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- | Stage V engines
- | iVT Expo!

WORLD-BEATING VEHICLES

- Cat D10 dozer at 40!
- Tractor of the Year 2018
- Autonomous concept 2020

Cutting Edge

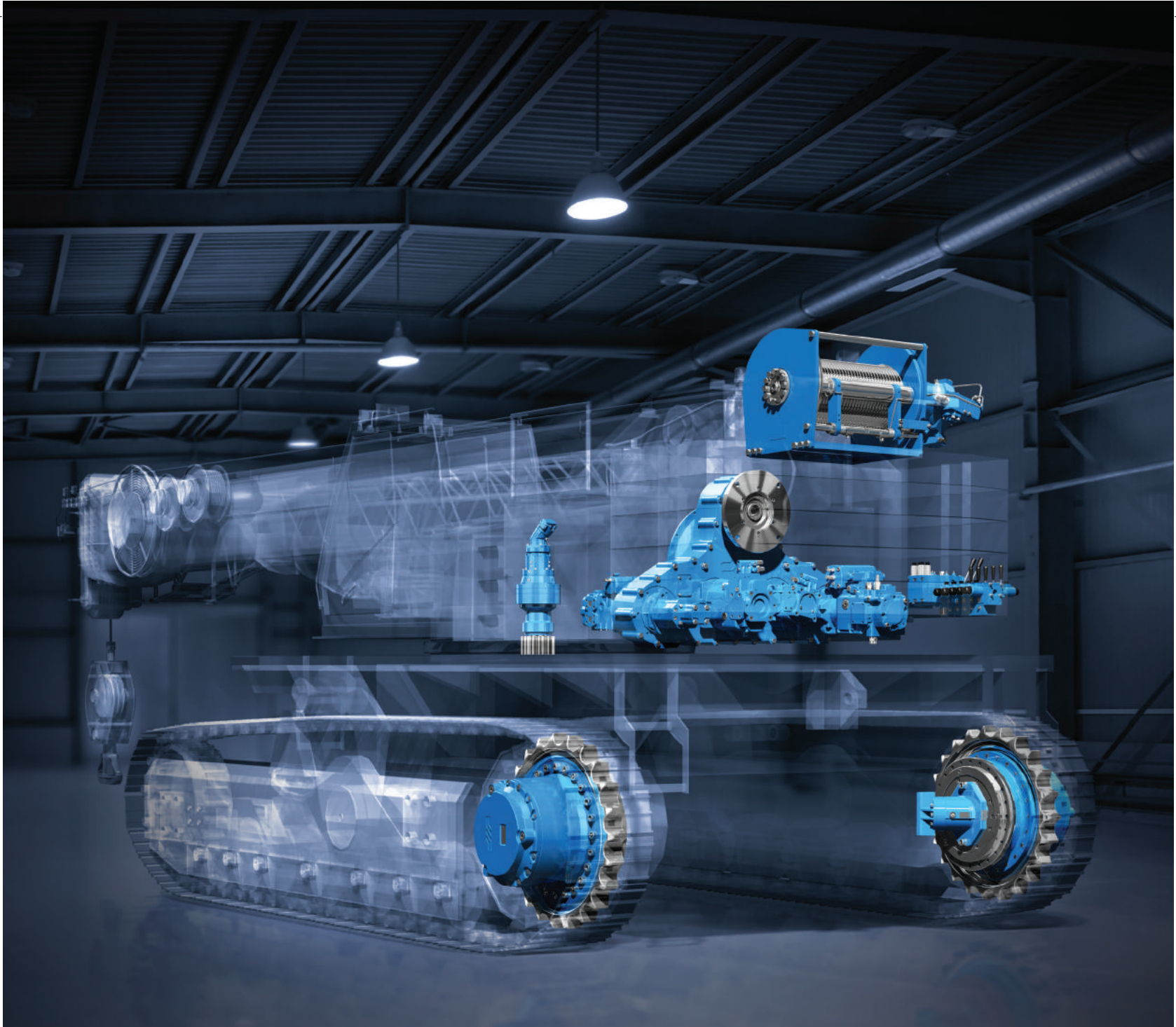
Laser blades, drone mapping, VR controls... The new technology that is set to revolutionize industrial vehicles in forestry, and beyond

"We have the most modern combine harvester factory in the world"

Claas CTO Thomas Böck on the OEM's Russian jewel

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Editor Tom Stone (tom.stone@ukimediaevents.com)
Deputy Editor Rachelle Harry
Assistant Editor James Allen

Production Editor Alex Bradley
Chief Sub Editor Andrew Pickering
Deputy Production Editor Nick Shepherd
Senior Sub Editor Christine Velarde
Sub Editors Tara Craig, Alasdair Morton

Art Director Craig Marshall
Design Andy Bass, Anna Davie, Louise Green, James Sutcliffe, Nicola Turner, Julie Welby, Ben White
Head of Production and Logistics Ian Donovan
Deputy Production Manager Robyn Skalsky
Production Team Carole Doran, Bethany Gill, Frank Millard, George Sprekley

Advertising Sales Manager Kevin Barrett (kevin.barrett@ukimediaevents.com)
Advertising Coordinator Michael Briant (michael.briant@ukimediaevents.com)
Circulation Manager Adam Frost (adam.frost@ukimediaevents.com)

SUBSCRIPTION / CHANGE OF ADDRESS INQUIRIES TO:
datachanges@ukimediaevents.com

Editorial Director Anthony James
Managing Director Graham Johnson
Chairman and CEO Tony Robinson

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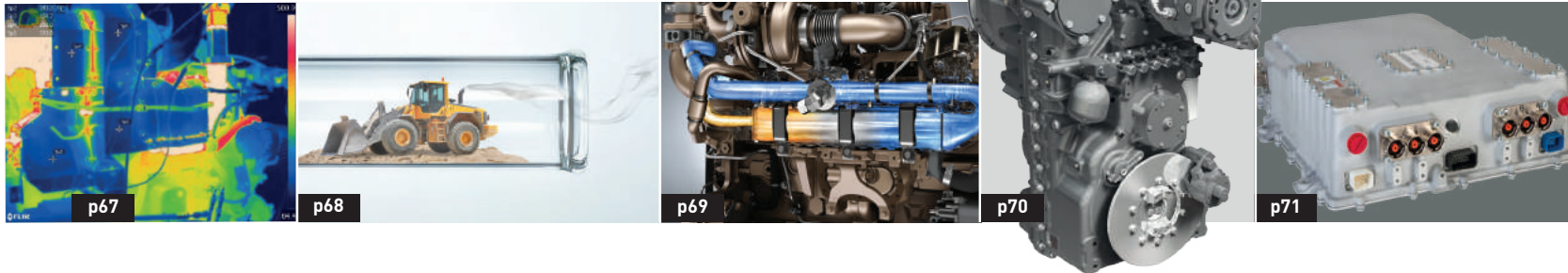
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FOREWORD

△ Last issue, in our Agritechnica special, we heralded the 'Birth of the electric tractor'. As I write this, I have just returned from the Agritechnica show itself in Hannover, and what I witnessed there wasn't just a single birth – it was more of a baby boom! Granted, the vast majority of the huge halls were very much dedicated to diesel. The old, wise, dependable technology is still holding court. Agricultural vehicles of all sizes and types are diesel driven, from the smallest tractor, aimed at the hobby farmer, to the huge 600hp beasts, designed to work on some of the largest farms in the world – and of course, not forgetting the giant combine harvesters that dominated some stands and were rightly revered, by young and old alike, as the reigning kings of fields.

But here and there, in certain pockets of innovation, a new generation was being born. Some had been expected, such as the Fendt e100 Vario, previewed last issue, and the winner of one of the Agritechnica Silver Medals for innovation (read more at ivtinternational.com/vario) as the world's first commercially available electric tractor. Others were complete surprises, such as the Farmtrac 26, the first electric tractor to be designed and built in India, and on display as a working prototype in Hannover. I was lucky enough to be there for the unveiling, which you can watch at ivtinternational.com/farmtrac. Executives from Escorts, Farmtrac's parent company, promise the compact machine will be available worldwide "within the next 18 months".

Over at the Avant stand, meanwhile, they were celebrating twins! The all-electric e5 wheel loader, which was profiled in our *Off-Highway 2018 Annual* (ivtinternational.com/e5) has been joined by the e6 – identical in size and looks and similar

in performance, but with a longer-lasting, faster-charging lithium-ion battery pack.

Moving further away from the world of tractors, but still very much part of the electric generation was the world's first all-electric, self-propelled mixer wagon, which was on show on the Supertino stand. This livestock farming essential was developed in Italy as a joint venture with the University of Turin, and is predicted to be on the market in the next year.

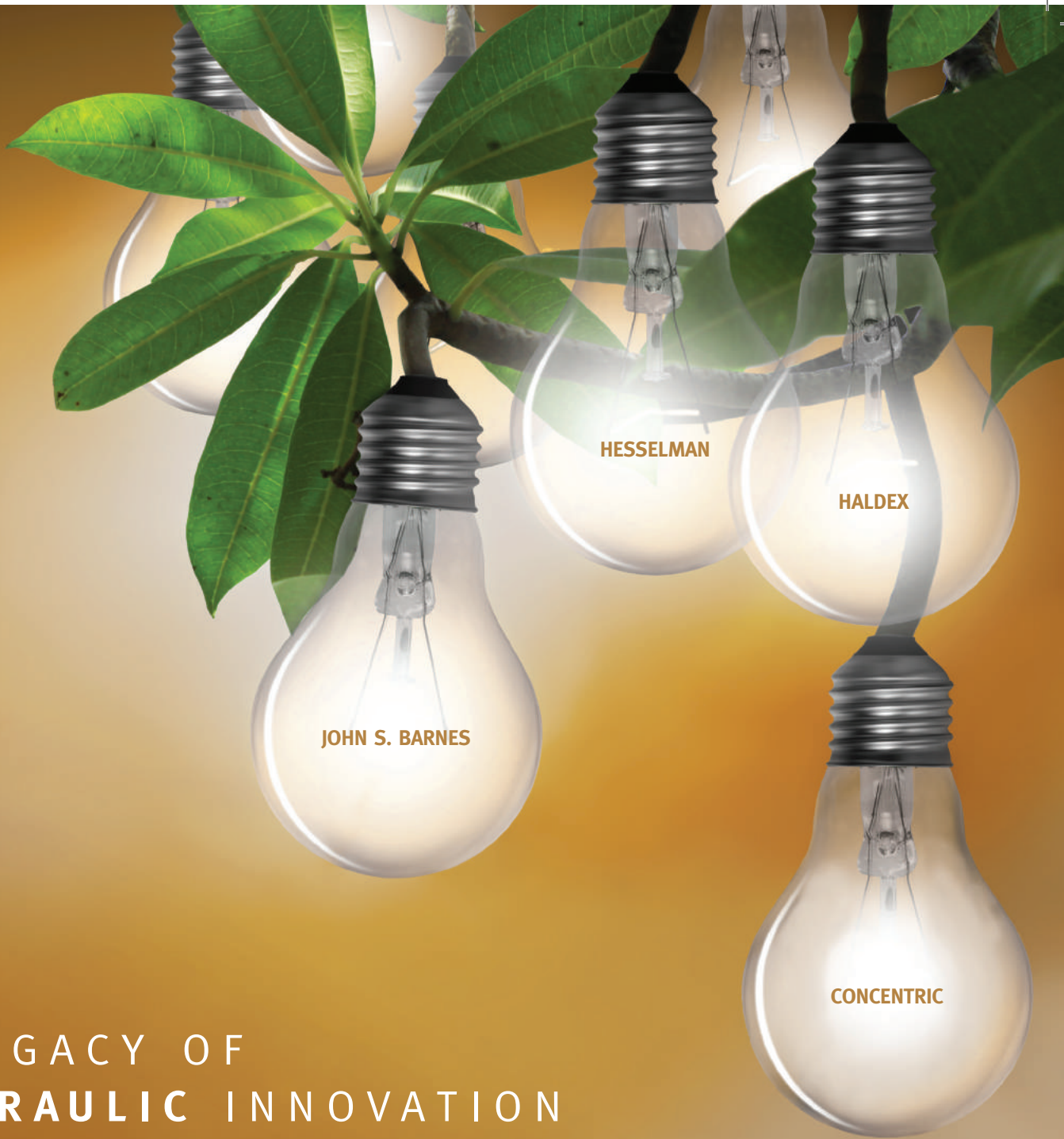
And it wasn't just OEMs that were joining the electric revolution. Component manufacturer Sensor-Technik Wiedemann (STW) proved that it is possible to get an old-school diesel tractor to change its ways... with a little electric therapy in the form of a 100kWh lithium-ion battery, and around €100,000 (US\$118,000) in aftermarket refitting, which ultimately creates its 'SymonE demonstrator'.

Sage commentators, such as our very own Phil Pope, remind us that getting carried away with the promise of electric vehicles is, at best, a little premature (read Pope's profile of the latest Stage V engines from page 18). But no generation is expected to be born and take control of the world at once. No one can deny that electric vehicles are now here, but where this sparkling new generation will take us is anyone's guess. Perhaps its early promise will lead to nothing and one of electric's funny cousins, such as New Holland's methane tractor prototype, the T6.180, also at Agritechnica (ivtinternational.com/methane), will one day rule the world. Either way, diesel could soon be under siege. The next generation has begun.

Tom Stone, editor, iVT International

Coming up in the March issue of *iVT*

• Powertrain and traction technology • Preview of the Intermat International exhibition for construction and infrastructure, Paris, April 23-28, 2018 • New vehicle case studies



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February 2019 will welcome the launch of IVT Expo – the world's premier event where OEM engineers and decision makers will get to discover cutting-edge technologies, Tier 1 suppliers, manufacturing experts, and engineering service providers.

There will be no vehicle launches hogging the limelight, no irrelevant, non-vehicle-related exhibitors – just the component suppliers and innovators you need to help you build and develop industrial vehicles, all in one place: Köln Messe, Cologne, Germany, February 13-14, 2019. What's more, the event will be completely free to attend.

At IVT Expo you'll discover the next generation of industrial vehicle components, materials, concepts and

manufacturing technologies, helping you build vehicles with reduced emissions, increased automation, improved durability and exceptional ergonomics. Every class of industrial vehicle will be covered, from off-highway loaders, mining equipment and excavators, to tractors, cranes and lift-trucks.

IVT Expo will bring together key innovators, enabling attendees to not only see and touch the components that are available, but also talk to the experts who can give invaluable insight into exactly how they can be integrated into vehicle designs.

Also on show will be a host of new control and testing systems that will be required to enable safe operation of new vehicles. From cabin equipment





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AGCO

WHAT'S NEW

TOM STONE, IVT INTERNATIONAL



Bobcat



Hitachi



Pope Design

LEFT AND ABOVE: From the electronic systems that help create cutting-edge cabs, to the sensors and components that go into today's highly efficient powertrains, you'll find them all at IVT Expo

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and sensors, to testing and validation services such as durability rigs, NDT and EMC testing systems, it's all going to be in Cologne in February 2019.

Incredible conferences

IVT Expo will also host our established annual conferences: the IVT Electric & Hybrid Industrial Vehicle Technology Symposium and the IVT Autonomous Industrial Vehicle Technology Symposium.

These highly respected events, which already take place every year in Cologne, 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 hybrid and electric powertrains as well as automation of industrial vehicles.

"The conference has a very interesting mix of speakers, all touching on the important disruptive technology of electric vehicles," said Dave Ross, VP for advance technology and verification at Volvo CE, speaking about the electric and hybrid event. "There were tons of good questions and a lot of really positive energy."

If you want to create innovative, market-leading industrial vehicles, with cutting-edge designs that improve efficiency and sales, you can't afford to miss IVT Expo. **ivt**

CONFERENCE EVENTS

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Rise of the robots

CATERPILLAR INVESTS IN ROBOT BRICKLAYER

50,000
Total new homes the Kingdom of Saudi Arabia is planning to build using 10 Hadrian X robots, according to an MoU with Fastbrick Robotics



Australian company could hold keys to the future of construction

With one eye clearly on the future, Caterpillar is investing in a robot bricklaying vehicle. Earlier this year (June 2017) it committed US\$2m to Australia's Fastbrick Robotics via a placement, and in October was granted an option to invest a further US\$8m in the company, in accordance with an earlier memorandum of understanding (MoU) between the two firms.

Autonomous and driver-assistance systems mean the lines

between industrial vehicles and robots began to blur some years ago. But now, perhaps, the line has been crossed with Hadrian – a mobile bricklayer that is more robot than vehicle.

The initial design for the Hadrian 105 used an excavator as its basis. Now, the new prototype, the Hadrian X, looks more akin to a truck. Nevertheless, it will find its home primarily on building sites, where developers aim to have it construct the brick component of a house within three days by laying up to 1,000 bricks per hour, 24 hours a day.

Fastbrick Robotics already has one working prototype of the

Hadrian X, but as we went to press, it announced that it is building a second. "Having a second Hadrian X will significantly de-risk the assembly and test phases of our revolutionary bricklaying robot," says Fastbrick Robotics CEO Mike Pivac. "By adopting leading-edge assembly and construction practices from the aeronautical and defense sectors, where building two or more parallel prototypes is the norm, having a second prototype will lead to more streamlined and improved outcome, enabling simultaneous testing and more durability testing in a fixed timeframe.

"The Hadrian X prototypes will enable the engineering team to test the robots alongside each other, applying what they have learned during assembly and debugging the whole process," continues Pivac. "We're also performing exhaustive 3D virtual testing and digital simulation for components and have begun procuring items such as hydraulic systems, motors and a latest-generation laser-tracking system." *ivT*

ABOVE: The Hadrian X looks like a cross between a truck and a crane, and will, it is hoped, lay up to 1,000 bricks an hour

"THE HADRIAN X PROTOTYPES WILL ENABLE THE ENGINEERING TEAM TO TEST THE ROBOTS ALONGSIDE EACH OTHER, APPLYING WHAT THEY HAVE LEARNED DURING ASSEMBLY AND DEBUGGING THE WHOLE PROCESS"

Mike Pivac, CEO, Fastbrick Robotics



LEFT: The first prototype, the Hadrian 105, was built on an excavator frame, with bricks tracked down the boom

On the Web 
Watch a simulation of the Hadrian X at work, at www.ivTinternational.com/fastbrick

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Top tracs

The Tractor of the Year awards were presented at Agritechnica 2017. Here's the lowdown on the three winners

7.4-liter
six-cylinder 271hp (202kW)
AWF engine



**Valtra Versu
T254 SmartTouch**

Tractor of the Year 2018
OVERALL WINNER!

Plus, winner for
Best Design

7,300kg
gross vehicle weight
(16,100 lb)
5.25m
turning radius (17.2ft)
1,000Nm
maximum torque

**McCormick
X6.440 VT-Drive**

Tractor of the Year
award winner!
Best Utility



140hp
(104kW) four-cylinder,
4.5-liter engine
with 577Nm
maximum torque

4,700kg gross
vehicle weight
(10,360 lb)

420mm ground
clearance
(16.5in)

**Fendt
211 Vario V**

Tractor of the Year
award winner!
Best of Specialized



3.3-liter, 112hp
(84kW) three-
cylinder engine

458Nm
maximum torque

40km/h
max. speed
(25mph)

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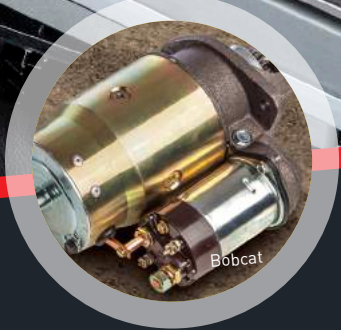
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CURTIS

Growth business

AT FAMILY-RUN CLAAS, A CAREFUL BALANCE IS STRUCK BETWEEN STICKING TO CORE STRENGTHS AND INNOVATING FOR THE FUTURE. HERE THE COMPANY'S CHIEF TECHNOLOGY OFFICER, THOMAS BÖCK, EXPLAINS HOW IT'S DONE

▶ Claas is a global giant of the agricultural machinery market, but remains at heart a family-run company still in touch with its roots in rural Harsewinkel in the state of North Rhine-Westphalia, Germany. In its 100+ years, Claas has had just three chairpeople, representing three generations of the family. August Claas founded the business in 1913 and it later became even more successful in the hands of his son Helmut. Today, Claas is run by Helmut's daughter, Cathrina Claas-Mühlhäuser, who has continued the success story despite not having trained as an engineer, presiding over an annual turnover of around €3.6bn (US\$4.2bn). The continuity of ideas and ethos has been aided by the longevity built into the family gene pool. August died in 1982 aged 94 and Helmut was 91 in July. He remains the personally liable partner.

"We have the values of a family-run firm, which means our growth is organic and we're careful to stick to our core strengths as a specialist provider of premium equipment for harvesting, including tractors," Thomas Böck, Claas's chief technology officer, tells *iVT* as we begin our exclusive interview. "Our

customers are highly educated and willing to pay for the best equipment. We are careful to stick to our strengths and we don't like to experiment too much with other areas, such as soil preparation, seeding and fertilizing."

Böck may not come from the Claas family, but he has absorbed the company's values in his 11 years there. As a trained electrical engineer, he began life as a developer of electronic and hydraulic systems. Spotting his technical ability, Claas appointed him in 2006 as head of system technology and managing engineer for R&D, production and logistics. Böck has since moved into senior managerial roles and in 2014 was appointed CTO. His dual experience with Claas in both development and managerial roles means he understands what makes the business function well.

Innovating for the future

One of the things that attracted Böck to work for Claas in 2006 was the company's famous capacity for innovation, which has been embedded in its DNA ever since August patented his knotting devices in the 1920s. Under Cathrina, who





US\$140m

The cost of expanding the Claas factory (left) in Krasnodar, Russia in 2015

“WE HAVE THE VALUES OF A FAMILY-RUN FIRM, WHICH MEANS OUR GROWTH IS ORGANIC AND WE’RE CAREFUL TO STICK TO OUR CORE STRENGTHS”

Thomas Böck, chief technology officer, Claas



took over from her father as chair of the supervisory board in 2010, there has been far more innovation in digital and electronics technology than before. One of Böck’s main goals as CTO is to make sure Claas stays ahead of its competitors in these fast-advancing areas of technology.

“Modern farmers don’t want to spend time in the office doing documentation after hours,” he says. “They want it to be done automatically. A lot of innovations in the past decade have been electronic, including improvements in displays, human-machine interfaces and laser steering, though we’re constantly improving the hydraulics and mechanics, too.”

Claas’s development of electronic, satellite-assisted farming systems began in 1994 under the name Agrocom, now known as Claas E-Systems. One of the many recent innovations from this dynamic subsidiary was the Culti Cam for automatic steering of cultivators in row crops. The high-performance camera system detects minor deviations and centers the cultivator with great precision, to fight weeds.

Recognizing the increasing importance of its electronics wing, Claas opened a new electronics center recently in Dissen, Lower Saxony, to house 170 software developers, engineers and other specialists. Böck is passionate about this development as it prioritizes a key aspect of the company’s future: “We’ve centralized a lot of the electronics know-how in one place. The facilities for testing are fantastic.

OEM INTERVIEW

It's got a test track, a garage and farmland, so we can do trials in the field as well as in laboratories, workshops and at workstations."

The next step for Claas is to move into cloud-based solutions, and it is also developing products for its subsidiary 365 FarmNet, which provides free web-based management software with the aim of supporting farmers in all aspects of farm management. Overseeing these developments is another major part of Böck's role as CTO.

The solution has proved hugely popular. Böck says that a total of 27 renowned agricultural partners already support 365 FarmNet with their know-how and by making intelligent components available.

The companies vary widely and include machine manufacturers, plant protection experts, manure product producers, breeders, feed suppliers and manufacturers of equipment for livestock farming. "The 365 FarmNet subsidiary is a big success story, seeing double-digit growth every year," says Böck.

Worldwide expansion

Though careful to define its marketplace, Claas has always had ambitions to expand. Its traditional markets have been in Europe, with some growth in North America and a small amount of business in South America. Now, future expansion is expected to come in Asia, where Claas has an increasing presence.

Böck is confident that the expansions will prove to be sound

"AT HARSEWINKEL WE OFFER APPRENTICESHIPS, UNIVERSITY DEGREES AND PHD SPONSORSHIPS"

Thomas Böck, chief technology officer, Claas



A HISTORY OF CLAAS MANAGEMENT

The structure of the Claas business is simple compared with many other family firms, with only three personal stakeholders from different branches of the clan. As there is no need to satisfy the demands of a multitude of shareholders, around €220m (US\$256m) a year in profits can be reinvested annually on R&D.

This is essential for the well-being of the company. Innovation has always been the lifeblood of Claas. Among many other landmarks under August, Claas launched its Super cross-axial flow combine harvester in 1946, impressing customers with its lightweight construction. More than

65,000 were sold until the model was discontinued in 1978.

August's son Helmut, who was born in 1926, studied engineering at universities in Hannover, Vienna and Paris before joining the firm in 1957 and becoming director of the engineering department in 1962. In his long working life, Helmut built Claas into a global brand, initiating or co-creating a whole series of innovations. Some of the highlights of his era included the 1970 Dominator series of combine harvesters, which were based on a platform construction concept and became world leaders. Then its successor, the

1995 Lexion, was the first combine to use a hybrid threshing and cutting system. It remains one of the most advanced combines available on the market today.

"I describe it as a 'legendary' machine because it has outperformed every other combine in the small grain market," says Thomas Böck.

Helmut Claas also took the far-sighted decision to acquire a majority share in Renault Agriculture in 2003, turning Claas overnight into a major manufacturer of tractors. Inevitably a string of tractor innovations has emerged from the Le Mans production site since then.



ABOVE: Tucano harvesters on the production line in Krasnodar, Russia

BELOW: Claas HQ in Harsewinkel, Germany

investments. "We have a lot to offer countries with growing populations and a lot of mouths to feed," he says. "We still sell some European products, but mostly we provide local versions for Asian markets, adapted to their demands. They are mainly small machines, but it's still premium Claas technology."

Claas acquired the Chinese agricultural machinery manufacturer Jinyee in 2013, closing the deal in 2014. The move has strategically positioned Claas to take advantage of the fastest-growing agricultural engineering market in Asia.

Meanwhile Böck says that Claas has perceived a further opportunity for expansion in Russia, where much land suitable for farming is uncultivated. The company has had a presence in Russia since 1992, when it intensified production there, and in 2005 Claas opened its first Russian plant in Krasnodar.

The second phase of the plant's development, completed in 2015, took Russian production capacity to a new level. At a cost of €120m (US\$140m), the Krasnodar plant is now nine times bigger with a surface area of 45,000m² (484,400ft²). It now produces an extra 2,500 vehicles a year, mainly the Tucano harvester.

"The facilities are unprecedented in Russian agriculture," Böck says. "It's the most modern combine harvester factory in the world."

Getting the best talent

Claas is not solely concentrating on developments in the outside world, however. Böck realizes the company has to stay modern to attract the best minds.

"Harsewinkel is in a rural area and it's a far cry from the bright lights of Berlin, Hamburg or Munich. But we offer apprenticeships, university degrees and PhD sponsorships. We're also improving working conditions. Just a few weeks ago we opened a modern co-working space, which is the kind of thing you see in Berlin. People can do workshops across companies and departments, and we have an integrated laboratory with robots and 3D printing, and a machining center. It's designed to create the cross-fertilization of ideas, but also a better working environment." iVT

On the Web

Watch the launch video for the Tucano at www.iVTinternational.com/tucano

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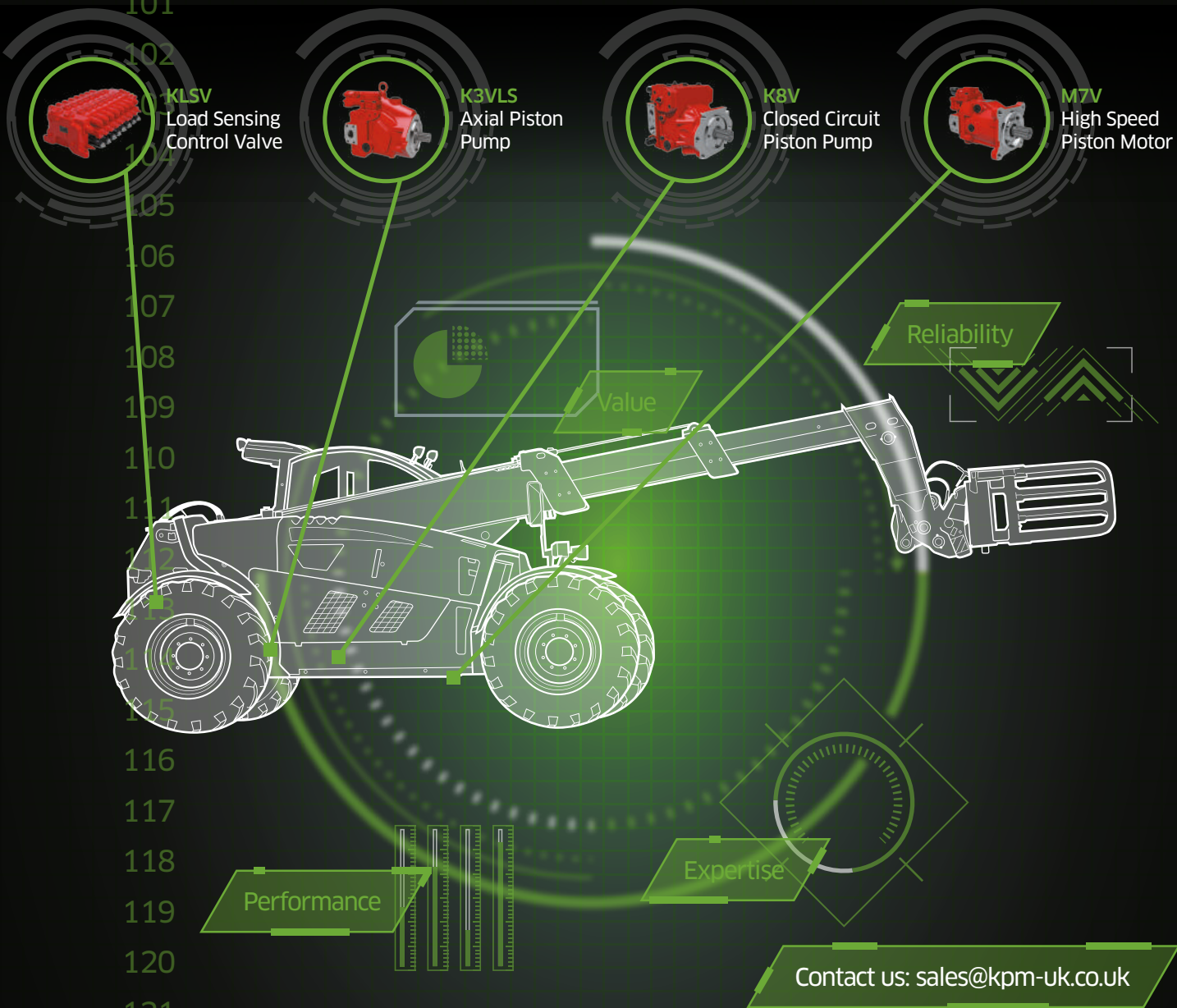
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Clean

▶ While some experts claim that fossil-fueled engines are finished and that industrial vehicle OEMs must look to electricity to provide motive power, the unique demands of the market suggest otherwise. Off-highway vehicles must function in virtually every corner of the globe and need to drive agriculture and construction projects at

a speed to cater for predicted worldwide population expansion from 7 to 11 billion by 2100.

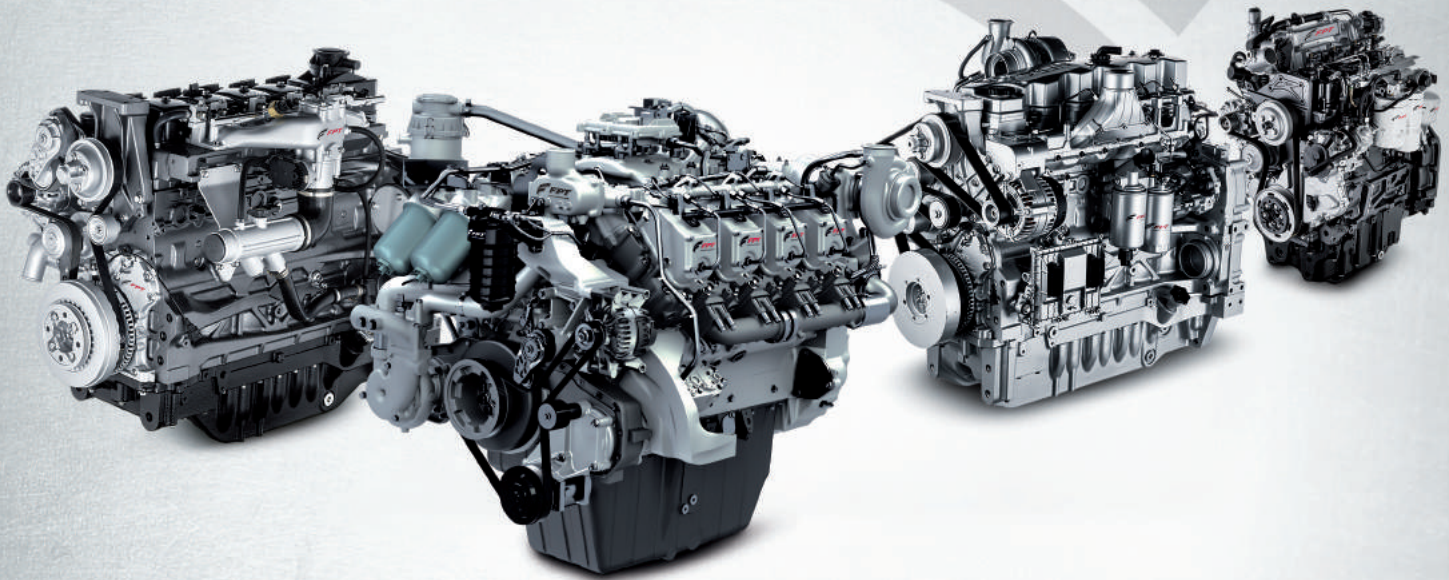
But that doesn't mean the world must accept a future of heavy pollution. Currently, we have cleaner, more efficient diesel products in the market than most would have believed possible a decade ago. *IVT* takes a look at how we got here, and what the future holds.

STAGE V EMISSIONS REGULATIONS PUT IDENTICAL CONSTRAINTS ON ALL OFF-HIGHWAY ENGINES SOLD IN EUROPE – BUT THERE IS STILL PLENTY TO DIFFERENTIATE THE MAIN MANUFACTURERS

drivers

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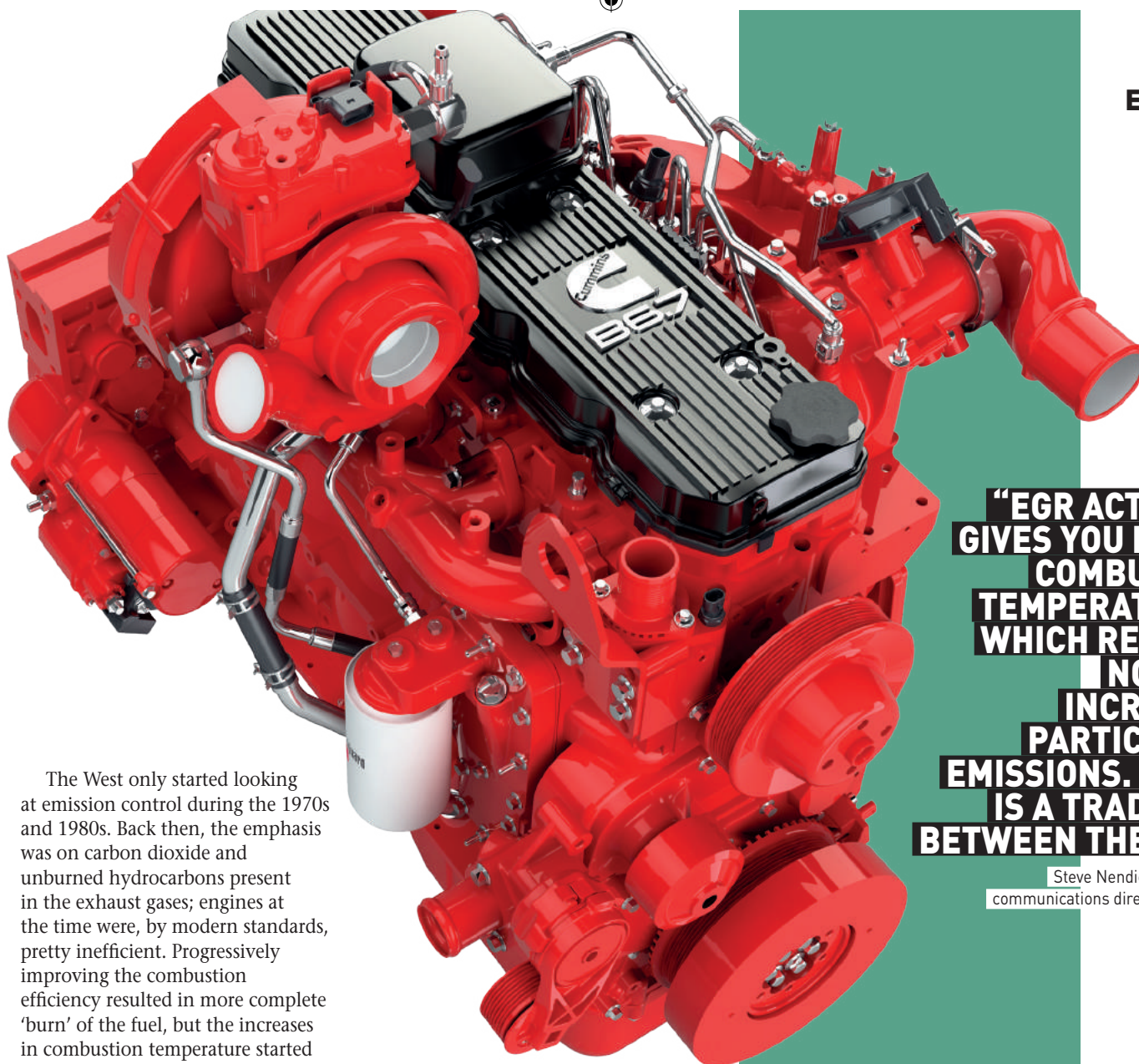
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POWERING THE FUTURE.



The West only started looking at emission control during the 1970s and 1980s. Back then, the emphasis was on carbon dioxide and unburned hydrocarbons present in the exhaust gases; engines at the time were, by modern standards, pretty inefficient. Progressively improving the combustion efficiency resulted in more complete 'burn' of the fuel, but the increases in combustion temperature started to result in the production of oxides of nitrogen (NO_x), which posed a different issue and is the gas one hears most about at the moment.

Popularity of EGR

Most manufacturers installed exhaust gas recirculation (EGR), whereby a portion of the exhaust gas was cooled and reintroduced into the air entering the engine.

"Cooled EGR systems take some of the used exhaust gas, cool it, and then mix it with the intake air as it goes into the engine," says Steve Nendick, off-highway communications director for Cummins. "EGR actually gives you lower combustion temperatures, which reduces NO_x but increases particulate emissions. There is a trade-off between the two."

As OEMs progressed their machines through the subsequent levels of control, other systems were

added. A big turning point was the inception of electronically controlled fuel injection, enabling an engine controller to monitor exhaust reactions and adjust the combustion accordingly.

Catalysts became necessary around Stage III and IV (i.e. DOC – diesel oxidation catalyst). Then, most recently, ammonia injection (selective catalytic reduction and diesel exhaust fluid, SCR and DEF) and diesel particulate filters (DPF) were adopted.

During this period, the constantly changing profile of the engine equipment envelope posed the biggest challenge to OEMs. Progressing through Euro Stage I to IV has required more and more resources, many of them to do with packaging issues. Different engine manufacturers have

"EGR ACTUALLY GIVES YOU LOWER COMBUSTION TEMPERATURES, WHICH REDUCES NO_x, BUT INCREASES PARTICULATE EMISSIONS. THERE IS A TRADE-OFF BETWEEN THE TWO"

Steve Nendick, off-highway communications director, Cummins

LETTERS OF MEANING: AN ACRONYM GLOSSARY

Before you read any literature relating to Euro Stage V engines, it's best that you are cognoscente with the many acronyms that will be encountered during discussions. This will allow you to nod sagely when others try to bamboozle you during those pre-presentation cocktail parties:

NO_x – Oxides of nitrogen

The gas formed in the combustion chamber of a diesel engine where elevated temperatures (typically above about 1,300°C/2,372°F) oxidize a portion of the nitrogen in air into NO_x gases. There are potentially three types of NO_x gas, but we really only have to consider these as a single entity.

continued overleaf

ENGINES

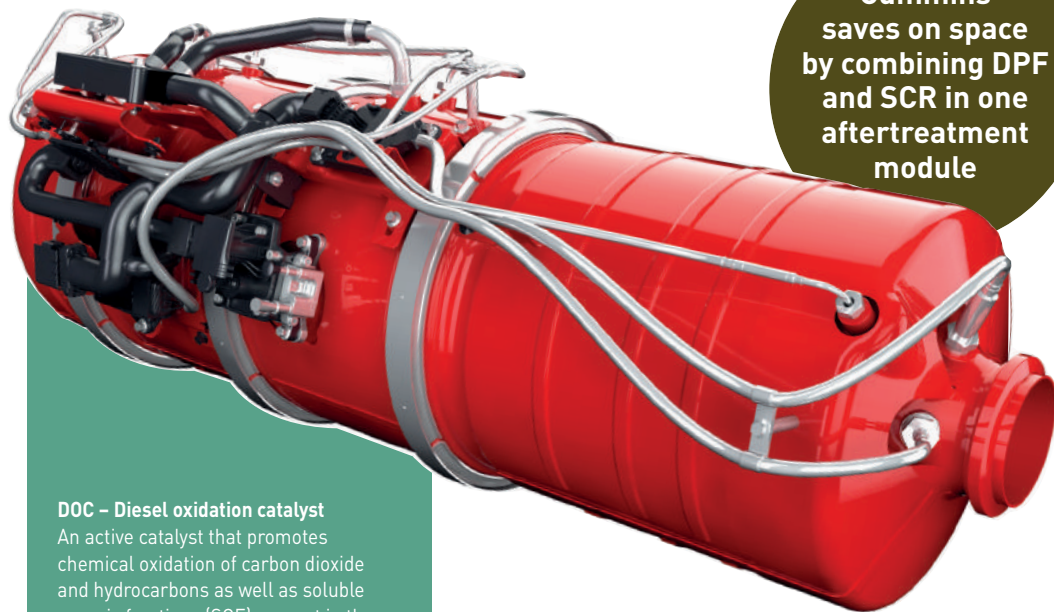
fulfilled different needs at different stages, with one UK-based OEM, who wished to remain anonymous, having used three already: CNH (Stage I-II; Perkins (Stage II-III); JCB (Stage III-IV). It is now looking to its fourth, Volvo, for Stage V.

Although serious emission control for internal combustion engines originated in the Americas, there has been a noticeable dilution of the demands from the US Environmental Protection Agency in the recent past. So, while European OEMs speculate the prospect of further controls beyond Stage V, the US Environmental Protection Agency has no plans to follow through to Tier 5 and in fact seem unlikely to push for tighter controls beyond Tier 4 Final. Tier 4 Final is roughly equivalent to Euro Stage IV which is after all a substantially effective control level. One could speculate that with the position taken by the current US administration on environmental issues, any further movement towards more stringent emission controls will be ostensibly curtailed.

To EGR, or not to EGR...

Stage V added a finer particulate specification and a size count, but from the engine hardware/control point of view, much of the technology was in place at Stage IV. This gave engine manufacturers the chance as they moved their product to Stage V to look at the issue of system packaging, optimizing in some ways and compromising in others to better accommodate the true demands of the OEM.

For example, Cummins and Perkins have moved away from



Cummins saves on space by combining DPF and SCR in one aftertreatment module

DOC – Diesel oxidation catalyst

An active catalyst that promotes chemical oxidation of carbon dioxide and hydrocarbons as well as soluble organic fractions (SOF) present in the exhaust derived from the fuel and the engine lubricating oil.

SCR – Selective catalytic reduction

An advanced form of catalyst system employing urea injection (DEF, see below) to allow the NO_x component to react within an oxidizing atmosphere, thus converting it into water, nitrogen and infinitesimally small quantities of carbon dioxide. Basically, all safe stuff. Needs to be fed with DEF.

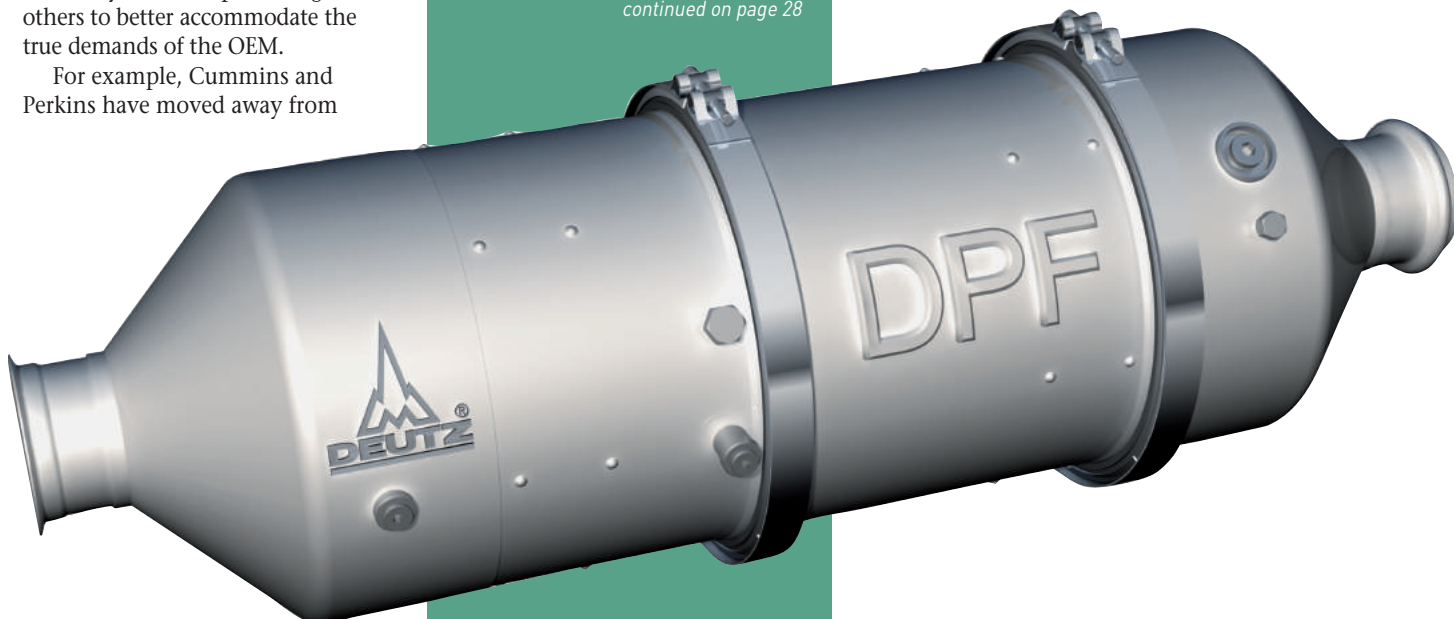
DPF – Diesel particulate filter

Once all the other systems have done their stuff, the DPF strains the carbon particulate component from the gases before they are released to the atmosphere. On a Stage V system, it needs to stop around 98% of these entering the atmosphere. There is also a size and count restriction at Stage V.

continued on page 28

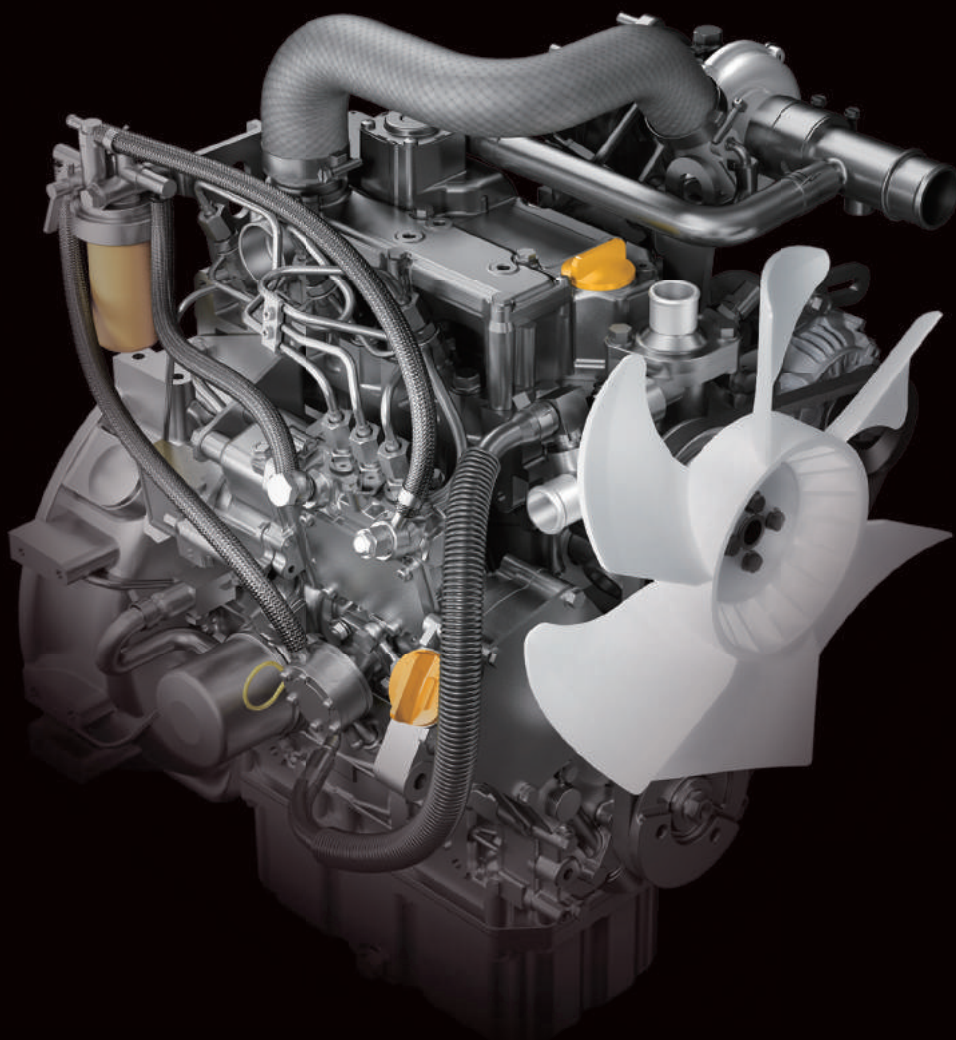
EGR in their systems in favor of simplified aftertreatment. Many, though, including John Deere, still cite EGR as a useful system. On its PowerTech range, John Deere plays the variables of NO_x versus particulates against aftertreatments. Units employing EGR can be configured to use smaller catalysts than DEF systems but with a particulate filter, while non-EGR models need no particulate filter but do need larger catalysts with higher DEF usage.

John Deere Power Systems' marketing communication coordinator, Sandrine Alem, explains, "Cooled EGR used in John Deere engines increases the effectiveness of NO_x reduction





YANMAR



The new 3TNV80FT

High power in a compact package

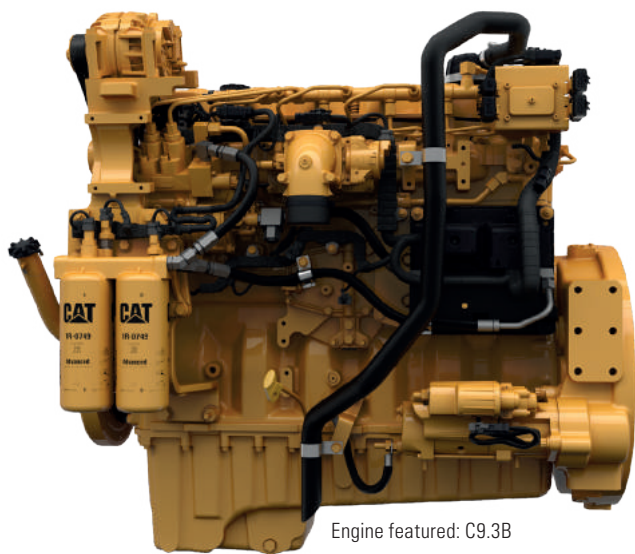
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Engine featured: C9.3B

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while enhancing engine efficiency. Engines with cooled EGR and a DPF are calibrated for improved total fluid economy, both diesel fuel and DEF.”

Deutz and MAN have emphasized flexibility by componentizing the aftertreatment modules. MAN, in particular, has worked from a position of strength on Stage V as the company already participated developing Euro 6 compliance for the commercial truck market and knows that all OEMs have the same basic demand: minimum disruption to their vehicle envelope. Like Deutz, it retains EGR and concentrates on componentized aftertreatment to fit the product to the job.

Florian Schaffelhofer, head of external relations for MAN, comments, “It is not possible just to put our AGN [Abgasnachbehandlung /exhaust gas aftertreatment] onto a Stage IV engine to achieve Stage V, since data sets of the engines are different and the engines use different internal technology. However, connecting dimensions of the engine are always the same, which is an important advantage for the OEMs. The concept of MAN Engines is the provision of dimensionally identical engines to fulfill different emissions standards

COUNTING ON BRIQUETTES

Burning diesel fuel creates microscopic carbon residues known as particulates. These have prompted the most vicious controversies in recent years without most actually understanding the problem. For most of us particulates are unquantifiable. We simply cannot grasp the concept. To use something familiar to help you visualize, a charcoal briquette used on barbecues weighs typically 20g (0.7oz), not particularly heavy, but you should duck if someone throws one at you. If we take a typical mid-range 100hp (75Kw) engine, prior to the introduction

of emissions standards, this unregulated engine operating for eight hours would have produced around 120g of carbon per day, or the equivalent of six charcoal briquettes. Hypothetically, if this carbon were charcoal briquettes, after a day you would still need quite a few more to cook anything significant. However, if we assume that our driver operates his engine for five days each week things start to stack up and with the 600g (21oz, the equivalent of 30 briquettes) generated after one week there would be enough charcoal to

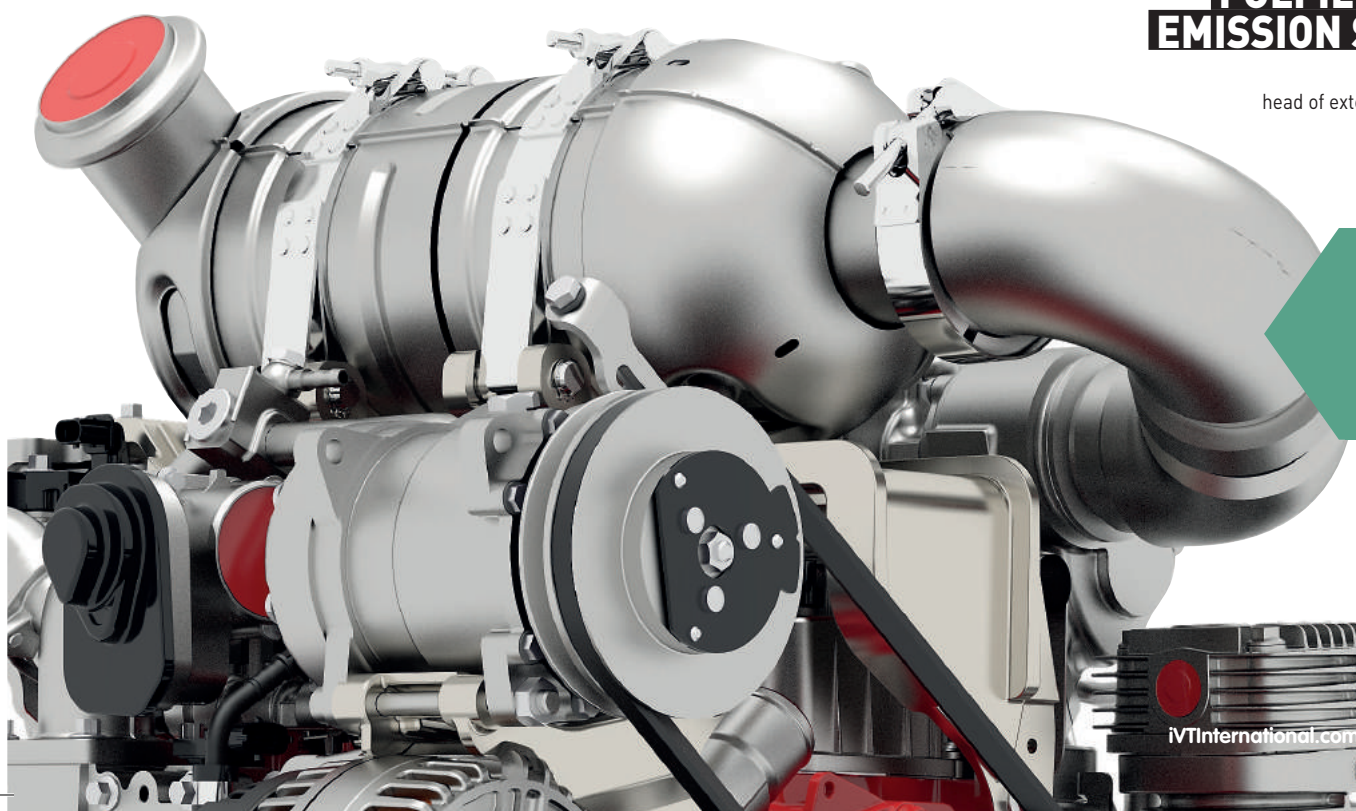
hold a relatively small and select barbecue party.

By contrast, and to understand the tremendous advances made by our engine suppliers in reaching Stage V emissions levels, let’s look at this again with a modern unit... Same scenario but with a Stage V compliant engine to produce our hypothetical cooking media, the barbecue guests would be waiting much longer for their burgers. Actually, the particulate output is so low that the wait would be around two years before accumulating the 600g for the social gathering.

“MAN’S CONCEPT IS THE PROVISION OF DIMENSIONALLY IDENTICAL ENGINES TO FULFILL DIFFERENT EMISSION STANDARDS”

Florian Schaffelhofer, head of external relations, MAN Engines

LEFT: Deutz’s unique aftertreatment system can regenerate without the need for downtime



ENGINES

“COOLED EGR USED IN JOHN DEERE ENGINES INCREASES THE EFFECTIVENESS OF NO_x REDUCTION”

Sandrine Alem, marketing communications coordinator,
John Deere Power Systems

using different data sets and exhaust components (DOC/DPF, SCR, EGR) depending on the power rating and engine series.”

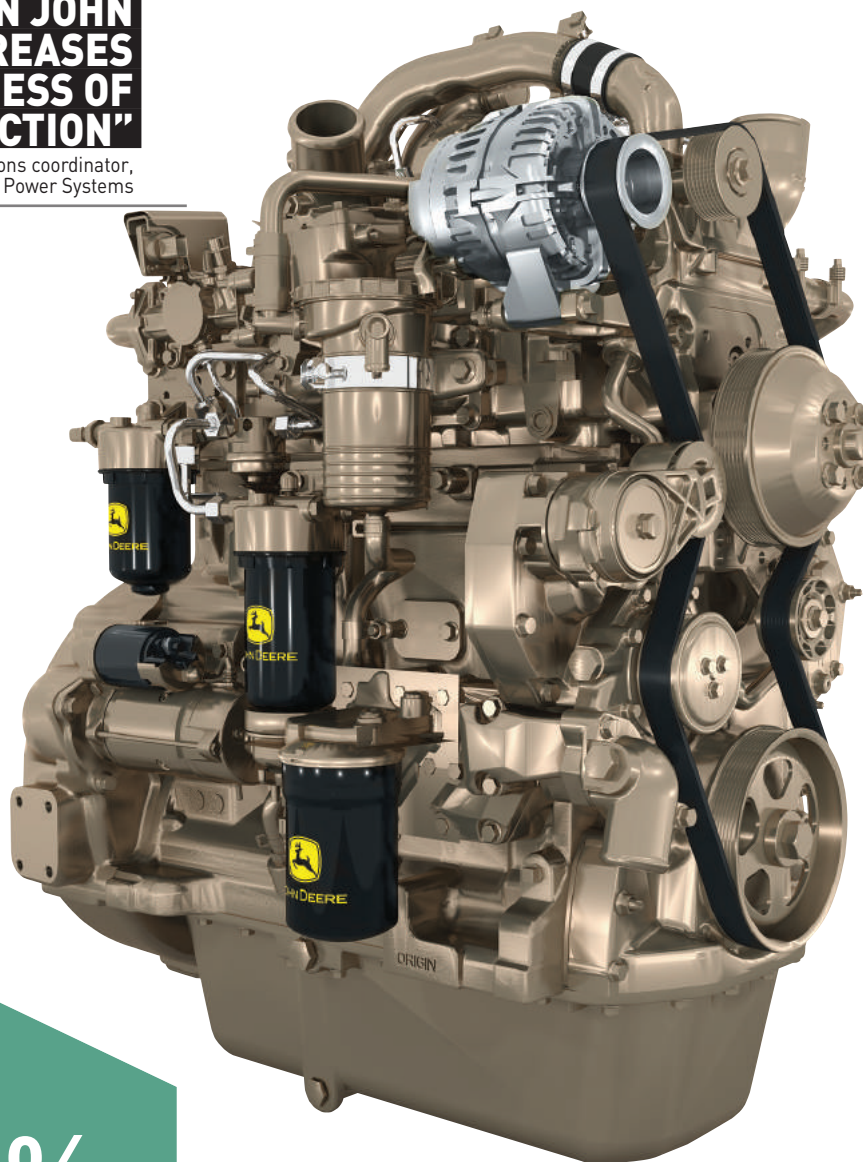
In the same way, the Deutz DVERT system comprises a modular system of aftertreatment modules that are not model specific and can be applied over a broad range of the company's products.

Going without EGR

Critics of EGR cite the fact that the recycled gas is counterproductive as it has a lower oxygen content than clean air and therefore is less efficient in practical terms. Although some manufacturers have added technology to address Stage V demands, Cummins and Perkins have taken an alternative route and rationalized their aftertreatment by removing EGR and combining particulate filters with SCR and DOC systems in one module.

Steve Nendick elaborates on the Cummins offering: “The latest Single Module aftertreatment technology is smaller and lighter than at Stage IV. Our EGR-free engine designs are compact with less weight and single module aftertreatment designs require less space. Using the Holset VGT [variable-geometry turbocharger] we also achieve exceptional power density with fuel-efficient performance.”

Perkins, meanwhile, emphasizes efficiency for Stage V. Its new four-cylinder Synchro is a 2.8- and 3.6-liter line-up ranging from 45-100kW (60-134hp). A full aftertreatment package is available including both DOC and DPF to cover the lower-rated engines with the addition of an SCR above 70kW. Of note here is the contrast in power ratings for these engines versus prior offerings. These Stage V engines achieve power ratings of up to 100kW on a four-cylinder engine with 3.6-liter configuration. The



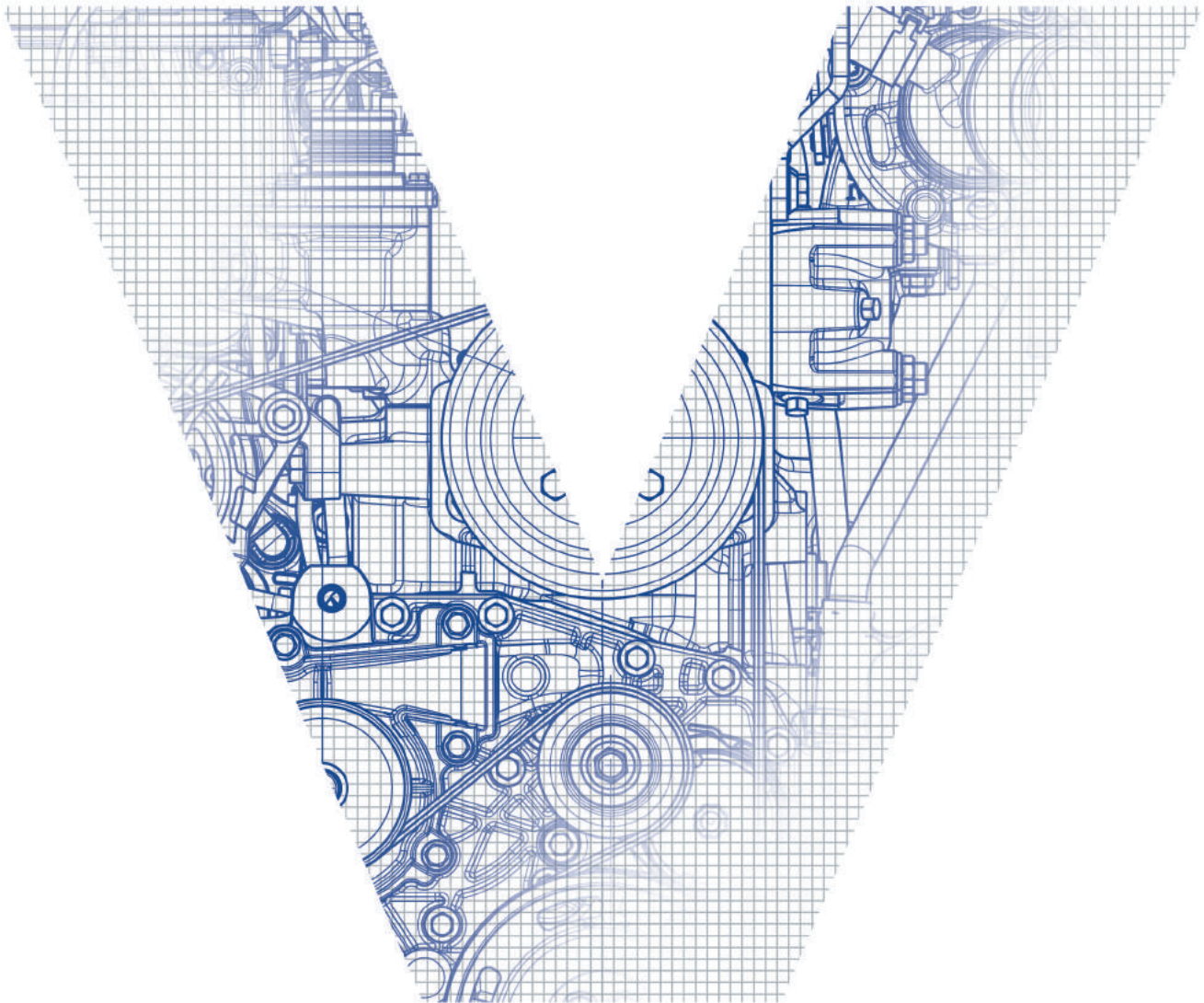
30%
Increase in
torque John
Deere Power
Systems
managed in the
PowerTech PSS
4.5-liter engine

lower power variants have only 0.7-liter/cylinder swept volume. A decade ago, swept volume would have been almost double and we would be looking at a six-cylinder configuration once we tipped over the 75kW (100hp) mark, so it is clear where some of the emission reductions come from. The engines are just burning less fuel and doing it a lot more efficiently.

Stage V without aftertreatment

However, you don't always need complicated aftertreatment and extensive filtering just to conform to Euro Stage V. At scarcely more than half a meter high (19.6in) and just over 400mm (15.7in) wide, the Perkins 402D-05 engine has an installation envelope of 0.7m³

Stage V engineering that fits your machine



For some, EU Stage V is a challenge. For Perkins, it's just another opportunity to support you when you need it most. This means a Stage V engine for every application, and a partner ready to guide you through this transition and beyond.

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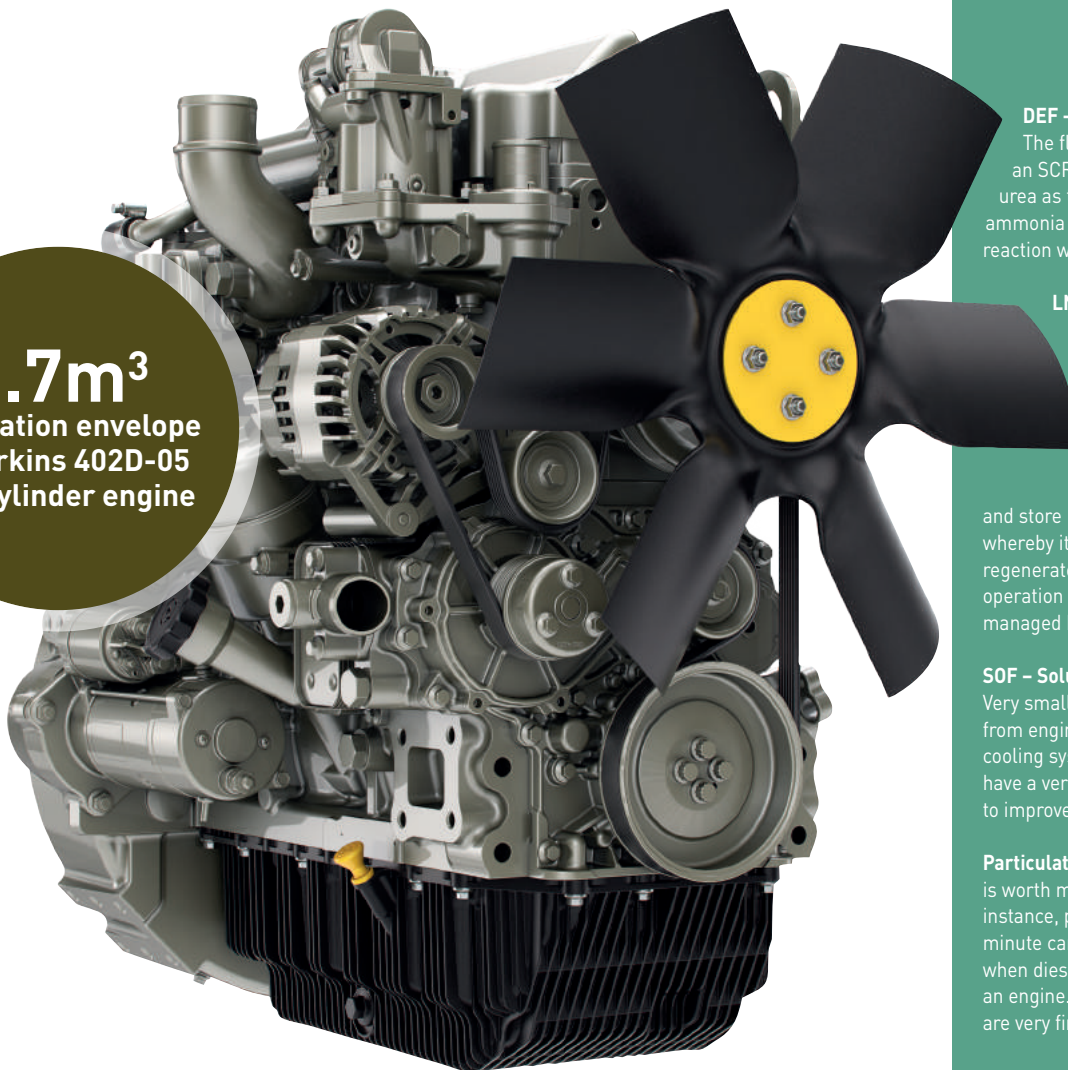
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THE HEART OF EVERY GREAT MACHINE

ENGINES

0.7m³

Installation envelope
of Perkins 402D-05
two-cylinder engine



(24.7ft³) and is likely to satisfy the installation requirements of the many OEMs operating in its power class. Knocking out a useful 10.2kW (13.7hp) from an in-line two-cylinder configuration of just over 500cc, this unit is mechanically governed with an indirect injection system, with absolutely no aftertreatments. Duncan Riding, technical sales manager at Perkins, explains why this is possible: “Engines smaller than 19kW [25.4hp] are controlled, but not to the same level as larger units. Emission limits are calculated based on grams of NO_x per kW, per hour of running time. Small equipment has low power, lower average load factors and generally lower annual running hours.” So at least at this level OEMs currently have a practical unit that installs without any complications.

Beyond Stage V...

It is clear that, for some companies, Stage V is the end of a long story

of expense and investment, which many endorse as necessary to save the environment. But it is worth noting that much of the future worldwide population growth (and therefore growing markets for OEMs) is predicted in semi-developed and developing nations of the world, which do not currently have such stringent emissions regulations.

Tightening emissions controls on off-highway vehicles in developing nations will directly affect the cost of the machines, which will slow down the investment in the sector, slowing economic growth.

Governments might do well to consider that, for the time being at least, engineering companies in the West have made their contribution and it is time that a comprehensive agenda on the impact of diesel emissions worldwide is properly formulated – and hopefully adhered to. **ivT**

DEF – Diesel exhaust fluid

The fluid used as a reductant in an SCR. Basically it is industrial urea as the catalyst employs the ammonia in the fluid to promote its reaction with the exhaust gases.

LNT – Lean NO_x trap

You are unlikely to see this system in an off-highway application. Basically, it is a catalyst fitted to smaller diesels, which has the ability to trap and store NO_x within the catalyst, whereby it can be periodically regenerated through a ‘burn’ operation within the catalyst. This is managed by the engine control unit.

SOF – Soluble organic fractions

Very small liquid particles derived from engines’ lubrication and cooling systems. Modern engines have a very low incidence of this due to improved production systems.

Particulates No acronym, but it is worth mentioning that, in this instance, particulates refer to the minute carbon particles formed when diesel fuel is burned within an engine. At Euro Stage V, these are very finely controlled.

**“ENGINES
SMALLER THAN
19kW [25.4HP]
ARE CONTROLLED,
BUT NOT TO THE
SAME LEVEL AS
LARGER UNITS”**

Duncan Riding, technical sales
manager, Perkins



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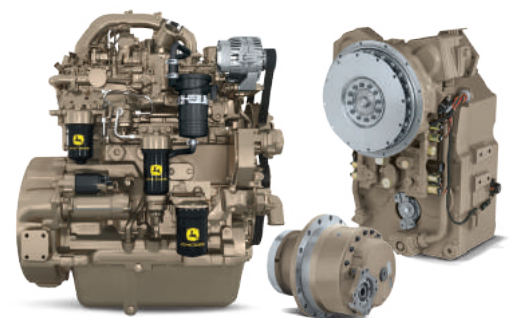
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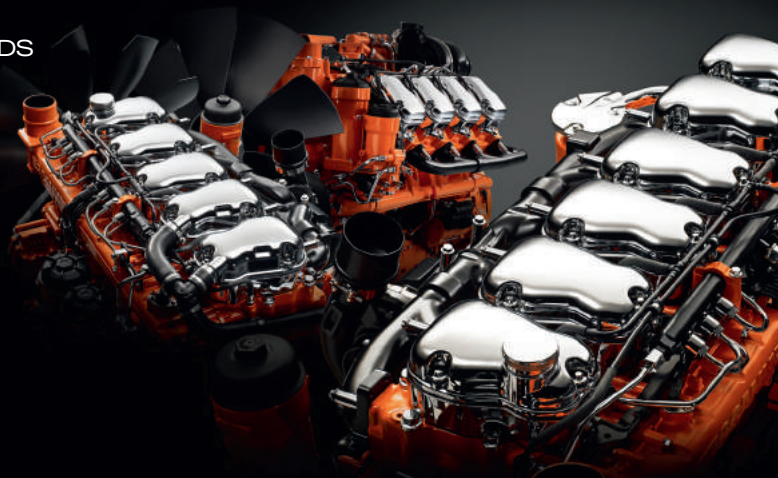




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Top 5 technologies at Elmia Wood 2017

WORLD'S BIGGEST WHEELED HARVESTER

#1

The world's biggest harvester on eight wheels – the Tigercat 1185 – made its world debut at Elmia Wood. Weighing in at 34 metric tons and delivering 308hp (230kW) from its diesel engine, the vehicle is 100% Tigercat-built, from the engine and transmission right up to the crane. Its eight wheels ensure low ground pressure and maximum accessibility.

The machine on show was a prototype, shipped direct from the factory in Canada. "We've developed it in response to customer demands in North America," says Tigercat's product manager, Jon Cooper. "They want to switch to the CTL method but they want bigger and more robust machines than the ones available on the market.

"It's an extremely robust machine suited to difficult conditions with steep terrain and large-diameter stems," Cooper adds. "It has separate hydraulic systems for the crane, harvesting head, etc, so it can deliver maximum performance in every situation."

The unique design of the crane helps to give a perfect line-of-sight in all directions, as well as high performance, even when fully extended. When the boom is 8.9m (29ft) long, the harvesting head can handle up to 2.5 metric tons, and at maximum extension (11m/36ft), the limit is 1.8 metric tons. This in turn creates the capacity for felling large-diameter stems and makes the CTL method competitive even in stands of such trees.

The machine also features the first curved windshield to be able to withstand a blow from a flying saw chain that has come loose – fulfilling the requirements of a new safety regulation in British Columbia.

11m
Maximum boom
extension of
Tigercat 1185
(36ft)



320

Maximum horsepower
of Volvo Penta's
870VE engine
(239kW)

VOLVO PENTA ENGINES IN ECO LOG VEHICLES

#2

Eco Log showcased its new E series harvesters and forwarders at Elmia Wood – the OEM's first machines to benefit from a collaboration with Volvo Penta. The machines use Volvo Penta's low-emission TAD870-870VE engines, which use selective catalytic reduction (SCR) and exhaust gas recirculation (EGR). They have a maximum power of 218-320hp (163-239kW) at 2,200rpm. Peak torque

reaches 1,050-1,300Nm when operating at low speeds of 1,060-1,310rpm.

"Forestry is our heritage and working place, and for this reason we want Eco Log products to minimize their environmental print," says Philippe Wion, business development manager at Eco Log. "This is the only way to ensure the sustainability of our business; this is our legacy. Volvo Penta engines contribute to making our machines environmentally friendly thanks to their low fuel consumption and low emission rates."



1,300
Maximum torque (in Nm) of Volvo Penta's 870VE engine



LEFT: Caldaro always works with high-quality materials. In this case, the customer wanted a grip made of oak

A NEW, SMARTER FORESTRY GRIP

#3 This year at Elmia Wood, Caldaro announced that it is redesigning its hugely popular Forestry Grip palm joystick.

When first introduced in 1992 it was a revolutionary design, with five buttons and a thumb rocker that made machine operation much more efficient. It meant an operator seldom had to move his hand from the joystick, because it had most necessary functions built in.

Caldaro is now redesigning the Forestry Grip with the intention of making it smarter, with more functions and even easier operation.

Manufacturers of forest machines are eager to be at the cutting edge of development in creating good working environments for operators. Caldaro has long been the leader in the design and development of functional and ergonomic work controls.

Because its designers explicitly listen to, and take advice from, experienced drivers, Caldaro has been able to innovate to meet real needs.

There are many options for customizing the Forestry Grip so that it fits even better into specific work environments. Caldaro invites designers to tell them what kinds of functions they need, and it will do its best to produce a grip to individual requirements.



FIRST EVER HYBRID HARVESTER

#4

At the front of the pack in terms of hybrid innovation at Elmia Wood was Logset's 12HGTE Hybrid – the world's first series-manufactured hybrid harvester, which can deliver up to 510hp (380kW) in short bursts. "It gives more power in the forest and also reduces fuel consumption," says Logset's export sales director, Pascal Rety.

While hybrid powertrains are often associated with smaller machines in some markets, the 12HGTE weighs in at 24.5 metric tons, making it the biggest harvester developed so far by Logset.

"The technology takes up space and costs a lot. That's why it's best suited right now to big machines," explains Rety. "Our tests show that this hybrid solution reduces fuel consumption by half a liter per cubic meter of felled timber," Rety says. "It's a 25% saving over a 9-liter diesel engine."

The hybridization techniques are similar to those used in sports cars to squeeze out extra performance. Between the engine and the transmission sits a combined electric motor and generator. Instead of batteries it has supercapacitors, which store the generated energy and release it immediately when there is a need for extra power. This enables Logset to use a smaller diesel engine of 7.2 liters instead of the 9 liters that would be normal in this size of harvester.

Because the electric drive cuts in when extra power is required, the diesel engine can also be run more smoothly with less fuel consumption. For more on Logset harvesters, see our feature on page 46.

THE LIGHTWEIGHT THAT DOES HEAVY WORK

#5

The forwarder Gremo presented at Elmia Wood harks back to the days when such vehicles could load their own weight. The 750 F weighs 10.5 metric tons, a whole 2 metric tons lighter than the outgoing model. Despite the significant weight loss, the new loader is still capable of handling loads of up to 8.5 metric tons.

"We've gone through every component and if possible, switched to a lighter one. In that way we've slimmed it

down by two metric tons," says Gremo CEO Martin Bredenfeldt. With its design based on the company's existing 12.5 metric ton 1050 forwarder, engineers were able to shrink the machine's width down to 2.4m. This feat was important for enabling the forwarder to easily be driven on Central European roads.

In terms of performance, with a 4.5-liter, 165hp (123kW) engine, hydrostatic powertrain and a crane with 6.5m (21ft) of reach, the result is a full-size forwarder with considerably lower ground pressure.



FORESTRY SPECIAL

p36 Cutting edge

Operator assist systems are making forestry vehicles easier to use than ever, and inspiring the wider industry



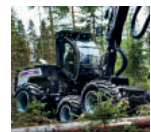
p46 Komatsu PC290LL-11

The international OEM giant turns its attention to an excavator specifically for forestry



p54 Logset harvesters

Bringing the world's first hybrid harvester to market has required some serious innovation



FOR YOUR HEAVY DUTY PLAY- GROUNDS



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SITTAB

Forests of the future

DRIVER ASSISTANCE SYSTEMS ARE BECOMING MORE PREVALENT IN ALL TYPES OF INDUSTRIAL VEHICLE, BUT IMPLEMENTING THEM IN THE FORESTRY SECTOR BRINGS SOME UNIQUE CHALLENGES - AND HUGE BENEFITS WHEN ENGINEERS GET THEM RIGHT...



▶ It is often described as Europe’s last primeval forest. Situated on Poland’s border with Belarus and spanning nearly 550 square miles (1,424km²), Białowieża Forest contains a rich variety of tall, ancient trees, including fir, oak, alder, lime and birch trees; and provides sanctuary for wolves, lynx and around 800 European bison.

But the age-old trees, some of which exceed heights of 164ft (50m), that make up these bountiful primordial woods, have also provided a home to an unwanted visitor – the spruce bark beetle.

They may be no larger than the point of a biro, but these ravenous beetles have the potential to fell trees in these woodlands and many other forests across the world, too. Across Europe, it is not just insects, but invasive tree diseases such as larch disease and ash dieback, which can devastate vast tracts of woodlands. Take a 2015 report by Forest Europe (the Ministerial

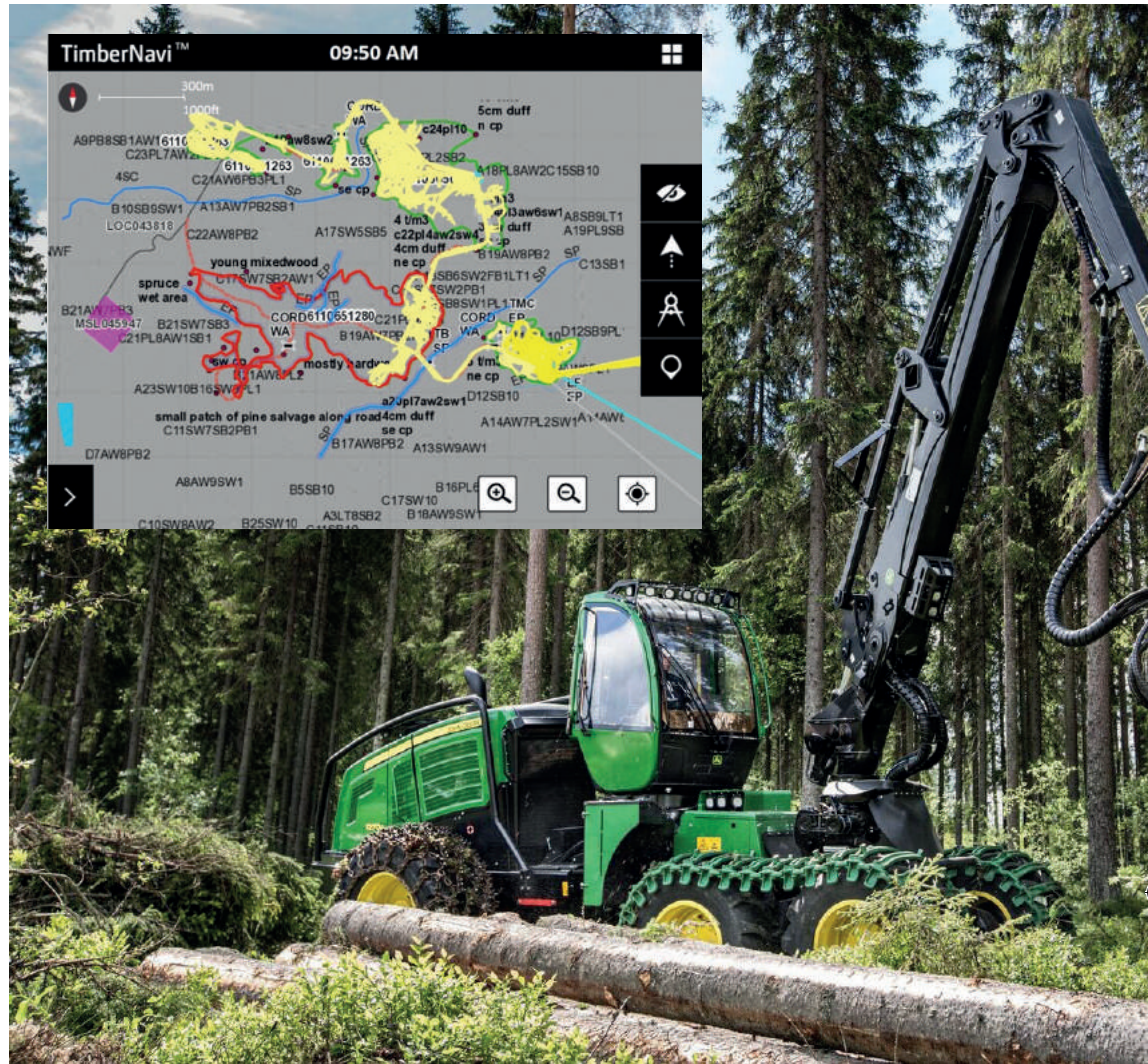
Conference on the Protection of Forests in Europe), for instance. Alarming, it revealed that 286,220 acres (115,829ha) of forest in Europe (excluding Russia) were damaged by insects and disease.

But as we enter a bright new age dominated by big data analytics and the Internet of Things, Juha Purmonen, executive director of the Photonics Finland Association, believes that photonics, which is the science and application of light, may have a role to play in the future. He believes that photonics and optics could potentially pave the way for forestry equipment to make use of laser and fiber-optic technology, and might one day prove to be an effective solution to preserving the world’s ancient forests.

“By using lidar technology, sensors on aircraft, and perhaps one day drones, scientists can create multi-dimensional models of a forest, including the canopy, the trees trunks below and the

OPERATOR ASSISTANCE

BELOW AND INSET:
John Deere's digital
forestry mapping
system, TimberNavi
RIGHT: Infected trees
being felled



undergrowth on the forest floor," says Purmonen, "By creating a more nuanced and data-rich picture, it could be possible to identify, treat and isolate trees that are affected by disease in the early stages. And, if drone data could be shared in real time with harvesters, then foresters could remove diseased trees and prevent them from spreading contagion or parasites.

"A harvester that is connected in real time to a forestry imaging application will be able to provide the operator with key information regarding each tree. For example, the species, the age, whether or not it is protected and if it is to be felled. An intelligent harvester could even potentially provide advice detailing the most efficient and sustainable way to remove the tree without disrupting the surrounding key flora and fauna."

The battle against disease

It is a view shared by Chloe Barnes, a researcher at the UK's University of Leicester, who has written her PhD on how remote sensing technology can help assess tree disease.

Barnes, who conducted the study in Ogmere Forest in South Wales and the Stratfield Brake Woodland in Oxfordshire, says, "We attached state-of-the-art laser scanning technology to light-aircraft and deployed drones, which collected multispectral imagery, to monitor the spread of larch disease and acute oak decline. By using the real-time data gathered, we believe that remote sensing techniques will help

"A HARVESTER THAT IS CONNECTED IN REAL TIME TO A FORESTRY IMAGING APPLICATION WILL BE ABLE TO PROVIDE THE OPERATOR WITH KEY INFORMATION REGARDING EACH TREE"

Juha Purmonen, executive director of the Photonics Finland Association



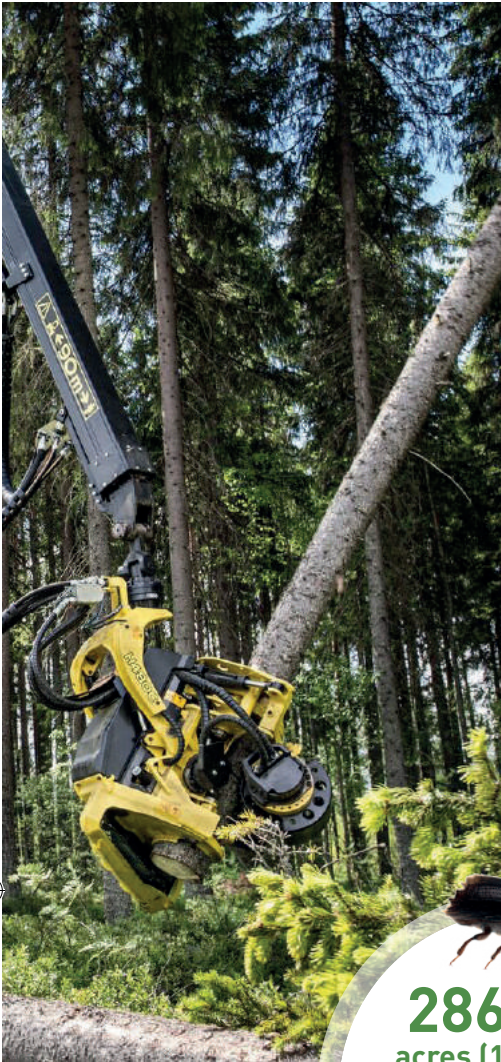
foresters identify defoliation much more quickly and with greater precision than is currently possible, enabling them to fell and isolate diseased trees before the infection spreads further. The technology could be used to even greater effect in containing the bark beetle, because by deploying lidar to provide an up-to-the-second 3D picture of spruce needle drop, which is often the first sign of a beetle infestation, it can be caught in the early stages."

Barnes also believes that forestry machinery can be used to good

effect in the battle to preserve the world's forests.

"In the future, connected forestry equipment, could be used to help researchers identify and manage tree diseases," she says. "Machinery, for example, that is able to communicate and relay real-time information from drones, aircraft and its own sensors to national forestry organizations, could play an important role in reducing the spread of these invasive diseases.

She continues, "In east Africa, for instance, my fellow researchers have

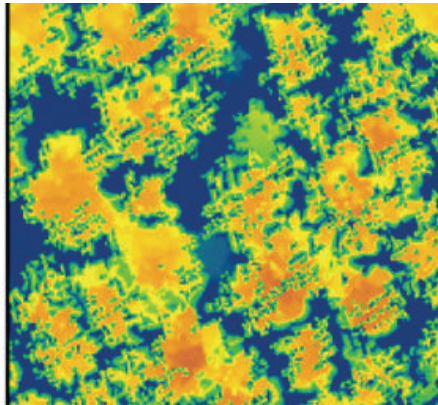
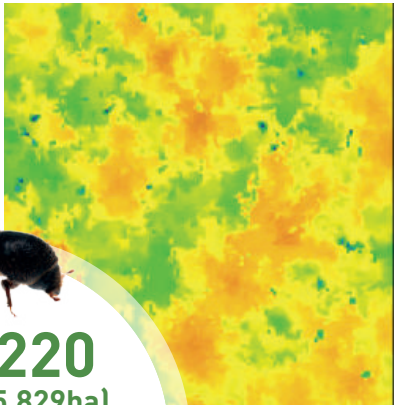


CUTTING WITH LASERS

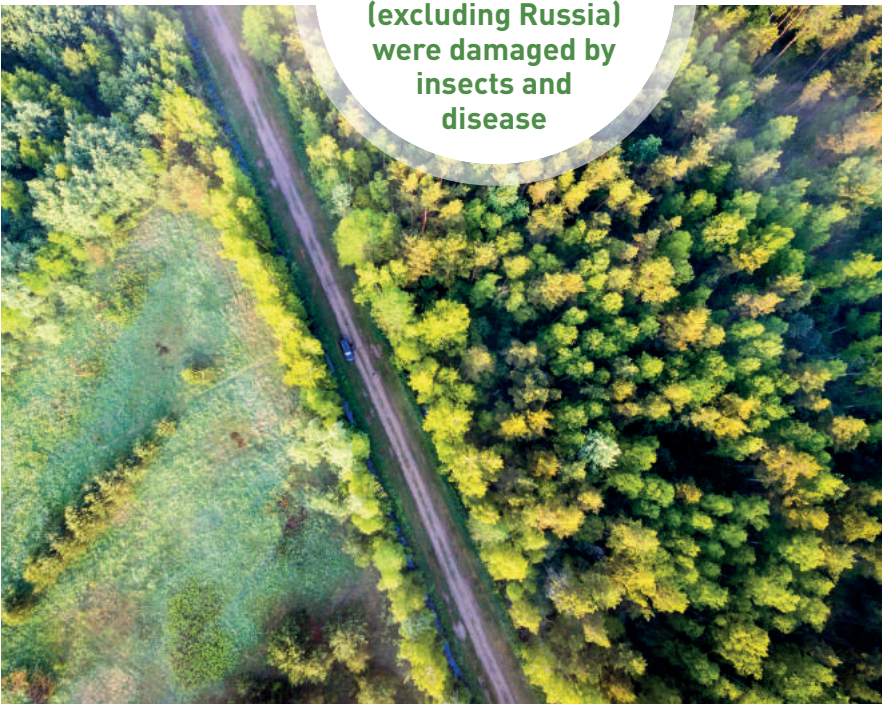
Imagine an operating landscape where harvester heads never have to be replaced and one where trees could be felled by laser. It may seem a long way off, but Juha Purmonen, who spent six years as spectral researcher at the University of East Finland, believes that harvesters, skidders and wheel loaders may one day have the capability to carry out this important work.

"I believe OEMs will look to incorporate photonics and optics sensors in harvester heads in five years' time," says Purmonen. "This would be a revolutionary step for

the industry because unlike a traditional harvester head, which has many moving parts and is prone to blunting over time, a laser beam is highly resilient and will deliver the same level of performance regardless of when it was installed. So when you calculate all the extra financial overheads, including the loss of efficiency, the cost of repairs, and the potential service downtime, that emanate from harvester heads today, it makes sense that OEMs see the photonics-enabled laser harvester head as a rich seam to be mined."



286,220 acres (115,829ha) of forest in Europe (excluding Russia) were damaged by insects and disease



LEFT AND ABOVE: Research led by Chloe Barnes, a researcher at the University of Leicester, used aerial imaging to identify areas of defoliation

embarked on a project that is helping the Kenya Forest Service to monitor its forests and woodland in almost real time. Intelligent algorithms have been specially programmed to identify deforestation from the satellite imagery and send an alert to the forestry service, so that it can tend to the trees before it is too late. Again, in the future, smart forestry machinery, I believe, will be closely integrated into data-driven forestry management efforts."

AI in the real world

Indeed, the vision of the future for forestry machinery isn't as far off as it might seem. John Deere is already rolling out a vast range of bespoke operator assistance applications for the forestry industry. Its ForestSight solutions include digital mapping system

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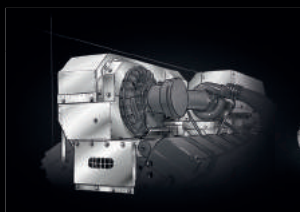
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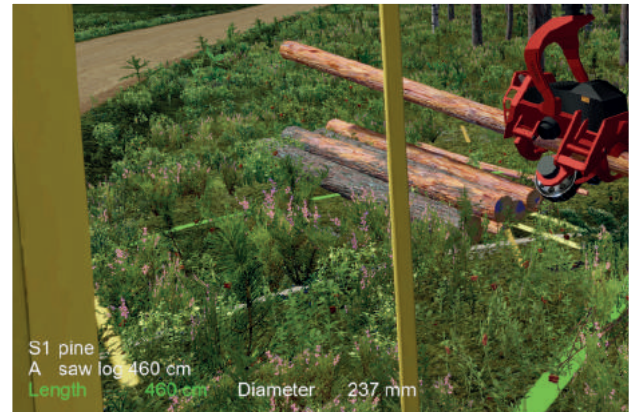


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OPERATOR ASSISTANCE



ABOVE: John Deere's forestry simulator helps to train operators with its realistic control interface

BELOW: A John Deere skidder in action

TimberNavi, which, while not yet detailed enough to include information about each individual tree, can increase productivity by mapping out large areas of woodland and providing visibility of other machine locations and production tracks. Matthew Flood, project manager for John Deere, says these systems will “enhance efficiency by harnessing real-time production data and information”.

The TimberNavi system works by using map data procured in an office setting. Next, the user can add to the map, creating site layers to differentiate parts of the work area. These files are then saved to a memory stick, which the operator takes with him to the vehicle and links with an interface in the cab. The satnav-style interface and navigation allows the operator to separate the harvested land from the land that has trees still to be felled, making the whole process

more efficient, saving logging firms time and money.

Currently, there is no live vehicle-to-vehicle link in this system; it works instead as an advanced forestry satnav, and herein lies one of the greatest challenges for using smart vehicle technology in rural settings: cellular network coverage.

“A lack of data and information sharing in rural areas is one of the most pressing challenges faced by some regions where forestry



equipment is heavily used,” says Matthew Flood, project manager for John Deere. “Finding faster and more efficient ways to communicate information from a rural location in real time to key stakeholders is a business-critical requirement, and needs to be woven into the fabric and DNA of equipment if operational performance is to be maximized.

“If more accurate mapping and production information, along with machine metrics, are available from jobsites and machines, it can be leveraged to help key stakeholders react more quickly to situations, which can ultimately help to increase margins,” says Flood.

Augmented reality

Smart mapping solutions provide the underlying technology on which augmented reality systems can

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Matthew Flood, project manager, John Deere



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VIRTUAL REALITY CRANE CONTROL

While smart-mapping based augmented reality isn't yet fully realized in forestry vehicles, one Swedish company, Hiab, has succeeded in creating a truck-mounted crane with forestry applications, that can be controlled using a virtual-reality headset.

Hiab's HiVision for forestry cranes, enables an operator to control the crane from the comfort of the truck. Using a pair of virtual-reality goggles, a joystick control system, and connected cameras that use 3D vision technology, he or she can stack logs while working in a safe environment.

Four cameras located in a small box on top of the forestry crane provide the operator with a 270° horizontal view of the loading area. To

achieve peripheral vision, the two forward-mounted cameras operate in high-quality stereoscopic 3D, while two 3D-enabled side-view cameras ensure that the operator has exactly the same view from the truck cab as from the crane cabin. Finally, a series of high-tech image processing algorithms enable the operator to see clearly in even the most challenging of lighting conditions.

The crane's movement is controlled via two joysticks, which have been built into the lorry interior. The HiVision system, which digitally connects the joysticks, the truck and the crane in real time, does so by transmitting information from joystick to hydraulic valve, which in turn powers the crane.



ABOVE AND BELOW: Hiab's HiVision virtual reality technology enables operators to remotely control forestry cranes from the comfort of their cab

blossom in the future. "In theory, augmented reality could be potentially fused with mapping applications to virtually differentiate and tag trees for harvesting, and leaving," says Flood.

Jenny Elfsberg, Volvo Construction Equipment's emerging technologies director, can see other potential advantages of computer-enhanced vision. "I think this technology could be a very effective tool to improve safety," she says. "For example, it could be used to highlight safe areas to walk in on a worksite, or to identify and pinpoint steep elevations where the angle of

elevation is too great for even a specialist harvester to operate in."

Machines helping people

Today's forestry vehicles are far from being fully autonomous, and our experts agree that the completely driverless machine in this complex field of operations is still a distant dream. However, the more advanced operator assistance systems become, the more savings can be made by operators, not only in increased operational efficiency, but also in terms of cutting down on the time and cost involved in training drivers.

"I THINK AUGMENTED REALITY COULD BE A VERY EFFECTIVE TOOL TO IMPROVE SAFETY. FOR EXAMPLE, IT COULD BE USED TO HIGHLIGHT SAFE AREAS TO WALK IN ON A WORKSITE"

Jenny Elfsberg, emerging technologies director, Volvo Construction Equipment



Volvo's Peter Lam, product manager for Volvo CE Excavators, who has helped to deliver technology solutions in Canada, New Zealand, Russia, Indonesia and Brazil over the last five years, says, "Providing an adequate level of education and training, so that workers can operate machinery safely and efficiently, is key. AI-enabled virtual reality and augmented reality educational programs, for example, can help address the skills and knowledge gap that is growing every day. Virtual reality systems, for instance, which replicate not only the control panel in the cab, but also the real-world forest environments by training students to operate in inclement weather, or on uneven ground and in hazardous environments, can reduce the high cost of classroom training, and as the technology gets

OPERATOR ASSISTANCE



ALL-TERRAIN SENSORS

A future challenge for operator assistance systems is helping them to negotiate unpredictable terrain.

"In Canada and New Zealand, however, where there has been an increased demand for steep slope harvesting, developing sensor technology that can notify the operator of even the tiniest movements, can save lives," says Volvo's Peter Lam.

"Also, for those at the controls of equipment operating on seemingly flatter ground, there is still a myriad of challenges to negotiate, such as uneven terrain, temperature extremes and hazards such as falling trees. These are the areas where the technology of tomorrow needs to be focused."

"AI-ENABLED VIRTUAL AND AUGMENTED REALITY EDUCATIONAL PROGRAMS, FOR EXAMPLE, CAN HELP ADDRESS THE SKILLS AND KNOWLEDGE GAP THAT IS GROWING EVERY DAY"

Peter Lam, product manager, Volvo CE Excavators

better, it may be able to eliminate this altogether."

Flood who began his career at John Deere as a test engineer, agrees: "There is a stark skills divide between experienced operators and their younger counterparts, which proves to be a challenge in getting maximum productivity out of machines today. Therefore, ensuring that new machinery is as user-friendly as possible, while at the same time shortening the training cycle, is the only way to close the gap. Technology, I believe, can help in this respect. The goal, therefore, in the near future, must be to achieve exactly the same level of productivity from each machine, no matter who is at the controls."

Both Elfsberg and Lam believe that fully autonomous forestry vehicle systems cannot replace

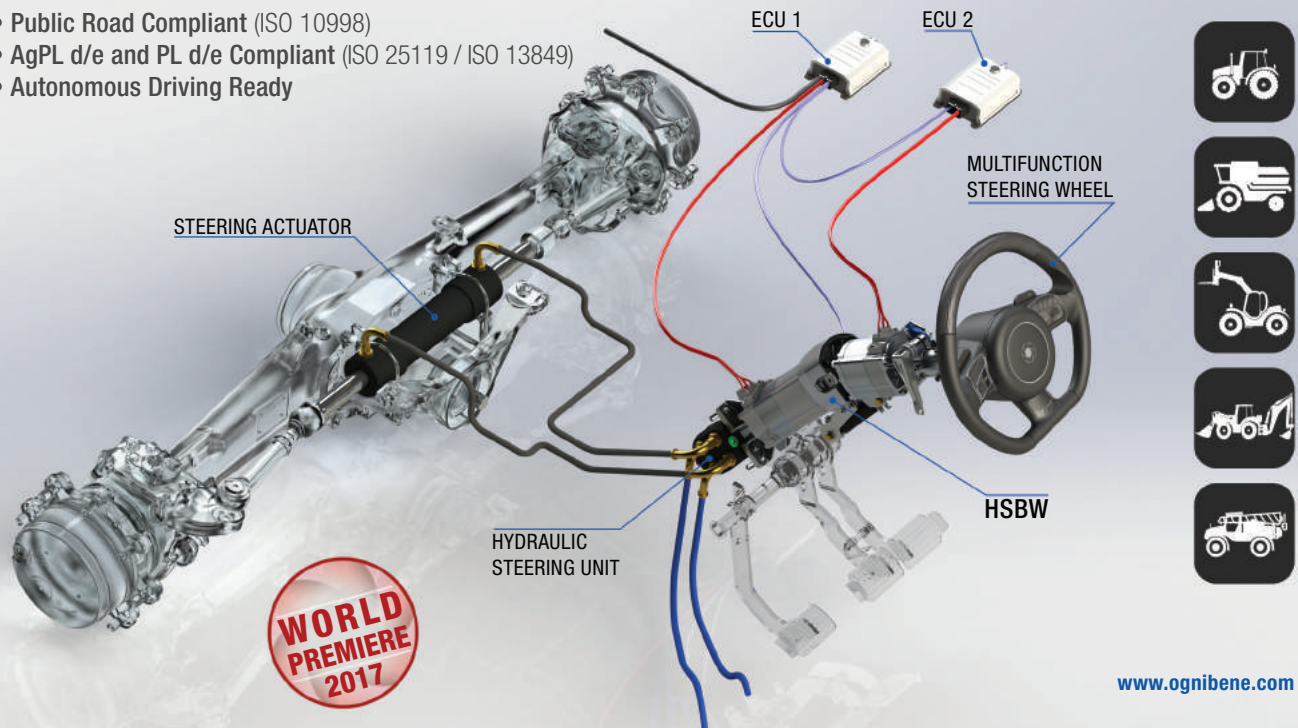
human drivers until AI-enabled augmented reality and driver-assist systems reach full maturity. And even then, some tasks will still prove hard to automate.

"We are starting to see systems that are less dependent on operator skills, ones that support operators with guidance or control primary functions," says Lam. "In the future, we will see increased machine autonomy and the operator will act more in a supervisory capacity. This will provide less stressful, more interesting work for operators, with perhaps several machines being controlled remotely by one operator. Of course, some tasks are so complicated that you really need to feel what you're doing, and in those cases, we will still need operators controlling the machines from inside the cab." **ivT**

BELOW: Aged trees are susceptible to irreversible damage from the spruce bark beetle and diseases such as larch disease and ash dieback



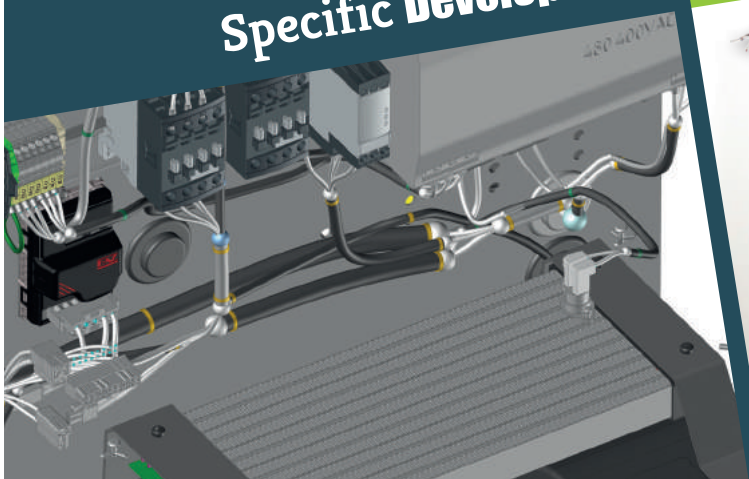
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THE HUGE AND UNPREDICTABLE WORK DEMANDS PLACED ON FORESTRY VEHICLES MEAN THEY MUST BE RUGGED AND ADAPTABLE. KOMATSU'S NEW EXCAVATORS ACHIEVE THIS WHILE INCORPORATING A HIGH LEVEL OF OPERATOR COMFORT AND CONTROL REFINEMENT

▶ The PC290LL-11 is the latest addition to Komatsu's range of forestry excavators, robust machines designed to meet the materials handling demands of the logging industry in markets encompassing the southeastern USA and Pacific Northwest. Felling operations necessitate transportation of heavy felled timber from frequently remote locations across challenging terrain.

Hauling the crushing and unpredictable weight of fallen trunks an initial distance (from stump to road landing) is work for a heavyweight excavator whose rugged physique is built to endure arduous labor in a brutal environment. Introduced to market in May 2017, the PC290LL-11 looks to be such a vehicle – a relentless and uncompromising workhorse adapted in every way to out-punch whatever challenge it may encounter in the woods.

“The Komatsu PC290LL-11 is a purpose-built forestry machine with rugged front equipment, high and wide undercarriage, and powerful swing and final-drive system designs,” explains Steve Yolitz, a vehicle systems expert at Komatsu America Corp. “It is the first 11-series log loader and incorporates the latest in Komatsu technology, delivering high performance in demanding log loading, shovel logging and road building applications.” It comes in two front-build configurations, tailored to distinct but related forestry applications.

Double header

Weighing in at 87,370 lb (39,630kg) and boasting a 40ft (12.1m) reach is the Log Loader model, whose forestry front incorporates a grapple and a live-heel. This live-heel functions as an opposable thumb to the fingered grapple, enabling logs



FORESTRY
SPECIAL

KOMATSU PC290LL-11

87,370

Total weight
(in pounds)
of Komatsu's
PC290LL-11
Log Loader
(39,630kg)





“THE KOMATSU PC290LL-11 IS A PURPOSE-BUILT FORESTRY MACHINE WITH RUGGED FRONT EQUIPMENT, HIGH AND WIDE UNDERCARRIAGE, AND POWERFUL SWING AND FINAL-DRIVE SYSTEM DESIGNS”

Steve Yolitz, Komatsu America Corp

to be manipulated and carried perpendicular to the boom, thus enabling efficient loading of cut trunks. “Application markets include loading logs onto trucks at a roadside landing, log-loading in a mill yard and shovel-logging – a method used to move logs from the forest to the landing,” says Yolitz.

“The Log Loader and Road Builder configurations differ only in the type of front-work equipment installed,” he continues. “A Road Builder front consists of a Komatsu factory-installed excavator boom and arm, onto which the distributor would typically install a bucket with thumb attachment, allowing it to pick up logs, brush piles and boulders.” This version of the PC290LL-11 is optimized for building access roads to timber harvesting sites, work that embraces tasks such as stump, brush pile and boulder removal, rough grading and culvert installation. The Road Builder has an operating weight

ABOVE: The robust, purpose-built PC290LL-11 is ideal for use in forestry applications

40
Total boom reach (in feet) of Komatsu’s PC290LL-11 Log Loader (12.1m)

of 82,410 lb (34,380kg) and also a 34ft (10.3m) reach – slightly shorter than its log-loading stablemate.

Rugged by design

Both incarnations of the PC290LL-11 are rugged customers specifically built to be equal to the tough demands of forestry work. Both feature a high-and-wide forestry undercarriage, using components from the next-size-up Komatsu excavator, to provide ground clearance of 28ft (8.5m). Both feature PC360-class final drives,

providing maximum drawbar pull of 64,250 lb (29,140kg) for optimum shovel-logging and rough-terrain work, as well as a PC360-class swing motor and drive, providing 75,902 lb-ft (103,000Nm) torque for demanding swing applications. Indeed, muscular components from larger size-class excavators, including three-times thicker compartment doors and covers, provide ruggedization throughout, while the machines move on heavy-duty tracks and rollers. Both feature high-rigidity booms forged from thick, high tensile-strength steel plates, providing long-term durability and resistance to bending and torsional stress. Both include a robust forestry-guarding package with enhanced right-hand corner guard system, a fully protected LED light and a hockey-stick style tree deflector. Good visibility is provided with a choice of 48in (120cm) hydraulic tilt for loading and shovel-logging, or a 7in (18cm) fixed cab riser for road-building applications.

Creature comforts

The cab itself meets all relevant forestry standards and the machine



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as a whole is the end-product of a rigorous regime of testing. "All Komatsu Log Loaders meet all applicable ISO and local forestry regulations, with compliance tested and confirmed as part of Komatsu's Engineering test process," Yolitz explains. "Komatsu follows a formal development template that has several tollgates throughout the process. Prototype machines are built and evaluated for performance and durability at Komatsu's test facilities and at customer sites prior to production of that model. At each tollgate the machine is evaluated and must be confirmed before moving on to the next development step, with formal safety check sheets used by test engineers to confirm that there are no concerns with the newly developed machine."

Inside, the working environment is spacious and comfortable, with a heated air-suspension seat. The rigid cab design provides excellent sound absorption, so operators experience low noise levels comparable to those in a modern automobile. Control is fluent and intuitive, with lower profile pilot



ABOVE: Komatsu has considerably raised the bar with the PC290LL-11's features. The model replaces the PC290LL-10

proportional control (PPC) levers governing boom, arm and heel functions, while new, thumb-actuated electroproportional control provides smoother and more accurate control of the grapple or bucket thumb than in previous models. An updated high-resolution LCD user interface offers a rear-view camera screen for 360° operational vision, and a wealth of machine gauge data, maintenance alerts and switchable display modes facilitate

optimum screen information for a particular forestry situation.

One of the family

Komatsu prides itself on an ethos of in-house innovation and these new woodland beasts are Komatsu machines from top to bottom. "All major components are Komatsu designed and manufactured, not sourced from a third party," says Yolitz. "As well as the next-size-up Komatsu bodywork, Komatsu cab



REMOTE OPERATIONS

Telematics on the PC290LL-11 is provided by Komtrax 5.0 (above), Komatsu's state-of-the-art remote vehicle monitoring system, which is calibrated to drive peak running efficiency and reduce overall costs.

Standard to all Komatsu log-loaders and excavators, this latest edition of Komtrax uses a wealth of machine data to inform intelligent decisions about the use of vehicles in a fleet. Accessible virtually anywhere via computer or smartphone, the app provides a detailed operational overview, keeping managers apprised of machine status and issuing automatic notification alerts. Machine health is continuously monitored and up-to-date records enable maintenance time and costs to be anticipated and managed.

"Komtrax 5.0 is Komatsu's latest generation of Komtrax, an industry-leading remote monitoring system," Steve Yolitz explains. "Version 5.0 includes new datapoints such as KDPF data, regeneration time, diesel exhaust fluid (DEF) level, DEF use, ambient temperature

and atmospheric temperature. Additionally, advanced reporting capabilities have been added to capture travel hours, travel distances, working modes, cycle times and max speed." All this facilitates systems adjustments to ensure that vehicles work with the greatest possible efficiency for a given work cycle.

Moreover Komtrax 5.0 monitors fuel consumption and time spent idling so that wasteful running of engines can be spotted and operators coached in more economical practice. Indeed, an identification ID can be set up for individual vehicle operators, allowing owners to analyze each driver's performance and take measures to support improvement where relevant. The system can also generate reports on a range of topics including fleet performance, machine history, energy savings and attachment use.

"These improvements in Komtrax give customers improved insight into their

machines, providing the peace of mind they desire," Yolitz concludes. "They will be confident that operators are taking full advantage of their machine functions and know that Tier 4 technologies are working seamlessly to do their job."

Built on Komatsu's own software and hardware, the free-to-use package is now installed in hundreds of thousands of Komatsu units worldwide.



KOMATSU PC290LL-11

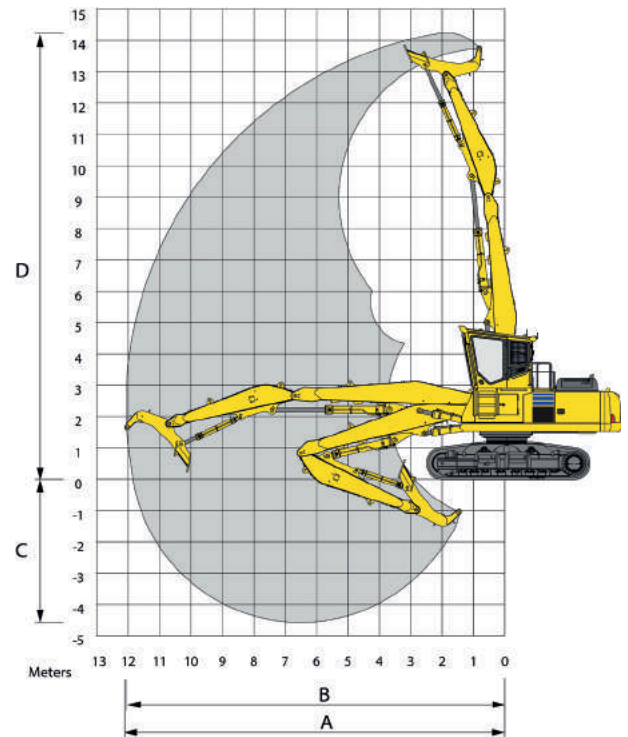
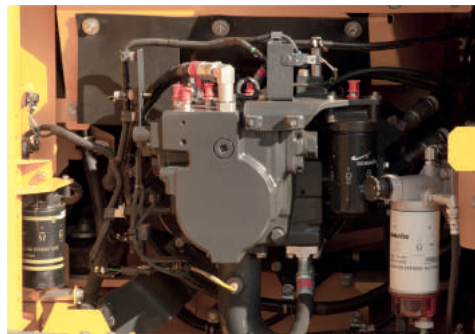
and Komatsu hydraulic pumps, motors, valves and cylinders, this includes the powerful 196hp (146kW) Komatsu SAA6D107E-3 engine, which satisfies stringent EPA Tier 4 Final standards. As well as reducing NO_x emissions by up to 80% compared with Tier 4 Interim levels, this draws on engine technologies developed in-house to minimize fuel consumption and optimize clean operation.

The KDPF (Komatsu Diesel Particulate Filter) has active regeneration, with soot deposits being burned off automatically during operation. The selective catalytic reduction (SCR) system injects diesel exhaust fluid (DEF) aftertreatment, decomposing malign NO_x into harmless N₂ and H₂O. The cooled exhaust gas recirculation (EGR) returns a portion of exhaust gases into the air intake, lowering the combustion temperature to further reduce NO_x output, with the upgraded variable geometry turbocharger (VGT) further refining exhaust temperature management. The heavy-duty common rail

(HPCR) system deploys computer control to match high-pressure fuel injection to operational demand, thus achieving close to complete combustion and reducing PM emissions. Such technologies are the fruit of what Komatsu see as a determined commitment to reducing environmental impacts.

In the woods today

The advent of the PC290LL-11 represents a major updating of Komatsu's forestry excavator line-up. "The PC290LL-11 replaces the Komatsu PC240LL-10," says Yolitz. "It has a number of improvements,



"TRANSPORT WIDTH HAS NARROWED TO 11FT 5IN [3.5M], REDUCING THE NEED FOR SPECIAL TRANSPORTATION PERMITS"

A SHORT HISTORY OF LOGGING

Although timber and firewood became the basic resources for construction and energy in the Roman era, a sustainable timber yield through systematic forest management was probably first achieved in 14th century Germany. The widespread use of steel whipsaws extended the scope of felling operations in the 1800s, and in 1918 the first portable chainsaw was developed in Canada. More recently, the advent of forestry harvesters and other industrial vehicles has rapidly advanced large-scale mechanization, and drones, planes, laser scanning, satellites and robots all now play a part in modern forestry.

Logging can be broadly understood as the business of felling trees and transporting timber lengths to a frequently distant processing site such as a sawmill. For centuries the most practical method was to float logs downstream on a river, either by log driving, with men guiding the waterborne trunks in order to avert

log jams, or timber-rafting. In the 1800s primitive loaders grew to prominence and logs were strapped between sets of wheels sometimes 10ft (3m) high to be pulled, first by oxen and then, from the 1930s, by tractor.

Today heavy machinery is employed to move logs from their stump positions onto trucks waiting on an adjacent road – which has often been constructed as part of the operation. Shovel-logging (or hoe-chucking) uses a specialized excavator (or log-loader) to swing logs to the transport landing. Instead of driving back and forth dragging logs, the excavator moves across the harvesting site, grabbing the logs lying within its reach and swinging them steadily closer to the road through progressive back-and-forth passes.

1918
The year the first portable chainsaw was invented, in Canada

ABOVE LEFT: The Komatsu Diesel Particulate Filter automatically burns soot deposits

ABOVE RIGHT: The length of the PC290LL-11 arm when 'sweeping'

including 11% more net horsepower (196hp versus 177hp), Tier 4 Final fuel efficiency, a high-capacity cooling system that includes 3mm versus 1.5mm cooling fins, and sealed air-intake doors for improved productivity and reliability. The log-loader configuration reach is 5% greater for increased productivity, transport width has narrowed to 11ft 5in [3.5m], reducing the need for special transportation permits, and a heavier counterweight maintains the PC240LL-11's lift capacities. With final drives upgraded to the PC360C-class, drawbar pull is increased by 15% for improved shovel-logging and rough terrain performance." The unforgiving demands of industrial logging in North America's forest wildernesses are certainly no picnic for any machine. But if you go down to the woods today in a Komatsu PC290LL-11, you may be in for a big surprise in terms of the performance, power and durability this formidable newcomer can bring to bear. **ivT**



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KEEP CLEAR

LOGSET HAS SUCCEEDED IN BUILDING THE WORLD'S FIRST SERIES MANUFACTURED HYBRID HARVESTER. WE TAKE A LOOK AT HOW IT WORKS, AND CONSIDER HOW IT STACKS UP AGAINST ITS DIESEL STABLEMATES

▶ A notable machine in Finnish forestry manufacturer Logset Oy's product range is the Logset 12H GTE Hybrid, which has been hailed as a real breakthrough in terms of using electrical energy to operate such a powerful machine.

According to Logset, the 12H GTE Hybrid is also the world's biggest forestry machine. Suited for large-scale harvesting, it features double circuit hydraulics, a stronger crane and a robust transmission.

A key feature is in the hybrid system that can deliver up to 510hp and generate an enormous torque of 2,000Nm within a microsecond, when using electrical energy. It is designed to react instantaneously to the work load, providing an extra power boost for the crane.

The 12H GTE Hybrid also has low running costs and uses only a fraction of the fuel that a full engine-



300hp
Maximum power
output of Logset's
8H GT harvester
(205kW)

RIGHT: Design of the
8H GT took two years

powered machine would use, making it an economical solution compared with its non-hybrid competitors.

Harvesters of choice

On the diesel-powered vehicle horizon, Logset's GT series of harvesters remains popular. All vehicles in the series are powered by extremely economical and fuel-efficient low-emission engines and they also feature ergonomic cabs, as well as a built-on crane that has a long reach and high lifting capacity.

A favorite among users in the GT harvester range is the 8H GT model, which is a robust, six-wheeled harvester with sufficient power and stability to make it suitable for use in the most demanding conditions.

"The Logset 8H GT is a versatile harvester that can carry out thinning operations or clear-fells," says Pascal Rety, vice president of sales at Logset. "It is powerful, stable, comfortable and economic."

LOGSET HARVESTERS

The 8H GT offers an adequate pump capacity for both crane and head with either a single 210cc pump or double pumps (190cc and 140cc). It is fitted with a powerful Agco Sisu Power 7.4-liter, 300hp engine (205kW) and it also features a Mesera M240H crane that gives it superior lifting power, a low gravity point, unique geometry, and maximized visibility thanks to the crane's narrow pillar.

Priced at around €400,000 (US\$464,740), it is best suited to contractors and medium-sized private forest owners.

When developing its 8H GT harvester, Logset intended for it to be productive and economical, and thus designed it accordingly. Rety says, "We always follow three main lines when designing new products: productivity, with the aim of achieving the highest production possible; economy, by way of reliable main components and low fuel consumption; and ergonomics,



LOGSET HARVESTERS

with first-class comfort and easy service access when needed.

"The Logset 8H GT is a medium-sized harvester, with high power and great productivity," says Rety. "However, it still remains top of its class in fuel consumption. Its Agco engine is a purpose-built engine that provides high torque at low RPM, so it is great for saving fuel."

Nokian tires are fitted to the Logset 8H GT. On the front bogie, the tires are sized 710/45 by 26.5 inch and on the rear axle, 700/55 by 34 inch.

Understandably, the practical and productive model is the result of years of careful planning. Rety confirms that the design of the Logset 8H GT took around two years, despite the company's 25 years of experience.

"The complete design of a machine is the result of years and years of input," says Rety. "It is a real know-how. The design process usually takes about two years, from



TRIED AND TESTED: ADVANTAGES OF THE LOGSET 8H GT ARE PROVEN THROUGH REAL-LIFE, EVERYDAY USE IN A FORESTRY BUSINESS IN FINLAND

» Kari Virtanen (right) has been working as a forestry contractor for the past 40 years and in a normal five-day week would harvest around 700m³ [24,720ft³] of wood.

In January 2017, he made a huge investment of €400,000 (US\$465,820) on a new Logset 8H GT harvester.

"This Logset machine runs on around 10-11 liters of diesel per hour and has more hydraulics than the older machines," he says. "It performs smooth movements on the arm and the head and has a very comfortable cab in which to operate the machine. Visibility is important in this job and when using the Logset 8H GT I can see all around the machine because the cab twists to suit the location."

Virtanen's business plan states he will pay the machine cost back in five years, so it is crucial for there to be no machine downtime. "I normally change my harvester

every five years and that's also the duration of the loan I take out to purchase the machine in the first place," he says.

During its first eight months, Virtanen logged over 2,000 hours of Logset 8H GT machine use, across a two-shift pattern with another co-worker.

With his decades of experience, Virtanen can instantly identify the trees that need to be thinned in order for the rest of the forest to flourish. When on thinning duties, Virtanen's 8H GT harvests about 10m³ (353ft³) or 7.5-9 metric tons of pulp wood in an hour. In final clear cut harvesting, the production is about double that amount.

Industry targets for a harvester like the 8H GT is to produce 25,000-30,000m³ (883,000-1,059,000ft³) of pulp wood from thinning, or 60,000-90,000m³ (2,119,000-3,178,000ft³) from final clear cut, per year. To save time, the 8H GT Logset harvester



records its own production statistics, which can then be used by forest owners for forestry management purposes, sales documentation and reporting.

Virtanen carries out most of his annual work on forest land belong to prominent Finnish businessman Ilkka Brotherus. Brotherus currently owns 3,700ha of forest that he has been building up since 1981. "Some of the trees are over 50 years old and we experience an average growth rate of 7m³ [247ft³] per year," says Brotherus. "In one hectare we would have around 170m³ [6,000ft³] of trees, which is ideal. We manage the forests ourselves and bring in a contractor to thin them out when required."

Virtanen is an important tool in the management of the forests and operates his Logset machine in a variety of situations. In his working day, he often cuts the wood before piling it up at the side of

► P59



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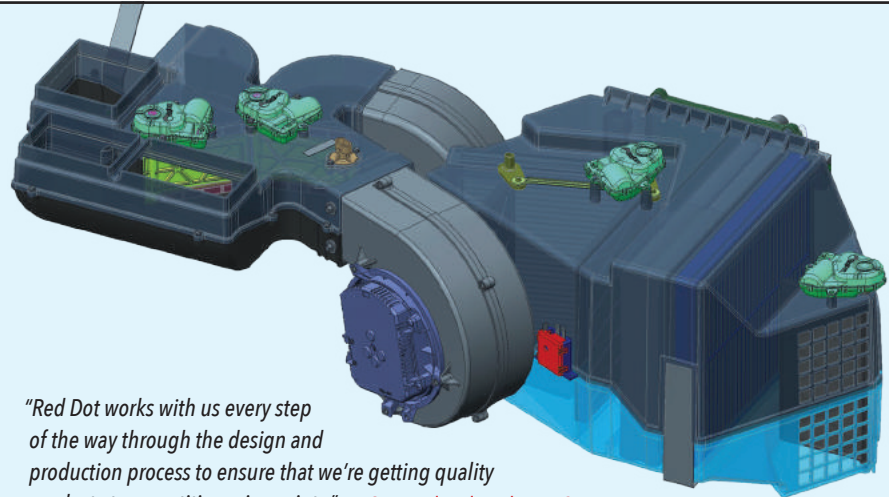


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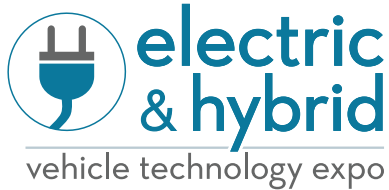


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RIGHT: The 8H GT has been developed to be productive and economical

planning stages to a ready-built product. Prototypes are then manufactured and are usually tested during a six-month period.”

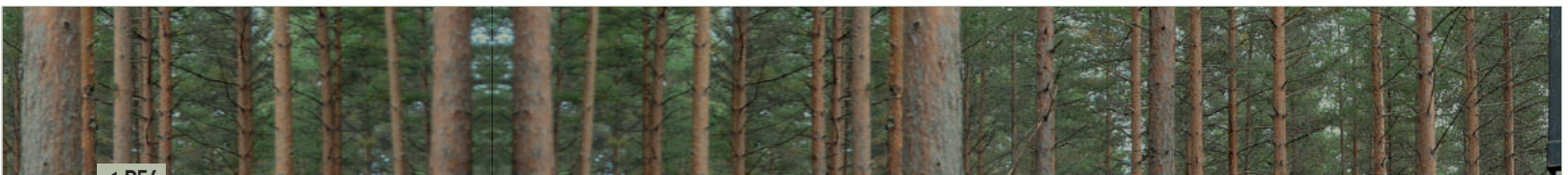
Ahead of the game

When the 8H GT is coupled with the Logset TH55 harvesting head, the machine duo are a match for any competitor.

Logset harvester heads are deliberately built to be lightweight and agile for efficiency, without compromising power. They are designed to have a strong and open structure, ensuring easy maintenance where no special tools are needed.

Depending on customer requirements, the TH range of heads comes with several optional extras including the latest software technology that is used in the cab during operation.

Notably, the TH55 head has been designed for second and third thinning, but it is also suitable for smaller clear cuts. Weighing 1 metric



◀ P56

the road by the forwarders, ready for collection. The buyers' trucks then load and weigh the pulpwood and the owner gets paid by weight.

“Typically, young woods are hand-trimmed twice to remove unwanted shrub before first harvester thinning,” he says. “On this logging site, the owner is thinning a 40-year-old pine forest. The target is to leave some 700 pines per hectare, which will be thinned again in about 15 years down to 500 pines per hectare.

“Typically, both thinning harvests produce 50-100m³ (1,765-3,530ft³) of wood. The final clear cut will be done, when the trees are about 70-80 years old.

“This is the most valuable timber. The yield at final cut varies typically from 350-500m³ (1,148-1,640ft³), but I have seen some woods as high as 800m³ (28,250ft³) yields.”

Sometimes, he gets to work on woods, that were never trimmed or thinned within the production cycle: “Such woods produce about the same, as well-maintained woods in final cut,” he says. “Also, it takes longer to reach maturity if you don't thin the woods. Therefore, the land owner loses the production of the two thinning cuts and waits longer for payback. There is a clear incentive to manage your woods professionally,” he added.

“We receive around €60 (US\$70) per cubic meter for good wood and €30 (US\$35) per cubic meter for pulp wood.

“We are making around a 5% return on our investment in the forestry industry, something in the region of €200 (US\$233) per hectare per year. Our forests are managed in a 10-year plan in terms of thinning, harvesting and replanting,” says Brotherus.



LOGSET HARVESTERS



US\$34.8m
Logset's 2016
annual turnover
(€30m)

ABOVE: The Logset TH55 harvester head is suitable for use in clear-cut harvesting

ton (1.1 ton), the TH55 can be equipped with a multiple stem handling option to enable trouble-free collection of multiple trunks.

Logs are measured with sensors, thanks to the top knives that can measure their diameter, and with a hydraulic wheel measuring the length. These are then cut according to the settings and requirements of the wood buyer.

Rety says, "The Logset TH55 harvester head is a medium-sized harvester head, but at the same time it is very compact. The ease of daily maintenance was a key criterion during the development process for the Logset TH55."

Global reach

Logset employs 70 people and it manufactures around 100 forest machines per year in its factory in Koivulahti, near Vaasa, Finland. Its practical and powerful machines – including six forwarders, eight harvesters and seven different



ABOVE: The 12H GTE's hybrid system can generate as much as 2,000Nm of torque in a microsecond

harvester heads – are currently sold to 25 countries around the world.

The company achieved an annual turnover of €30m (US\$34.8m) in 2016 with the average price of a harvester being €500,000 (US\$581,375) and a forwarder costing €350,000 (US\$406,962).

With these impressive figures in mind, what are Logset's future

plans? Although new products are expected to include new technology in the cab that can identify and select perfect candidate trees for thinning, making the process a lot easier for an inexperienced harvester operator, Rety is not giving any secrets away just yet but maintains that announcements will be made by the company in the near future. **iVT**

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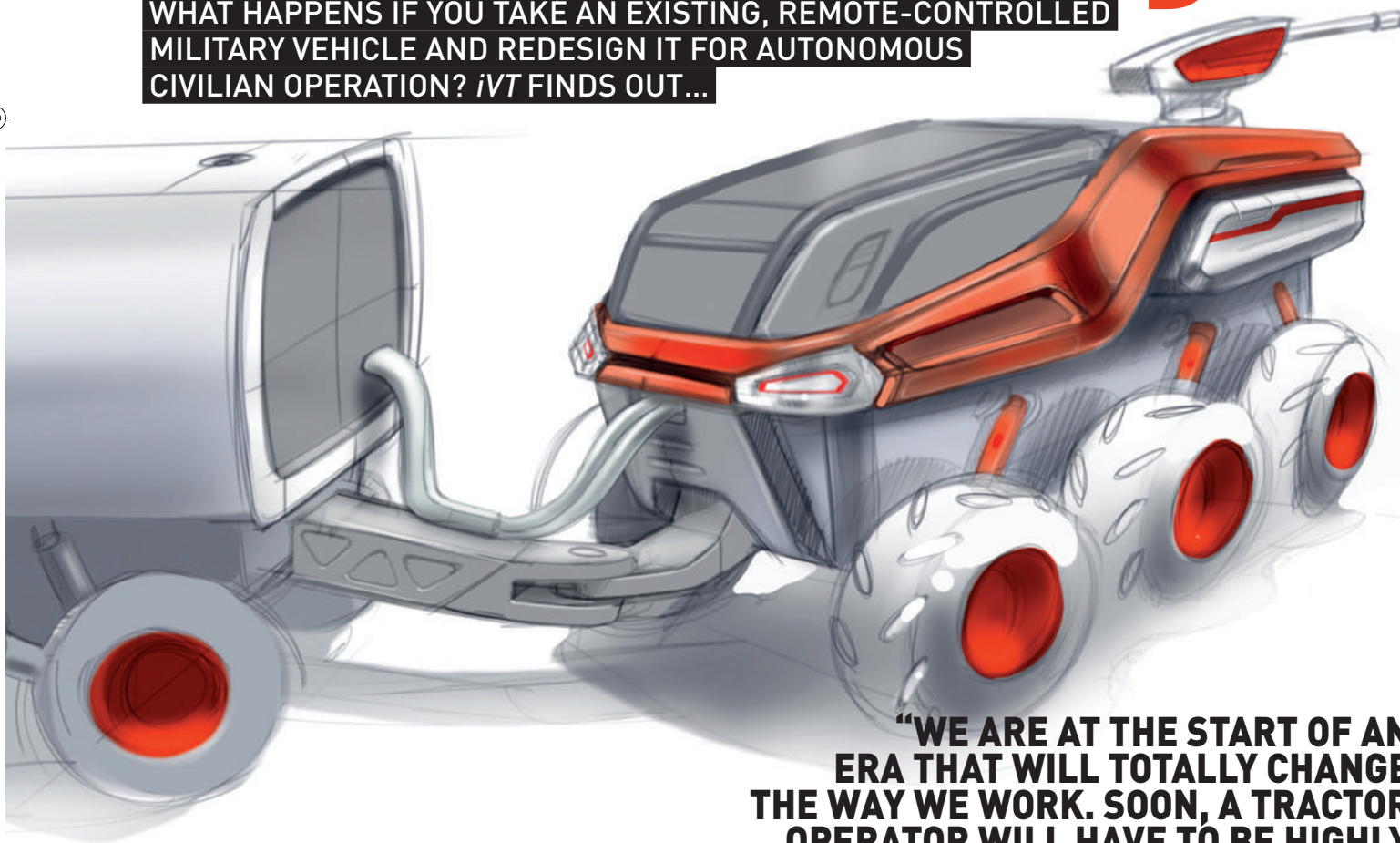
iVT CONCEPT

AMOS BOAZ, AMOS BOAZ STUDIO



All-terrain autonomy

WHAT HAPPENS IF YOU TAKE AN EXISTING, REMOTE-CONTROLLED MILITARY VEHICLE AND REDESIGN IT FOR AUTONOMOUS CIVILIAN OPERATION? *iVT* FINDS OUT...



“WE ARE AT THE START OF AN ERA THAT WILL TOTALLY CHANGE THE WAY WE WORK. SOON, A TRACTOR OPERATOR WILL HAVE TO BE HIGHLY SKILLED, AS HE OR SHE WILL NEED TO CONTROL A TEAM OF MACHINES”

Amos Boaz, industrial designer, Amos Boaz Studio

▷ The BLR is an unmanned military ground vehicle prototype, designed and built by BL Advanced Ground Support Systems. It offers extreme ground mobility, coupled with drive-by-wire technology, giving the ability to remotely operate the vehicle in a loose control circuit.

Now, industrial designer Amos Boaz has been commissioned to sketch out what a civilian version of the BLR might look like. The concepts he has come up are for a variety of use cases, all capitalizing on the BLR's excellent all-terrain ability.

Boaz sees his concepts as ideal for rough-terrain situations such as those that are often encountered in forestry works. Other possible civilian applications include firefighting, where situations can develop in rough terrain where normal vehicles cannot operate; and search and rescue, which is, by its very nature, an off-road job.

"Unmanned vehicles are a great opportunity to design something new, something different," says Boaz.

"There's no need for a cab any more, so there's no windscreen. This means you can have a much lower platform. The BLR is a tough tool, so it needs to deliver a strong look of power and reliability."

Several autonomous BLRs could be virtually linked together to work as a team, with perhaps one human operator remote controlling a lead vehicle, or taking overall control in unpredictable situations.

Different BLR machines in a robotic team could be equipped for different purposes. For example, one could carry equipment, another could be fitted with a dozer foot, while a third might have more unique tools, such as a remotely manipulated arm for cutting trees.

"Today, we are at the start of an era that will totally change the way we work," says Boaz. "Soon, a tractor operator will have to be highly skilled, as he or she will need to control a team of machines. I believe this job will be very attractive to many young people, as controlling machines in this way might be like playing a computer game." **IT**



ABOVE: A BLR unmanned military ground vehicle prototype

TOP: A civilian version of the vehicle equipped with a harvesting arm for forestry applications

LEFT: For firefighters, the BLR would be very useful on rough terrain

The 6x6 drive configuration of the BLR, using hydrostatic hub motors, allows for unprecedented obstacle negotiation, ranging from a 1,500mm (59in) step climb, to a 1,000mm (39in) open-ditch crossing. Individual hydro-pneumatic suspension arms allow for a 610mm (24in) suspension travel, and the ability to alter drive height and drive stiffness 'on the fly', over the control bus.



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Model 1622 High Frequency On-board Battery Charger maximizes battery life and vehicle run time with easy and convenient opportunity charging. CAN communication allows better vehicle energy management.



With dual 32-bit microprocessors running faster than any previous generation, the **Model AC F2-A** controls any AC induction motor accurately and efficiently and provides significantly greater safety. It features the largest memory space for VCL code to-date, allowing over 4,000 lines of customised code and over 200 custom parameters and variables.



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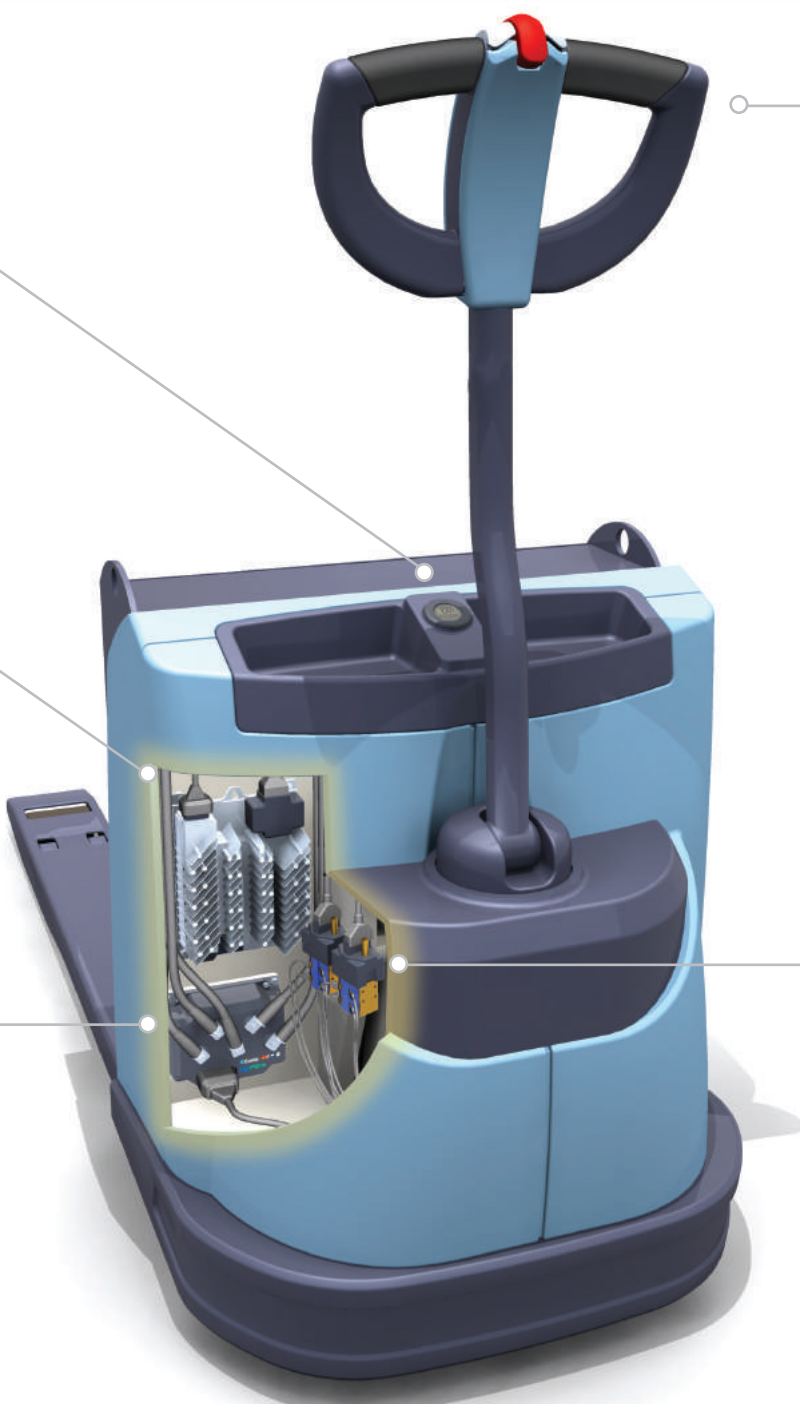
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CURTIS EV SYSTEMS

New high-current controllers

A NEW PRODUCT IS HELPING MACHINE OPERATORS RUN HIGH-CURRENT SYSTEMS SAFELY, SIMULTANEOUSLY AND WITH A SINGLE CONTROLLER

The recently released MC018 high-current controller from Danfoss Power Solutions is designed to solve many of the challenges customers face in terms of controlling high-current devices, among them excessive noise, moderate pin/controller power and lack of intelligent capabilities.

The MC018 provides a more powerful, intelligent, focused solution for controlling high-current applications. By bringing high-current control to a new level, it will greatly help customers looking to implement electrification.

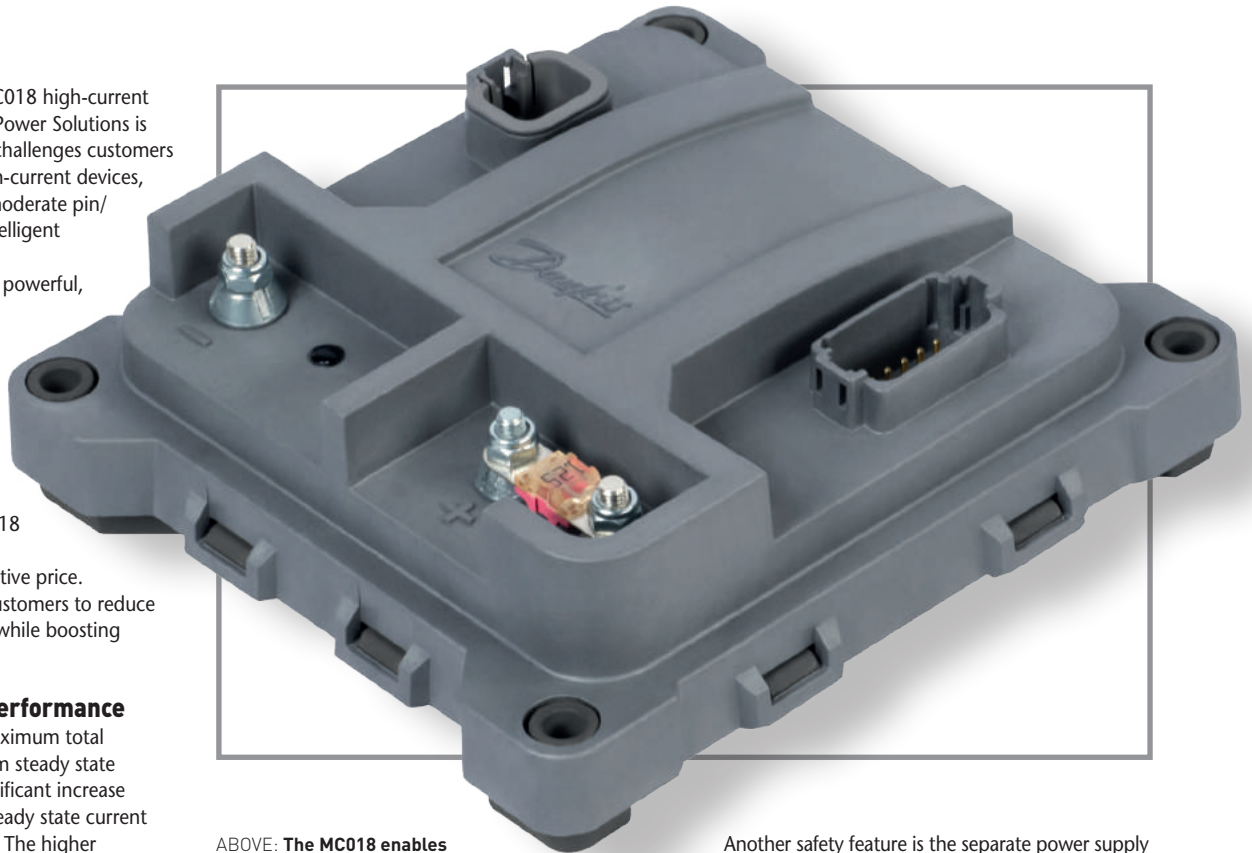
Compared with other controllers on the market, MC018 offers greater power and more intelligent features at a competitive price. Its innovative features enable customers to reduce system and maintenance costs while boosting the efficiency of their machines.

Reduce costs, improve performance

The MC018 controller has a maximum total current of 160A and a maximum steady state current of 120A, which is a significant increase over the maximum total and steady state current of 75-80A on the market today. The higher maximum current allows more devices to be simultaneously powered by one controller, cutting the number of controllers needed and thereby reducing the total cost of the system.

At maximum load, MC018 can run up to 4kHz, and up to 20kHz at a reduced load. The higher frequency makes it possible to control in-cab applications with smoother and more precise control, and with a reduced noise level.

MC018's programmability also helps improve control. As part of the PLUS+1 microcontroller line, MC018 is already compliant with the PLUS+1 platform. The pre-engineered function blocks in PLUS+1 give OEMs the opportunity to program functions that would otherwise require extra time or components, or may not have been feasible at all. These features include the 'soft fuse' – a programmable fuse that can be set to switch off when the current is above a certain value, making the controller safer.



ABOVE: The MC018 enables simultaneous control of high-current applications with one device, thereby saving the operator the cost of buying additional controllers

Another safety feature is the separate power supply for the logic circuit. This keeps the controller running even when outputs have short-circuited, meaning it can continue to provide insights to the master controller. Time in diagnostics and repair is reduced and could cut warranty costs. Because of this, MC018 meets fault detection requirements.

Implementing MC018 in your machine

The MC018 high-current controller provides power and control to a number of machine applications, such as linear actuators, windshield wipers, the fan drive, lamps and lights, engine starter, leveling control, sprinkler system and active suspension, among others.

For more information about the MC018 controller and how to integrate it into an intelligent machine design, contact a local Danfoss distributor. **ivT**

Evangel Zhang is global product marketing manager at Danfoss Power Solutions



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No heat, no fire

HIGH-TEMPERATURE INSULATION SYSTEMS CAN INCREASE SAFETY IN AGRICULTURAL MACHINERY

▶ What constitutes a machinery fire? Even without injuries, the consequences of a fire can weigh heavily on a company. A total loss or serious partial loss can stop work, ultimately putting the business at risk. If fields are completely burned, there is obviously crop destruction. Insurance premiums can be expected to rise and the producer's reputation could be damaged. As a result of the frequency of machinery fires, there is growing pressure from insurers and trade associations on producers and operators to protect people and machines.

What are the causes?

Causes of machinery fires are combustible deposits of flammable material, including dry particles from the harvest, or liquids such as oil and fuel. During operations these materials inevitably get into the engine compartment or onto the engine itself, where they can form a highly flammable layer. There are two ways in which they can actually ignite.

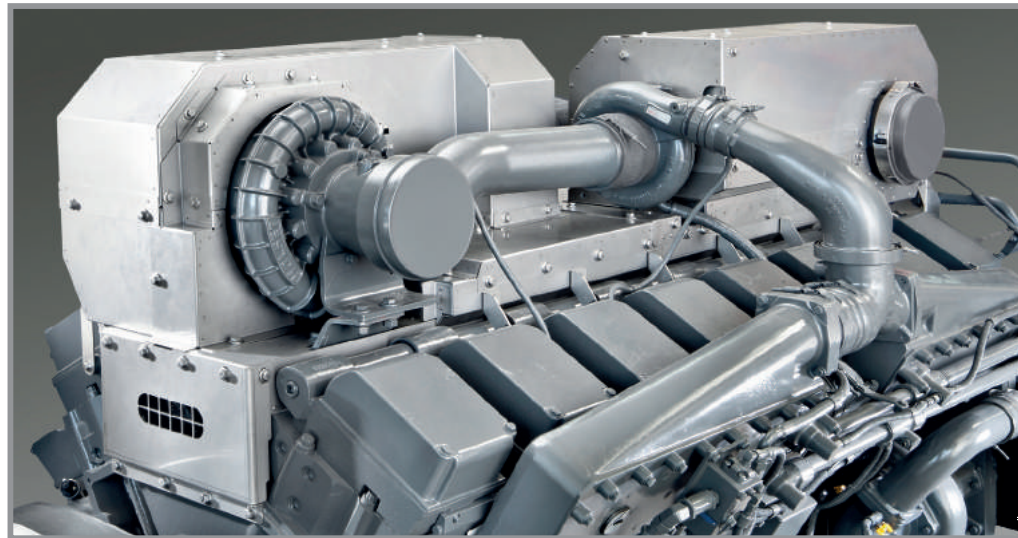
The first is by direct contact of the layer with components containing hot exhaust gases (with surface temperatures of 450-750°C (842-1,382°F)). The second is when airborne particles in the engine compartment glow as a result of contact with hot components. They then drop onto heaped material causing it to ignite.

A large number of flammable items around the machine can accelerate the spread of the fire and even cause it to encroach on the field itself. But there are other factors that, in combination with the very high temperatures, can lead to catastrophe. These include slipping v-belts, hot running bearings and cabling short circuits. The need for effective fire protection measures is great.

The solution

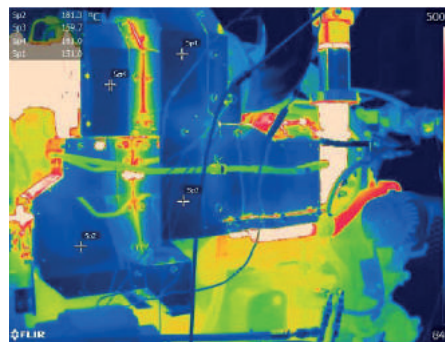
Thermamax's Tmax-Insulation Cladding efficiently prevents the escape of dangerous temperatures from critical components such as turbochargers, exhaust pipework and elbows. Surface temperatures are reduced to 200-220°C (392-428°F), dramatically cutting the risk of a fire.

Tmax-Insulation Cladding comprises three components in a cassette design: the outer shell, the insulating material and the inner shell. The non-jacketed components are thermally insulated, so combustible deposits can no longer accumulate on the surfaces. In addition, temperature-sensitive



ABOVE: The safety of agricultural machinery can be improved with Tmax-Insulation Cladding

BELOW: A thermography image shows the effectiveness of Thermamax's technology



components in the immediate area are protected from excess heat.

Temperatures of 600-750°C (1,112-1,382°F) in the system are reduced to a maximum of 180-220°C (356-428°F). That meets, thanks to the company's expertise in the marine sector, the strict temperature requirements of the 1974 SOLAS guidelines – an international agreement on the protection of life at sea.

With regard to safety and effectiveness, Tmax-Insulation Cladding exceeds alternative solutions that use matting and moldings. These

can lower the temperature and limit the deposition of combustible material onto hot components, but they also have disadvantages, including, the risk of overheating turbochargers, which can make other components unsafe.

The use of the most modern metalworking processes allows Tmax-Insulation Cladding to be tailored precisely to the requirements of each engine or machine. Torsionally rigid and vibration-resistant components meet the high mechanical requirements of the engine compartment and can be easily removed and refitted.

Benefits and proof

The advantages of Thermamax's Tmax-Insulation Cladding include: effective fire protection for people and machines; increased machine reliability; more attractive insurance premiums for operators; ability to be tailored to all requirements; high mechanical strength; quick installation and/or refitting.

How does Tmax-Insulation Cladding work? Thermamax has measured it. The results can be seen in the thermography image (above left), which shows that the surface temperatures of Tmax-Insulation Cladding are well below those of the hot system components. This means that combustible material will not ignite and temperature-sensitive components are protected from overheating. **ivT**

Ida Mariotti is marketing manager at Thermamax



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Element control with Stage V

TIGHTER EMISSIONS GUIDELINES WILL START TO BE PHASED IN FROM 2018, REQUIRING ENGINE MANUFACTURERS TO UP THEIR GAME IN DEALING WITH HARMFUL AIR POLLUTANTS

In 2014 the European Commission proposed measures to cut emissions of major air pollutants from engines in non-road mobile machinery (NRMM) and reduce the complexity of the existing legal framework. Off-road engines account for some 15% of the nitrogen oxides (NO_x) and 5% of the particulate matter (PM) emissions in the EU. It is widely acknowledged that these substances harm both human health and the environment.

At the end of 2016 the commission released a new NRMM regulation, commonly known as Stage V. Due to be implemented incrementally between 2018 and 2021, Stage V reflects a broader general trend in Europe and the USA toward wider and stricter environmental controls, with lower ceilings for harmful substances and the addition of other chemicals and chemical species to the monitoring mix.

Although Stage V is European in scope, it is expected that many other areas will align themselves with the standards it establishes. It also applies to non-EU manufacturers that place their products on the EU market.

Crackdown on four elements

The new legislation focuses on four main types of gaseous and particulate emissions: hydrocarbons, PM, carbon monoxide and NO_x, with the latter comprising nitrogen monoxide and nitrogen dioxide. New to this legislation is the introduction of particulate matter number (PN) limits as an additional metric.

The proposed legislation will also set stricter limits for NO_x and PM. This means that manufacturers will need to improve emission performance and measure emissions more precisely.

What's more, many vehicles and items of equipment not covered under previous legislation will now be affected. Examples include snowmobiles, low-powered diesel equipment and high-powered engines used in generator sets. As a result, some manufacturers may need to add engine after-treatment systems to their machinery.

The introduction of in-service monitoring is a further key impact. Manufacturers will need to use portable emission measurement systems (PEMS) to check the emissions performance of vehicles in



ABOVE: Stricter emission rules for off-road machinery will be introduced in phases between 2018 and 2021

real-world conditions, and will need portable gas cylinders to do so.

To meet these new requirements, many manufacturers of NRMM engines will have to review their testing and certification processes. So although some manufacturers may be measuring the same chemical species, their calibration gas or mixture specification may change in terms of lower concentrations, blend tolerance and analytical uncertainty.

Last but not least, the need to measure more chemical species (for example, ammonia) calls for more instrumentation, more calibration and instrumentation gases, plus additional calibration mixtures to align that equipment, which includes PEMS.

Given the reach and complexity of this new regulation, it is hardly surprising that companies such as specialty gases expert, The Linde Group,

anticipate a growing need among engine manufacturers for assistance in interpreting and applying the new legislation. The Linde Group can help by offering calibration gases and mixtures for Stage V compliance in the purity and accuracy levels mandated by the new legislation. In addition these gases and mixtures are certified and fully traceable to help customers document process compliance. Moreover, besides offering a range of supply modes and packages – portable cylinders for PEMS included – The Linde Group also designs suitable gas supply systems with specialty installation equipment and regulators engineered specifically for demanding analysis and instrumentation tasks. Indeed, The Linde Group has a lot of experience in helping customers manage compliance with changing environmental legislation. The key lies in turning a complex situation into a simpler one. And that is exactly what The Linde Group does. **ivt**

Roberto Parola is global product manager, specialty gases, at The Linde Group



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Diesel technology trends

ELECTRIC AND HYBRID-POWERED VEHICLES ARE BECOMING INCREASINGLY POPULAR. DESPITE THIS, DIESEL-POWERED ENGINES WILL STILL BE USED FOR QUITE SOME TIME – ALBEIT WITH NEW AND IMPROVED ELEMENTS OF TECHNOLOGY



▶ Even in a transitioning engine marketplace, the internal combustion engine as we know it still has a long life ahead. New technologies allow for ICE engines to meet stricter emissions standards today, and pave the way for a smarter, yet just as reliable, diesel engine for the off-highway industry.

As the industry moves forward in developing aftertreatment technology, weight and packaging will continue to be a primary focus. When opening the hood on a tractor, for example, there isn't much space left for the addition of anything else –



ABOVE: JDPS has developed an aftertreatment solution that is 20% smaller and 40% lighter than standard aftertreatments

making packaging optimization very important. To help achieve these goals, John Deere has been working to leverage new catalyst technologies and emissions control calibrations to enable the downsizing of aftertreatment. Its next-generation aftertreatment solutions deliver greater package flexibility and offer easier installation, while providing up to 20% reduction in size and up to 40% reduction in weight.

Changing the way with new technology

In the coming years, in order to continue achieving more packaging efficiency, there are different technologies that can be pursued. New advanced substrate technologies like an asymmetric substrate, which features a different size for the inlet channel versus the outlet channel, is one example that may enable manufacturers to achieve more packaging and weight reduction efficiencies.

Looking ahead to advancements in engine electronic controls, however, there will likely be a totally new generation of systems that will be more capable than ever before. As advanced engine control units (ECU) offer greater engine control

and advanced diagnostic capabilities, it is likely that the industry will rely less on sensors.

Further advancements for the diesel engine market in the coming years include a continued investment in electronic control systems. Engines will become smarter and more capable – not only in terms of lower emissions or higher power, but they will also be more likely to run in the way that people want. Telematics, and the remote diagnostics and prognostics capabilities of those systems, will also continue to expand. Another area of advancement is the increase in the integration and use of electric drives.

Advancements in engine technology and emissions compliance have further extended the life of the internal combustion engine. The off-highway market is very demanding and requires a product that can withstand the more rugged demands than those of on-highway applications. Due to these demands, off-highway engines need a fuel source that has enough energy density to meet the power needs of those applications. Diesel is still the best solution when it comes to off-highway. **iVT**

Dr Xinqun Gui is a manager of technology, control systems and emissions compliance at John Deere Power Systems



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Fuel-saving systems

THE OFF-HIGHWAY INDUSTRY IS BEING MOVED FORWARD WITH COLLABORATIVE HYDROMECHANICAL VARIABLE TRANSMISSION TECHNOLOGY

▶ As the demand for fuel-saving technologies continues to grow in the off-highway vehicle industry, collaborative partnerships are driving innovative solutions to improve fuel economy and reduce emissions. Dana Rexroth Transmission Systems demonstrates such a relationship between two leading suppliers with a 50-50 joint venture formed in 2011 by Dana Incorporated and Bosch Rexroth AG.

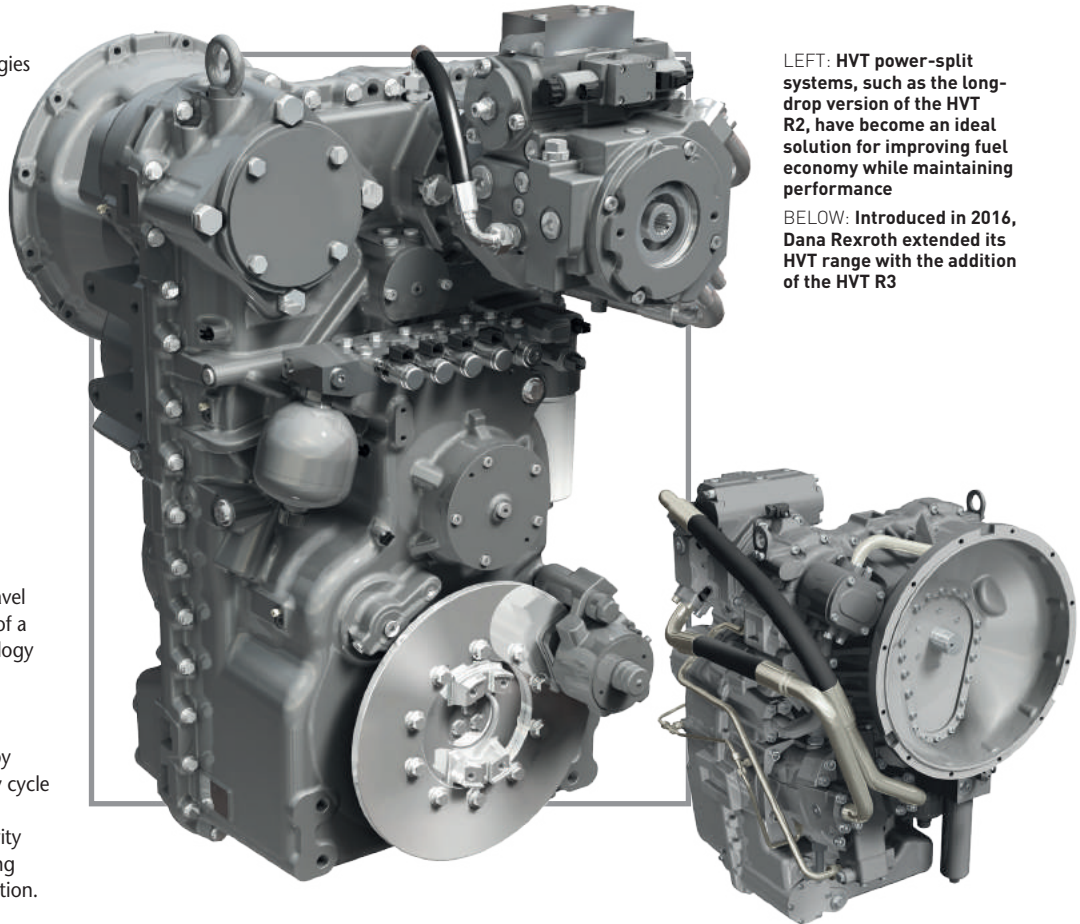
Combining Dana's expertise in off-highway transmission engineering with Bosch Rexroth's experience in hydraulic systems, Dana Rexroth develops advanced hydromechanical variable transmission (HVT) systems with a focus on meeting customer needs for improved fuel economy, productivity, emissions and maneuverability.

HVTs are an ideal solution to improve fuel economy while maintaining performance. Combining the advantages of a mechanical travel drive and torque converter system with those of a hydrostatic travel drive, this powersplit technology can considerably reduce fuel consumption.

Fuel savings in a compact design

Dana Rexroth HVTs reduce fuel consumption by decreasing engine speeds throughout the duty cycle and also at idle, when speeds can drop to as low as 600rpm. These HVTs improve productivity by enabling sensitive, precise vehicle positioning and stepless drive with no interrupted acceleration. The compact design contains all hydraulic and mechanical components as well as the appropriate tubing and piping. This gearbox occupies the same space within the design envelope as conventional torque converter transmissions while allowing for engine downsizing.

HVTs designed by Dana Rexroth help to reduce complexity for equipment manufacturers, since the entire system of gears, clutches and hydrostatic units is managed by an advanced electronic control unit and optimized for efficiency by a single supplier. Recent updates to the system's transmission control software have resulted in more precise operational data and deeper analysis capabilities, improved machine cycle time and enhanced steering, and an improved anti-stall/load limiting function. In addition, this HVT system now offers improved ease of operation with flexible driving modes, increasing productivity in a range of duty cycles.



LEFT: HVT power-split systems, such as the long-drop version of the HVT R2, have become an ideal solution for improving fuel economy while maintaining performance

BELOW: Introduced in 2016, Dana Rexroth extended its HVT range with the addition of the HVT R3

The HVT R2 currently supports power outputs from 130-235kW (174-282hp) including wheel loaders, motor graders, industrial lift-trucks, reach stackers and forestry skidders. The HVT R2 has demonstrated fuel savings of up to 25% over traditional transmission designs, with additional savings possible through further optimization with equipment subsystems.

The long-drop version of the HVT R2 has been in production since 2015 and is featured on Kalmar's Gloria generation of reach stackers as part of the highly efficient Kalmar K-Motion drivetrain. Designed for 45-ton Gloria reach stackers, this system can reduce fuel consumption by up to 40%. As a result of this collaborative relationship, Dana Rexroth was recently named a 2017 Supplier of the Year and received an Innovation Award from Kalmar Global.

A short-drop version of the HVT R2 was introduced earlier this year, with preproduction testing by original-equipment manufacturers expected to begin in 2018. Featuring a modular configuration with a redesigned transmission case that reduces input/output distance, the short-drop version of the HVT R2 can be adapted for a variety of vehicles including forklift trucks, empty container handlers and terminal tractors.

Dana Rexroth's full range of HVTs also includes the R3 hydromechanical variable transmission. Designed for applications with net input power from 200-270kW (268-362hp), the HVT R3 is now available for field testing by off-highway vehicle manufacturers. **ivT**

Roland Friedl is a sales and product manager at Dana Rexroth Transmission Systems



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Essential new systems

WITH VERSATILE AND EASILY INTEGRABLE ERGONOMIC AND ELECTRONIC PARTS, THE PERFORMANCE AND PRODUCTIVITY OF THE LATEST INDUSTRIAL VEHICLES, INCLUDING ELECTRIC AND HYBRID, CAN BE ENHANCED

▶ Curtiss-Wright Industrial is a recognized leader in the research, design and manufacture of electronic throttle and joystick controls, human-machine interface (HMI) consoles, sensors, transmission shifters, hydraulic levers and power management electronics. Many of its systems are found in applications in the hybrid vehicle market and on today's most advanced commercial vehicles including medium- and heavy-duty trucks, school and transit buses, recreational vehicles, and agricultural and off-highway equipment.

Latest innovations

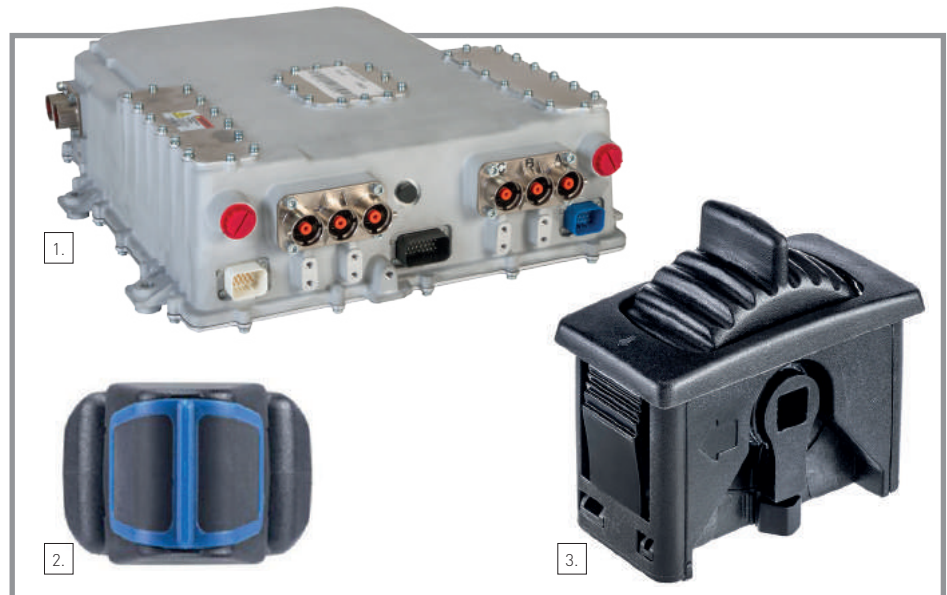
The JC1210 from the Penny & Giles brand is a single-axis paddle joystick that extends the JC1200 family. Offering center-line or corner-mounting solutions in a single body, the new joystick controller also incorporates an additional 10° of travel at both ends of the axis, allowing machine designers and end users to specify either latching and overpress functionalities, or a combination of both, to meet system requirements in order to hold functions at full speed/float.

Additionally, a choice of nine, soft-touch colored insert areas increase operator comfort and decrease the likelihood of finger-slip during operation. These features help to make the new JC1210 ideal for use in control panels and armrest assemblies found in material handling vehicles, industrial trucks, agricultural equipment and construction machinery, where cost-effective, long-life operator controls are essential.

Another newcomer from Penny & Giles is the Hall-effect JC050 thumbwheel roller. It is suitable for integration within joystick hand-grips and other in-cab human-machine interfaces and features a low under-panel depth of 23mm (0.9in) and return-to-center functionality over a range of ±37° roller travel.

The new JC050 is rated for three million operating cycles thanks to the use of non-contacting technology and, like the JC040 rocker, benefits from a 'pass through' design for any liquid or dust contamination. Electronic robustness is ensured with the sealing of the internal electronics to a rating of IP67.

To ensure safety is enhanced, the JC050's dual-redundant electronic architecture is constructed using two power supplies and two sensing circuits, the two sensor outputs can either both be set



- 1: **WTI-Traction Inverters can moderate voltages**
- 2: **The JC1210 is a single-axis paddle joystick**
- 3: **There is an under-panel depth of 23mm on the JC050**

to positive or negative ramps, have a combination of positive and negative ramps, or just a positive ramp from center to full roller travel.

New technologies

Developed by its Arens Controls brand, Curtiss-Wright's new WTI-Traction Inverter series offers state-of-the-art technology and innovative design for use in hybrid and pure-electric applications.

Operating with multiple motor technologies, including AC induction, permanent-magnet synchronous (PMS) and interior permanent-magnet (IPM) types, major components – including insulated-gate bipolar transistors (IGBT), capacitors, filters and circuit boards – are all automotive-grade and certified to AEC-Q100, Q101 and Q200 to ensure electrical reliability and an impressive power-cycle rating exceeding seven million.

WTI-Traction Inverters offer a high level of self-protection with both current and transistor temperature measuring locally to the IGBTs, rather than through remote components. This technique delivers fast and accurate temperature measurements, offering effective protection against adverse

high-current conditions, including short-circuit or thermal overload.

Advanced motor control algorithms using field-oriented control with space-vector modulation, combined with a 2-10kHz variable switching frequency, mean high operating efficiency and increased operation time. A fundamental frequency up to 1,000Hz allows WTI-Traction Inverters to drive high pole-pair, high-speed motors. A torque motor-control mode is available for hybrid applications, speed mode for pure-electric applications or DC bus voltage mode. In DC bus mode, the inverter can moderate adverse and damaging voltages resulting from situations including regenerative braking.

WTI-Traction Inverters offer a versatile connection to master control systems by either J1939 or CANbus protocols. A customizable, discrete interface supports digital, analog and solenoid-drive control options.

Whether Curtiss-Wright is customizing existing products to better suit an application, or creating completely new concepts to address an OEM specification, its global team of engineers is ready for the challenge and will partner with design teams to ensure the most reliable and cost-effective equipment is developed. **iVT**

Mike Iles is marketing manager at Curtiss-Wright



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Fuel saver

ORGANIZATIONS MUST BE WILLING TO ACCEPT AND EMBRACE CHANGE IN ALL AREAS, INCLUDING PRODUCT DESIGN, IN ORDER TO REMAIN SUCCESSFUL WHEN STAGE V EMISSIONS STANDARDS COME INTO EFFECT IN 2019

▶ Yanmar's latest entrant into the small industrial engine market, the 18.4kW (at 2,600rpm) 3TNV80FT, made its debut at Agritechnica 2017. The engine is an ideal choice for powering agricultural, landscaping and construction machinery.

Its specific power output is a deliberate choice, because it avoids the need for an expensive aftertreatment system, which is mandatory for engines above 19kW. This will comply with the upcoming Stage V emission standard in Europe, commencing on January 1, 2019. The 3TNV82A, an older model, delivered a little more power than 19kW at the same speed. Despite this, the new model offers higher peak torque than the 3TNV82A/76/80F and has one of the best power densities in this segment.

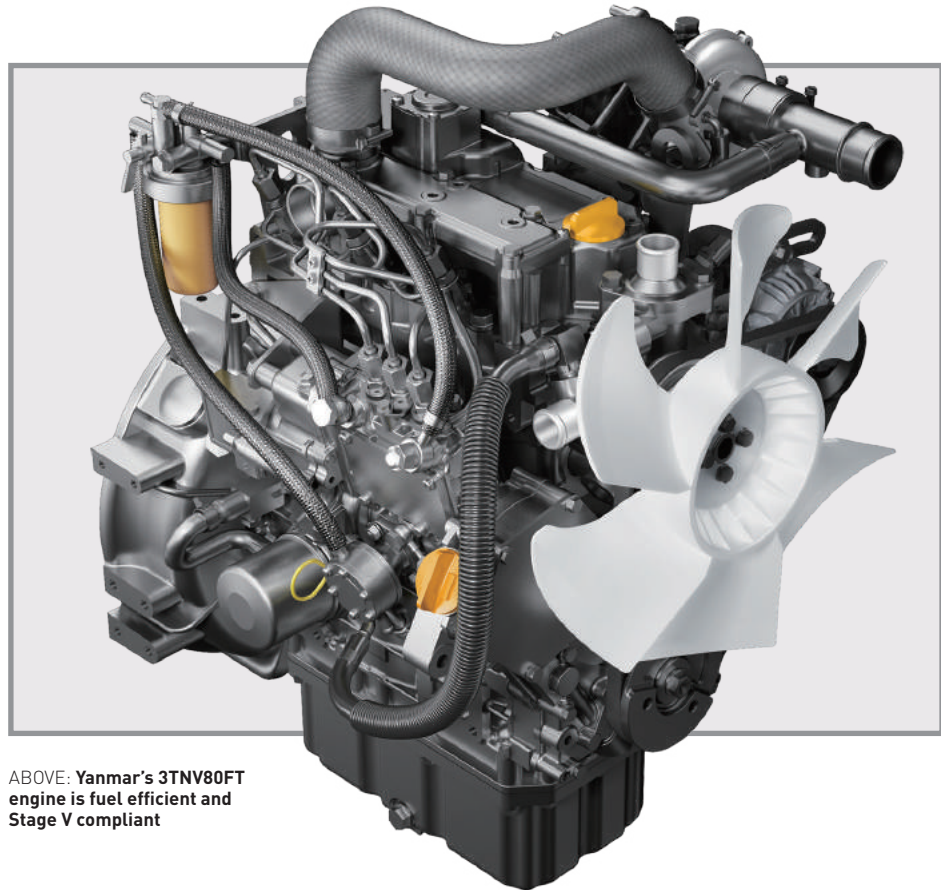
The 3TNV80FT achieves these excellent performance levels by combining mechanical fuel injection with a turbocharger, overseen by a clever electronic control system. This package offers unrivalled fuel efficiency and remains EU Stage V and EPA Tier 4 compliant.

Hitting targets

Thanks to a good design, Yanmar has solved the problem of hitting low-emissions targets without ruining the fuel economy figures. This mission started in earnest in the early 2000s when a huge investment in in-cylinder modeling moved piston and combustion chamber design forward. Since then there has been a procession of improvements resulting in the engines of today.

Regarding customer relationships, Gert Maris, a sales manager at Yanmar Europe, explains, "We work so closely with our customers that they are like partners now. They give us feedback from the end users, so we know exactly what end users are looking for. We are seeing a trend now, even on these smaller units, where the end user is demanding the same sort of lifetime value as on the bigger machines. Everyone has a budget to stick to. And it's about more than just money; customers expect quiet and smooth operation, low vibration, long service intervals and easy maintenance."

Yanmar's philosophy has always been that change and improvement is inevitable, so instead of being feared, it should be enthusiastically embraced, with customers being offered ongoing support



ABOVE: Yanmar's 3TNV80FT engine is fuel efficient and Stage V compliant

throughout an engine's entire life. The company is running a campaign called 'Our partnership has no downtime' to emphasize this.

Small machines

For the machine's designers, use of space is especially important, and the 3TNV80FT measures just 652mm tall, 450mm wide and 545mm long, which is smaller than the outgoing 3TNV82. Maris confirms, "As these engines are going on small machines, we have thought very carefully about packaging the ancillaries in such a way as to offer the most compact profile. That will make installation easier where space is tight, and where it's not it gives the designers options like space for toolboxes or storage space for implements, further adding to the operator appeal." This new engine has the same

footprint as the 3TNV76/80F, making for a trouble-free installation.

The 3TNV80FT is not the only piece of exciting product news from Yanmar. For all those looking for a Stage V-ready Power Pack, the company is in the process of converting its range with a view to a roll-out next year. The preparations are taking place now at the firm's Italian production facility.

Maris adds, "This will appeal to all those who want a Stage V-ready package from one manufacturer that is ready to install. We showcased full-specification 4TNV98C Power Pack at Agritechnica, so visitors could get a preview of what advances to expect from our new range." **ivT**

Carlo Giudici is director of the industrial powertrain division at Yanmar Europe




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BULLETIN BOARD

Magnetic angle sensor fits into door hinges

 Confined installation spaces in mobile machine or industrial vehicle applications require special sensor designs. In addition, these sensors must withstand harsh environmental conditions. **ASM Sensors** presents a sensor that meets these requirements: Posirot Pras1 is a very

small stick-design magnetic angle sensor. It measures 10.6mm in diameter and 53mm in length. Due to its slim design, the sensor is suited for narrow installation spaces – even fitting into door hinges.

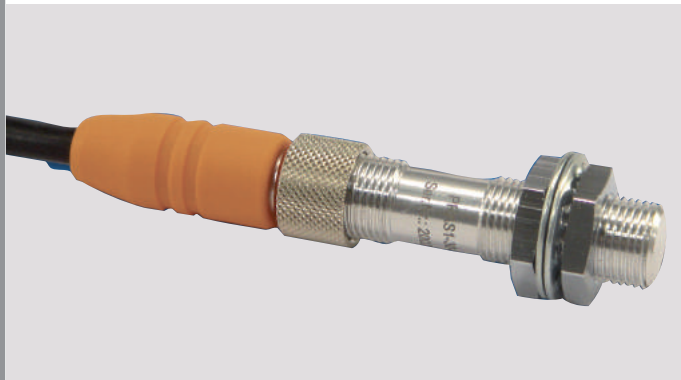
The Posirot Pras1 sensor measures rotary positions from 0° to 360° using a multiple Hall-effect

sensor array and a position magnet. As the magnetic encoder technology is entirely contactless and solid state, Pras1 sensors are resistant to shock and vibration. The protection class is IP67, optional IP67/IP69, with corresponding mating connector. The sensor housing material is stainless steel. Due to its robustness, the sensor is suitable for applications in mobile machines and other rugged outdoor applications.


The sensor's measurement ranges are 0-360° (in 15° increments). Analog outputs are available in 0.5-10V, 0.5-4.5V or 4-20mA. The resolution of Pras1 is 0.03% (60-360°) and 0.1% (15-45°), the linearity is ±0.3% of full scale.

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Electrohydraulic steering for industrial vehicles

 **Concentric's** EHS electrohydraulic power-steering pump replaces the conventional IC engine-driven pump on a hybrid or pure electric truck or bus and off-highway vehicles.

The EHS has been developed in collaboration with a leading supplier of electric motors, resulting in a permanent magnet, brushless DC motor with integrated motor drive electronics.

The EHS offers system power savings through its variable pressure and speed control capability with the option of low-noise pump technology and direct electronic control features via CANbus communication. It also offers on-demand steering and variable speed capability, down to a low of 350rpm in typical steering cycle mode. Depending on the application, the unit can be rated up to 276 bar, with flow from 12-80 l/min and peak output from 1.5-7kW.

The new EHS product range allows CANbus communication between the motor and the vehicle's main control system to control pressure and flow on demand. This greatly reduces system losses compared with mechanical drive systems, ensuring optimum performance from the steering system.


The EHS has the following main features:

- Compact design and low weight;
- Ingress protection, IP6K9K;
- Easily installed electric motor and integrated controller;
- Full controllability with CAN J1939 interface;
- Chassis mounted – no external covers needed;
- Software designed to meet the required safety demands.

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Test system setup times cut

 **First Sensor** offers a modular area view application for the setup of 360° all-round view systems for special vehicles and machines. The Area View System allows solution providers, integrators and OEMs to quickly and easily build up, develop and test a demo system, thereby accelerating the development process and minimizing technology risks. The system consists of four digital HDR-CMOS cameras with a range of accessories for mounting on the vehicle, or on a metal plate for desktop applications. Software stitches the images of the individual cameras together to form a virtual overall picture and allows the programming of arbitrary viewing angles and zoom functions.

The Area View System delivers real-time images not only from a bird's-eye view, but also from any angle in a 360° all-round view. The driver or operator looks virtually from the outside of their machine and recognizes obstacles and distances to objects. This increases both reliability and productivity through faster maneuvering



and avoidance of accidents and interruptions. The robust, high-performance CMOS cameras of the Area View System feature a very wide dynamic range >100dB to cope with difficult lighting conditions and can withstand the harshest environmental conditions.

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Heavy-duty Hall-effect joysticks

Tecnord's range of JHM joystick controllers has been designed for use in mobile and industrial field applications. The use of Hall-effect sensors, which eliminates any contact between moving electrical parts, improves the overall resolution, precision and service life.

The use of a supervised microcontroller implements Hardware Category 2 according to the EN 13849 safety standard.

A complete line of built-in electronic drivers, generating on-off, proportional and CANbus control signals, guarantees the highest controllability of any type of electrohydraulic system.

When coupled with an ergonomic multifunction handle of the 'M' range, up to five proportional axes and nine on-off push buttons can be integrated into the same joystick.

Tecnord's comprehensive portfolio of standard push-button switches and thumbwheels enables quick and cost-effective customization to suit any application or request.

As optional features, the joystick can include:

- Integrated PWM driver with electronic directional switches on axes, fully programmable via PC by means of user-friendly calibration software;
- CANbus interface (CANopen or SAE J1939 protocols available);
- Ratiometric voltage output;
- Capacitive dead-man switch;
- Magnetic position detent on the y- or x-axis.

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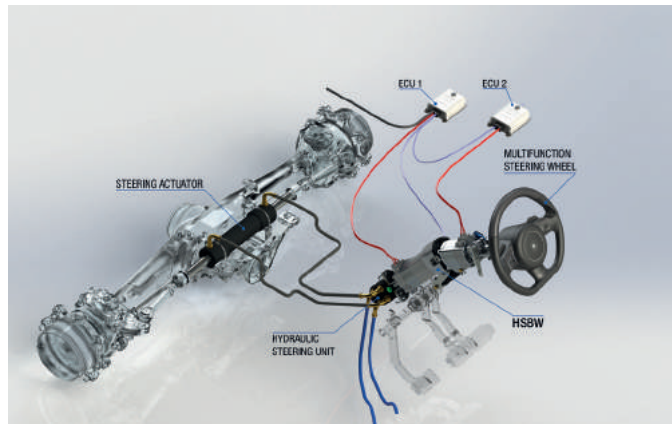
Advanced hybrid steer-by-wire system

Ognibene Power SpA, a leading company for hydraulic steering systems (actuators and steering units) for more than 60 years, will make its world premier at the Agritechnica 2017 exhibition.

The company's patented HSBW (hybrid steer-by-wire) system for public road use, designed to reach AgPLe/PLe performance level (ISO 25119/ISO 13849), will be presented at the German trade fair.

This new technology is placed over the traditional steering architecture of off-highway vehicles, decoupling the steering wheel from the steered wheels, improving maneuverability and enabling the use of the GPS and autonomous driving systems without any external steering kit.

Thanks to the decoupling clutch, the driver is able to override the system through the steering wheel and keep full control, even in the event of failure.



- The main benefits are:
- Synthetic boost curve;
 - Variable steering ratio and fast steering feature;
 - Improved maneuverability (high stability at high speed and low effort during maneuver);
 - Direct integration with GPS;
 - Realignment of wheels in forward and reverse directions.

Ognibene has production sites in Italy, Brazil, India and China, plus a logistics site in the USA and a commercial office in Japan – ensuring the production of steering systems to the world's largest OEMs.

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Quote Ref: **512**

Next stage in HVAC comfort

Webasto has brought a revolution in off-highway products to market: the Ultra Low Profile HVAC (heating, ventilation and air conditioning) concept. It uses a unique approach to air management. Webasto was able to design an HVAC unit with a height of just 40mm that fulfills high customer requirements in terms of cooling and heating power as well as airflow. It is designed to be installed in the roof of agricultural and construction machines. Due to the unit's super-slim shape, it enables OEMs and cabin manufacturers to make fundamental innovations in their cabin designs, such as enabling more head space and more visibility while operating the machine.


With the new Ultra Low Profile HVAC concept, Webasto is again demonstrating its ability to make innovations in existing products and markets. The unit delivers 7kW of cooling power (at 35°C (95°F) and 60% relative humidity) and 6.0kW of heating power (at -10°C (14°F) with 800 l/h at 90°C (194°F)) with an airflow (free-blowing) of up to 635m³/h. The concept unit has dimensions of 631 x 507 x 40 mm (24.8 x 19.9 x 1.5 in) and weighs only 6.5kg (14.33lb).

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Silent power

 The **Hatz 4H50TIC** diesel unit performs up to 74hp at a maximum torque of 240Nm and complies with EU Stage IIIB and US EPA Tier 4 final. In connection with the insulation the Hatz 4H50TIC Silent Pack reaches a reduction of the noise emission by 4dB despite the cooler fan. Therefore the engine is 60% less noisy compared to the non-capsulated Open Power Unit (OPU).

All the advantages of the non-capsulated Hatz four-cylinder diesel engine are the same for the insulated Hatz 4H50TIC with Silent Pack. During the development of the Silent

Pack version it was very important for the engineers to keep the installation dimensions as small as possible and still keep engine access for any necessary maintenance work.

The high release temperature is identical to the non-capsulated version and the turbo charging gives enough buffer for applications in altitudes.

The Hatz OPU plug-and-play solution, which is also the base for the Hatz 4H50TIC Silent Pack, is ideal for equipment manufacturers who need complete, ready-to-install engines. The main application areas

are for example hydraulic lifts, hydraulic power units, forestry machinery, drilling rigs and stationary applications such as pumps and generators.

Due to the integrated and optimized specification of the radiator tubing and wiring of electronics, the Hatz OPU concept makes installation a very simple process.

The Hatz plug-and-play 4H50TIC Silent Pack is a system which is reasonably priced and tested by the engine manufacturer, sold by Hatz sales and serviced in 120 countries worldwide.



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Quote Ref: **514**

Hassle-free electric heaters

 Since 1999 **Kalori** has been developing specific electric heaters and HVAC, adapted to the needs of manufacturers.

The case of manufacturers who've created an electrical version of their vehicle, based on an existing design using an internal combustion engine, is covered by the electrical HVAC range, named E.HVAC.

E.HVAC is an electric version of a standard HVAC: Compact, Super K, Kool and Falcon all already exist.

The shape remains the same. The electric heat exchanger is positioned within the body, and the brackets and attachment points remain the same. The manufacturer can therefore use the same air diffusion system.

In terms of the heating elements, Kalori sources the best quality PTC elements, to guarantee performance at the right consumption. The safety of these elements is ensured by their operating principles. On every Kalori unit, the security is reinforced by an additional sensor, designed to preserve the casing, which in turn is principally manufactured using

high-quality injected polyamide or polypropylene, with glass fiber.

In terms of air-conditioning, years of experience in the design of air duct parts and air diffusion systems, simulation software and test benches enables Kalori to offer the right solution, to preserve both autonomy and comfort. While users may agree to pay for air conditioning, they do not want to pay for little more than a bit of fresh air. Comfort must be total without compromise and must be achievable using just electric power.

The circuits are closed, using one of the best electric compressor ranges on the market: 12V, 24V, 48V, 80V and 600V versions are available as standard.

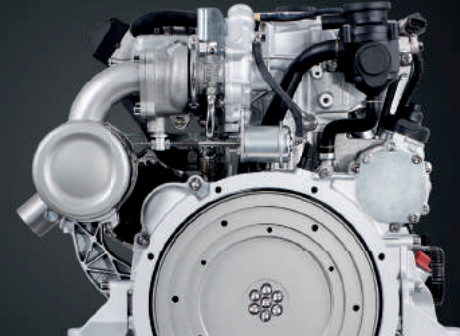
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- 46 or 62 kW power, 1,5 or 2 litres displacement
- Compact installation dimensions at only 133 or 152 kg weight
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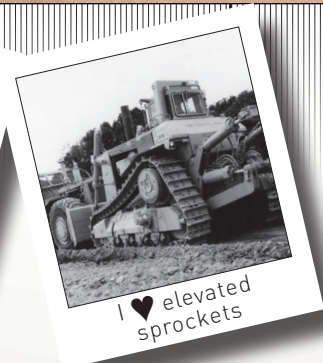
THE DOZER REVOLUTION

When Caterpillar reinvented the dozer...



The D10 was a radically different design in 1977, offering higher weight (190,000 lb/86,180kg) and more horsepower (700hp/522kW) than its predecessors

70s memories



This year, Caterpillar is celebrating the 40th anniversary of the revolutionary Cat D10, which changed the dozer market forever with its elevated sprocket design. By separating the drive sprockets from the track roller frame and elevating them above the tracks, more track remained on the ground for improved traction. The elevated sprocket design was also better able to absorb ground shocks for longer life and greater operator comfort.

Changing the design in such a radical way took courage. Dozers have formed part of the company's product line since it first began in 1925, and the D10 was a complete departure from the design of its closest cousin at the time, the D9.

"The D9 dozer was the best track-type tractor of the day," says George Alexander, a retired Caterpillar engineer who served on the D10 research team and one of four individuals named on the patent for Caterpillar's elevated sprocket design. "It worked great for dirt operations, but interstate and heavy rock applications were hard on the solid bottom tracks that were a part of all dozer designs of that era."

With management approval in 1970, a testbed was built for the new track. Engineers started by flipping the final drive for a D9G upside down. "We worked on undercarriage geometry a lot, and within six months we had it operational," says Alexander.

While initial testing proved the efficacy of new undercarriage, there were still some skeptics. "It didn't look like any traditional Cat dozer," says Alexander. "It was different in almost every way, except for the engine."

Added benefits

Beyond looking different, the new undercarriage required the transmission to be mounted behind the engine to provide for the only track-type tractor final drive system with a common centerline between the steering clutches and brakes. It also enabled engineers to move both the dozer blade and ripper closer to the tractor, providing a concentrated center of gravity and improving the balance of the machine.

The pilot D10 dozers, built in 1977, were immediately embraced by Caterpillar customers. Their ripping and pushing capabilities made a significant impact on the mining industry, as studies showed the cost per yard to move material using the D10 was comparable to that of larger draglines.

The original big and bad Cat D10 legacy lives on today with thousands of Caterpillar elevated sprocket dozers operating around the world. The elevated sprocket track concept has been expanded to today's Cat D6N and D6T medium dozers and the D8T, D9T and D11T large dozer models, as well as the current D10T2.

"After I retired in the 1990s, I gave my presentation on the development of the elevated sprocket design, and a person said to me afterward, 'Wherever you go, you will see the results of your work,'" recalls Alexander. "He was right. No matter where I traveled in the world, I saw dozers with the elevated sprocket design, and it made me proud to be a part of the original research team."

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