we invested heavily in training our suppliers, providing them with the relevant technical information, laws and standards, tolerances, etc."

"We have built up very good relationships with them," he adds. "We precisely define the components and their desired characteristics before we source. But it is not only about price – the best suppliers will also offer reliability, flexibility, superb service, short delivery times and, of course, best-in-class quality."

This has had a huge beneficial impact on the lead times of these built-to-order machines, rendering machine production much more agile. "Sometimes clients ask for



**MAIN IMAGE:** Putzmeister Underground Technology's chief operating officer, José Luis Castro: "Our philosophy is, we only assemble, not fabricate"

**INSET:** The production of prototypes is the only time you'll see welding going on at Putzmeister Underground Technology – this is the Wetkret 5

**ABOVE:** An SPM 500 Wetkret undergoing final checks before shipping

specifications that might call for two or three more days," he adds, "so to increase flexibility we give our suppliers forecasts for stock purchases that they have to consider with a tolerance of  $\pm 25\%$ . We review these monthly as it's vital to maintain our stocks at optimal levels for just-in-time reasons – and we have daily communication, so we don't receive any large components that would be lying around for over a month."

### End-to-end process

In a refreshing change that echoes the artisan approach of high-end specialist auto makers such as





Morgan, each machine is assembled from start to finish in the same cell by four technicians, usually comprising two mechanical/hydraulic specialists and two electrical specialists.

José Luis states that from delivery of the chassis to completion of the final machine, each piece typically takes just 10-12 days – six days to build, two or three days of testing depending on the model, followed by another two days or so in the finishing section. In fact, of the approximately 1,500 assembled components, 300 or so items will be thoroughly checked at this stage.

“We have a continuous internal checking system for quality control at every step of the process, plus quality inspections, and once the machine is finished it goes to the quality station for final inspection. So it takes virtually the same time to test the machine as to build it!”

Putzmeister’s flexible production setup enables it to produce more than 150 units per year, depending on market conditions. An undoubted underground shotcrete specialist, the company serves two distinct industries – mining and tunnelling – which often make up a 50:50 share of sales, though the latter will often help to compensate for the mining sector’s infamously volatile demand.

“Currently, we are seeing a lot of demand for our SPM 500 Wetkret shotcrete spraying machine, which typically makes up around 35% of production,” José Luis explains.

ABOVE: Each machine is built in the same cell from start to finish

RIGHT: The Wetkret 3 – how else are you going to spray subway escalator tunnels?



“We are working on a new shotcrete spraying machine prototype, the Wetkret 5, to serve new markets. It will boast several key differences, among them an integrated stainless steel additive tank, stronger axles and more efficient hydraulic pumps. The SPM 500 Wetkret model has a Cat engine, while the Wetkret 5 will have a Cummins engine to conform to current emissions regulations. Because of this, the Wetkret 5 will help us expand and consolidate our geographical footprint.”

In addition to this forthcoming Wetkret 5, I was privileged with a sneak preview of another prototype being developed. Confirming my belief once again that it’s often the smaller OEMs who create the real innovations and most interesting

## MEET THE PARENTS

The acquisition of Putzmeister by Sany Heavy Industry was one of the major talking points of 2012 – however, according to José Luis, it’s still pretty much business as usual in the Underground division. “So far our parent company has facilitated our entrance into the Chinese market through its existing sales network. We are going to leverage that to introduce more of our machines to the Chinese market,” he says.

The Chinese heavy construction machinery giant seems quite happy leaving all Putzmeister divisions to do what they do best, and the Putzmeister group continues to operate and preserve its brand value. “Sany has its own products for the construction market. It moves in different markets and price segments, and there is no confusion for the customer.”

The streamlining of logistics rings through across the entire business structure. And in regard to the German parent, the Putzmeister group has recently introduced new sourcing policies that allow every unit to source direct from vetted suppliers, optimizing logistics.

“This way, we can ensure top-notch quality and reduce logistics costs to a minimum while serving our customers in the shortest time,” states José Luis.

machines, the Wetkret 3 (which was launched at Bauma this April) is a compact tracked machine purposely designed for spraying small tunnels – with the main application being subway escalators. “We have tested it to make sure it can tackle steeper [30%] slopes than a wheeled machine,” states José Luis.

The company continues to work on other innovations, including one in a brand-new size class expected to come to market during 2017.

This article kicked off by eagerly seizing upon similarities of certain operational characteristics uncovered by my three visits, so perhaps it’s only fair to conclude by highlighting a key difference. While AUSA ruthlessly streamlined its portfolio by almost a third in recent years, Putzmeister Underground Technology continues to stand by the niches of its niche products: “We’ve built one unit of the Cemkret dry-mix transporter to cover a special request by a key client – we use the same chassis as for the Mixkret 4 and 5 low-profile mixers, so it’s more like an attachment,” José Luis says.

“The Minelift scissor-lift platform is also low volume, but we expect many more sales once the mining sector recovers. Again, the chassis will be used for other machines, and for other devices and tasks.” **IVT**

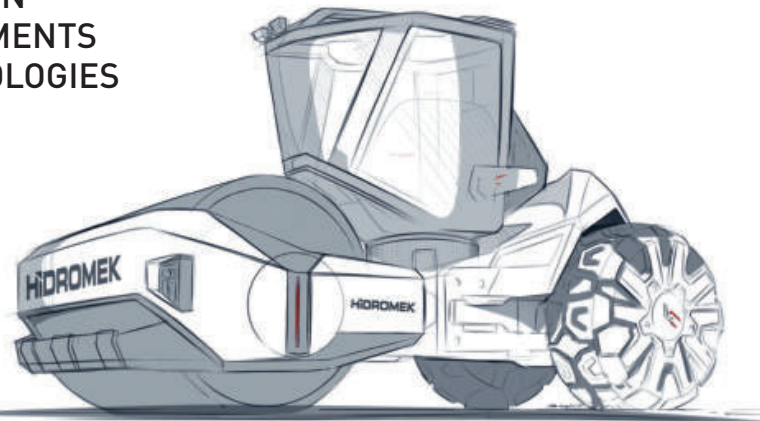


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WITH AN IF DESIGN AWARD TO ITS NAME, HIDROMEK IS RIGHTLY SINGING THE PRAISES OF THE HMK VISION COMPACTOR CONCEPT, BOASTING MAJOR IMPROVEMENTS TO CURRENT OPERATING AND COMPACTION TECHNOLOGIES



Soon after Hidromek's acquisition of Mitsubishi's motor grader business, the subject of expanding the product range arose – and the 15-tonne capacity HMK Vision Compactor concept was the result. "We thought it may be good to make such a concept to open up our path to the road construction segment," says Hakan Telesik, Hidromek's design studio executive.

Going on to receive an IF Design 2016 award in the Professional Concept Discipline category, the startling concept reflects how the latest technological advances could change the way vibratory compactors look and operate over the next 10 years.

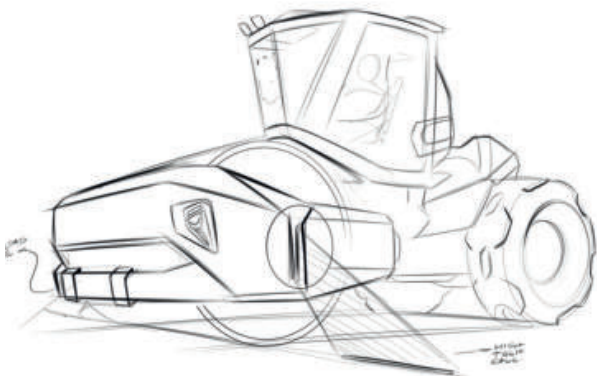
Soil compactors currently rely on the use of standard or special attachments to respond to varied ground conditions, but the Vision Compactor combines different attachments in a single 'shape-shifting' drum with 17°

of oscillation, saving a great deal of time and labor. This mechanism responds to magnetic force, which causes ribs to arise from the drum. This enables the machine to efficiently perform compaction of both loose and densely packed ground without requiring any intervention from the operator, due to the incorporation of the Ground Hardness Tester (GHT) feature, which automatically activates the mechanism. Located in the front lamp assembly, where it is protected from external impacts, this ultrasonic distance sensor perceives and transmits forthcoming changes in ground hardness up to 1m ahead of the machine.

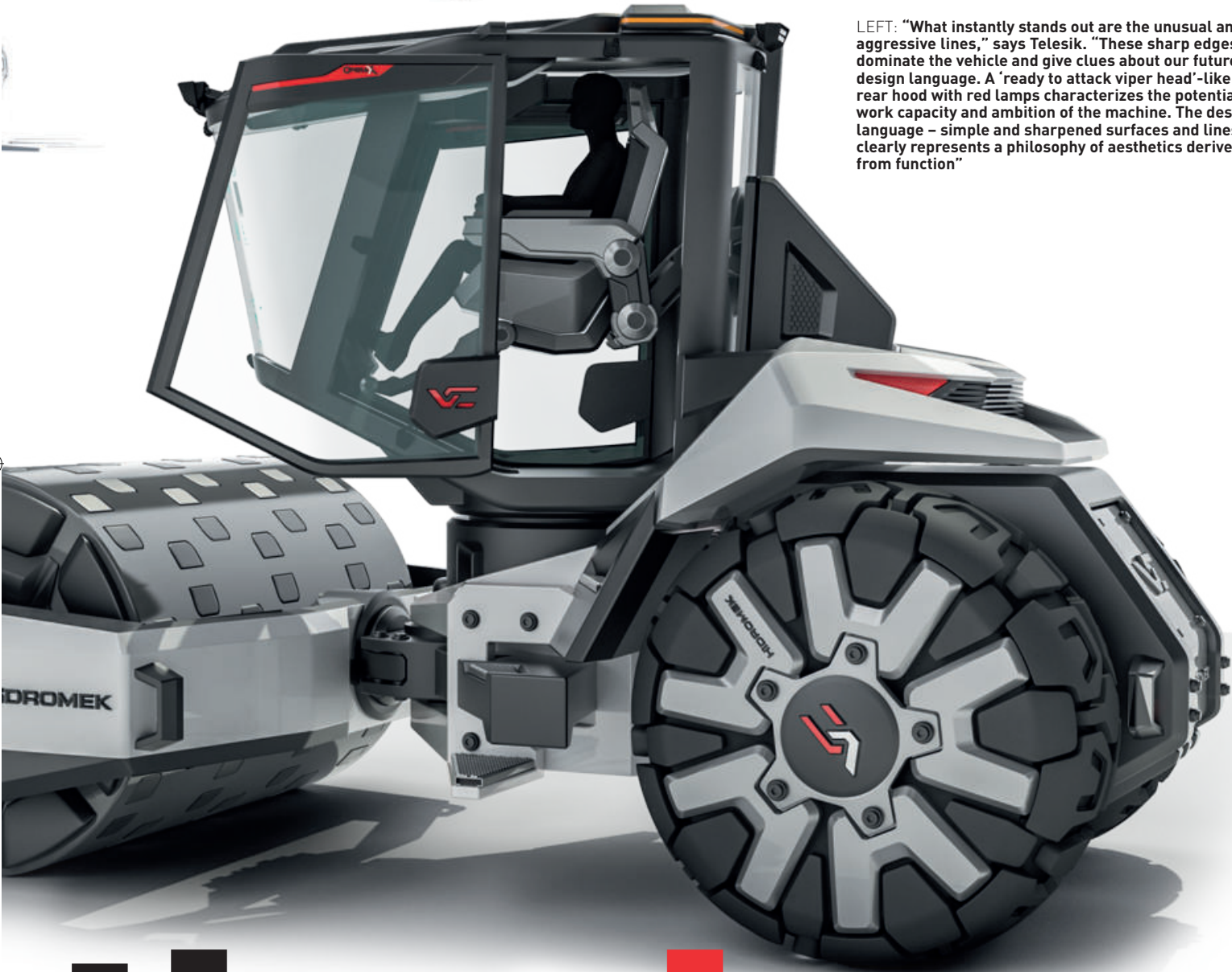
During the compaction process, a laser distance meter projects the impact area of varied frequency vibrations on the ground ahead of the operator, clearly enough to be visible in any conditions.



# Beating



LEFT: "What instantly stands out are the unusual and aggressive lines," says Telesik. "These sharp edges dominate the vehicle and give clues about our future design language. A 'ready to attack viper head'-like rear hood with red lamps characterizes the potential work capacity and ambition of the machine. The design language – simple and sharpened surfaces and lines – clearly represents a philosophy of aesthetics derived from function"



# the drum

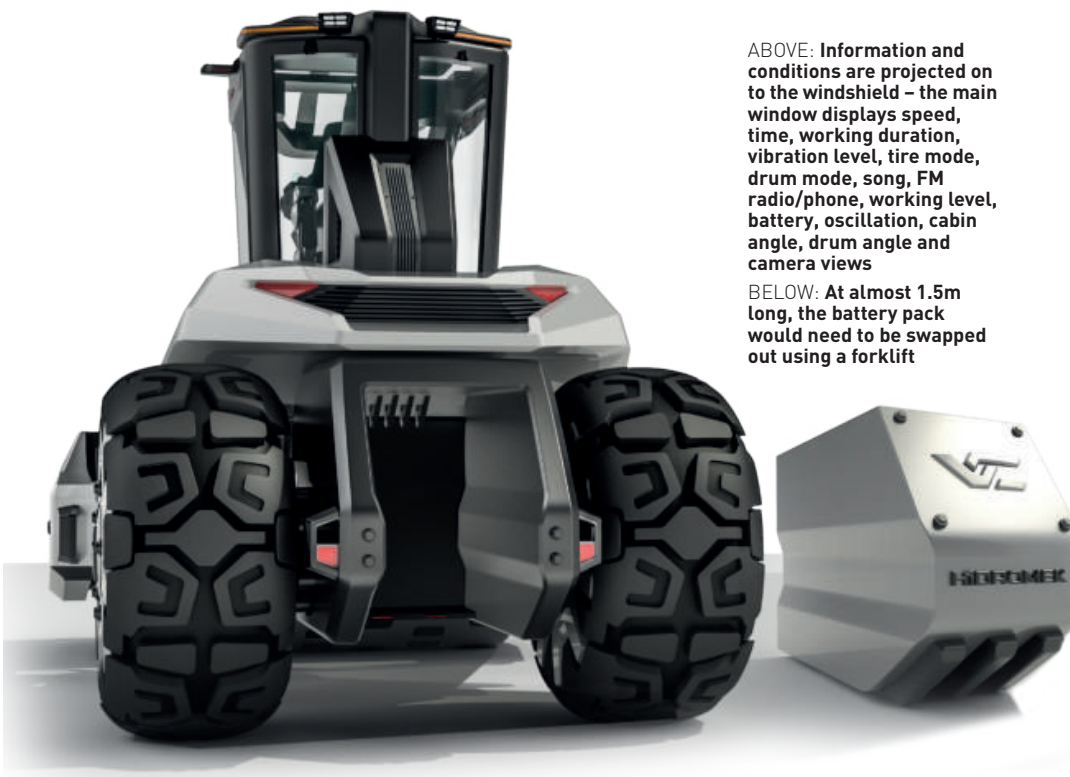
## DESIGN CONCEPT

The same flexible approach is used for the rear wheels, where the expandable concept tire not only optimizes efficiency and aesthetic appearance, but again offers a single solution for a range of needs. Emphasizing toughness and durability with its robust shape, it employs a series of kinetic ribs that are forced out from the tread area as a result of magnetic polarization to provide highly adaptable traction as ground conditions change.

The vehicle is powered by lithium-ion batteries that send electric power to four hub motors, providing high efficiency but with zero emissions. The weight and position of the battery pack has been designed to fit in precisely with the overall weight balance and operating principle of the vehicle. Considering its dimensions (1,490mm long x 620mm wide) and weight, a forklift would be required for the battery exchange process.



ABOVE: "In the cabin, there is virtually nothing but a complex seat which offers huge flexibility and comfort," Telesik says. "Called Operax, this is a future incarnation of the Opera unit used in our recent vehicles which unites all the controls in a single device"



ABOVE: Information and conditions are projected on to the windshield – the main window displays speed, time, working duration, vibration level, tire mode, drum mode, song, FM radio/phone, working level, battery, oscillation, cabin angle, drum angle and camera views

BELOW: At almost 1.5m long, the battery pack would need to be swapped out using a forklift

The Vision Compactor is operated from a cabin that can rotate through 360°, thereby offering optimum levels of sight, comfort, safety and control, and effectively enabling the operator to drive forward even when in reverse gear. Air blowers in the roof keep rain away from the windshield.

Inside, a seat acting independently from the cabin is at the heart of the new Operax operating system, oscillating up to 10° to obtain a much more comfortable operating position when the compactor is traversing sloping ground. Operax provides automatic positioning, moving on two distinct sensitive joints to absorb vibrations, and also moves backward and forward to increase visibility in response to operator commands. It also enhances ingress and egress ergonomics via an armrest with 90° of rotation – to offer maximum comfort, it rotates both automatically and manually.

All functions are easily accessed, with three-axis elliptical joysticks combining maximum comfort with minimum effort. The left joystick controls motion; the right joystick controls the cabin and Operax. **ivT**

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BELOW: The Ground Hardness Tester – sensors on each arm perceive the ground conditions and transmit the information to a central processor that evaluates the information and decides whether or not shape shifting of the drum and tires is required

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# Urban outfitters



**CONSTRUCTION SITES AIN'T WHAT THEY USED TO BE – AND THE DEMANDS ON THE MACHINES THAT OPERATE THERE HAVE CHANGED GREATLY TOO. FOR JCB, THE SOLUTION WAS TO DEVELOP A COMPLETELY NEW KIND OF WHEELED EXCAVATOR**

▶ Throughout most developed markets, the market share of construction machinery intended for repair and maintenance operations has massively improved, largely at the expense of the earthmoving monsters as the majority of infrastructure work nears completion. As a result, jobsites are very different places from what they used to be.

So what an operator requires from a machine has also changed – to such an extent that evolution of traditional product sometimes just doesn't fit the bill. This formed the theme at the long-awaited unveiling of JCB's Hydradig 110W in March, where the key words of visibility, stability, mobility, maneuverability and serviceability almost became some sort of mantra.

JCB had already revolutionized how customers went about digging, lifting, loading, placing and moving bulk material, began chief innovation and growth officer, Tim Burnhope, at the launch: "In 1953, when we introduced the backhoe loader, and in 1977, when we introduced the

Loadall telehandler, we changed the industry. These products may have seemed a little unconventional, but they were truly groundbreaking."

In those days, however, safety on building sites was rarely a concern – and whereas they were once wide, open spaces, they have become much more congested. Contractors usually widen highways instead of building them, for instance, and can only close off one lane when doing so. And few new trenches for utilities are required now – instead, existing services, often on narrow busy city streets, must be repaired or upgraded.

"Three years ago, discussions with customers revealed a need for change in response to how their industries are changing," he continued. "They told us the wheeled excavator was growing in importance – but in its existing form, had many limitations.

"But before we could come up with a better solution, we had to ask – what are the problems customers face when using wheeled excavators on jobsites today?"

And so began the 'ility' mantra, with visibility being the first. With these machines being increasingly used in confined urban spaces, safety management is now of prime importance. "They want more all-round visibility from a large-capacity machine that feels physically small to the operator," stated Burnhope. "An operator's view is quite limited, particularly over the engine. There's a vast area around the machine that they just can't see, often being blind

**BELOW: Developed in complete secrecy over a three-year period, under the code-name 'Project 710', the Hydradig rewrites the rulebook on wheeled excavators**

**JCB'S HYDRADIG CAN LIFT 1,000KG OF LOAD AT FULL REACH OVER 360° OFF SINGLE TIRES WITHOUT THE USE OF STABILIZERS**





## CASE STUDY

The five key concepts of visibility, stability, mobility, maneuverability and serviceability became some sort of mantra at the Hydradig launch

to pedestrians or to a workmate standing in a shallow trench.”

There is also a need for increased stability as wheeled excavators are being increasingly used for loading, heavy lifting and placing bulk or bagged materials. Traditional models may offer good stability, but this is a result of their large rear overhang. “Customers are requesting reduced tailswing, a smaller physical size, but with the stability of higher-capacity machines,” he clarified. “They were essentially asking for a compact wheeled excavator that could lift twice the load over the side while having a reduced tailswing!”

“They told us that machines need to move around more and more,” he continued, broaching the topic of mobility. “Many of today’s machines have been designed to sit and dig, so they can’t hit high speeds, they have poor acceleration and they struggle to go uphill.”

That huge counterweight doesn’t particularly promote maneuverability either: “These machines need to turn in ever-tighter spaces. Most wheeled excavators are two-wheel steer with a large rear overhang, making it almost impossible to turn in a confined space.”

The final revelation was just how much customers liked the way smaller machines such as backhoe loaders and Loadalls benefited from ground-level serviceability. “Safety while servicing large excavators is achieved by fitting boxing ring protection on the upper structures. Today’s wheeled excavators need to be serviced and refueled at height [without a] boxing ring. It is neither safe nor practical to perform service checks at height on a small and unprotected upper structure.

“Never before has there been a demand for a solution that cannot



be fulfilled with today’s traditional offerings,” Burnhope summed up.

### Vision for the future

The solution to this conundrum, of course, was the Hydradig 110W. Conveniently, successfully tackling one of the ‘ilities’ often proved to have a beneficial effect on the others, as director of JCB’s Heavy Products division, Mick Mohan, revealed as he discussed visibility: “We looked at the cone of vision, and set ourselves the objective of making sure the operator could see each wheel, with 1m worth of visibility around the machine – that’s something that

**MAIN IMAGE: The ability to lift heavy loads in confined spaces is a prime concern on modern jobsites**

**INSET, FROM LEFT: Placing loads is now a key part of a wheeled excavator’s duties; high stability is crucial while lifting (in this case on to the specially designed trailer – the operator can even see the hitch from within the cab); excellent maneuverability in built-up areas is a boon; operation in urban settings calls for superb levels of visibility; and F1 levels of serviceability result from the ground-level checks**

no one else can do today with a machine this size.” [The Hydradig is roughly equivalent to a traditional 10 metric ton wheeled excavator.]

The first task was therefore to create an unusually asymmetrical upper structure to maximize those sightlines, in conjunction with a specially designed new ROPS/TOPS certified cab incorporating 4.3m<sup>2</sup> of glass (approximately 15% more than a conventional excavator) and the same Command Plus design DNA originally seen on the company’s larger wheeled loaders.

However, Burnhope stressed that visibility is better measured by ‘blind

## “THE CHALLENGE FOR OUR ENGINEERS WAS TO PACKAGE THE LOWER HALF OF THIS MACHINE WITH PARTS THAT TRADITIONALLY SIT AT THE BACK OF AN EXCAVATOR”

Mick Mohan, director of JCB Heavy Products



enabled it to transfer the complete driveline and hydraulic pump into the wheelbase. And as the engine is now side-mounted well over 1m lower, there is no longer a requirement for handrails, mirrors or a rear-view camera.

“That offers some major benefits. Clearly visibility is number one, but by taking all that componentry into the lower half, we’ve significantly lowered the CoG by between 0.5 and 0.75m so the stability is dramatically improved,” Mohan added. “The effect that has on performance is huge in terms of roading, digging and lifting.”

This has resulted in an overall height of under 3m – about 150mm lower than those of the OEM’s major competitors – and has, of course, reduced the superstructure’s weight.

“There’s still 2 tonnes of counterweight there, but it’s weight where it works for the customer,” he clarified. “It is still highly effective – we’ve got a reduced tailswing that is far ahead of the competition [at 120mm this is 29% less than other machines], yet can still lift 1,000kg of load at full reach over 360° off single tires without the use of stabilizers or dozer legs.” This tight configuration also allows it to rotate and change attachments within a single lane of a carriageway.

For even more stability, Hydradig can be fitted with any combination of dozer blades and stabilizer legs at either end of the machine.

That lower CoG planting the machine firmly to the floor results in a very smooth, comfortable ride – its 2.65m wheelbase (longer than that of a 10-ton wheeled excavator) offers near 50:50 weight distribution between the axles, so there is no forward or rear ‘nodding’ while being driven at high speed. The OEM’s Smooth Ride System boom

suspension is optionally available to further improve ride comfort.

As you’d expect, this helps to enhance mobility too. The stepless hydrostatic transmission provides effortless rapid travel, with drive to all four wheels and top speed options of 20km/h and 40km/h. “It’s simply press and go – we wanted it to be as simple as possible for the operator, not like on some competitor models where they have to stop to change ratios or gears,” explained Mohan.

A Bosch Rexroth system is used, providing drive via a variable piston pump and a variable piston drive motor, through a central transfer box and then to both axles. With this layout, there is no requirement for multiple gears or any break in tractive effort as speed changes.

“It’s an excellent hill climber, the transmission adjusting to the slopes to deliver constant engine power,” Burnhope added. “There are three mobility modes: highway mode, which isolates the upper structure and dig end for traveling at speed; site mode, which limits it to 20km/h with all hydraulic services available; and creep mode, with a speed limiter to ensure precision control.”

### Star turn

The latter mode will certainly help boost maneuverability, along with other design concepts taken from the Loadall. Its extended all-wheel steer chassis incorporates the telehandler’s in-house SD70 axles, providing two-wheel, four-wheel and crab steer modes. An innovative optional feature is the push-button operated reverse steer function, which provides intuitive steering control in all modes by changing the direction of the steering wheels when the cab is ‘turned’ 180°.

“A front axle with 16° of oscillation and constant 4WD means rough-terrain traction and

spot’ plots: “We have carried these out against all of the competition and we have notable percentage improvements – for obvious reasons based on the platform architecture and the lower belt line on the right-hand side, but also due to the care we took to minimize large pillar sections.”

“That was the easy part,” Mohan continued. “The challenge for our engineers was to package the lower half of this machine with parts that traditionally sit at the back of an excavator.” The chassis therefore conveniently resembles that of a telehandler, so the company’s huge experience in that sector has



## CASE STUDY

maneuverability is outstanding," claimed Burnhope. "It offers an incredibly tight turning radius of 3,946mm on single tires and 4,511mm when equipped with a front-mounted dozer blade." The machine can also be ordered with extra-wide flotation tires or twin tires on each axle.

As you'd imagine, dropping all those major components down into the chassis hasn't just improved stability – Mohan claimed that, using the standard SAE rating for serviceability, this aspect is 33% better than the closest competitor. A wide-opening steel canopy provides complete ground-level access to the same side-mounted cooling pack and engine configuration as used in the Loadalls – and, of course, its 81kW Ecomax T4i engine requires no DPF.

Panels on the other side provide access to the battery pack, diesel and hydraulic tanks. All boom and arm pins are nitro-carbonized and bushes are carbon-bronze to extend greasing intervals to 500 hours and further reduce downtime.

"All daily checks are undertaken at ground level so there's no need to climb on the machine and work at height," reiterated Burnhope. "It will also come with a five-year LiveLink telematics contract as standard, so customers can remotely monitor fuel use and operating data." LiveLink also delivers improved security, by enabling geofenced operation and

pairing with the machine's ECU to prevent unauthorized engine starting.

### Digger and better

After such a torrent of advantages, it suddenly dawned on me that the topic of digging hadn't really been addressed. Was that because this excavator is rubbish at excavating, I cheekily asked Burnhope? "It's designed to dig and has plenty of power!" he confirmed. "The closed-loop hydrostatic system has separate pumps for traction and boom power, making it easy to multifunction the dig end." A high-flow auxiliary circuit comes as standard, and the machine can also be equipped with low-flow and quick-hitch dedicated circuits.

"The electrohydraulic controls are very precise, driving the digger end on the kingpost, which has a full 120° of additional movement to get the bucket close to the dozer blade, which is so important in confined working

spaces," Mohan added. Around 50 JCB attachments and a variety of tilt rotators are compatible.

"This was an idea borne out of customer need, an opportunity to do something different through innovation – this could only have happened in a family business with a culture of never being content," concluded Burnhope as he invited JCB's chairman, Lord Bamford, to make the closing remarks.

"We've broken the mold," he began. "This really answers all those problems. I'm probably to blame for the name; it really came from Hydra-Digga, the name my mother came up with for my father's first backhoe loader. We try to give names to new families because I don't like them just being a number. This is Hydradig and then a number, so maybe there'll be a family of these – in fact, I know jolly well there'll be a family!"

More details of how extended this family will be aren't yet available, but you suspect that, given its immediate success, it won't be too long before we see the next one. Within a month or so of the launch, full production began in response to hundreds of orders, creating around 85 jobs for engineers, welders and assembly-line employees. It even appears that some of Hydradig's innovations could make their way into JCB's future crawler excavators too – although the OEM is remaining tight-lipped on the topic.

"The launch of the Hydradig is not only one of the most significant launches in the company's history, it is also one of the most successful," said CEO Graeme Macdonald. "The response has been unprecedented and we have very high hopes for this revolutionary new product."

It certainly appears to be a timely product anyway. While this latest innovation will presumably take a bite out of sales of one of JCB's core products, the backhoe loader market is in gradual decline as operators in the West, at least, graduate to more specialist equipment. By producing a highly mobile excavator that also offers the exceptional handling and tool-carrying characteristics of a telehandler, JCB may well have, as Tim Burnhope said, built a machine that will change not just how it, but how the entire construction industry operates in the 21<sup>st</sup> century. **ivT**

MAIN IMAGE: Tim Burnhope pictured with the Hydradig and the rapid prototype models of the 3CX Compact and DualTech VT variable transmission (see page 78)

INSET: Not to be confused with JCB's first backhoe loader (although you could see all four 'wheels' from the driver's seat even back then!)



### ON THE WEB

View the Hydradig video and more images at:  
[www.ivTinternational.com](http://www.ivTinternational.com)



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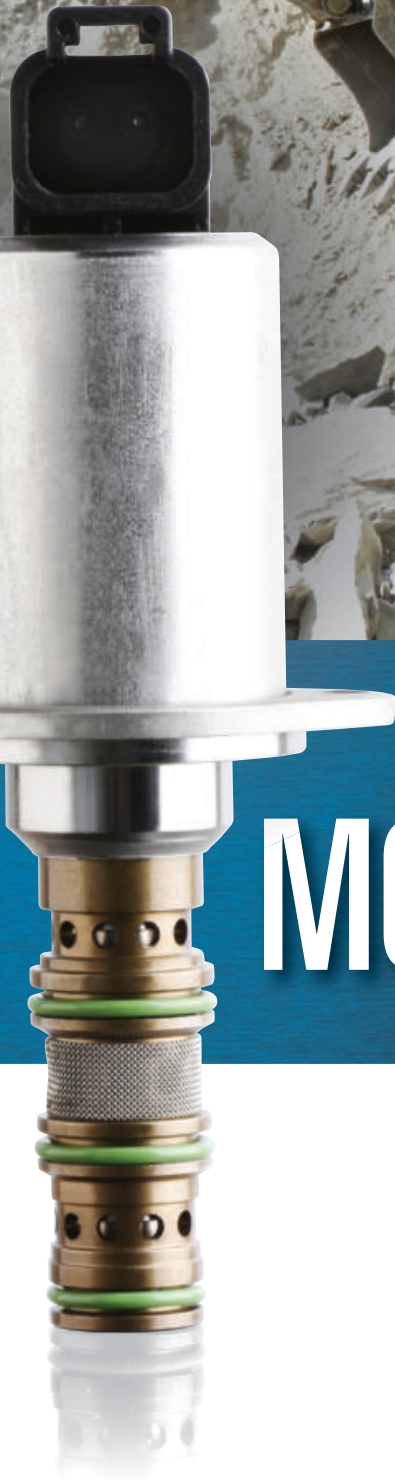
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ALBACH'S NEW SELF-PROPELLED WOODCHIPPER IS A WOODSMAN'S BEST FRIEND, WHETHER THROUGH ITS REDUCED 'DOWNTIME' DUE TO 70KM/H ON-ROAD SPEEDS OR THE PROCESSING OF HUGE QUANTITIES OF WASTE WOOD WITH MINIMUM FUSS

# Diamant in the rough





▶ Not all timber is fit to be used for floorboards or furniture, but woodland waste can still meet an economic end through conversion to woodchip. Turning trunks into chips, though, demands strength, precision – and plenty of power.

If there was a market for machines to make molehills out of mountains, it's likely that Albach would be chief among its protagonists. As it is, the forestry equipment manufacturer does something very similar – but with timber rather than rock.

Watch one of the German company's Diamant 2000 chippers chew up a tree trunk and spit it out into a heap of chippings, and it is hard not to be impressed by the way in which it converts waste wood into material suitable for power generation via burning, and a wide range of landscaping uses. But not long ago, neither the company nor the concept of an on/off-road self-propelled chipper existed.

In fact, Albach was created in 2006 to design and manufacture what was claimed at its launch to be the world's first self-propelled machine

of its type. So, ever since the company's foundation by German engineers Richard Alzinger, Franz Bachmaier and Michael Bachmaier, aside from a handful of custom manufacturing projects, it has focused series production on self-propelled chippers.

Up to that point, most chippers on the market were either customized trucks well suited to speedy highway travel between jobs but suffering with accessibility issues in the forest, or tractor-trailed machines that could easily access woodlands but were slow on the road.

Albach's answer was to create a machine that, much like a timber forwarder, was self-propelled and self-loading, speeding up operations both at and between sites. However, unlike a forwarder, the conditions in which the machine was expected to perform called for a design that incorporated a rigid chassis along with four-wheel steering and large-diameter wheel/tire equipment providing high clearance.

The result was the Silvator 2000, launched in 2008. Equipped with a

The successor to Albach's first machine, the Silvator, the new Diamant 2000 self-propelled chipper has a much higher top travel speed

**TECH SPEC: DIAMANT 2000**

Height (with cabin lifted)	3.94m (4.79m eye level)
Weight	32,000kg
Tires	650/65 R42

**Chipper**

Infeed width (inc. feed rolls)	1.22 (1.72)m
Infeed height	0.98m
Rotor speed	Up to 420rpm
Max. throughput	440m <sup>3</sup> /hr
Retraction speed	Variable (dependent on material) 3-step control

Rotor diameter	1.04m
Quantity of knives	6, 8 or 12
Rotor drive	Mechanical

**Processor**

Number of rotor blades	6
Rotor speed	270–700rpm
Rotor diameter	1.2m
Rotor weight	2,400kg
Rotation angle chute	240°
Chute length	6.1m

**Crane**

Crane	Palfinger 10F
Reach	10.0m
Length	10.33m
Width	2.54m

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## CASE STUDY

hydromechanical drivetrain that enabled the machine to power its way through typically tough post-harvest forest terrain yet still propel it at close to 50km/h between forest sites to reach the next job, it also featured a side-mounted intake 2.0m wide by 1.0m high, fed by an integral fold-down conveyor and the machine's own loading arm. This was therefore the first on/off road solution to processing timber waste in the forest.

However, with the industry becoming more concentrated – but at the same time more fragmented as fewer, larger operators look after bigger areas – higher output became a matter not just of being able to chip material quickly and precisely, but also of being able to reach the next job quickly. Time on the road, spent traveling rather than chipping, is, in essence, downtime. In an effort to minimize this, the team behind the Silvator therefore began to develop a machine capable of higher travel speeds, and with more processing power into the bargain.

"Its 44km/h top legal travel speed was okay for minor roads, but along main highways, was too slow to keep pace with modern traffic – indeed it doesn't meet legal minimum speed requirements in many countries," says Albert Gaul, engineer at Albach.

"This was the key demand from Silvator customers looking to improve the output of their operations. They were pleased with what the machine was capable of in the forest and in other chipping situations, but they wanted less downtime on the road. So in order to meet that need, while also boosting chipping performance, we started to design an upgraded model, the Diamant 2000."

### Power talks

Turning trees into chips is a power-hungry process, and although the 450kW (612hp) provided by the Silvator's Mercedes-Benz OM 502 LA V8 had proved sufficient to meet most customers' demands, it was decided that, to meet the Stage IV/Tier 4 Final emissions regulations under which the Diamant would ultimately operate, a reassessment of potential power sources was called for.

"We talked to a number of manufacturers about what we were looking for in an engine," says Gaul. "With the new machine, we were seeking something that could handle not only the high torque demands of intensive chipping of tough material, but also an engine that would be responsive on the road, given our planned transmission upgrade to increase travel speed.



Volvo Penta's brief when it began working alongside Albach was to come up with a compact yet powerful engine solution to fit the design and application of the Diamant

"As we are a relatively low-volume manufacturer, we also wanted to work with a firm that would give us the same level of commitment that they would a larger buyer.

"Volvo Penta was particularly responsive and enthusiastic when we explained what we were looking for, and the light weight and compact dimensions of its engines impressed us, particularly given their power density and fuel efficiency."

The two companies began working together on the Diamant 2000 project three years ago, with Volvo Penta providing full backing and access to engineering expertise by supporting Albach with application engineers who advised on driveline integration, and by assigning to the OEM a dedicated engineer to provide quick answers and advice as the project progressed.

"When working with major component providers, I think it's essential as a designer and engineer of a machine project to have one person from a supplier involved throughout," says Gaul. "Having a dedicated contact who is available

**"WE WERE SEEKING SOMETHING THAT COULD HANDLE NOT ONLY THE HIGH TORQUE DEMANDS OF INTENSIVE CHIPPING OF TOUGH MATERIAL, BUT ALSO AN ENGINE THAT WOULD BE RESPONSIVE ON THE ROAD"**



The rotor operates from 270-700rpm to process everything from unwanted trunks to branches to create woodchip



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to have face-to-face discussions on requirements and progress is an important part of the process.”

After being trialled in one of Albach’s machines for the first time during 2014, undergoing extended 1,000-hour testing of its reliability and efficiency, Volvo Penta’s TAD16 series unit was finally chosen as the powerplant for the Diamant 2000.

“Our brief was to come up with a compact yet powerful solution to fit the design and application of the machine,” says Miron Thoms, head of industrial engines for Volvo Penta Central Europe.

“At the same time, given the demanding nature of the work, it needed to be as fuel efficient as possible. Albach did everything it could with the design of the Diamant 2000 to minimize fuel consumption and maximize productivity, and our aim was to contribute as much as possible from our side.”

The switch in engine source also marked a change in configuration, with a move away from V8 format to a more compact in-line six-cylinder unit. For the Diamant, Volvo Penta supplies the 16-liter TAD, which incorporates SCR technology to meet the latest emissions legislation, in three power ratings of 450kW (612hp), 515kW (700hp) and 565kW (768hp). In its two smaller variants, as the TAD1671VE and TAD1672VE, the engine produces maximum power at 1,800-1,900rpm and peak torque of over 1,000Nm (on the latter unit) at 1,800rpm. The largest engine, meanwhile, is the engine brake-equipped TAD1643VE-B.

Volvo Penta’s new 16-liter diesel range has been developed in answer to customer requirements for a reliable, compact and cost-effective off-road industrial power unit, says Naval Singh, the company’s global segment specialist in mining and construction. “OEMs and end users expressed their desire to find an



Volvo Penta supplies the 16-liter TAD, which incorporates SCR technology to meet the latest emissions legislation



LEFT & ABOVE: The cabin can be raised to 3.94m, and the operator’s seat and controls can be rotated through 180° to provide complete visibility of the work at hand

alternative to the bigger 19- and 20-liter engines that would give them similar power while suiting mobile applications where engine weight, dimensions and limited space are prime concerns.

“This new product is an example of close cooperation between the customer and the manufacturer,” says Singh. “The idea and the push came from our existing customers.”

**“WHEN WORKING WITH MAJOR COMPONENT PROVIDERS, I THINK IT’S ESSENTIAL AS A DESIGNER AND ENGINEER OF A MACHINE PROJECT TO HAVE ONE PERSON FROM A SUPPLIER WHO IS INVOLVED THROUGHOUT”**

The TAD1643VE-B incorporates a new water-cooled turbocharger with electronically controlled wastegate, new fuel injectors and more efficient combustion for improved fuel consumption and lower operating costs. Meanwhile, Volvo Group’s patented technology offers 250kW engine braking performance and 10 times greater engine brake capacity than on previous comparable models.

“It also produces an extended torque curve,” elaborates Singh, “allowing for better performance across a wider RPM range, particularly at the lower end.”

### Speed counts

The engine has three primary areas to oversee in the Diamant – putting power to the wheels; operating its hydraulic functions to control the stabilizers, intake, chute and cab height; and powering the processing element – i.e., the intake conveyor, chipping rotor and the distribution outlet that propels the resulting material into a heap or trailer.

For the first of those roles, and to achieve the considerable jump in top travel speed from a possible 50km/h to 70km/h, it works in combination with a 2-speed hydromechanical Omsi transmission. This incorporates a gearbox on each axle, with power transfer via a dual-clutch system. Bosch Rexroth wheel motors power all four wheels full time.

## CASE STUDY

On the road, when traveling above 20km/h, the transmission has an automatic shift feature, while an eco-drive mode can also be used to save fuel by way of a slower throttle response. The Diamant benefits from full-time 4WD and a pneumatically engaged differential lock.

"In line with uprating the transmission, we obviously also had to ensure that the other elements of the machine were capable of handling higher speeds," says Gaul. "We wanted this to be the market's first self-propelled chipper able to travel between worksites by using main highways, so it had to be capable and road legal at 70km/h (45mph). That meant we had to incorporate an antilock braking system for the first time.

"But the off-road capabilities of this machine are still of primary importance. The design was based around a central tubular frame that allowed us to increase the steering lock of the front axle by more than 30%, and when coupled with all-wheel steering and a reduction in machine width to 2.55m, this considerably improved in-forest maneuverability."

To handle forest inclines, the machine incorporates what Albach terms 'monSystem', a combination of suspension and slope compensation that automatically inclines the axles by up to 7.2° by way of four hydraulic suspension cylinders. A highway mode switch retracts the stabilizers and disengages the brakes, and vice versa, to prepare the machine for travel on/off the road in under 20 seconds. Meanwhile, a central lubrication system and automatically reversing engine-cooling fan reduce maintenance downtime.

### Prolific output

Albach also redesigned the chipping rotor in the Diamant so as to reduce overall energy consumption and the creation of dust. Weighing 2,400kg, the rotor has also benefited from improvements in geometry to

**Weighing 2,400kg, the rotor has also benefited from improvements in geometry to provide an overall output increase of 15% over the Silvator**



provide an overall output increase of 15% over the Silvator. Equipped with six, eight or 12 blades, plus two knives, its counterweights for six- or eight-blade usage ensure a rotationally symmetric blade distribution and a smooth, fluent and energy-efficient cut. The counter blade also has an automatic traction feature to prevent damage caused by foreign material, while wear parts are manufactured from Hardox steel so as to stretch maintenance intervals and decrease maintenance costs.

**TOP: The Palfinger-supplied crane ensures efficient transfer of wood through the rotor**

**ABOVE: The well-specced cabin was developed in-house by Albach, with seating sourced from König**

A 240° swiveling chute with up to 3.0m height adjustment transfers chips into trucks or can be used to form a heap to be later shifted via a wheeled loader. The extended angle of the chute enables trucks to stand by in virtually any position, while a new feature of the Diamant 2000 is the ability to turn the chute to point over the cabin during the ejection of chips. Trucks can also be filled sideways over the cowl, allowing the use of multiple trucks at the same time and so reducing the idle time caused by shunting. Its output is claimed to be up to 380m<sup>3</sup>/hr.

Albach has also worked with fellow German off-highway OEM Ropa on a transfer/loading device, which uses the latter's self-propelled Euro Maus loader, more commonly used for shifting piles of sugar beet, to load heaps of chips created earlier by the Diamant, in a process that eliminates the constant forward/reverse shuttling that is the nature of more commonplace loading systems.

The operator benefits from an air-sprung cabin that can be raised hydraulically up to a height of 3.94m to provide all-around visibility. The seat is sourced from König and offers 180° swiveling capability to enable the operator to face the direction of travel or provide the best view of the work, eliminating the need to face the design and cost challenges of a more complex rotating cab design.

New software for the machine's electronic management systems has been made in-house by Albach, and is supplied with 14 languages as standard, while further languages can be manually integrated. The touchscreen terminal offers full data downloading capability via a flash drive port to allow performance and order data to be exported.

And to speed by those long days in the forest, not only is there full climate control and a sound system, but also an integrated cupboard system containing a fridge and a microwave. What more could a woodsman want? **ivT**

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# Raising

**AS OPERATORS CONTINUE TO DEMAND EVER-GREATER FUNCTIONALITY, PRODUCTIVITY AND CAPABILITIES, HAS THE ROLE MOBILE HYDRAULICS CAN PLAY REACHED ITS LIMIT? AND IF SO, WHAT CAN BE DONE ABOUT IT?**

▷ Hydraulic systems have been common elements on mobile equipment for many years and their basic principles and components are well understood and established. Manufacturers of today's systems are therefore now working to provide their systems with more 'intelligence' so as to offer their OEM customers optimized systems that meet their ever-growing demands.

Andreas Kling, EMEA product group manager at Eaton Hydraulics, says, "End users are demanding more from their equipment. They want to maximize performance and productivity while minimizing operating costs. They want better safety and improved reliability, as well as more simplicity and less complexity."

"The industry is moving to smarter, more efficient machines," he continues. "It's no longer just about components; it's about how they can connect to create intelligent subsystems that will dynamically adapt and respond. Electrohydraulic systems aren't a vision for the future – they're a requirement for today."

"We're not only changing the way end users operate mobile and industrial machines – we're also significantly improving the way OEMs design and build them."

This was a sentiment echoed by Bosch Rexroth's Mobile Applications president, Dr Bertram Hoffmann, at a recent conference, where he informed the audience, "Connectivity is becoming an important topic. It is a prerequisite for integrated systems

the bar

## MOBILE HYDRAULICS

and also construction machines.” The use of electronics is the key to meeting other needs as well, he added, such as lower engine emissions and the development of specific customized solutions.

He elaborated, “Connectivity is *the* topic of the future. At Bosch Rexroth, we are concentrating on increasing the availability of our components and modules in the field with a particular emphasis on new maintenance concepts. All models are based on the concept that machinery is equipped with intelligent components that record and forward information on a machine’s operating status.

“To achieve this, we constantly expand our range of sensors, such as position, temperature and pressure sensors, and integrate them into the hydraulic systems. This creates the prerequisites for functional diagnosis and logging of measured data in our electrified drive solutions, which in turn allows for state-dependent maintenance, thereby ensuring optimum machine availability.

“A good example is our new A4VG series 35 axial piston variable pump. Using an open interface, it forwards previously recorded sensor data to the machine’s control unit. The control unit ... is connected to the OEM’s cloud via the internet.”

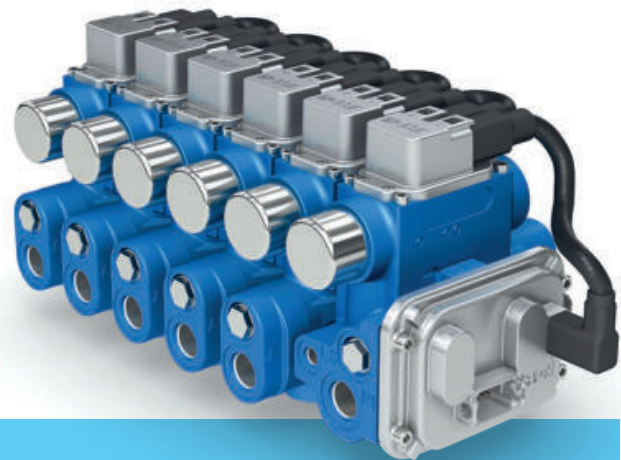
Eaton’s Kling confirms, “We have reached the limits of performance optimization in traditional solutions – in terms of what is mechanically possible. Nowadays, advanced vehicles combine a number of mechanical systems that must function reliably within rigid parameters. These systems must work flawlessly, enduring thermal shocks, heavy vibration and often climbing and descending hills on a 60° slope.

“Response time, controllability and dynamic machine control are becoming even more important. Also, simplified manufacturing and improved service periods are key. That is why we truly believe that electrohydraulic solutions will change the way we design, build, operate and service the hydraulic systems of the future.

“We see an increasing trend of electrohydraulic solutions being integrated in order to increase productivity, decrease both manufacturing and operational costs, and, generally speaking, shorten the machine design period.

“Our Dynamic Machine Control [DMC] program is driving the future requirements for integrating pumps, motors and valves with electronics and sensors (i.e., pressure, flow, oil temperature, condition monitoring) for our customers. As the working pressures increase – up to 500 bar in closed-loop applications – the

BELOW: Eaton’s CMA90 CAN-enabled electrohydraulic sectional mobile valve features independent metering with pressure and position sensors, onboard electronics, and advanced software control algorithms



## DISPLACEMENT ACTIVITIES

The use of electronic controls and high-speed on-off valves could be a major disruptive technology in off-highway, revolutionizing how hydraulic systems are designed and potentially eliminating system-level inefficiencies, suboptimal control schemes, and space claim issues. The newly emerging technology of digital displacement hydraulic pumps and motors uses pistons that maintain a constant stroke regardless of effective displacement, via fine control of an inlet and outlet valve at each cylinder in a phased relationship to crankshaft position.

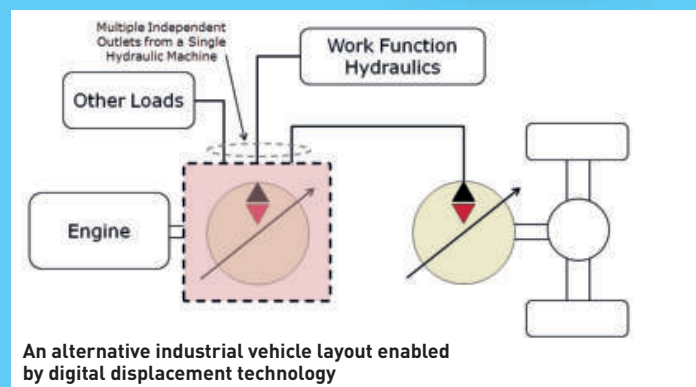
A digital pump is effectively a more complex variable-displacement open-circuit pump, with a tank port and flow delivered only from its high-pressure port. But it can also receive flow from a high-pressure source, rather like a variable open-circuit pump that can go ‘over-center’, reversing the flow.

The technology can even eliminate the need for proportional valves between the pump and the load. This ‘direct-cylinder control’ architecture is only possible due to the extremely fast and

stable response characteristics, and eliminates potential throttling losses.

The technology is well suited for subsystems where the shaft is driven by a prime mover. For applications such as propulsion, a digital motor is ideal, drawing on its additional internal functionality to allow starting from zero shaft speed at high torque. A final drive digital motor can be commanded to provide positive or negative torque when spinning in either direction; an arrangement enabling the integration of energy storage in the high-pressure line to allow for energy recovery and reuse. Adding a hydraulic accumulator on the outlet port will store otherwise wasted energy, whether from the engine, braking or load lowering for potential reuse by the machine.

As the flow from individual pistons/cylinders is controlled independently from one another, the system designer enjoys far more flexibility in choosing how to combine these flows into net output flows, as a single pump assembly can serve multiple consumers. When sizing the entire system, the working



An alternative industrial vehicle layout enabled by digital displacement technology

and propulsion requirements can now be considered together, to capitalize on synergies and reduce installation package size. When high flows are required for high-speed driving, for example, displacement can be taken from the working hydraulics, which reduces engine RPM – as well as fuel consumption – and the total installed pump displacement. As a result of the superb shaft-to-shaft overall efficiencies, OEMs can now enjoy the efficiency of a powersplit transmission

with the reliability of a high-torque, infinitely variable transmission.

The software parameters can also be easily adjusted to create specific drive behavior, even mimicking the very soft drive feel of a torque converter powershift transmission, or the increasingly aggressive drive response of a hydrostatic drivetrain.

### ON THE WEB

This is a brief summary of a white paper written by Danfoss, which can be found online at: [www.iVTinternational.com](http://www.iVTinternational.com)

## MOBILE HYDRAULICS

components must also operate safely at these higher pressure levels.

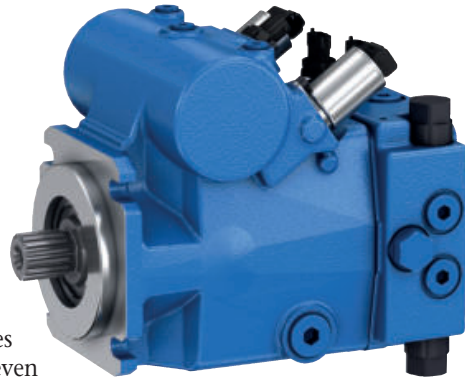
“New products offer much more functionality, such as integrated sensors featuring built-in software functions. This considerably reduces total manufacturing costs, while offering functions never thought of before.”

Machine design does not have to be a highly labor-intensive, months-long process, however. Featuring easy-to-use software tools and a robust library of pre-programmed function blocks, Eaton's Pro-FX Technology Platform enables OEM engineers to connect and configure Pro-FX Ready products in minutes.

According to Kling, Eaton's new CMA advanced mobile valve with independent metering, for example, features embedded intelligence. This intelligence enables end users to

interact, adapt and optimize the performance of the machine in continually changing conditions. At the same time, its flexible architecture reduces routing complexity, reduces hose lengths and even provides improved weight distributions on the vehicle chassis.

“The market trend in the design of hydrostatic drive systems for agricultural and construction machines goes toward higher flow rates, increased working pressures and greater performance,” he adds. “In order to reduce weight, conserve energy and improve the performance



ABOVE: Rexroth's A4VG series 35 axial piston variable pump sends sensor data to the machine's ECU

of mobile machines, the industry is moving forward using hydraulic pumps for the hydrostatic drive system, providing up to 500 bar.

“As a result, Eaton Hydraulics has developed a technical solution for its fluid conveyance product using a spiral hose, which can be used for high-pressure applications without impacting on ease of installation, weight or bend radius. Dynamax EC850 multibend hose and fittings match perfectly to the requirements of the hydrostatic drive of agricultural machines. Together with a leading agricultural machine builder, we are now implementing this new fluid conveyance technology.”

### The OEM perspective

Although Bertram Hoffmann referred to ‘connectivity’ in a system context, it's a word that can be applied equally to the relationship between OEMs and their hydraulic system suppliers. JCB's director of engineering research and development, Simon Ratcliffe, told *iVT* that the company is working ever closer with its hydraulic system suppliers during the design of its new



**“CONNECTIVITY IS THE TOPIC OF THE FUTURE. AT BOSCH REXROTH, WE ARE CONCENTRATING ON INCREASING THE AVAILABILITY OF OUR COMPONENTS AND MODULES IN THE FIELD”**

Dr Bertram Hoffmann, president, Bosch Rexroth's Mobile Applications division

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## MOBILE HYDRAULICS



models to tailor the hydraulics to ideally suit the machine.

"It's all about efficiency and lowering the cost of ownership, as demanded by our customers, by providing maximum productivity," he explains. "The key new element is a quick working cycle, although controllability is crucial. It's a matter of providing the operator with the ability to get it right first time every time, while making the machine easy to use. Looking to the future, we need to be looking at improving the efficiency of valve blocks and then there is the potential use of an alternative control architecture, but the question is, how does this technique fit with construction equipment?"

"Energy recovery also offers potential for the future but fully understanding the duty cycle is key to making this efficient," Ratcliffe continues. "Also, we want future systems to use less power. Then we come to the fluids that drive the system – is it possible to find a non-hydrocarbon-based solution, especially as oil is a finite and expensive resource? Water/oil emulsions are used in mining, but with water you introduce the associated corrosion implications. Another area that could be looked at is having hydraulic fluids that last the lifetime of the machine."

### It's what you do with it that counts

John Deere's product marketing manager, crop care, for the EU28,

**ABOVE: Standardization of hydraulic connectors is more important than higher flow rates and pressures, according to John Deere's Mark James**

## ADDRESSING NVH

Noise and vibration reduction is another major area of concern, according to Danilo Persici, an R&D engineer at Marzocchi Pompe who explains that, "These requirements have increased considerably of late due to the strict environmental regulations introduced in industrialized countries. Noise emanating from industrial vehicles was once seen as a much less pressing concern than limiting harmful emissions, but the EU already has extensive legislation in place designed to reduce NVH [noise, vibration, harshness] and provide a much more comfortable environment for vehicle operators, not to mention anyone within hearing distance. Demand for quieter products is particularly high in Europe and North America. It is now clear that operating with noisy machinery has become a burden, so attention to this has increased."

In addition to high performance and low noise, the market is increasingly calling for greater reliability and extremely low contamination levels, he adds.

Mark James, points out that hydraulic system design for agricultural equipment – and particularly where tractors are concerned – is generally determined by the implements that the machine is likely to be used with. This then dictates the flow rates, the oil tank capacity (a major factor) and the number and type of outlets.

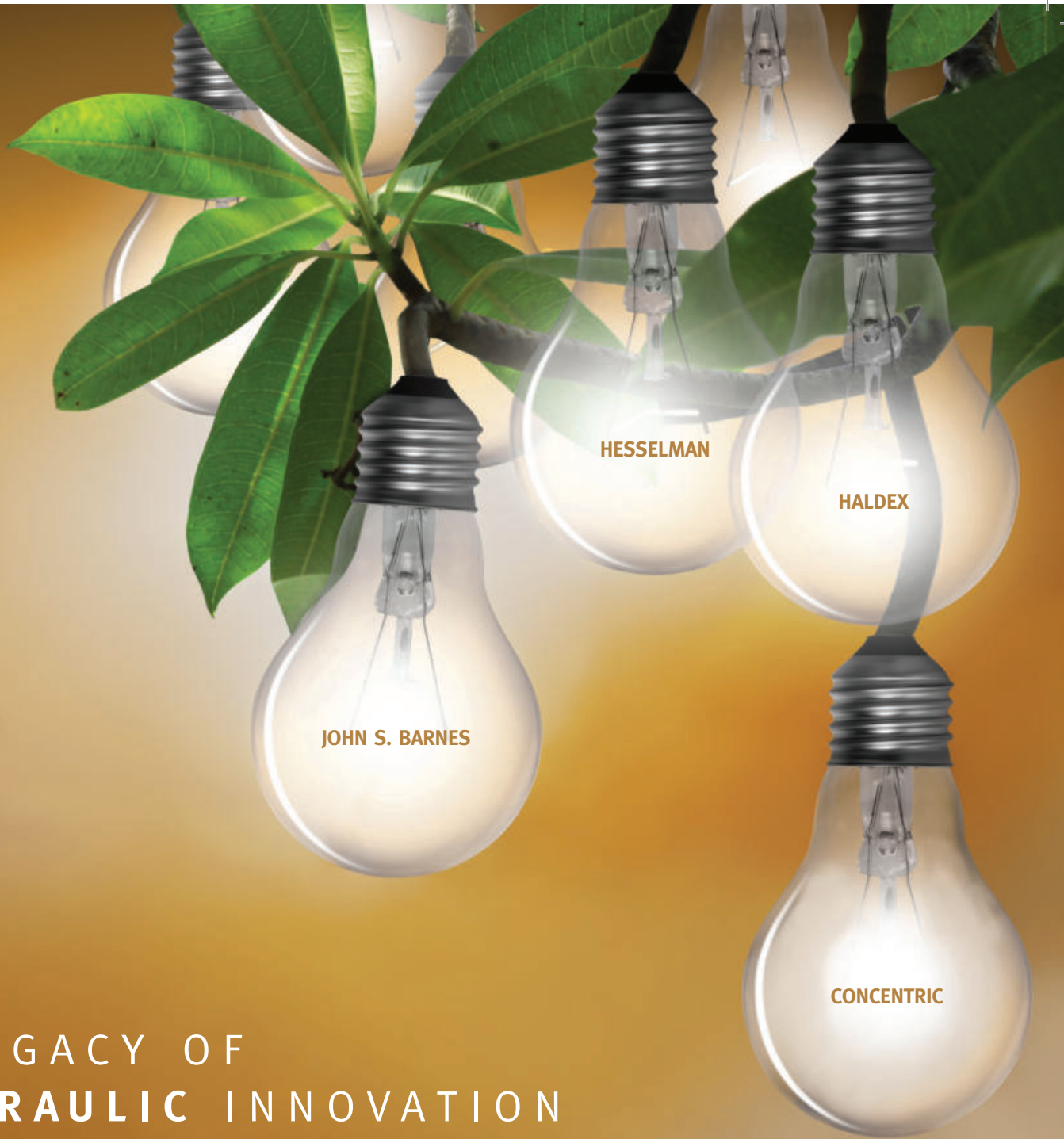
With the latter, and particularly load-sensing connectors, there are countless configurations in use on implements, meaning that dealers and users will often have to make changes. "For us, then, hydraulic connector standardization would therefore be an important future goal. Flow rates and pressures are not an issue," he states.

These load-sensing connectors are increasingly to be found on implements as part of the effort to produce machines that optimize themselves to use the lowest possible amount of fuel. John Deere also aims to minimize the volume of oil being

carried by the machine, while still being able to operate even the most demanding implement efficiently.

"The biggest change in recent years is the move to the use of electrohydraulic systems from their mechanically actuated counterparts," he observes. "This has enabled the development of control systems that allow the operator to program a sequence of events that involve multiple hydraulic activations – all with individual timings and individual flow rates, that can be initiated with the push of a button, or even fully automated and activated by GPS, such as turning a machine around at a headland."

Another major change over recent years, he adds, has been the increasing availability of load-sensing implements as part of the effort to produce machines that optimize themselves to use the lowest possible amount of fuel. It would appear that the mobile hydraulics world is moving firmly into the digital age. **ivT**



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# Monitor wizards

AS THE INTERNET OF THINGS BEGINS TO TAKE HOLD, SMART COMPONENTS THAT OFFER CONDITION-BASED MONITORING AND DIAGNOSTICS COULD BE THE MAGIC FORMULA THAT MEANS UNEXPECTED DOWNTIME BECOMES A THING OF THE PAST

▶ In response to the rise of low-cost country sourcing and its impact on their output, western manufacturers in all sectors have increasingly begun to rely on two key weapons: their engineering expertise and their access to the latest technologies. The automotive industry in the UK, for instance, may be a shadow of its former glory in terms of volumes, but virtually all of Formula 1's R&D innovation is carried out there.

Likewise, if you're a manufacturer of easily reproducible components, a key way to maintain your dominance is to add extra value by making them 'smart'. Dana's Spicer Smart Suite technology, for instance, converts the humble axle into a source of fully integrated, connected-vehicle features that turn operating data from the drivetrain into actionable insights for enhancing productivity,

improving operator and machine safety, as well as reduced TCO.

"Dana is actively developing a wide selection of leading-edge technologies that can transform passive drivetrain components into intelligent, powerful forces for boosting performance," says Aziz Aghili, president of Dana Off-Highway Driveline Technologies.

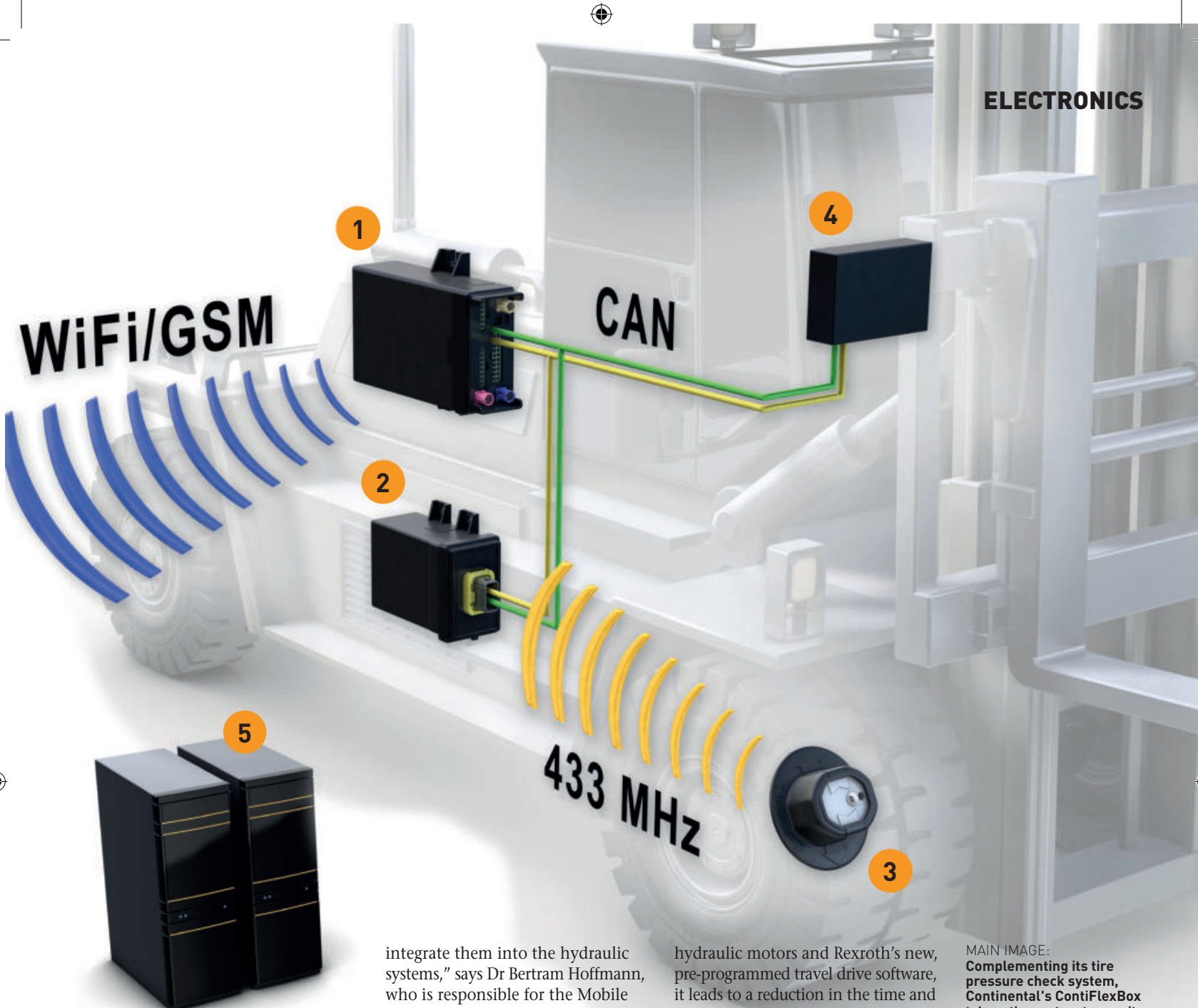
Spicer Smart Suite is an integrated system that manages, communicates and acts upon data sourced from the drivetrain. A host of sensors provide up-to-the-minute status reports on steering angle, input and output speeds, torque management, load monitoring and condition monitoring of items such as brakes and seals. This technology provides deep, accurate insights into vehicle performance, giving actionable insights on and off the vehicle, allowing critical alerts and analysis to be shared on vehicle central display panels, via tablets, and

in fleet management centers. It's also designed to take these insights a step further by performing key functions independent of operator intervention.

The technology enhances the intelligence drawn from drivetrain components through a solution that includes sensors that capture data from key drivetrain operating processes; computing capabilities that consolidate, manage and analyze data; and compatibility with common vehicle communication protocols and telematics systems.

The technology is fully integrated into component housings, delivering optimum packaging and ensuring that sensitive mechatronic subsystems are fully 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 all over the vehicle to more effectively prevent tip-overs, provide better estimates of static loads, and supply much more intelligent calibration management.

#### Status update: fluid power

Bosch Rexroth is now placing a great deal of emphasis on new maintenance concepts. All models are based on the concept that machinery is equipped with intelligent components that record and forward information on a machine's operating status.

"To achieve this, we constantly expand our range of sensors and

integrate them into the hydraulic systems," says Dr Bertram Hoffmann, who is responsible for the Mobile Applications business unit. "This creates the prerequisites for functional diagnosis and logging of measured data in electrified drive solutions – which in turn allows for state-dependent maintenance, ensuring optimum machine availability."

As an example, he cites the new A4VG series 35 axial piston variable pump, which Rexroth says is already designed for the requirements of future electrified travel drives with their integrated sensors and higher burst strength. Using an open interface, it forwards previously recorded sensor data to the vehicle's control unit, which is connected to the OEM's cloud via the internet.

Whether used as an individual component or as a complete solution together with optimally adapted

hydraulic motors and Rexroth's new, pre-programmed travel drive software, it leads to a reduction in the time and money spent on engineering new drive concepts. More and more OEMs are working on new travel drive concepts with higher working pressures and electronic control, with the aim of bringing down consumption and exhaust emissions while improving driving comfort.

Offering a nominal pressure of 400 bar and a maximum pressure of 530 bar, the A4VG series 35 axial piston variable pump is designed for these future requirements, with an integrated extensive sensor package in the short pump, which simplifies the electrification of travel drives in closed circuits.

#### The hose that knows

Few component breakdowns have quite the disastrous consequences of

MAIN IMAGE:  
Complementing its tire pressure check system, Continental's ContiFlexBox telematics system transmits tire-related data to a central server

- 1 (& INSET): ContiFlexBox
- 2: Receiver/CCU
- 3: Sensor
- 4: OBd (display)/FMS
- 5: Server



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## THERE'S NO SUBSTITUTE FOR EXPERIENCE

All this Industry 4.0-level of technology may well make it seem that unexpected breakdowns will soon be a thing of the past, but industrial services partner Eriks warns that an overreliance on condition-based monitoring data could actually hamper maintenance teams in their quest to improve plant operational efficiency. The industry risks making vital mistakes if first-hand diagnostic work is phased out in favor of extensive data analysis, according to David Manning-Ohren, an Eriks expert in condition monitoring.

"Our ability to capture vital data has really advanced the potential of condition monitoring in recent years, yet we now find ourselves in a position where we're almost overloaded with it. Given the increase in available information, some in the industry may be guilty of data-grabbing, and trying to let computers rather than a trained engineer undertake the diagnostics," he comments.

Condition monitoring has effectively been around for hundreds of years, stemming from the operators who oiled and greased the mechanical parts within a specific application, being close enough to the application day-in, day-out to notice if something was amiss. "If you don't have the diagnostic capabilities of an engineer equipped with extensive thermodynamic, vibration analysis or flow technology knowledge, then the data you've gathered will be redundant," Manning-Ohren continues. "For example, an inverter can add on noise to a motor that could easily be misconstrued as a bearing defect. Until you can understand vibration signatures and evaluate these with respect to electrical noise versus mechanical noise, you wouldn't necessarily know the difference between the two.

"Ultimately, the devil's in the detail, not the data, when it comes to condition monitoring," he concludes. "While the level of data we can gather as part of the condition monitoring process will undoubtedly pave the way for much greater insight into improving overall process performance, without an expert on hand to undertake the diagnostic and follow up remedial work, the data itself is redundant."

a hydraulic hose assembly failure. Perhaps due to the cover becoming abraded, or premature wear of the tube walls if the hose is bent too far, such a failure could release up to 50 gallons of oil into the environment. In addition to the obvious bills and downtime, the cleaning up costs approximately US\$1,000 per gallon spilled, while US operations also risk potential fines from the EPA.

To prevent potential hose failure, it has long been common practice to swap out all hydraulic hoses at set intervals, say every three years. The true lifespan of a hydraulic hose is difficult to predict, however. Some hoses may not make it that far; others may last much longer. This makes it tricky to determine exactly when a hydraulic hose should be replaced without either discarding a hose with useful life remaining or preventing a failure from occurring.

So it is no surprise that many err on the side of caution with predictive maintenance to keep equipment running. But employing condition-based monitoring systems using technology to monitor the health of a component in real time can actually diagnose issues as they arise, rather than just predicting them based on equations and historical data. It can keep track of the health of each hose, with the need to swap them out only as they near the end of their life.

For example, Eaton's LifeSense hose condition monitoring system electronically monitors the state of the entire length of a hose assembly. The wireless system (a wired system is also available) transmits operating performance data every hour to the



ABOVE: Eaton's LifeSense hydraulic hose condition monitoring system removes both the need for unnecessary replacement and the risk of unexpected failures

BELOW: Spicer Smart Suite technology converts the humble axle into an extremely useful source of data

hose diagnostic unit (HDU), and sends alerts to operators and maintenance crews when issues are detected. The wired HDU continuously monitors 11 hose assemblies, providing a visual alert to signal an impending failure; the wireless unit can continuously monitor 100 assemblies via a 433MHz frequency communication protocol.

The LifeSense system can sense when the hose starts to experience internal fatigue – once this is the case, an alert is generated, allowing maintenance to be scheduled and performed during planned downtime. This system has been demonstrated to realize up to 50% longer hose life.

In a recent customer project, Eaton engineers found that – unbeknown to the customer – a hose was rubbing on another piece of equipment and causing the cover to abrade. After installing the LifeSense system on the machine, the system was able to sense the abrasion and send an automated email alert to the team,



## ELECTRONICS

enabling them to quickly pinpoint where the abrasion was occurring. The customer was able to change the hose out, and adjust it to prevent future abrasion.

Another area of development that supports the Industry 4.0 concept is that of RFID technology opening up new approaches to seal management. RFID chips placed onto seals can facilitate more accurate identification and traceability, greatly simplifying maintenance and replacement tasks.

### Sick and tired

Most car drivers will be familiar with the work of tire pressure sensors, and under the motto 'Tire Intelligence', Continental CST is presenting two smart solutions that extend the technology's scope to all vehicles in the area of intralogistics: the CPC (ContiPressureCheck) system and the ContiFlexbox telematics system. This enables fleets to be managed



ABOVE: CPC features sensors attached to the inside of the tire, safely within a rubber container

BELOW: Daimler's Virtual Technician system (left) and Cummins' Connected Diagnostics tool (right) provide immediate notification of engine faults

more efficiently and safely, while reducing the environmental impact.

CPC continuously measures a tire's air pressure and temperature via sensors attached to the inside by means of a rubber container to ensure high-precision data. The values are transmitted wirelessly to a central control unit and transferred to an in-cab display, providing a constant overview of every tire – even while driving. If the values change due to a gradual loss of pressure or a tire defect, the operator is warned by an audible alarm. This early warning conserves the material, prevents tire damage, and thereby minimizes downtime.

Rolling resistance is reduced as a result of ensuring the correct tire pressure, saving fuel, reducing CO<sub>2</sub> emissions and improving running performance. A handheld measuring tool enables fleet managers to check the tire pressure and temperature of the entire fleet in a very short time.

CPC can be complemented with the ContiFlexbox telematics solution, which will be available from 2017. This will facilitate the collection, display and transmission of tire-related data to a central server. The transmission of all values via WLAN or GSM to the server for analysis and processing will be possible. The development plan also includes the opportunity to forward the data to mobile end devices, as well as to the display in the driver's cab.

A particular advantage of this new telematics system is the simple installation procedure, which will be handled by a team of experienced technicians, ensuring fast deployment and minimal downtime during daily operations. Moreover, the tire pressure monitoring system is also compatible with tubeless tires from all manufacturers' brands, and for vehicles of every size, rendering it exceptionally versatile. **ivT**

## ON THE ROAD AGAIN

**Tim Blakemore** looks at what our heavy-duty on-highway cousins are doing in terms of on-the-go CBM and diagnostics

When Daimler's commercial vehicles boss Wolfgang Bernhard talks about his vision for "the ultimate connected truck" [one that operates 24/7, always fully loaded, never stuck in traffic jams, and is so reliable that unscheduled downtime caused by breakdowns is a thing of the past], hard-nosed vehicle operators may be inclined to sneer. But look a little more closely at what lies behind his comments, especially at recent developments in remote condition monitoring and associated telematics systems, and you soon come to the conclusion that maybe they are not so far-fetched after all.

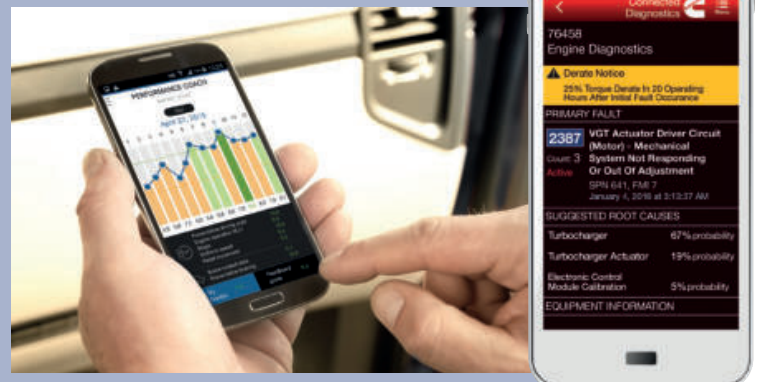
Five years ago, Daimler Trucks North America teamed up with Zonar Systems, a Seattle-based telematics and fleet management software firm, to introduce the Virtual Technician remote fault diagnosis system for Daimler's Detroit truck engines. This is claimed to be the first system of its kind in North America able to remotely determine the cause of an engine's fault code while the vehicle is in operation. At the same time as a warning message appears on the truck's dashboard, a real-time report on the engine's condition is sent to the Detroit

customer support center. This report is quickly analyzed and the operator is sent a recommendation by email or text message within minutes.

Depending on the seriousness of the fault, the recommendation could be for the truck to be driven to a workshop immediately or just for it to be booked in at a more convenient time. So well received has the Detroit Connect system been that no fewer than 185,000 trucks are now said to be employing it. In fact, Daimler recently bought a small stake (of unknown size) in Zonar Systems.

Not to be outdone by an arch-rival, Cummins has been following a similar route with its Connected Diagnostics system in North America. It has teamed up with telematics company DriverTech to provide immediate notification of urgent engine system faults to fleet customers. Cummins then sends recommendations to operators in easy-to-understand reports, avoiding any techno-babble. The combination of the DriverTech DT4000 system and Cummins' Connected Diagnostics, available in North America since April, promises less downtime and improved overall efficiency of equipment powered by Cummins diesel and natural gas engines.

One measure of how seriously Cummins is taking this whole field of connected vehicles is that it now has



appointed John Malina as an executive director of its newly formed business division firmly focused on 'product connectivity'. "Connected Diagnostics' value will enhance our customers' daily operational efficiency as well as support the repair process that may be required," he explains. "We look forward to greater opportunities in the near future with DriverTech."

Tire failures are one of the most common causes of truck breakdowns in Europe. So it is hardly surprising that truck operators have begun to take to the latest tire pressure monitoring systems, even though there is still no sign of legislation forcing them to do so.

Hartwig Kühn is head of the global ContiPressureCheck (CPC) division at

the Hannover, Germany-based Continental group. Such has been the growth in demand for CPC in the past 12 months that Conti has struggled to produce the equipment fast enough, according to Kühn. The CPC system was introduced about three years ago but truck operators initially showed little interest, he admits, primarily because it was incompatible with various fleet management/telematics systems already in service. Now it is compatible, following development work by Continental engineers to ensure that the RFID signals being transmitted by CPC's tire-mounted pressure sensors can be received and interpreted by independent telematics systems such as those from Astrata, MiX Telematics and Verilocation.

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# Commercial brake

ON-HIGHWAY MACHINERY ISN'T OUR USUAL CUP OF TEA, BUT SOME OF THE LATEST DEVELOPMENTS IN HEAVY-DUTY VEHICLE DRIVELINE TECHNOLOGY – SOME OF WHICH WILL NO DOUBT BE IN EVIDENCE AT THE IAA THIS SEPTEMBER – ARE WELL WORTH PAYING ATTENTION TO

▶ Given the recent spate of headlines about wi-fi-linked 'platoons' of commercial trucks and related developments of misleadingly described 'driverless' or 'autonomous' vehicles, a casual observer could be forgiven for assuming that the advanced engineering departments of the major truck manufacturers are doing scarcely anything but work related to the Internet of Things. It is certainly true that the potential for improving the efficiency of increasingly intelligent digital connections – not least through advanced condition monitoring

systems (see *On The Road Again*, p62) – is a top engineering priority.

All this will most certainly be in evidence at the huge biennial IAA commercial vehicles exhibition in Hannover, Germany, in September. However, mechanical engineering developments, especially in terms of drivelines and cabs, continue apace.

#### Twice the performance

One of the most significant developments in engine braking for quite some time – the HPD (high power density) brake from Jacobs Vehicle Systems – was demonstrated

recently to engineers from most of the leading European truck makers at Millbrook Proving Ground, UK.

Five years in the making, the HPD brake follows the established 'compression release' principle to produce braking torque – but manages to create more than twice the braking performance at low engine speed. So the HPD, it is claimed, can produce as much braking effort at an engine speed of 1,400rpm as a conventional Jake Brake can at 2,100rpm.

It does this courtesy of a clever adaptation of the established Jacobs engine-valve control mechanism,



**“THAT TWO-STROKE OPERATION AT 60 BAR GIVES US MORE BRAKING EFFORT THAN FOUR-STROKE OPERATION AT 80 BAR. IT’S QUIETER, AND THERE ARE TWICE AS MANY PULSES GOING INTO THE TURBOCHARGER AT A LOWER PRESSURE”**

**MAIN:** The addition of two crawler gears to Volvo’s I-Shift transmission tremendously improves low-speed performance on tough terrain

**ABOVE RIGHT:** Truck makers from all over Europe attended the demonstration of the HPD at Millbrook Proving Ground

**BELOW:** The latest Jacobs engine valve control mechanism doubles the number of piston strokes on which braking is available



The HPD, it is claimed, can produce as much braking effort at an engine speed of 1,400rpm as a conventional Jake Brake can at 2,100rpm

this time bringing inlet valves as well as exhaust valves into play when the brake is activated – thereby doubling the number of piston strokes on which braking is available. The HPD system in effect delivers two-stroke braking from a four-stroke engine, so whereas a conventional engine brake has one compression release and one brake gas recirculation ‘event’ per camshaft rotation, the HPD system offers two braking events per rotation of the cam.

But there is much more than this to the HPD project, according to Steve Ernest, engineering and business development vice president at Jacobs Vehicle Systems. Several important truck technology trends deemed likely to have a big impact on the company’s core Jake Brake business were identified about five years ago, he said: disc brakes were getting better all the time, while vehicle operators and manufacturers were calling for better retardation in general. Gross weights were going up, whereas both rolling resistance and air drag were tending to fall, due to the advent of low-friction lubricants, low-rolling-resistance tires, and better aerodynamic efficiency from trucks and trailers.

The upshot was that a truck tended to maintain speed for longer when the driver’s foot came off the accelerator pedal: good news for fuel economy, but not so helpful for any secondary braking system. And then there was the growing tendency for truck engine ‘downsizing’. The Jake Brake’s operation has always depended on pressure build-up in the engine’s cylinders. It is the sudden repeated release of this pressure that causes the brake’s distinctive noise.

The maximum cylinder pressure in a 13-liter engine with a conventional Jake Brake is about 80 bar (1,100psi). Ernest recalls calculating that if the engine downsizing trend continued as expected, that pressure would have had to have been increased to over 100 bar (1,450psi) just to maintain engine brake performance. That was the key driver for Jacobs engineers to pursue the development of two-stroke braking, which ultimately led to today’s HPD.

“Because it operates twice as many times, we only need a cylinder pressure of about 60 bar (870psi),” he elaborates. “That two-stroke operation at 60 bar gives us more braking effort than four-stroke operation at 80 bar. It’s quieter, and there are twice as many pulses going into the turbocharger at a lower pressure.”

## HEAVY-DUTY VEHICLES

### Plus two

Volvo Trucks' engineers have been particularly busy in transmission development, introducing the dual-clutch option for the FH range two years ago, then following up early this year with the addition of a couple of exceptionally deep crawler gears to the well-liked I-Shift automated manual transmission (AMT).

A fresh addition to Volvo Group's range of in-house truck gearboxes is aimed mainly at winning a greater share of Europe's burgeoning heavy-haulage sector – partly a result of the increasing need for wind-turbine blades of 70m or more in length, to be carried to and from electricity-generating wind-farms, sometimes accessible only by road and track.

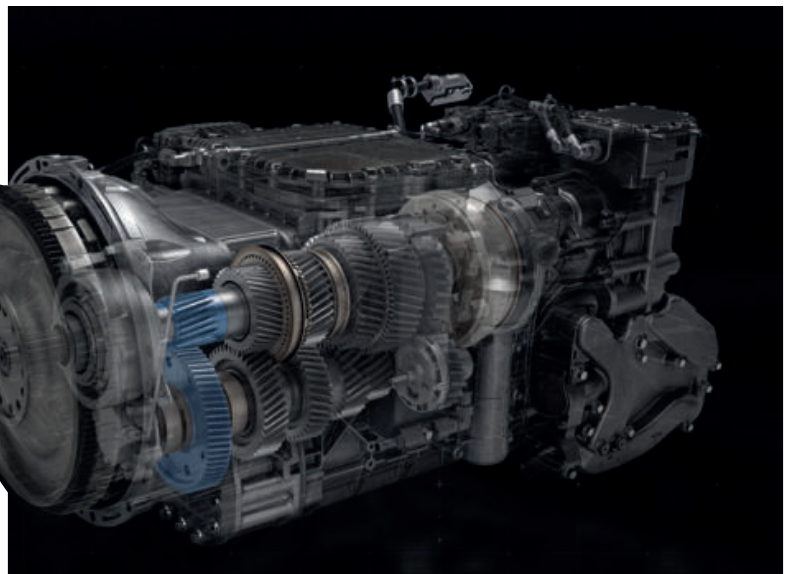
Trucks used for these operations, with all-up weights of 250 metric tons or so, demand special trannies, including the ability to cope with ultra-low-speed maneuvering. Instead of the normal 12 forward ratios, the new I-Shift box has 14, courtesy of two extra crawler gears, with a ratio as deep as 32:1. The whole gearbox has been beefed up to withstand

**“I-SHIFT WITH CRAWLER GEARS OFFERS AN ENTIRELY NEW SCOPE FOR HEAVY TRUCKS WITH AUTOMATED TRANSMISSION TO REGULATE THEIR SPEED WHEN CRAWLING SLOWLY AND REVERSING”**



ABOVE: Instead of the normal 12 forward ratios, the new I-Shift box has 14, courtesy of two extra crawler gears, with a ratio as deep as 32:1

BELOW: New trends in heavy haulage have led to the development of Volvo's latest gearbox



exceptionally high input torques and gross combination weights up to 325t. Gearbox weight inevitably increases, but only by 48kg compared with a standard 12-speed I-Shift. The new gearbox is also 12cm longer than a standard I-Shift.

But heavy-haulage operators are not the only ones taking an interest – tipper and other construction truck operators are also likely to specify it for vehicles that often go off-road in difficult conditions. Trucks can be driven at speeds as low as 0.5km/h without any clutch slip, it is claimed.

“I-Shift with crawler gears offers an entirely new scope for heavy trucks with automated transmission to regulate their speed when crawling slowly and reversing,” Peter Hardin, Volvo Trucks product manager for the FM and FMX ranges, states.

“The driver can haul a heavy load without worrying about getting into situations that may lead to costly downtime. The vastly improved driveability and startability with the new crawler gears makes the driver's job far easier when operating in difficult terrain, particularly slippery surfaces, with heavy loads, such as in the construction, forestry or mining sectors. The heavier the transport operation and the poorer the surface or the terrain, the more a driver will gain from a truck with crawler gears.”

The challenge of low-speed maneuvering at extremely high gross weights is met in different ways by other truck manufacturers. The latest Mercedes SLT range of heavy-haulage trucks employs a Voith turbo retarder clutch (as does Grove's GMK5250L mobile crane – see *iVT*, March 2016, p26) – a combined fluid coupling, lock-up clutch and hydrodynamic retarder mounted behind Mercedes'

own PowerShift 3 automated manual 16-speed gearbox.

The deepest ratio on Scania gearboxes used for heavy-haulage trucks up to 250t gross weight is 16.32:1. Scania depends on software control of its Opticruise automated manual gearbox, now with EH clutch control, for efficient low-speed maneuvering at high gross weights.

### A change of tack?

Significantly, Scania sent engineers to take a close look at the HPD at Millbrook. Unlike just about every other truck maker in Europe, the OEM has so far not been persuaded by the arguments in favor of engine brakes, preferring instead to use its own hydraulic retarder, bolted on to its own gearboxes, in tandem with an admittedly better-than-average simple exhaust brake.

But now, just like every other truck maker, Scania is having to cope with both lower engine speeds in general and demands for smaller cooling systems, all in the interests of better fuel economy and lower CO<sub>2</sub> emissions – and it is also being forced to find ways of keeping Euro 6 exhaust aftertreatment (SCR and DPFs) working at critical optimum temperature.

That becomes increasingly difficult to achieve with just a hydraulic retarder to control vehicle speed while the engine is idling on long downhill stretches, so perhaps an engine brake like the Jacobs HPD could be just what the doctor ordered for the long-awaited new Scania truck range. **iVT**

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# The silent minority

**WHEN WEIDEMANN REALIZED THE HYDRAULIC SYSTEM WOULD BE THE MAJOR SOURCE OF NOISE IN ITS NEW ELECTRIC WHEELED LOADER, IT TURNED TO THE SILENCE PLUS GEAR PUMP. WHY ISN'T EVERY OEM USING IT?!**

▶ With the new 1160 eHoftrac from Weidemann, exhaust gas and noise in agricultural buildings are now things of the past. The OEM uses external Bosch Rexroth gear pumps noise-optimized with Silence Plus technology for the work hydraulics to ensure this compact, electrically driven wheeled loader functions as quietly as possible.

The advantages that these quiet and exhaust-free machines provide can be seen at Copenhagen Zoo. It has been a Weidemann customer for years and was one of the first businesses to put the 1160 eHoftrac through its paces in its daily business. The experiences gathered during intense practical tests were so good that the zoo recently ordered another vehicle.

The yard loader has two electric motors – one serves as the travel drive; the other drives the Silence Plus external gear pump for the work hydraulics. This division raises the energy efficiency of the vehicle, which is reflected 1:1 in more operating time per loading cycle. The travel drive requires electricity only when the yard loader is being driven. The same applies to the hydraulic pump, which is not driven by the electric motor until hydraulic pressure is required. The continuously variable engine speed control using the inverter also ensures that both motors are always in operation with the appropriate RPM. This minimizes energy consumption because the amount of power output that is needed is reduced.

Weidemann lists the average battery life at between two to five hours depending on the operating conditions and the energy turnover. It needs between six to eight hours to charge depending on the type. Intermediary charging is possible at any time. As the 1160 eHoftrac is in operation at businesses where it is often used for a few hours in the morning and in the evening, these cycles can be implemented without a problem.

Additional savings in operating costs can be made in the future once the buildings have photovoltaic systems installed. Because the more attractive option is to use solar power generated on-site rather than feed it into the power grid for a return of only a few cents, charging the battery of the 1160 eHoftrac is a good way to use electrical power generated on-site.

## Longer utilization periods

With this huge step in noise reduction in agricultural industrial vehicles, Weidemann opens up measurable



cost advantages for its customers. Because the quiet, exhaust-free vehicles can also be used at times when there is a lot of activity at zoos or horse ranches, the employees no longer have to restrict themselves to narrow time windows in the morning and evening. Consequently, work can be spread out throughout the day without causing the guests or horseback riders any appreciable annoyance.

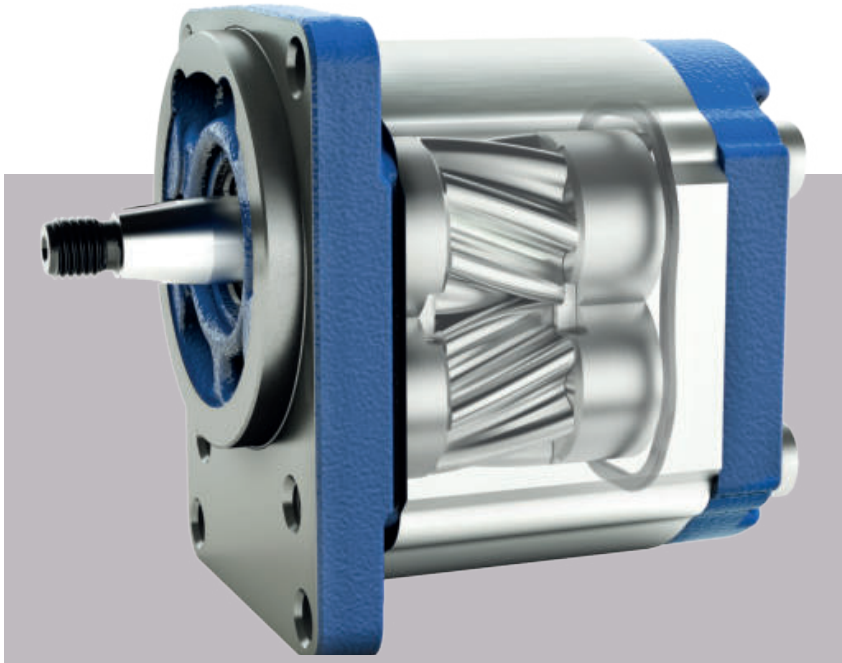
Another positive result is that the combination of electric drive and whisper-quiet independently driven hydraulics increase the productivity of the business and also ensures competitive advantages. "Especially in the affluent suburbs of metropolitan regions, the competition among horse stables is palpable," says Weidemann's marketing director, Christina Heine. "Riders want to spend time with their horses in peace. Whoever operates their business quietly and without exhaust has the advantage."

Another advantage for operators is that noises in the surroundings coming from colleagues, animals or visitors are much easier to hear, meaning drivers can

react more quickly. That's why Weidemann, a long-term customer of Bosch Rexroth based in Diemelsee-Flechtendorf, Germany, was looking for an alternative and quickly found what it was looking for with the Silence Plus external gear pump – a solution that works quietly and also generates a frequency similar to that of the electric motor.

With its pleasantly deep sound, the Silence Plus pump blends in harmoniously with the quiet operating sounds of the travel drive. The sound of any hydraulic pump will be drowned out acoustically by the much louder diesel engine, but the original model "was suddenly distinctly audible in combination with an electric motor," says Heine, looking back at the 1160 eHoftrac's development. "A high buzzing noise that overwhelms the sounds of the vehicle was not desirable when it comes to being in such close quarters with animals."

In general, external gear pumps have been tried and true for decades as robust and cost-effective displacement units. Their primary characteristics – a



LEFT: The Silence Plus external gear pump from Rexroth renders secondary measures for dampening noises – which would be otherwise needed for many applications – unnecessary

BELOW: The tooth profile provides zero-backlash continuous contact without any chambers of squeezed oil



pressure range of up to 280 bar, a very high level of efficiency, and their low price – have become as much a matter of course as their sound volume. Ever since quiet pumps have existed, this aspect has been an additional criterion during procurement.

With a number of structural improvements, Bosch Rexroth has been able to reduce the noise emissions of the Silence Plus by up to 15dB(A) over conventional pumps. The company tackled the noise development with three central approaches: dual flank contact, helical teeth and compression oil compartment.

Due to low tolerances for center distance and tooth profile, Silence pumps guarantee zero-backlash dual-flank contact. This way, the back flank also contributes to sealing, and therefore to hydraulic displacement, which becomes notably more steady while pulsation is cut by about 75%. The entire hydraulic system creates far less vibration, and reduces noise to a lesser degree.

The zero-backlash angular tooth profile reliably prevents compressed oil entrapment while eliminating vibrations and flow noises. The helical teeth reduce the noise generated by the pump due to the tilt of the teeth, the mesh exchange of the tooth pairs, and because the related fluctuations of transmitted forces no longer take place over the entire gear width simultaneously. These processes are distributed over time and space, thereby helping the wheelset to run more smoothly. The pump works with a zero-backlash tooth drivetrain with helical teeth. Its non-involute tooth profile eliminates any chambers of squeezed oil.

### Protecting health and the environment

The electric drive is especially attractive when the batteries are charged using power generated on-site with photovoltaic systems, biomass or wind. Moreover, this technology has positive effects on the health of both human beings and animals. Especially in existing buildings that have low ceilings and limited air interchange, an electric drive greatly improves the quality of the air. Fewer hazardous substances and less fine dust improves the health of both the animal population and the employees in equal measure.

With the Silence Plus, Rexroth has therefore developed a hydraulic pump very well suited for use in electromotive applications due to its efficiency and low noise emissions. In addition to the 1160 eHoftrac being used in the zoo in Copenhagen, on many dairy farms, at equestrian stables and at animal husbandry businesses, in the hotel business, in the public sector and even in cemeteries, the pump also finds general use in tractors, forklifts and buses in the mobile sector, as well as in trash and paper compactors in the stationary sector. The low noise of the external gear pump makes it easier to attain legal limit values without expensive secondary measures for acoustic decoupling, damping or encapsulation.

Its compatibility with other Rexroth pumps facilitates trouble-free retrofitting. **ivT**

*Christian Böhmcker, product manager for external gear units, has worked at Bosch Rexroth AG for 28 years*



ABOVE: The zoo employees no longer have to restrict themselves to the narrow time windows in the morning and in the evening. Instead, they can use these quiet vehicles even when the zoo currently has a lot of visitors



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# Commercial break

MAKING ONE OF OUR OCCASIONAL FORAYS INTO THE COMMERCIAL VEHICLE SECTOR, WE TAKE A LOOK AT THE EFFECTS NEW DRIVE SYSTEMS AND ALTERNATIVE FUELS WILL HAVE ON THE HOSES AND LINES ON WHICH THEY RELY

Commercial vehicle manufacturers must now meet ever more stringent emissions standards, offer alternative drive concepts particularly for inner-city use and, at the same time, satisfy their customers' requirements for affordability. Jacques Malfroy, key account manager, truck, at ContiTech Anoflex in Caluire, France, and Mark Klein-Hietpas, head of sales and key account, truck, at ContiTech Techno-Chemie in Karben, Germany, reveal the efforts that are being made in this regard – and how hoses and lines from Conti can help with this.

**What are the current trends in the commercial vehicle market, and how can ContiTech help the CV OEMs to be among the front-runners?**

*Jacques Malfroy:* The Euro 6 standard is now in force and has made new solutions in terms of the exhaust treatment and fuel supply systems necessary – for example, SCR technology, EGR, particulate filters and innovative fuel-injection systems. We supply our hoses and lines developed specifically for SCR technology and fuel-supply systems.

Furthermore, development projects are currently underway in the field of exhaust heat recovery with vehicle manufacturers.

**Does that mean the manufacturers have done their homework and can now relax?**

*Mark Klein-Hietpas:* No, there's still a long way to go. We are still faced with a whole raft of new local and international regulations which will have an impact on the market. However, all the manufacturers had to launch their Euro 6 and Euro 5 trucks during a period of weak demand in Europe and Brazil. Consequently many of those OEMs could only target their resources very specifically during this time or even had to cut them. But that will soon have to change again if they are to meet the future requirements.

For example, we will soon be confronted with new CO<sub>2</sub> requirements that call for further fuel-reduction measures. In addition, all manufacturers are under significant competitive pressure to reduce their overall operating costs.

**What direction will future developments take?**

*MK-H:* We need to distinguish here between trucks on the one hand, and buses and minibuses on the other.



The Euro 6 standard has made new solutions in terms of the exhaust treatment and fuel supply systems necessary – for example, SCR technology



Jacques Malfroy



Mark Klein-Hietpas

The truck manufacturers wish to specifically use those fuels that are best suited to their particular vehicles and markets. The picture we see emerging right now is that the big trucks will probably stick with diesel, while biogas-powered, hybrid or fully electric trucks will be used in urban operations sooner or later. All these solutions are currently being trialled, and we are already seeing an increase in the numbers of hybrid vehicles.

The trend toward specific solutions is being strengthened by global urbanization. Large semi-trailers are increasingly being used just for long-distance haulage of goods to the outskirts of the growing number of megacities. Light and medium trucks then handle distribution within the city.

**And what about the situation with buses?**

*JM:* In the case of buses and minibuses, people are holding their breath slightly when it comes to future regulations. Some cities, such as Paris, France, are already considering banning diesel vehicles soon. That is forcing bus manufacturers toward biogas solutions or electric drives.

Two possible solutions for biogas already exist: the solution developed by Westport, for example, works with a gasoline/gas mixture and retains the compression ignition principle, while the Cummins solution works with spark plugs. Most of the bus manufacturers have not developed a gas engine of their own and have therefore signed contracts with one of these two companies.

Buses using these engines will probably be used mainly in the regions surrounding towns and cities in future, while rapidly charging electric buses will be used in urban centers. Bus manufacturers are also looking into fuel-cell technology; however, the appropriate infrastructure for this is still lacking.

**So, when will the first electric buses be operational?**

*JM:* Fully electric buses are already a reality. They are mostly recharged using rapid charging systems at corresponding bus stops. They use a lot of our fluid lines, which can also be found in buses with IC engines. These include air lines in, for example, brakes, door-closing and seat-adjustment systems, power-steering lines and air-conditioning lines. While there is no need for fuel and oil lines, new applications include cooling lines for batteries as these become very hot while charging.

**Are electric trucks also conceivable? And where could they be used?**

*JM:* Several options are currently being considered. One of our customers has already tested a fully electric truck, although the outcome was improvable. This customer has now switched to a small diesel



engine connected to a generator. With such a system, a truck can drive to the town using its diesel engine, charging the batteries at the same time, before then switching to electric drive in the city center for as long as the battery charge lasts. That saves fuel because the engine is not running permanently or, when it is running, for the most part it is at constant revs.

**What are the major challenges faced by ContiTech as a result of the future emissions regulations?**

*MK-H:* We have to find solutions to deal with the very low temperatures in the biogas engines. That's why we are putting every effort into discovering new materials and manufacturing processes that meet these requirements. When it comes to issues such as exhaust heat recovery, completely new media are even under consideration, although these still need to be tested. If necessary, we would have to adapt our systems to these and supply products that satisfy the new requirements.

**Saving costs is also a timeless issue: so how can ContiTech contribute to cutting fuel consumption and even keep the purchase costs as affordable as possible?**

*MK-H:* Reducing weight to save on fuel, simplifying fitting and integrated solutions are the key ways of making a difference. We are already working in this direction with plastic pipes and quick connectors. We have also set up a new Competence Center for Plastics in our plant in Vác, Hungary, where we will research and develop further solutions.

Some truck manufacturers have also started using aluminum for making their air-conditioning lines. We have already gained many years of experience with such applications in the automotive sector. The principal benefits here lie in the weight.

Another option that can be considered with reference to the air-conditioning system when it comes to fuel savings is our internal heat exchanger. This increases the efficiency of the air-conditioning

systems by means of a simple thermodynamic effect, without consuming additional energy to do so. Field trials using our solution are already underway with one of our truck customers.

There are major benefits – not least, if there is no need for interfaces, adapter solutions are replaced and the latest hose generations are used. These can be incorporated more easily and have a weight-optimized design.


We should also not forget the question of quality. Every non-compliant product – identified either when supplied to the vehicle manufacturer or only later when the customer is driving the vehicle – causes costs that need to be avoided.

If we always keep that in the forefront of our minds, we will help our customers remain competitive. **ivT**


*Peter Abbes is head of communications of the Industrial Fluid Systems and Mobile Fluid Systems business units of ContiTech, which he joined in 1984*

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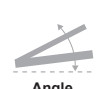
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Technology with Vision



# Hitch fest

A HUGE VARIETY OF TRACTOR IMPLEMENT HITCHES HEADLINE ONE COMPANY'S OFFERING FOR THE AGRICULTURAL MARKET, WITH POWER, RELIABILITY AND SAFETY TOPPING THE BILL OF CUSTOMER DEMANDS

▶ CBM Group offers an extensive, technologically advanced range of trailer hitches for the connection of tractor implements to satisfy the needs of the end user – each of them designed, tested and manufactured to meet the most demanding market needs. In satisfying the main requirements of the end users, safety, functionality and simplicity in use can be ensured – even at road transport speeds over 40km/h.

In pursuing this goal, over recent years CBM Group has expanded its trailer hitch range by manufacturing, testing and homologating new solutions of slider clevises with automatic or manual pins. The company's automatic trailer hitch slider clevises are equipped with two independent safety systems to guard against accidental release. These are activated automatically when the coupling pin reaches its lower position. As the operator only needs one hand to move the handle, the other is free to fix the clevis at the desired height.

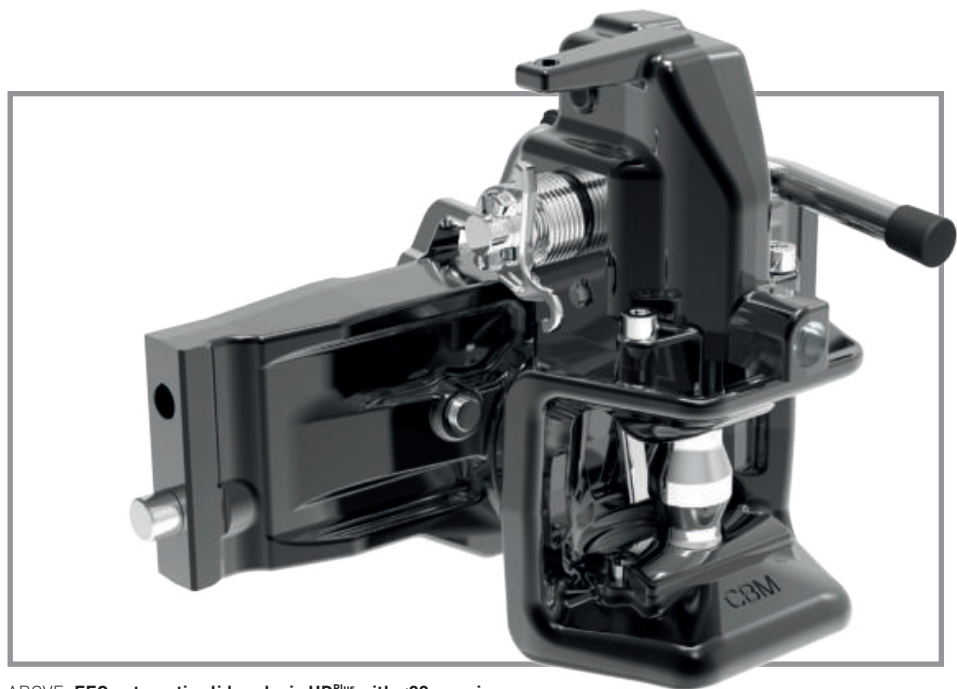
To satisfy the ever-increasing requirements of the agricultural market in terms of loads and resistance, CBM has developed a new HD<sup>Plus</sup> version. This advanced model has been designed and tested to resist a D value of 120.9kN and a vertical S load of 2 tons.

For the coupling of trailers equipped with the special large towing eyes (model DIN 74053; ø50mm) a new automatic trailer hitch slider clevis has been developed to comply with DIN regulations. This type of clevis is available for particularly severe applications and for use at speeds greater than 40km/h.

Among the different solutions available is the trailer hitch system with ø80mm ball and ø50mm lateral ball. This application is mainly used for road transport and is designed to assist and provide better control of the articulated steering systems of multiple-axle trailers in compliance with the existing laws, and to satisfy the needs of the end user. For this modular slider bracket with ø80mm ball, a new HD<sup>Plus</sup> version exists, which has been tested to resist a D value of 120.9kN and a vertical S load of 4 tons for speeds of over 40km/h.

## Drawbar improvements

In line with the above, CBM Group has also improved its very wide range of drawbars, which now includes an HD<sup>Plus</sup> Category 5 version. The key to these successful developments lies in the company's deep



ABOVE: EEC automatic slider clevis HD<sup>Plus</sup> with ø38mm pin



BELOW: EEC drawbar HD<sup>Plus</sup> Cat. 5

BOTTOM: EEC slider bracket HD<sup>Plus</sup> with ø80mm ball and ø50mm guide balls

know-how in this market, as well as the special materials and manufacturing processes that have been adopted. These special HD<sup>Plus</sup> versions are intended to be used for the high-horsepower ranges, i.e. tractors from 250-500hp.

CBM Group's high quality arises from the constant commitment to design and develop new components, paying particular attention to the research of new materials and the latest technologies, in order to achieve the highest production standards. Specialized in the design and manufacture of lifting, handling and towing systems for agricultural tractors, and a world market leader in this sector, it focuses heavily on technology and innovation and continues to invest substantial resources in R&D to ensure its production remains up-to-date with leading-edge technology.

Today, CBM Group is a reliable and trustworthy partner for all of the most important tractor brands, both for the quality of its products as well as its manufacturing flexibility. **IVT**

*Enrico Cornia is managing director of CBM Group*



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# Vehicles of change

NEW DEVELOPMENTS IN INSTRUMENTATION TECHNOLOGY PROMISE TO HELP OPERATORS AND FLEET MANAGERS INCREASE PRODUCTIVITY AND OPTIMIZE COMPANIES' INVESTMENTS IN FORKLIFT TRUCKS

▶ Mike Miller, director of product management for Curtis Instruments, leads the worldwide product development and marketing of the company's instrumentation products for industrial electric vehicles. As a recognized expert in the field, he has held technical leadership positions at Curtis for 27 years, guiding its global instrumentation and battery monitoring system development programs.

In a recent interview at the Curtis Instruments world headquarters in New York, USA, he shared his personal insights about the present and future of vehicle instrumentation.

**Let's kick off by talking about how we arrived at where we are today in instrumentation for the forklift market. For example, what's the state of displays?**

From a technical perspective, and also from an instrumentation point of view, forklift manufacturers tended to follow the automotive market, where auto makers had the volume to set trends and drive our choices for display types and technologies.

Over the past 5 to 10 years, that's changed. Now we're driven by consumer products: smart devices, such as iPhones and tablets, that exceed the number of vehicles built. And because the best bang for our buck in displays comes from using what the consumer electronics market uses, almost everything we do now has a liquid crystal display (LCD) at its core. Plus, the price of color displays has come way down to the point where there's almost no difference between monochrome and color.

So a trend we're seeing from this is the integration of historical dashboard elements into full-color LCD message centers that tell you what's going on with the vehicle. And where you used to have some indicators outside of the main LCD, now you can put them all into a single full-color display.

**How about the current state of microcontrollers and the overall mechanical package?**

For microcontrollers that perform our calculations, drive our LCDs, and essentially do all the work of the instrument, we remain focused on ARM processors, because here, again, we can piggyback on the consumer product and automotive market's volumes and drive our costs down.



ABOVE: Mike Miller, director of product management for Curtis Instruments: "Where you used to have some indicators outside of the main LCD, now you can put them all into a single full-color display"

In mechanicals, Curtis has a 50+ year history of designing instruments for vehicles that will be used in very tough environments. Devices today must be designed to work under conditions of extreme temperature, vibration, shock, UV and electrical noise. We know how to do that very well and can design for the harshest of applications.

**Can you give some examples?**

Sure. Suppose you're moving frozen foods from an outdoor loading dock into a freezer in Arizona, a US state where desert conditions mean temperatures reach extremely high levels in the summer. With that huge difference in temperature and humidity, the display's going to instantly fog up. We can prevent that with innovative packaging techniques and a breathable membrane that enables the instrument to expel condensation as soon as it starts to form and doesn't allow it to come back in.

Or, as another example, we've developed the know-how for choosing the lens for LCDs to make them readable in sunlight and help them survive long term under UV.

**What changes in vehicle technology have influenced today's instrumentation?**

A big one is battery technology, because one of the things Curtis is well known for is our ability to measure the state-of-charge of a battery. That's very important, obviously, so you know either how far you can go or how much work you can do before you have to recharge it. Historically, these vehicles have used lead-acid batteries but now some are changing over to lithium-ion. So we have developed new algorithms to measure state-of-charge and history of use, whether the battery is lead-acid or lithium-ion.

We have a product called Acuity, a complement product to our instrumentation that sits on a vehicle battery and measures and reports all of its operating parameters. It lets the operator, service technician or fleet manager quickly understand the battery's status – if it needs to be charged, watered, or equalized – and, most importantly, whether it's approaching the end of its service life and needs to be replaced.

**Let's look at the future. If iPhones and tablets are driving you to LCDs, are we also going to see touchscreens in battery-powered vehicles?**

Definitely. Swipes, double clicks and all those sort of touchscreen interactions are entering our area, and at the real high end, some vehicles already have them. Curtis will be developing them over the next year. This is a bit more of a challenge, given a working environment that can include dust, condensation, water and gloved hands. But we are developing

solutions to those concerns, so you'll eventually be seeing more instruments that have touchscreens, instead of buttons, on vehicles.

**LCDs can display a lot of data. How do you avoid information overload?**

Our goal is always to make the operating condition of the vehicle obvious to the operator. As more things are integrated into the display, that puts more of an emphasis on the graphical user interface. And that involves a lot more software and diligence in defining what the driver needs or wants to see at any given time.

We go through a very specific flowcharting process that looks at each stage of operation, from when the operator turns the key, starts to drive, and engages the lift – so that a typical instrument will have anywhere between five and a dozen different screens that come up automatically based on the vehicle's condition, or are initiated by the operator pushing a button or swiping the display.

We try to design our screens and instruments so that the operator can focus on doing the work and only needs to intervene with the vehicle when there is a problem: when the battery state-of-charge gets low and they have to recharge, or the motor gets hot and they need to let it cool down, or some other operating condition where they need to pay attention to the vehicle instead of the work they're doing.

That actually relates to a trend we're seeing in all businesses where data is much more important than ever. So today it's our job to turn data into information so that it's meaningful to the operator. So, for example, it's not enough to just display the motor temperature – you have to say the temperature's too high and specify what needs to be done about it.

**So it's about helping operators and companies get work done?**

Yes. And so another big trend now is productivity. We can measure and record data and then apply some intelligence to it to inform the user and management of how productive the forklift truck or the operator are, based on factors such as how much time is spent idle, driving and lifting. We can measure all those and provide feedback to fleet managers to tell them whether they're optimizing their capital investment in forklift trucks.

We typically handle the vehicle side of that. But there is also an increasing requirement to integrate warehouse management system (WMS) functions into one display that not only shows operators the vehicle status, but also provides the work information they need to do their job – such as pick a specific pallet and take it to a specific location.

This also feeds into overall fleet management. Our instruments can integrate easily with wireless fleet management systems to provide the information that helps companies manage and optimize their fleets to provide the most productivity at the lowest cost.

**What drives the development of a successful instrumentation product?**

Customers' needs. Obviously, that is invariably the case for custom-developed OEM products for specific customers. However, in developing platforms for the broader market, we use three inputs: what the competition is doing; what the new technology is; and, most importantly, what the customer is saying. So I'm visiting customers all the time and asking them where they're having problems, and what their needs are, and incorporating that into the definition of our next-generation products.

**Does the global nature of the industry have any impact on instrumentation products?**

We are definitely operating in a global market, in which companies are trying to develop lift-trucks with engineering and design that can apply to as many geographical regions as possible. And because the manufacturers themselves are global, we've seen trucks designed in the USA, built in China, and then localized for multiple markets.

The impact of this on instrumentation lies in how easily and quickly emerging trends can be identified and then incorporated into new vehicles. The best way a provider can do that is by being where the customers are, everywhere around the world. At Curtis, our global presence, matrix structure and internal cooperation often enable us to share insights about worldwide activities of which our customers might not always be aware. **ivt**

*Ken Norkin is a technical writer based in Brooklyn, New York, USA. See [www.curtisinstruments.com](http://www.curtisinstruments.com)*



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# Dialog of the DEF

**DIESEL EXHAUST FLUID IS GREAT FOR REDUCING NO<sub>x</sub>, BUT THE VALVES THAT REGULATE FLOW TO THE HEATING ELEMENT CAN OFTEN BECOME UNRESPONSIVE. THIS SOLENOID-POWERED GATE VALVE SHOULD ENSURE A LONG AND PRODUCTIVE INTERACTION**

▶ Selective catalytic reduction (SCR) systems using diesel exhaust fluid (DEF) are now an established method for control of NO<sub>x</sub> emissions in diesel engines. However, because DEF systems have a freezing point of -11°C (12°F), on occasion engine coolant must be circulated to the reservoir to thaw the fluid. Most systems have adopted poppet, diaphragm or spool valves to regulate flow to the DEF heating element; however, these valves are susceptible to contamination and do not perform well when a low pressure drop is required.

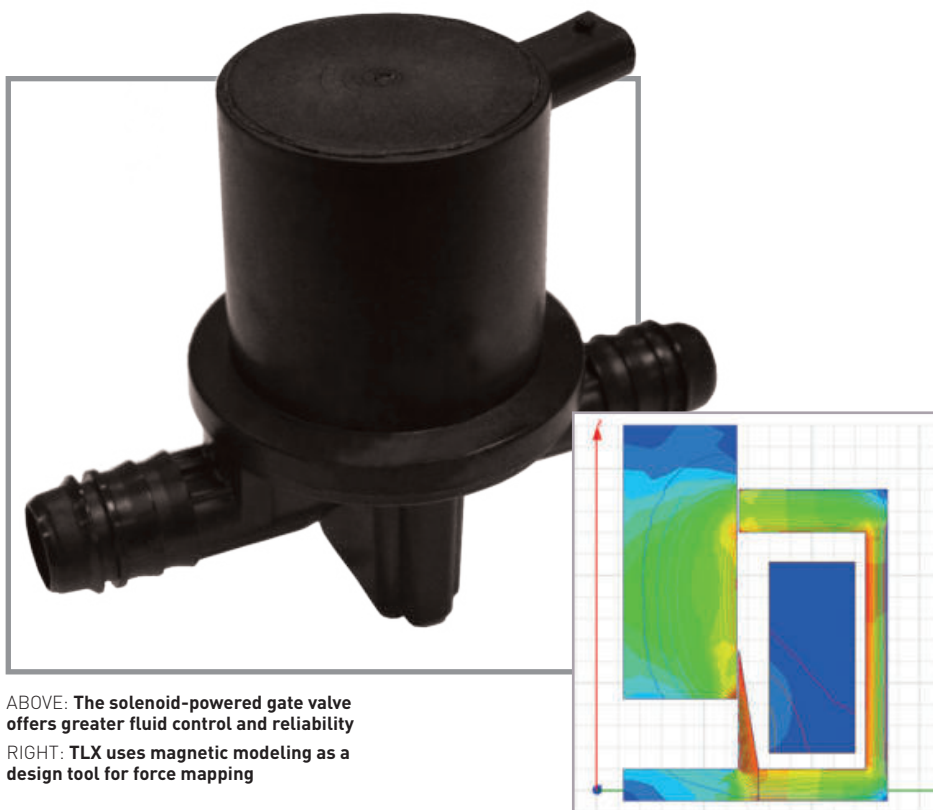
Superior operation of a diesel engine fluid coolant system can be achieved using a solenoid-powered gate valve, where the automated or 'commanded' valve responds to a signal from electronic controls. The coolant valve has a sprung gate assembled with elastic materials to reduce friction forces as the gate moves from open to closed. The sprung gate contains a continuous elastic band assembled with two gate members. There is an interference fit within the gate that provides a complete seal. The elastic quality of the gate allows system pressure to provide the sealing force needed in a closed position.

Alignment of the armature of the solenoid to the valve body is made through a mechanical rail system. This mechanical coupling to the armature reduces the chance of binding whenever the alignment of the armature, coil and stem is not perfectly concentric. The mechanical coupling can be accomplished in a variety of orientations, making it easy to set the valve either normally open or normally closed.

## Unique designs

TLX Technologies is a leader in the manufacture of quick-response, high-force custom solenoids, offering patented features and unique expertise to deliver effective solutions for tough automotive and off-highway applications. It has now patented technology for a solenoid-powered gate valve that greatly improves performance in a variety of applications.

The technology provides a continuous membrane gate valve with high contamination resistance and greater reliability in real-world applications with less than perfect alignment. Availability of multiple control methods means this new technology can replace poppet, diaphragm and spool valves, and provide superior reliability and flow control.



ABOVE: **The solenoid-powered gate valve offers greater fluid control and reliability**  
 RIGHT: **TLX uses magnetic modeling as a design tool for force mapping**

But the technology of this solenoid-powered gate valve has applications beyond SCR diesel systems. The solenoid valve can be driven by direct voltage, PWM, and peak and hold electric systems. The peak and hold signal will supply high force with smaller package sizes and lower heat generation. The smaller package size can be critical in engine applications, opening up the possibility for flow control where previous solutions would not fit.

The gate valve can be operated on a proportional control basis, rather than normally open or normally closed, with a PWM signal. With proportional control, the gate valve can replace diaphragm valves in most applications. The gate valve will never need a pilot valve or line for operation. This simplifies the design of valves traditionally used in water and oil pump applications. Removing pilot lines reduces complexity of valve bodies, which makes them less expensive to

manufacture and increases reliability. The elastic gate reduces friction, helping to reduce the force needed to operate the valve. Using a solenoid to actuate the gate provides a quicker response time in a smaller package than any motorized gate valve.

Selecting the correct elastic material for the gate valve allows it to be used in most off-highway and automotive fluid systems. With proper material selection, life expectancy of the gate valve will meet or exceed off-highway and automotive requirements in water, oil or air systems. Off-highway applications will particularly benefit from this high resistance to contamination. Overall the benefits of this new technology will provide better flow control in a variety of off-highway applications. **ivt**

*Bradley Behlke is a sales engineer at TLX Technologies, LLC in Wisconsin, USA*



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# On the road again

TRUCK AND BUS ENGINES WITH IMPROVED TORQUE AND STOP/START CAPABILITY ARE UNDER THE SPOTLIGHT AS WE TAKE ONE OF OUR OCCASIONAL DETOURS INTO THE COMMERCIAL VEHICLE SECTOR

▶ At the IAA exhibition in Hannover, Germany this September, Cummins will highlight its new SmartEfficiency engine ratings for 2017 and the Euro 6 OBD C requirements\*. This latest step in the Euro 6 legislation will affect all new vehicles from December 31, 2016. The most important changes to the regulations impact the onboard diagnostics (OBD) requirements as follows:

- The NOx emissions threshold detected by the system reduces from 1,500mg/kWh to 1,200mg/kWh;
- Particulate matter emissions detection threshold is introduced at 25mg/kWh;
- The level at which standard quality AdBlue is detected is lowered from 0.9g/kWh to 0.46g/kWh;
- OBD diagnostic operation must report how many times the monitor actually successfully runs per the number of drive cycles.

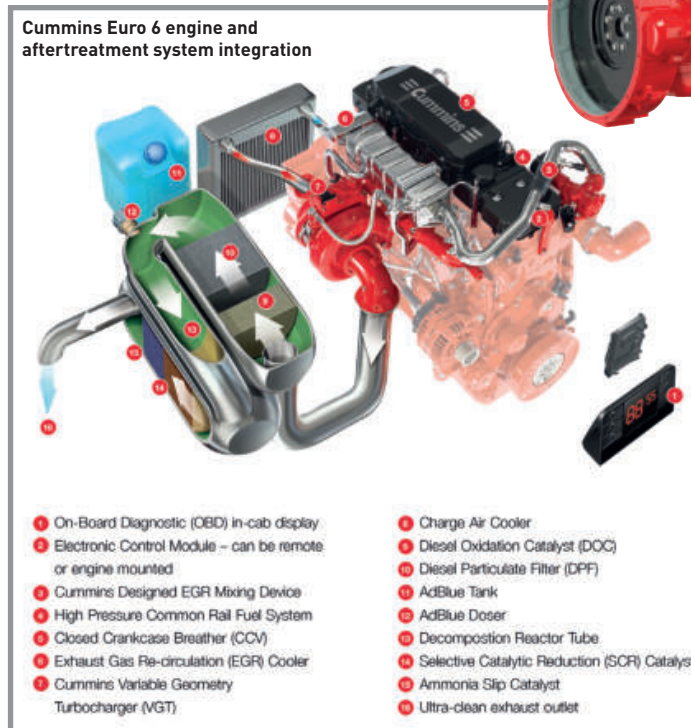
For 2017, Cummins will offer new ISB truck and bus engine ratings with substantially improved low-end torque, from 700rpm, that will deliver improved vehicle acceleration across the rpm range. The ISB4.5 four-cylinder engine moves up to a new peak torque of 850Nm from 760Nm. The six-cylinder ISB6.7 moves to a high peak torque of 1,200Nm from 1,100Nm along with a new 300hp/224kW top bus rating and a higher 320hp/239kW truck and coach rating.

This increases the scope of the Cummins product offerings, making them suitable for a much broader range of applications, vehicle weights and duty cycles. Cummins' capability to offer greater power density with no impact on displacement is a key factor behind this. Its 2017 engines will enter production in the fourth quarter of 2016.

## Stop/start capabilities

Also available on Cummins ISB engines is the first stop/start system for conventional bus use. This has been developed by the company's engineers to deliver proven savings for operators with a competitive payback period. Although stop/start systems have been available as part of diesel-electric hybrid bus technology for some time, the high investment cost has prevented many operators from justifying the investment and achieving savings without some level of subsidies.

Cummins has therefore developed a cost-effective system to deliver 4-7% fuel savings that meets the



ABOVE: Cummins 2017 Euro 6 ISB6.7 engine

\*OBD A was introduced with the original Euro 6 legislation in 2014. OBD B for diesel is being merged with C due to the availability of hardware

durability requirements of city bus duty cycles. Such a vehicle can stop every minute, so to meet such tough operational needs, the company has redesigned all of the critical engine components and is validating them across four million stop/starts.

Cummins has also made a considerable number of hardware updates to the ISB Euro 6 engines to ensure the technology is successful. These include a new starter motor that is capable of 210,000 starts, a new flywheel and ring gear, new wiring, a new engine speed sensor, an updated fuel system, new con rod bearings, and new crankshaft bearings. These, as well as the parts of the existing engines, have all been validated during the test cell and field test program covering both bus and truck installations.

The ISB engine software has been upgraded to better manage the technology and provide flexible architecture, enabling customers to choose what they want from it and tailor it to their operations. Cummins

engineers are therefore able to work closely with bus manufacturers on the integration to ensure that the bus does not limit the full capability of the stop/start system being achieved.

Additional benefits seen from stop/start include passenger and pedestrian comfort with reduced noise and vibration on the bus when it comes to a halt, as well as reduced emissions around the bus stops. Results so far seen include a 4-7% improvement in fuel economy and CO<sub>2</sub> emissions as well as a 30-40% reduction in NOx emissions, helping support further improvements in clean air. **ivT**

Based in Darlington, UK, Steve Nendick is marketing communications director at Cummins

## ON THE WEB

White paper on long route EGR turbocharger development for commercial engines at: [www.ivTinternational.com](http://www.ivTinternational.com)

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# Dual in the crown

HAVING BUILT A REPUTATION MANUFACTURING DRIVELINES, JCB HAS HIT NEW HEIGHTS WITH THE DEVELOPMENT OF A VARIABLE TRANSMISSION THAT COMBINES POWERSHIFT AND HYDROSTATIC TECHNOLOGY TO SPECTACULAR EFFECT

▶ When JCB launched its Loadall Agri Pro range in April, few outside the company expected it to have the world's first dual-technology transmission designed specifically for agricultural telehandlers – one that optimally combines the best characteristics of powershift and hydrostatic drives.

The DualTech VT variable transmission has been developed by JCB's own engineering team and is at the heart of a new range of premium-specification, high-performance telescopic handlers powered by the 4.8-liter JCB Ecomax engine.

Key features of the new DualTech VT include:

- Fully hydrostatic drive providing fine stepless speed control up to 19km/h from standstill;
- Automatic switching to electronically modulated 3-speed powershift above 19km/h for optimum power efficiency in higher-speed field work, road travel and towing;
- Power and Economy modes to optimize efficiency, performance, and minimize running costs;
- Flexi mode to provide independent engine speed and ground speed control;
- Selectable full-time 4WD or Auto 2WD over 19km/h for optimum driveline efficiency and reduced tire wear.

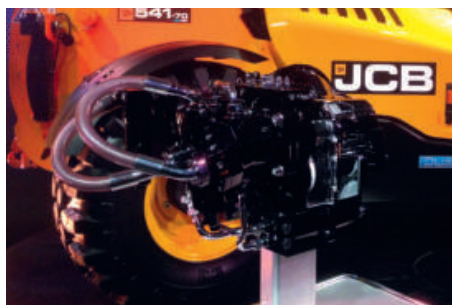
Thanks to these features, the new Loadall Agri Pro machines boast exceptional low-speed maneuvering control and smooth, progressive response for loading and handling cycles, which the operator can fine-tune to suit different applications and personal preferences. At the same time, the direct drive powershift element of the transmission gives these new handlers the best climbing and high-speed towing ability. It all adds up to productivity gains of up to 25% across the board over existing competitive telescopic handlers.

The new JCB DualTech VT transmission combines hydrostatic and powershift drive technologies using proven components uniquely combined for the first time in a single housing. The two modules work in harmony, seamlessly and automatically, to provide easy driving characteristics that can be fine-tuned to optimize driving comfort and performance for different applications.

The advanced hardware and control calibration for the DualTech VT transmission were developed in-house by JCB engineers and the transmission is now being produced on a new high-tech assembly line at JCB Transmissions in Wrexham, UK.



**ON THE WEB**  
Agri Pro video and images at:  
[www.iVTinternational.com](http://www.iVTinternational.com)



## Hydrostatic and powershift drives

The hydrostatic drive module of the DualTech VT transmission employs an electronically controlled hydraulic pump and motor combination to provide fast response, fine speed adjustment and infinitely variable working speeds up to 19km/h.

Unlike other telehandler hydrostatic transmissions, which must handle power delivery from zero to top speed, the hydrostatic module in the DualTech VT is optimized for low-speed response and controllability. As a result, it is extremely quiet and smooth, as well as responsive and power-efficient.

In normal Drive mode, pressing the accelerator pedal influences both hydrostatic output and engine speed, with the control electronics balancing the two according to the driver's demands. Precision inching is available through the brake pedal – initial movement

**The innovative DualTech VT variable transmission in JCB's Agri Pro Loadalls has revolutionized agricultural material handling by bringing together the best of two technologies**

progressively disengages hydrostatic drive, giving the operator total control when pushing into a muck heap, with no wear and tear on the brakes.

Engaging Flexi mode by pressing and holding the transmission downshift button enables engine speed and ground speed to be controlled independently for the first time on a full-size Loadall.

When a Loadall Agri Pro telehandler accelerates beyond 19km/h, whether in the field or on the road, the DualTech VT variable transmission automatically switches to its powershift system, where electronically modulated clutch packs make barely noticeable shifts between three mechanical gears up to the 40km/h top speed. With no torque converter needed, direct drive in each gear makes the most of available torque to deliver quick acceleration, strong climbing ability, and the impetus to maintain speed on road inclines.

The transmission will skip-shift down to the lowest ratio, ready to pull away after slowing for a road junction and will short-shift when accelerating with a light load. Also, the transmission can be restricted to gears one, two or three as appropriate for field work – gathering and loading bales, for example. **iVT**

*Tim Burnhope is JCB's chief innovation & growth officer*



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# All systems go

**LIEBHERR-COMPONENTS IS MAKING THE TRANSITION FROM BEING A SUPPLIER OF INDIVIDUAL PARTS TO COMPLETE SYSTEMS TOO – WITH SOME HEALTHY INNOVATIONS IN CYLINDERS, PUMPS AND POWER UNITS HELPING TO SPEED UP THE PROCESS**

Offering customers even more cost-effective and efficient system solutions in the fluid power sector, Liebherr has expanded its portfolio with energy-efficient hydraulic power units, a new hydraulic cylinder series for pressures of up to 350 bar, and a highly efficient axial piston pump.

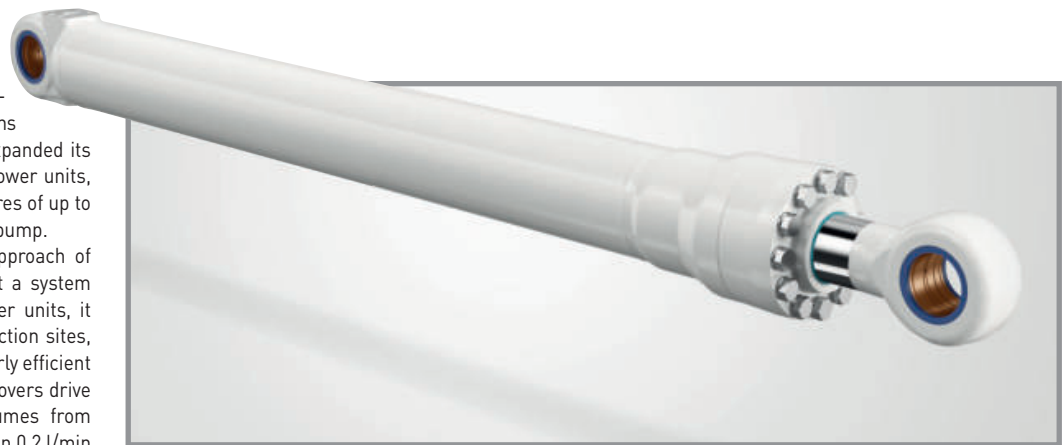
The company has also adopted the approach of being not just a component supplier, but a system supplier too. For the new hydraulic power units, it relies on components from its own production sites, ensuring a perfect match to form particularly efficient units. The hydraulic power unit portfolio covers drive power from 0.75-75kW, with filling volumes from 6-2,000 liters. The flow volume lies between 0.2 l/min and 500 l/min at an operating pressure of 350 bar. The hydraulic power units can also be combined with further components, such as sensor technology or a control system, and are ideal for construction machinery such as tower cranes.

Another innovation is the hydraulic cylinder series for heavy-duty applications requiring up to 350 bar. These double-acting differential cylinders are used in excavators and in the industrial sector. The product line includes 20 piston diameters, each of which can be combined with one of two piston rod diameters. To seal these cylinders, Liebherr applies an innovative dual-sealing concept comprising a primary and a secondary seal. This reduces the 'stick-slip' effect, prevents leakage and makes the cylinders particularly low maintenance. Due to a wide range of optimized piston rod coatings, the cylinders can be used in a variety of environmental conditions.

The standardized selection of single components enables a large number of different cylinders to be combined flexibly – while being quickly available at cost-effective conditions. In addition to the standard solutions, Liebherr also offers customized cylinder variants in accordance with customer requirements. In short, Liebherr can provide individual hydraulic systems consisting of hydraulic power unit, hydraulic cylinders and control systems to its customers.

## Medium well done

At Bauma, Liebherr presented its newly developed LH30V0 axial piston pump of swashplate design for mobile applications with open circulation. This medium-pressure pump complements the existing



ABOVE: New series-production hydraulic cylinders at pressures of up to 350 bar



ABOVE: The LH30V0 has a through-drive option of up to 130% as standard. A DE- and a LS-DA control are available at the time of the market launch

product portfolio in the range of 280 bar nominal pressure and is suited for use in machinery such as excavators or wheeled loaders – for example, as a steering pump, fan drive or a drive for equipment cylinders. It has a specific delivery rate of 45cc/rev and is available with two of the most common controls – an electric proportional pressure control with negative characteristic curve (DE) and a load-sensing control (LS-DA) with pressure restriction, i.e. a pressure cut-off or pressure restriction. The swashplate adjustment is extremely precise and robust.

More controls are gradually being added, with priority determined by customer requirements. A proportional volume control (VE), a power control (LR)

and an electronic pressure control with positive characteristic curve are envisaged.

With the design and production process being closely coordinated, the LH30V0 can be distinguished by its compact and dynamic housing design. High efficiency levels are therefore possible with the use of new procedures in the rotary group area. Several patentable solutions contribute to an optimized production and assembly process. Not only current market requirements, but also experience in the high-pressure pump area, were taken into account during the development.

The pump was designed as a modular system right from the start. Larger and smaller sizes will be added to the currently available size of 45cc/rev delivery volume for each rotation. Here, Liebherr also responds flexibly to customer requirements. Further important parameters are, for example, the maximum speed of 3,000rpm in the standard version. A 130% through-drive option is another notable highlight.

Liebherr has been producing hydraulic pumps and motors since 1978, up to now primarily in the high-pressure pump area from 400 bar. The product portfolio is constantly being expanded – and with the new medium-pressure pump, Liebherr-Components is not only responding to the needs of the Liebherr Group, but opening up further customer potential on the international market as a flexible provider of hydraulic components. **ivT**

*Reyko Müller is product manager for hydraulic cylinders and power units, and Thomas Fischer is director of sales for hydraulics at Liebherr*



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# Group dynamics

OF THE 13 PARTNERS INVOLVED IN THE CAB CONCEPT CLUSTER, ONE BROUGHT LIGHT AND ELECTRONICS SOLUTIONS TO THE GENIUS CAB



CLOCKWISE FROM ABOVE: The SignatureLight increases passive visibility and brand awareness; illuminated door handle; matrix LED work lights; and intelligent interior lights

▶ A key highlight at this year's main construction equipment exhibition, the Genius Cab cluster project was a deserving recipient of the 2016 Bauma Innovation Award. Founded in 2014, the Cab Concept Cluster's 13 partners encompass global players, innovative suppliers, renowned scientific institutions, designers, industry associations, machinery hire companies and operators – all of whom have been contributing their expertise and decades of experience to the development of the Genius Cab concept cabin.

Cluster members include the companies Aurora, Bosch, Fritzmeier Systems, Grammer, Hella, Hydac, Lumod design agency, Mekra Lang, Savvy Telematic Systems, S.M.A. Metalltechnik, TU Dresden University of Technology, VDBUM association and Max Bögl. Their joint objective was to illustrate the incredible potential of efficient systems integration to OEMs in the construction, agricultural and material handling sectors. The Genius Cab is therefore a tangible vision of a groundbreaking wheeled loader cabin based on knowledge networking, functional integration and a simultaneous process of development, combining the trends of tomorrow with the customer requirements of today. All of its features serve specific user needs based on technology close to series production.

## Light innovations

Lighting and electronics expert Hella was an active contributor to the development with a variety of

innovations. The Genius Cab reflects Hella's broad product range: its LED work lights, SignatureLight, interior lighting, vehicle key, transponder system, accelerator pedal and rain-light sensor all act to enhance safety, comfort and system integration.

The Hella LED work lights of the Genius Cab are oriented toward the matrix technology used in the automotive sector. The work lights in this case are split into several reflectors, with every segment dimmed down or up depending on the position of the bucket. This means the light beam can be precisely controlled non-mechanically with optimum light distribution achieved in the work area. Furthermore, the integrated Hella ZeroGlare technology produces a sharp cut-off line, which prevents the driver being dazzled by reflections on the machine or by other operators. In addition, the work lights are integrated directly into the cab structure. The benefits are many: not only are the headlamps more effectively protected, but they do not obstruct the view of the driver, can be mounted more easily, and the heat from the LEDs is removed more effectively.

The SignatureLight lends the cab an impressive and striking appearance that can emphasize the brand identity of the vehicle manufacturer. It consists of flexible LED light strips encased in an impact-resistant silicon element, with distinctive signature modules integrated into the ROPS frame. The system integration also plays an important role in the interior

lighting. In addition to the ambient lighting and reading light functions, displays for the access control and visual check-back signals from the ultrasonic sensors have been integrated.

The radio remote control was specifically developed for use in harsh conditions. The radio receiver has up to four output signals, enabling the user to activate other functions, such as work lights or other lamps, via radio remote control. Additionally, the illuminated door handle indicates whether the doors are locked or unlocked. The Hella transponder is a further innovation that operates in tandem with the Savvy cloud-based Access and Identity Management to allow user profiles to be configured in different ways, thereby achieving a far higher degree of fleet management flexibility.

The robust electronic accelerator pedal is also worthy of note due to the wear-free measuring principle of the Hella CIPOS sensor and exceptionally low mechanical wear, even as a result of frequently recurring small movements.

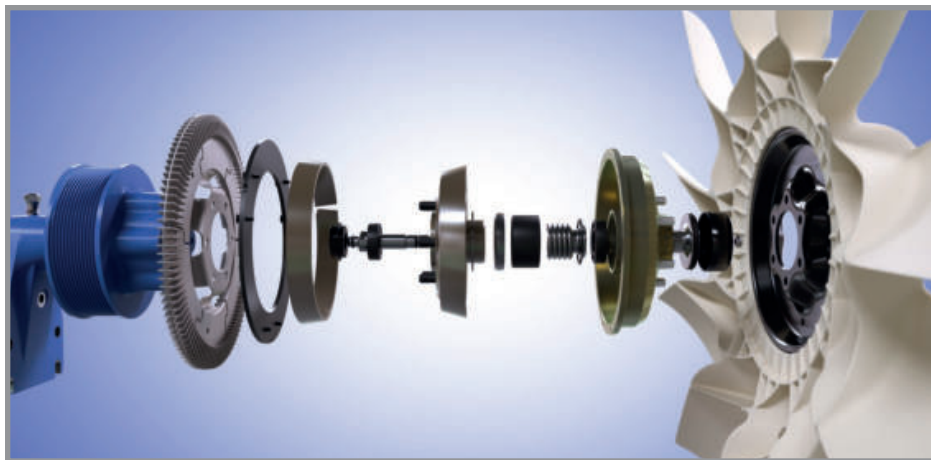
A special rain/light sensor developed by Hella for steeply raked windshields is also used. This can recognize a variety of rain situations and controls the windshield wipers in such a way that the driver will rarely need to intervene. The light sensor governs when the low beam is switched on or off under different light conditions. More information on the Genius Cab and several other Hella innovations can be seen at [www.cabconceptcluster.com](http://www.cabconceptcluster.com) **ivT**

*Sandra Schmölz-Döring has worked as head of global marketing off-highway at Hella since 2010*

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# It takes two

AN ADVANCED FAN DRIVE THAT MEETS THE NEEDS OF VOCATIONAL AND OFF-HIGHWAY VEHICLES ALIKE USES A HIGHLY EFFECTIVE, DURABLE AND EASILY ADAPTABLE TWO-SPEED SOLUTION TO INCREASE FUEL EFFICIENCY WHILE ENHANCING ENGINE PERFORMANCE



Various factors influence the features certain technologies have to offer commercial vehicles. For instance, because they maximize fuel economy by minimizing fan engagements for over-the-road applications, on/off fan drive systems are ideal for many long-haul applications – yet the requirements for fan drives used for severe-duty vocational and off-highway applications are very different. In construction vehicles or municipal trucks, on/off fan drives may even dis/engage every 90 seconds, which can greatly increase operating noise and clutch liner wear.

For this reason, BorgWarner recognized the special needs of severe-duty applications and developed the modular DuroSpeed two-speed fan drive according to its customers' requirements. This advanced fan drive solution for both vocational and off-highway vehicles therefore offers high durability and adaptability while maintaining a simple and lightweight design.

On/off fan drives are often disengaged, with the fan running at the lowest possible speed of approx 100rpm, as ram air is sufficient to cool the engine under most on-highway driving conditions. This low speed reduces parasitic losses and noise while also improving fuel economy. The fan drive only engages when active cooling is needed – for example, when driving uphill. Once it has engaged, the fan runs at full speed until the engine has cooled down sufficiently again.

However, vehicles such as ADTs and mining trucks operate under very different conditions. Their cooling

systems rarely benefit from ram air, so temperatures in the engine rise quickly when the fan drive is not engaged. This causes conventional on/off fan drives to repeatedly dis/engage, increasing noise and clutch wear. To allow sufficient cooling while reducing the number of engagements in harsh environments, the disengaged fan speed must be about 500rpm. To reach this speed, the pneumatically actuated DuroSpeed two-speed fan drive features several magnets, the number of which can be varied depending on the application, and eddy current technology is utilized.

The more magnets, the higher the disengaged fan speed, and vice versa. Using various configurations, tailor-made solutions can be provided for each specific application. This is a major advantage as too low disengaged fan speed can cause excessive cycling in harsh applications, whereas too much can lead to overcooling and excessive power consumption by the fan. Severe-duty applications will benefit from a high disengaged fan speed as this prevents temperatures from rising too quickly and provides additional cooling without the need to re-engage the fan. Fewer dis/engagements increase clutch life, decrease noise, minimize dust build-up in the radiator and make more horsepower available for a higher work output.

In addition, the solution uses an innovative flux ring for improved durability in harsh environments. This comprises a steel mounting ring with aluminum cooling fins and essentially acts as a fan within a fan, which



ABOVE: The DuroSpeed two-speed fan drive delivers reliable cooling while greatly reducing fan engagements for less noise and improved durability  
LEFT: The modular design allows for quick and easy conversion of any BorgWarner Kysor on/off fan drive into a DuroSpeed fan drive

transfers heat away from the bearings, seals and friction liner. As a result, the DuroSpeed two-speed fan drive on average operates at a temperature that is about 21°C (70°F) lower and dissipates heat 27% better than competing models. Due to the lower internal operating temperature of the clutch, bearing and friction liner durability increase significantly, allowing for nearly twice as many engagements over the fan drive's lifetime. In addition, the flux ring can easily be removed from the fan drive assembly to prevent overcooling during the winter months.

## Less is more

In many cases, simplicity is the key to innovation. BorgWarner's engineers used its proven Kysor series on/off fan drive as the basis, adding the innovative flux ring for increased disengaged fan speeds and better internal cooling. The result is a solution with 11 fewer parts than other two-speed fan drives, with reduced maintenance complexity, and a saving of approximately 2.3-4.5kg of overall weight, contributing to improved fuel economy.

The design is also highly adaptable, making it ideally suited for vehicle fleets requiring durable, low-maintenance and easily convertible solutions. The DuroSpeed two-speed fan drive features a highly modular design that shares many base components with the Kysor on/off fan drive, enabling quick and easy upgrading by simply installing the two additional components. No new wiring harnesses or special controls are necessary for the conversion.

In addition, the DuroSpeed and Kysor fan drives use the same bearing seals and liners, enabling fleets with mixed applications to stock fewer parts while offering them the flexibility to upgrade quickly and according to their needs. In addition, the simple design has no spinning air connections to wear, inspect or service. **ivT**

Ryan Livingston has worked as program engineer for BorgWarner Thermal Systems for over 19 years



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# The bogie men

AS WORLD LEADERS IN THE PRODUCTION OF BOGIE AXLES, THESE GUYS HAVE THE ANSWER TO ALL YOUR DRIVELINE NIGHTMARES – INCLUDING THOSE OF THE RIGID OR STEERING AXLE VARIETY

Since 1960, NAF Neunkirchener Achsenfabrik AG has been a specialist in the production of high-performance drivelines for construction, forestry, agricultural, heavy load and mining vehicles that have to deal with the toughest environmental conditions all over the world. Its range of products includes planetary drives, gearboxes, differentials, planetary rigid axles, planetary steering axles, portal bogie axles and planetary bogie axles – all of which are developed and manufactured exclusively in Germany.

NAF offers a wide range of bogie axles as well as rigid and steering axles. These application-specific designs feature a cast construction with a patented oil-immersed self-cooling disc brake and integrated gearbox. With flexible adaptation enabled as a result of the NAF-Modular-System, they also offer a centrally driven steering axle with adjustable track width, and a gear drive for high durability and longer working life in bogie axles.

Competence and technical know-how have made the company a world market leader in bogie axles for more than 40 years – but increasingly NAF has been making a name for itself with the manufacturers of forestry and construction machinery. The perfected technology of its bogie axles has meanwhile proven its worth in articulated dump trucks and motor graders from a variety of distinguished off-highway OEMs.

NAF claims to be the only supplier able to offer a range of bogie axles between 10 and 50 metric tons payload and a wheelbase in several steps from 1,300-1,980mm. Rather than using two single rear axles, a bogie axle offers much better utilization on rough terrain due to its independent oscillating bogie housings. This guarantees optimum ground contact, providing tractive effort even in the harshest terrain. The company's latest product in this range is a bogie axle for construction machinery with a dynamic load of 46 metric tons up to 58km/h (36mph).

## Special features

In addition to this wide range of sizes, NAF also offers a variety of special patented features, such as the patented Permanent Balanced Bogie System (PBBS), or NAF turbo brake. Wherever ground pressure and increasing demands on tractive effort challenge the capabilities of standard axles, a NAF bogie axle equipped with PBBS could be the right choice.



LEFT: TAP 89 planetary bogie axle for axle loads of up to 50 metric tons, with a self-cooled, oil-immersed disc brake in each wheel end

BELOW: Directly driven steering axle with adjustable track width

Along the driveline from the axle beam to the oscillating bogie housing, a planetary gear has been connected in parallel with a second planetary gear. When torque is applied on the driveline, a reverse torque is created that counteracts the lifting torque coming from the tractive force. Combined with one of NAF's planetary standard axles (6x6) or pair of bogies (8x8), and equipped with the PBBS technology, this provides unbeatable off-highway capabilities and outstanding durability.

The NAF turbo brake – which is directly integrated in the wheel end and runs at wheel speed – suffers almost no wear over its lifetime so service effort is reduced to a minimum. The patented system is able to realize road speeds up to 65km/h. As an additional advantage, this 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.

The system is one of the major components in NAF's 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 centrally located driveline provides a weight-optimized design, with the simplified hydraulic control

and regulation system requiring only one central motor. In addition, the tractive effort can be almost doubled in comparison with legacy systems using two wheel-mounted hydraulic motors.

An adjustable track width has also been integrated into the central drive concept to ensure the highest performance across all harvesting conditions and the use of different tire sizes.

These three developments are long established and proven – and they offer optimum drive performance in every kind of drive situation.

The design of all NAF drivelines is completely in accordance with the NAF-Modular-System that enables their effective use even in completely new applications, adapting existing parts of products in different combinations – with only a small level of new developments or modifications being required. As a result, the components and individual parts have been long-term tested and can be variably combined to create an individual drive solution with substantial cost advantages. **ivt**

Head of NAF's sales and marketing, Peter Illig has been employed by the company since 1987, working in sales for more than 15 years



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# Tough luck

GIVEN THE HIGH RELIANCE PLACED ON TODAY'S HMI DEVICES, IT'S JUST AS WELL THAT THE LATEST POWERVIEW MODELS OFFER A HIGHLY DURABLE SOLUTION TO ENSURE VEHICLE OPERATION REMAINS AT ITS OPTIMUM LEVEL FOR AS LONG AS POSSIBLE

Displays that are simple, intuitive and easily configurable can considerably enhance vehicle operations by providing vital information to the driver while remaining a cost-effective and reliable solution. The human-machine interface (HMI) device is therefore rapidly becoming one of the most important pieces of equipment in industrial vehicle applications. Various factors – such as increased electronic integration and new emission requirements – have created a multi-layered labyrinth, making the use of an HMI device essential to keeping the operator up-to-date.

Murphy by Enovation Controls has a reputation for building tough, durable displays that meet stringent industry requirements. Its PowerView 300 Series has been enhanced with the PV350 and PV380 models that offer the same ruggedness plus a host of extra features that include a 3.8in sunlight-readable LED backlit QVGA monochrome display; a wide viewing angle; IP67 sealing; extensive testing for vibration and shock; operating temperatures of -40° to +85°C (-40° to +185°F); and compliance with stringent EMC/EMI directives. The PowerView 300 Series has five tactile buttons, red and amber warning LEDs and an I/O complement to meet various application needs. Mounting the display is performed via a 3.5in hole cutout, while its small footprint helps provides quick integration into existing or new designs.

Equipped with a 180MHz processor coupled with 2MB of RAM, which allows enough storage for multiple configurations, multilanguage support and an RTC for timestamp capability, the PowerView 300 Series is versatile and boots into software in less than three seconds. Both displays have CAN 2.0B with support for SAE J1939/Freeform protocols, a resistive input, a digital 500mA switched low-side output, and power and ground on a Deutsch DT Series six-pin connection.

In addition to the above I/O, the PV380 adds three analog inputs capable of 0-5V/4-20mA measurements; three resistive inputs (making four inputs in total); a digital output; RS-485; and a frequency input on a Deutsch DT Series 12-pin connector. Boasting ECE-R10 certification, the PV350 includes an isolated NMEA 2000 CAN port on a five-socket M12 receptacle.

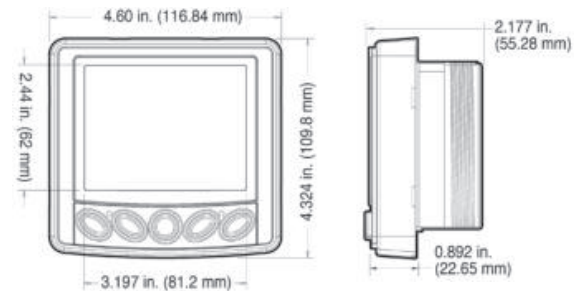
## Think out of the box

Built for use as a standalone unit or as part of a distributed system, the PowerView 300 Series is an



ABOVE: The PowerView 380 (left) and PowerView 350 (right) bring sophisticated control to engines. These rugged displays are cost-effective, reliable solutions

RIGHT: With its compact size, the PowerView 300 Series fits in tight spots while providing important information to users



out-of-the-box solution for multiple applications. Its standard software includes an intuitive user interface that provides an easily configurable solution. Upon entering the correct password, operators can quickly set up an electronic or mechanical engine type and configure it according to their application directly from the display. Quick changes can be made, such as enabling/disabling DPF and SCR; changing the throttle configuration type and customizing the parameters; and configuring the resistive inputs, fault conditions and overspeed conditions.

In addition, the essential engine data is selectable for monitoring, service reminders can be set up and – with a second-level password – an advanced setting can be unlocked for TSC1 configuration. Once setup is complete the display is ready to run. The operator's manual is available for download from the Murphy website to enable users to get quickly up to speed.

For greater customization, PowerView 300 models combine with Murphy's PowerVision Configuration Studio software to give users the ability to personalize the display. Integration is made simple through easy

setting up of the J1939 data library with proprietary messaging and configuring custom sender curves for analog input devices. A personalized splash screen and custom images can be added to provide a consistent theme across an OEM's product range.

With PowerVision Configuration Studio software, designing automated routines with the use of activity diagrams and state machines is fast. With full control, settings and key event data that occurs at setup or during runtime can be saved into the EEPROM for later recall and viewing. The configuration of password protection for various user levels is also provided.


Software configuration deployment is enabled via a CAN conduit to the display. Furthermore, the displays can be factory programmed to custom configurations, which speeds up field release of applications. The PowerView 300 series is available now to assist with all OEM projects. **ivT**

*Osas Imade is HMI product manager for the power controls group at Murphy by Enovation Controls, where he has worked for five years with a focus on displays*

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# BULLETIN BOARD

## Computing power at the service of comfort

 Kalori's development of an HVAC unit relies on the use of highly reliable data. The thermodynamic and energy-calculating Simulka software calculates precisely the thermic needs of the cab based on its characteristics and the speed of required heat-up or cool-down. The required exchangers and fans are also calculated, while verifying the adequacy of all the components of the selected cooling circuit.

A design approach and complete and structured tests ensure limited risk of dimensional errors right from the beginning of the project; and all of this without a physical cab being built. The technique used here allows precise anticipation of costs, without the risk of oversizing.

If there is a compromise, it has been accepted in full knowledge early on in the project.

The thermal contributions are also taken into account. The impact of the



proximity of the gearbox, hydraulic hose or any other heat source will therefore not be a surprise that disturbs the user's comfort.

The Kalori technicians can therefore produce, in their brand-new double climate chamber, real validation on the prototypes of each chosen component. The evaporator will be positioned in a chamber where technicians can vary the climatic conditions to simulate the interior of the cab, with the condenser in another chamber


simulating the exterior climatic conditions. Every real situation can be tested, even when a cab doesn't actually exist yet. Then, at the end of development, the complete vehicle is tested in the 300m<sup>3</sup> climate chamber that can recreate all climates. As a result, HVAC units are now becoming smaller, yet more powerful!

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## Can't touch this?

 **ASM Sensors** has introduced the PosiRot PRAS6 non-contact analog angle sensor. The sensor measures angular displacement and position of rotating objects from 0-360° using magnetic Hall technology. Because the magnetic encoder technology is entirely contactless and solid state, PRAS6 sensors are resistant to shock and vibration. What makes the sensor unique is its robust laser-welded stainless-steel 1.4404 housing. This housing is hermetically sealed and therefore especially suited for applications with humid, wet and dirty environments and even for underwater use.

The robust sensor housing also withstands aggressive fluids and is perfectly suited for hygiene-critical applications with intensive cleaning and sterilization processes.


The PRAS6 has a sealing capability protection class to IP69K, which makes it perfectly suited for heavy-duty outdoor applications such as mobile working machines, and even hygiene-critical applications such as food-processing machines and medical equipment. For safety applications, the PRAS6 sensor housing can be equipped with redundant electronics.

The sensors measurement ranges are 0-15° to 0-360° (in 15° increments). Outputs are available in voltage of 0.5-10V, 0.5-4.5V or current of 4-20mA. The resolution of PRAS6 is ±0.3% (60-360°) and ±0.1% (15-45°). The linearity is ±0.3% f.s.

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## Level best

 Preserving fast and precise movements while ensuring high standards of safety has always been crucial for front loaders. **Tecnord** has therefore developed the Omni-Level electrohydraulic system for bidirectional control of the bucket and loader equipment.

Self-leveling control refers to a mechanism whereby the bucket maintains its relative angle to the ground during lifting and lowering. Omni-Level employs a load-sensing closed-center valve, driven by a joystick through a microprocessor-based machine management system and sensorized by a MEMS accelerometer/gyroscope to handle the complexity of multi-axis angle measurement on moving vehicles in harsh environments, regardless of high shock, acceleration and vibration.

Requiring no mechanical adaptations or master and slave circuitry configuration, the Omni-Level gyro-accelerometer is simply case-aligned and orthogonal to the

bucket's frame in a fully adaptive way, with no need for inertial and dynamic calibrations. The system performs three main functions – self-leveling, anti-rollback and return to dig – with no need for the operator to manually adjust the bucket angle on boom-up or boom-down.

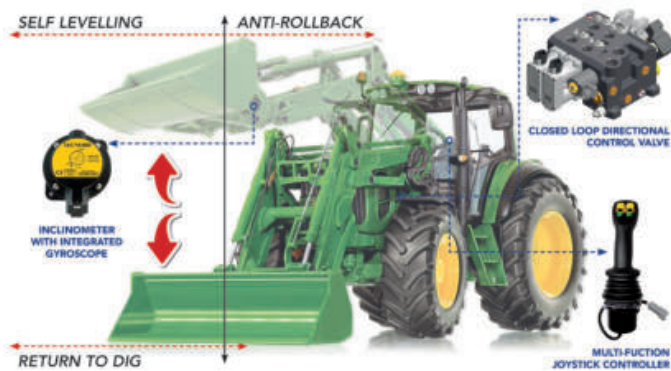
Pressure-compensated for load-independent multifunction operation, Tecnord's TDV100-MLT proportional directional valve is equipped with

proportional actuators for closed-loop position control of the valve spool movement.


The Omni-Level gyro-accelerometer employs high stability, temperature-compensated MEMS components to ensure long-term performance and reliability.

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## CAN configure with ease

 Create sophisticated hydraulic control logic – without having to code anything – with the new **HydraForce ECDR-0506A** electronic valve driver. This CAN-capable controller can be used to enhance mobile equipment electrohydraulics, including fan or transmission controls, attachment controls, joystick controls, or any remote function in a distributed control network.

The ECDR-0506A features six inputs and five outputs and a 32bit processor with high calculating power. It accepts input from analog or SAE J1939 CAN/CANOpen operator interface devices (joystick, potentiometer, sensors). Designed for use in extreme environments, the ECDR-0506A driver has a robust, compact and fully sealed housing that provides superb environmental protection from contamination and moisture, and Deutsch connectors that qualify for the highest IP69K environmental rating. It has an

operating temperature range from -40° to 85°C (-40° to 185°F).

It is easy to configure using HF-Impulse software, which is available as a free download from [www.HydraForce.com](http://www.HydraForce.com).

Based on the success of its EVDR one- and two-input electronic valve drivers, HydraForce has added this larger, CAN-capable model to the family.

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## High-pin-count solutions fit the bill

 **TE Connectivity (TE)** Industrial & Commercial Transportation's LeavySeal, Deutsch DRB series, and Deutsch DRC series connectors are designed for high-pin-count applications in the construction and agricultural sectors. They are used in critical applications, such as the ECU, and in applications where multiple wires need to pass through a vehicle's firewall.

LeavySeal connectors are offered in arrangements from 15 to 92 positions and are for high-vibration and extreme temperature environments. They are constructed from heavy-duty thermoplastic, utilize TE's industry-proven AMP MCP terminals, and feature a novel lever lock mechanism for connector mating.

Deutsch DRB series connectors are heavy-duty thermoplastic bulkhead connectors that accommodate

multiple wire gauges and feature high pin counts, including 48, 60, 102 and 128 cavities.

The DRB series offers several mounting flange options and wire arrangements. These connectors accept Deutsch contacts that carry amperages from 7.5-100A continuous capacity.

The environmentally sealed DRC series is a rugged connector series that offers arrangements of 24, 40, 50, 60, 64, 70 and 76 cavities. Accessory items are available to complement the connectors, including boots, gaskets, backshells and wire routers. DRC series connectors accept Deutsch contact sizes 16 (13A) and 20 (7.5A).

As even a small degradation in electrical connections can be critical to off-highway equipment, OEMs depend on TE's environmentally sealed electrical connectors. With a wide variety of rugged electrical connectors available, they can find a connector for nearly any high-pin-count application.

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## Simplified handling for LHDs

 With a comprehensive line of Spicer brand products designed specifically for mining vehicles, **Dana Holding Corporation** has the ability to meet a full range of market needs with value-driven solutions for premium configurations featuring advanced technologies.

Spicer drivetrain systems for underground mining vehicles have been designed to improve traction, positioning, braking and reliability, as well as provide unique features that maximize productivity. All transmissions designed for mining vehicles can be specified with Spicer electronic controls to enhance performance even further.

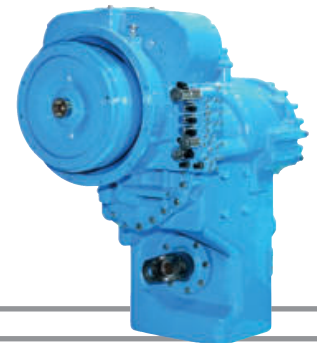
A range of options enable precise inching, eco-drive, power drive and overlap control. These electronic controls offer wider systems integration through upgraded software and enhanced hardware capacity, flexibility and expandability, while requiring minimum alterations to the vehicle's design envelope.

A prime example of Dana's advanced technology capabilities is

the Spicer Model TE32LD powershift transmission, the centerpiece of a robust, efficient drivetrain system for load haul dumpers that delivers simplified handling, improved operator comfort and reduced noise. Configured with a freewheel and lock-up design to further improve overall drivetrain performance and optimize fuel efficiency, this powerful, efficient transmission is designed to support vehicles with engines of 250-325kW and a bucket capacity up to 15.5 metric tons.

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## Polar Cab is worth exploring

 Based on the Polar Cab TS (an engine-off cabin cooling system with exclusive cold storage technology), the all-new Polar Cab ES has been launched by **Webasto**. The company offers two off-highway solutions, one being battery driven and the other featuring a cold storage technology. With such innovative tailor-made solutions, operators can increase productivity while decreasing fuel costs and engine hours during downtimes.

Polar Cab TS features an exclusive cold storage technology to bridge longer downtimes. Inside the storage core is a series of aluminum micro-channels that route liquid refrigerant around a graphite honeycomb substrate impregnated with water. It is capable of storing cold energy at an extremely high efficiency, which is transferred to the cab for on-demand engine-off cooling. The Polar Cab TS has a cooling capacity of up to 4,450 BTU/h. It requires very little power, so the batteries can be correspondingly small.

Webasto offers Polar Cab TS as an aftermarket kit, which includes the thermostorage core, electrical compressor (24V), condenser with fan, air handler, wire harness and miscellaneous hardware.

To bridge shorter downtimes, it provides purely electrically driven solutions. The Polar Cab ES offers a cooling capacity up to 7,000 BTU/h, despite low power consumption and includes a compact 24V variable-speed electric compressor. It can be installed with two aftermarket kit configurations: operators can decide between a universal overhead, or universal vertical floor-mounted unit with evaporator.

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## Streamlined sensor installation

 Curtiss-Wright's Industrial division has launched the NRH300DP, a non-contact, rotary position sensor from its Penny & Giles brand family.

With an 8mm low-profile sensor body and small footprint, the fully encapsulated, IP68/IP69K-rated NRH300DP offers exceptional levels of performance against water, dust, shock, vibration and temperature. It is ideal for use in on- and off-highway machinery destined for challenging environments, and as a cost-effective solution for medium-volume applications where a select number of options or degree of customization may be required.

Benefits of the NRH300DP include:

- Non-contact sensing technology to provide a long mechanical life;
- Can be factory set to correspond to rotations of 20° to 360° in 1° increments;
- Industry-standard 38mm mounting centers – for easy replacement or upgrades;

• Onboard diagnostic functions allow the two outputs to be put into safe, predefined states should an internal sensor error be detected.

Additional features include an innovative circuit design, enabling the sensor to be powered from a regulated 5V supply or a varying voltage – such as a vehicle's battery – in the range of 9-30V. Versatile, factory-programmable electronics can also be easily set to one of two analog voltage output ranges (0.5-4.5V or 0.2-4.8V) or one of three PWM frequencies.

The NRH300DP uses proven, wear-free Hall-effect sensing technology and replaces the earlier NRH280DP for new applications. It also features a number of magnet arrangement options, and includes an over-molded magnet carrier that simplifies the interfacing of the magnet and sensor during the installation process. Optional bolt, plug or loose carrier variations are also available.

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## You lift me up

 Stertil-Koni will be exhibiting its Earthlift mobile column lifts at the IAA exhibition in Hannover (Hall 23, booth 29). The Earthlift features an extremely sustainable Active Energy Retrieval System that enables a range of heavy-duty vehicles to be raised up to 50 times without the need to recharge the batteries, increasing maintenance productivity by up to 35%.

The patented battery retrieval is as simple as it is clever, with the energy generated as the vehicle descends on the mobile column lift being reused to charge the battery.

Claimed to be the world's most environmentally friendly wireless mobile column lift, the Earthlift offers maximum flexibility and can lift a wide range of mobile machinery, including buses and trucks, forklifts, and construction and agricultural vehicles and equipment. It is available in capacities between 8.5 and 10 metric tons, in configurations of up to 32 columns, which are made from recyclable materials (as are the batteries). It uses biodegradable oil in a closed hydraulic system, and electronic components according to environmental norms, including the ebright Smart Control system with full-color touchscreen controls and MESH stable connectivity.

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## Torquing Italian

 FPT Industrial, one of the world's leading players in industrial engines from 2.2-20 liters, offers a full range of sustainable products for on- and off-road vehicles, marine and power-generation applications.

Responding to the needs of the customer, FPT develops its diesel and alternative fuel products to deliver outstanding performance, efficiency and adherence with the appropriate emissions regulations, while having low fuel consumption and reduced total cost of ownership.

To comply with Euro 6 and Tier 4 Final emissions regulations, its EGR-free patented HI-eSCR aftertreatment solution maximizes combustion efficiency. The solution uses clean air – rather than EGR – before the aftertreatment HI-eSCR converts NOx to diatomic nitrogen and water, and does not need a DPF.

To comply with Stage V emissions standards, FPT Industrial developed HI-eSCR2, the second generation of its renowned and patented High

Efficiency Selective Catalytic Reduction (HI-eSCR) aftertreatment technology.

And, as one of the few engine manufacturers with 25 years of experience in natural gas, compressed and liquefied (CNG and LNG) in on-road applications, FPT Industrial also offers engines for light, medium and heavy applications. The available range goes up to 400hp, creating a valid alternative to diesel, even for long-haul missions.


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C9 CNG engine from FPT Industrial

## Get busy drying

 Compliance with exhaust emission limits presents high demands during the development of IC engines and the associated exhaust aftertreatment. It's in this area that Thermamax has developed its hydrophobic fiber elements, Tmax-DryTec technology.

With conventional insulation systems there is the risk of water spray or other fluids, possibly mixed with salt or other dirt particles, ingressing during engine cleaning or sometimes just due to poor weather conditions. The porous insulation material soon becomes saturated; the result is a delayed light-off characteristic in the aftertreatment system due to losing useful heat energy in drying the insulation material. Fuel consumption and emissions levels are also particularly high during this period.

Durability of the insulation system is also reduced. Worst affected are insulation systems on the vehicle underfloor such as DPF systems, SCR modules, mufflers and acoustic insulations.

Insulating the exhaust line can greatly help in meeting emissions

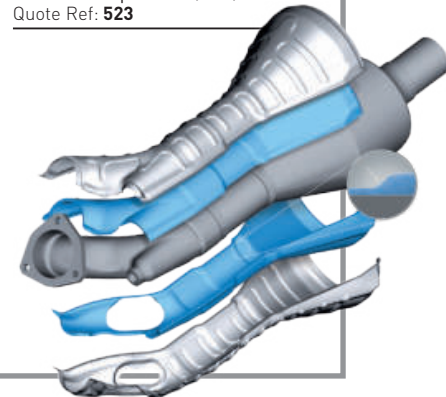
guidelines, and provide protection from water ingress and other pollutants.

Tmax-DryTec provides some impressive 'dry' figures:

- 400 times less water absorption;
- Improved light-off characteristic due to shorter warm-up period;
- 95% fewer deposits mean increased durability and reduced thermal conductivity over lifespan;
- Improved fit due to variable insulation thickness in the fiber element;
- High resistance to vibration.

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## MARS MAKES YOU WORK (FOR FOUR HOURS), REST (FOR 30 HOURS) AND PLAY (AT STRETCHING THE VIEWER'S CREDULITY ABOUT THE EFFECTIVENESS OF FULLY ELECTRIC DRIVETRAINS)

▷ My mum spent her entire life believing that there was more to life than the humdrum existence we were experiencing. She looked to escapism to nourish a deep disquiet that had existed within her since she survived the London blitz of the 1940s. So when Captain James T Kirk exploded onto television at the helm of the Starship Enterprise during the 1960s, she became a 'Trekkie' and spent the rest of her life convinced that routine space travel would one day become a fact of life.

For her, that never happened, but it did leave me with an enduring fascination for sci-fi. So a few weeks ago I watched the Matt Damon film *Martian*. Now if you have not seen the movie, this is your spoiler alert!

It is set, I believe, in the not-too-distant future, where Mr Damon's character is accidentally left for dead when the rest of the Mars mission team evacuates under less than ideal circumstances. Slightly injured, he quickly recovers and sets about ensuring his survival until a rescue can be planned. Now, as you probably can guess, he does have some pretty convenient resources at his disposal (otherwise it may have been a very short film).

One resource is a manned ascent vehicle (MAV) deposited there to await the arrival of a future mission in four years. Unfortunately that vehicle is 3,200km from his base. At this point the story does twist and turn a bit, but the nub of it is that at the crucial moment, he has to make the epic dash to the MAV and ascend at exactly the right time and trajectory to rendezvous with the main spaceship, which has slingshot around Earth and returned to pick him up.

Okay, so far so good. (Unlikely, but possible, at least.) His only vehicle is a Mars Rover, by which point most of us would get a warm, cosy feeling as this machine is a basic forward cab, articulated six-wheeled pivot steer machine with a load bed and crane – so yes, a basic, recognizable off-highway utility



Illustration: Julie Welby

vehicle. In fact, if you put it down at any construction site today, most people would not give it a second look except that in the film it would have been made by Grumman or Northrop instead of one of our more terrestrially focused OEMs.

And of course, instead of having a nice healthy diesel as the power plant, this baby is electric. The range of the vehicle is designed to be 32km, but the ever-resourceful Mr Damon improves this by scavenging the battery packs from other vehicles and plumbing them in. Fortuitously the base camp still has power so he can charge them. Fine – but one charge is still not enough to cover 3,200km, so he then harnesses the solar panels of a defunct probe as a portable recharging source, for which he builds a trailer and sets off in the direction of the launch site.

Now I know that time becomes plentiful when you are alone on a new planet, but one of the mission controllers notes that he drives for four hours in the night, then rests for 30 hours while the batteries recharge. Obviously, he gets there, makes the rendezvous, and everyone slaps backs and begins to sing *God Bless America*.

But the whole thing underlines the rarely addressed limitations of off-highway electric vehicles under certain circumstances. Even if he solved the issue of the charge time being so long in relation to travel time, the machine was burdened with batteries to the point that the

load bed was full and it was towing a trailer just in order to travel, let alone work.

We tend to assume that off-highway kit will always operate within easy access to three-phase electricity. Once that assumption becomes invalid, the 'Mars scenario' kicks in, illustrating perfectly that for any electric vehicles working in remote conditions, the provision of charging would become a more serious operational consideration even than the supply of the vehicles themselves.

Now, some of you are shaking your heads and saying, "Yeah, but this is just a movie!" Well, in these days of social media, you don't make a film like this without doing the maths unless you want to open yourselves to scorn from millions of armchair astrophysicists who believe themselves completely capable of tearing apart the scenario.

This film is seriously laced with technical facts and is made all the more believable by the addition of humanized solutions such as the prodigious use of duct tape as a repair medium, so I think the Mars scenario makes a very valid point.

However, I do concede that the plot lost credibility for me when a Chinese rocket was used to resupply the mothership as it passed Earth after the American spaceship had exploded during launch. The Chinese must be using the good stuff for their space program! **ivT**

Comments: [theinsider@ukipme.com](mailto:theinsider@ukipme.com)

THIS FILM IS SERIOUSLY LACED WITH TECHNICAL FACTS ... SO I THINK THE MARS SCENARIO MAKES A VERY VALID POINT