THE MAGAZINE FOR INDUSTRIAL VEHICLE TECHNOLOGY, DESIGN & ENGINEERING

November 2013

iVT INTERNATIONAL
INDUSTRIAL VEHICLE TECHNOLOGY

GSE SPECIAL

New Vehicles

Kalmar TBL 800 hybrid tow tractor

TBDUK electric Jet Tug 35-50

OEM Interview

Ron Cowley, MD, Douglas Equipment

October Expo Highlights

Inter Airport & BICES

20th ANNIVERSARY YEAR

Step on the gas

Is dual fuel/natural gas the answer to off-highway's insatiable thirst for diesel?

www.iVTinternational.com

iVT Industrial Vehicle Technology International

NOVEMBER 2013 VOL 21 No. 4

www.iVTinternational.com

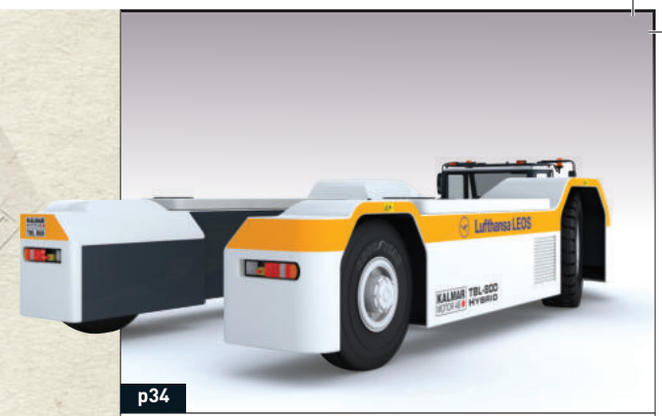
Published by UKIP Media & Events Ltd

CONTENTS

COVER STORY **p50**

GAS GUZZLERS

While oil reserves dwindle, the reserves of natural gas appear to grow larger every day. So how long will it be before dual fuel or gas engines become the norm in off-highway?



p34

p22

REGULARS

"The use of supercaps will be a game changer for us... We could drop from a 750hp engine to 200hp or so" **p26**

CASE STUDIES & SPECIAL FEATURES

Vol. 21 No 4
Cover image:
John Deere Power Systems

SUBSCRIPTION / CHANGE OF ADDRESS ENQUIRIES TO:
Subscriptions Manager Suzie Matthews
suzie.matthews@ukipme.com
Circulation Adam Frost *adam.frost@ukipme.com*
Database Manager James Taylor
james.taylor@ukipme.com

Editor Richard Carr
richard.carr@ukipme.com

Production Editor Alex Bradley
Chief Sub Editor Andrew Pickering
Deputy Chief Sub Editor Nick Shepherd
Proofreaders Aubrey Jacobs-Tyson, Christine Velarde

Art Director Craig Marshall
Design Louise Adams, Andy Bass, Anna Davie, James Sutcliffe, Nicola Turner, Julie Welby, Ben White

Head of Production & Logistics Ian Donovan
Deputy Production Manager Lewis Hopkins
Production Team Carole Doran, Cassie Inns, Frank Millard, Robyn Skalsky

International Advertising Coordinators
Kevin Barrett (*kevin.barrett@ukipme.com*)
Michael Briant (*michael.briant@ukipme.com*)

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

iVT International USPS 018-627 is published quarterly, in February, July, September and November, by UKIP Media & Events Ltd, Abinger House, Church Street, Dorking, Surrey, RH4 1DF, UK.
Annual subscription price is US$102. Airfreight and mailing in the USA by agent named Air Business Ltd, c/o Worldnet Shipping USA Inc, 155-11 146th Street, Jamaica, New York 11434. Periodicals postage paid at Jamaica, New York 11431. US Postmaster: send address changes to *iVT International* c/o Air Business Ltd, c/o Worldnet Shipping USA Inc, 155-11 146th Street, Jamaica, New York 11434.
Subscription records are held at UKIP Media & Events Ltd, Abinger House, Church St, Dorking, Surrey, RH4 1DF, UK.
Air Business is acting as our mailing agent.
iVT International, ISSN 1471-115X, is protected by copyright ©2013.

Average net circulation per issue for the period 1 January-31 December 2012 was 10,391.

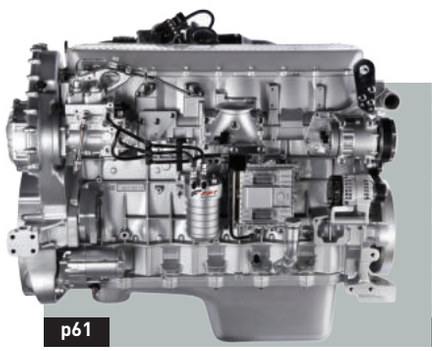
Published by
UKiP
UKIP Media & Events Ltd,
Abinger House, Church Street,
Dorking, Surrey, RH4 1DF, UK
Tel: +44 1306 743744
Fax: +44 1306 742525
Ed. fax: +44 1306 887546

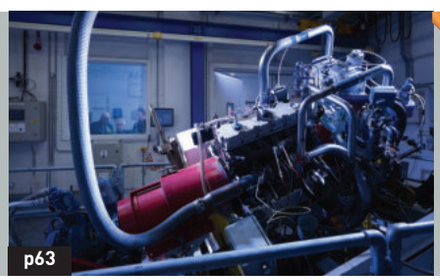
Printed by William Gibbons, Willenhall, West Midlands, WV13 3XT, UK

abc Member of the Audit Bureau of Circulations

CONTENTS

PRODUCTS & SERVICES


p61


p63


p75

FOREWORD

Ever since I picked up on a remark about the 'Saudi Arabia of natural gas beneath our feet' at a Caterpillar event last October, I've been keeping my eyes and ears open for signs of a trend towards off-highway machinery moving away from diesel. To be fair, we're still not being deluged by innovations on that front just yet, although the recent BICES exhibition in Beijing once again showed that it's the Chinese wheeled loader manufacturers that are the ones pushing LNG solutions. What's particularly revealing, though, is that two of those (SEM and SDLG) are viewed as the 'value' brands of Caterpillar and Volvo CE respectively; neither of whom have yet made similar solutions available in their more technologically advanced machines – though they are carrying out research in this area, as you can see in our feature on page 50.

But given that both Cat and Volvo have involvement in on-highway vehicles, a recent Frost & Sullivan report – *Strategic analysis of the medium- to heavy-duty natural gas commercial vehicle market in Europe* – is worth checking out. Key statistics include natural gas truck and bus penetration reaching an estimated 3.4% and 12.7% respectively by 2018, with spark-ignited technology accounting for 90% of those buses, and compressed ignition engines dominating the LNG truck market (i.e. long-haul applications) with around 60% share. The heavy-duty segment is set to account for 75% of gas truck sales, with LNG a dominant fuel option.

So if history repeats itself and off-highway follows on-highway's lead yet again, it's not beyond the realms of possibility that servicing personnel could one day have to relearn how to change a spark plug. How bizarre would that be? Whatever next – setting the points?!

While some of the views we've canvassed for our cover story suggest that it's the giant stationary or mining truck engines that may be the most viable applications, it's worth reiterating Martin Richenhagen's comments from the interview in our September 2013 issue (p74). He predicted that AGCO Power's biogas engines – already used in some Valtra tractors – would be quite feasible for adoption across the AGCO range in future.

He wasn't quite so effusive about the potential for electric motors, though. But given that we've mentioned two hybrid aircraft tow tractors in this special GSE issue that use supercaps or Li-ion batteries to enable engines of a typical 750hp to be downsized to the output of a typical family car, who knows where that could end up?

Richard Carr, editor, iVT International

Coming up in the February issue of iVT

- CVT in construction equipment • Traction technology • OEM report: Liebherr
- Market report: USA • The latest vehicle case studies, including Aebi's VT450 Vario
- ConExpo/IFPE Preview • Look out for the *Off-Highway Annual* soon!

BUILT FOR YOUR APPLICATION

C4.4 ACERT™
Industrial Power Unit
74.5-129.4 bkW (100-173.5 bhp)
U.S. EPA Tier 4 Final, EU Stage IV

The Cat® C4.4 ACERT engine is an integral part of our full range of industrial power solutions. Included in a medium power range of 45-225 bkW (60.3-302 bhp), this new Tier 4 Final, Stage IV engine has the fuel efficiency, durability, flexibility and strong Cat dealer support that you expect. **See the full product range at catindustrialpower.com**

BUILT FOR IT.™

CAT®

Best in Class AC controller technology...

e series

The safest.

Dual-micro architecture meets or exceeds the latest international functional safety requirements.

With unmatched performance.

Outlasts and outperforms with more features, improved ratings and simple motor auto-characterization routine. Powerful, enhanced 64 MHz main-microprocessor and extended FLASH memory.

With vast flexibility.

Super programmability with minimum effort. Configurable CAN master capability with proprietary Vehicle Control Language (VCL).

The most reliable.

Decades of Curtis controller experience by a global technology leader with millions sold back every unit.

That's all true!

But, those are many words. Let's just say it simply:

Curtis = Confidence

CE

The Curtis Difference

You feel it when you drive it

Plus – Someone to help you use it!

Meet Kerry Green, your partner in industrial vehicle system integration.

Even the most experienced EV OEMs can be challenged by today's highly specialized, advanced controller technology. At Curtis, we understand that – and we have a solution. We provide an expert partner to assist you from beginning to end, at every stage of the process.

Kerry, of Curtis UK, is just one of our many experienced and enthusiastic customer support engineers around the world. Each member of this highly skilled team stands ready to support major OEMs in leading-edge product development. Our global network makes Curtis an extension of your own engineering department.

We will partner with you to specify, design and build a complete electric vehicle control system, so you can build the best possible EV.

We are ready to help you.

CURTIS

www.curtisinstruments.com

Whether on the road or in the field, the new infinitely variable transmission option looks set to enhance versatility and fuel efficiency of Claas's new Arion 500/600s

To infinity... and beyond

PADERBORN, GERMANY – With the addition of the brand-new CMatic transmission option to its Arion 500/600 tractor series that was launched in September 2012, Claas can now offer the choice of infinitely variable transmission (IVT) across its entire tractor range, from the 145hp Arion 530 up to the 530hp Xerion 5000.

The seven models in the Arion 500/600 series, producing from 145-184hp, are fitted with the EQ 200 transmission which was designed and built by Claas Industrietechnik (CIT) and Claas Tractor on an assembly line conforming to ISO automotive standards.

The result of a €40m investment, it has undergone over 80,000 hours of development, with over 17,000 hours on a newly developed test rig that is able to generate up to 1,000hp of braking or drive power and reach 150,000Nm of torque. Although the test stand can realistically simulate both static and dynamic loads, a further 15,000 hours of validation have been performed on the road and in the field.

"No variable transmission on the market met the needs of the Arion class," claimed Thomas Lorf, MD of CIT, at the press launch. "Versatility is particularly important in this power range, enabling road transport and field applications such as potato harvesting. This versatility was at the front of our minds during the five years of development."

Stepping up

Although Claas bought the Mali Motan CVT design several years ago, very little of that technology is said to remain in the EQ 200. Instead, it is based on a stepped planetary transmission that uses multidisc clutches to provide an intelligent connection between two planetary transmissions incorporating two Danfoss Power Solutions wide-angle hydrostatic units.

When there is a change from the lower-ratio planetary transmission to the higher ratio, the functions of the two hydraulic units change, with the pump becoming a motor and vice versa. There is therefore no need to manually change the range – the automatic gear changes alter not just the transmission ratio but the entire power flow.

During acceleration, the two clutch shafts gradually adjust their rotation speed to match each other – once they reach the

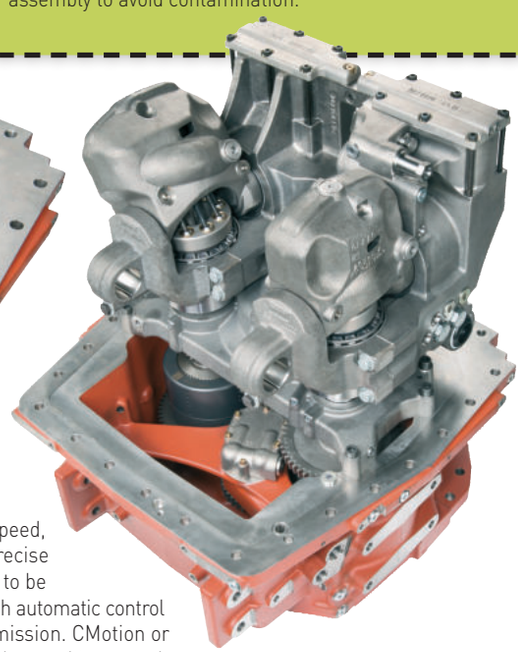
Anything but generous to a fault

Covering an area of 1,300m², the new assembly line for the EQ 200 transmission comprises five areas for pre-assembling components, 12 stations for main assembly work and an end-of-line test stand.

A huge investment was made in ensuring zero-defect production – in fact, it is even claimed that untrained staff could assemble the module as a result of the state-of-the-art production system. This provides detailed step-by-step on-screen instructions to guarantee that the correct components are assembled using the correct tools – which can electronically monitor the torques, angles of rotation, pressing forces and other parameters employed. Should there be a mismatch between the actual and preprogrammed values, the processes at the workstation in question will be automatically stopped until the error is rectified.

Every assembled transmission is subjected to a test run of almost half an hour on the end-of-line test stand. Every possible load condition is simulated using two electric motors, with several devices being used to measure oil temperatures, revolutions, vibrations and a variety of other parameters to ensure even tighter quality control.

The highest cleanliness standards were also vital, and required a central pass-through washing station. All gears are first demagnetised, then washed and dried and packed in corrosion-resistant VCI bags for internal transportation. All parts are delivered in closed containers, while workers wear gloves during assembly to avoid contamination.



RIGHT:
Mechanical and hydrostatic sections of the new Claas EQ 200 transmission (left and right respectively)

same speed, the multiplate clutches can then change gear in perfect synch. There is no abrupt increase in either speed or torque during gear changes, even under load, so acceleration all the way up to the maximum speed of 50km/h is steady and consistent, providing a very even efficiency curve. The driver is claimed to remain unaware of the changes in drive ratio – and that top speed can be achieved at fuel-saving engine speeds of just 1,500rpm.

Although up to 40 litres of oil is available for external hydraulic demands, the design of the transmission housing lowers the oil level in the oil pan, thereby helping reduce churning losses. This also leads to a useful reduction in fuel consumption during on-highway driving.

Cebis kit's a winner

As with other Claas CMatic models, the new Arion tractors feature the Cebis control system, with a CMotion control unit on the armrest. Cebis enables the easy setting up and selection of three transmission modes, three cruise-control speeds during forward or reverse travel, and the adjustment of engine droop under load over a 5-40% range in 1% increments.

In Automotive mode, acceleration is via the foot throttle – the transmission and engine are then automatically controlled to ensure optimum fuel economy, while engine braking can be achieved by pulling back on the CMotion control. In CMotion mode, the CMotion control is used to govern the speed, particularly where precise ground speeds need to be maintained, again with automatic control of engine and transmission. CMotion or the foot throttle can be used to control engine speed in Manual mode, with the transmission ratios being changed manually – and independent of rpm – via the CMotion.

By ensuring optimum power transfer to the ground, it seems a further reduction in fuel consumption is likely. In a recent DLG PowerMix test of 135-225hp Tier 4i tractors, the Arion 650 came out on top with a fuel consumption of just 273g/kWh.

ON THE WEB

Video/animations at:
www.iVTinternational.com

OFF-ROAD 105–565 kW **POWER GENERATION** 85–770 kVA

Agricultural
Forestry
Mining/Quarrying
Construction
Materials handling
Stationary

Power generation

UPTIME IN PRACTICE

Today, machine uptime is decisive for agricultural companies' profitability. You depend on harvesters, sprayers, pumps and other equipment to just keep on going. That's why Volvo Penta engines are reliable and safe – and a perfect match, whatever your specific application may be.

By meeting present and future environmental legislation they are also your investment in a more sustainable tomorrow.

POWERING YOUR BUSINESS

WWW.VOLVOPENTA.COM

VOLVO PENTA

DRIVING IT UNDERGROUND

ÖREBRO, SWEDEN – Meeting demands for improved energy efficiency, Atlas Copco has launched The Green Line of electrical underground loaders and trucks. Built on the proven Scooptram platform, the new EST1030 and EST14 add to the existing lineup of the EST2D and EST3.5 to provide totally diesel-emission free operation.

ABB's electric motors, with 132kW and 180kW respectively, mean the loaders require less energy, generate less heat and reduce noise emissions.

"By replacing a 10-tonne diesel loader with the Electric Scooptram EST1030, you can lower your annual emissions by an amount equal to 140 cars," says Erik Svedlund, product manager, electric vehicles. "Besides the fact they don't consume diesel, they require a minimum of ventilation."

A new portable generator makes transportation of the loaders a one-man job.

The two new underground trucks – the EMT35 and EMT50 – are an update of the Kiruna Electric trucks following the 2012 acquisition of GIA, and provide 35- and 50-tonne load capacities. Producing speeds about twice as fast as their diesel equivalents, Atlas Copco says they are the world's most productive trucks, with Erik Svedlund citing 50% cuts in the cost of ownership.

Running on a trolley system, energy consumption is slashed by up to 70%, with regenerative braking capturing energy when going down the ramp and returning it to the grid. This effectively reduces demand on uphill grades by a third.

To minimise transmission losses, each Kessler axle is driven directly by an electric motor – 200kW on the EMT35 and 355kW on the EMT50. The latter produce over 1,000kW during acceleration. A 72kW Cummins QSB 4.5 engine can be used whenever there is no access to the trolley line.

TRAMP THE DIRT DOWN

AURORA, IL, USA – Cat's 836K landfill compactor has adopted several fuel-saving solutions to enable its C18 ACERT Tier 4 Final 496hp (net) engine to operate highly economically. Auto Idle Kickdown reduces rpm after inactivity passes a preset time interval, while Idle Shutdown completely stops the engine after a safe interval. An auto-reversing hydraulic fan adjusts its rpm to match the cooling demand, reducing horsepower draw.

SCR is used to tackle NOx emissions, with Cat's CEM – incorporating DPF, DOC and an automatic regeneration system that doesn't interrupt the work cycle – handling PM.

Its mechanical drivetrain was purpose-built for waste-handling, adopting an impeller clutch torque converter with a throttle-lock feature to enable modulation of rimpull to reduce ground speed while retaining engine rpm. This ensures full hydraulic power for blade and steering functions at all ground speeds, with hydrostatic-drive-like performance.

The newly designed cab has improved ingress/egress, with automatic temperature control and interior noise levels of just 73dB(A) promoting operator comfort. Sound-suppression packages are an option.

Membrane switch panels feature on the new instrument pod, while the STIC controller uses a single lever for steering and transmission control, so the operator can comfortably sit back in the seat. An Auto-Blade feature automatically raises the blade on reversing, before lowering it to a preset height when moving forwards.

CONSTRUCTION FOCUS

JIM MANFREDI, *MACHINERY OUTLOOK*

BISMARCK SPEEDS UP

Bobcat has broken ground on its €16.5m Acceleration Center project in Bismarck, North Dakota. It will initially house 135 staff tasked with innovating and advancing designs, testing, prototype engineering, and computer simulation of concepts.

The project includes expansion of an existing building to provide a total of 160,000ft² of workspace as well as the development of a 35,000ft² indoor testing arena next to a 22-acre outdoor testing and track area. Construction is set to be complete by mid-2014.

CONCRETE INTENTION

Sany Germany intends to surpass €96.75m in sales in 2015 following its acquisition of Putzmeister in 2012. It has found expanding its business in Europe challenging, due to suspicion over low prices and quality.

In response it will now only import components – not entire machines – from China, to localise production in Europe. Sany has also localised its workforce – once predominantly Chinese, approximately 80% of its 150 workers are now European.

HERE'S LOOKING AT...

Cat's new mini-excavator plant in Bogart, Georgia, USA built its first two mini-excavators in June. After testing and the building of additional units, production was set to begin fully on 1 November.

It took 20 days to build the first two units, but the plant will be able to produce up to 20,000 units p.a. and employ as many as 1,400 people.

Cat has manufactured mini-excavators in Japan for years, but the 308 model it built in Bogart is part of a new series, and the largest of the excavators that will be made there with an almost totally new supply base.

The Bogart plant features just two assembly lines; one for the mini-excavators and one for small track-type dozers. Production of the latter is another year away.

EXCAVATORS FOR SALE

Mitsubishi and four of Japan's largest rental companies have formed the Diamond Construction Machinery Corp, to sell excavators in the international used-equipment market. The JV was formed to sell used Tier 4 machinery that requires ULSD fuel, which is rarely available in Asia.

Historically, Japanese rental companies disposed of used machines on the Asian market, but are now looking to develop other wholesale channels.

LION'S SHARES

Chinese media have reported the clumsy beginning of a Zoomlion takeover attempt. It began when units of Sany Heavy purchased Zoomlion shares on the open market.

Zoomlion later confirmed that 6.6m shares valued at US$5.7m had been bought by two units of Sany. Zoomlion only learned of the purchase after checking records from its latest AGM. Investors speculated Sany was making a bid for Zoomlion, sending its shares up by 6%.

CATHAY CULTURE

According to the Chinese Manufacturers Association, Chinese brands accounted for 42% of the domestic market in June, three points lower than May; Japanese brands accounted for 25%, up two points; South Korean brands made up 14% of the total, remaining flat; while European and American brands accounted for 16% of the total market.

NEW | T4 FINAL | ECOMAX ENGINE

EFFICIENT BY DESIGN.

NEW UP TO 10% FUEL SAVINGS OVER STAGE III/TIER 3

NEW EFFICIENT TO PACKAGE: NO COMPROMISE

NEW EFFICIENT COMBUSTION: NO DPF

Compact high efficiency SCR – The innovative "one can solution" and reduced mixer length assembly - still without a DPF makes for a compact installation without the need for bulky alterations to machine bodywork - maintaining our "No compromise" approach with the minimum impact on the OEM.

JCB POWER SYSTEMS

Telephone: +44 (0)1889 590312

www.jcbpowersystems.com

THE BIG COMBO

MARKTOBERDORF, GERMANY – Targeting farmers requiring the highest levels of reliability, technology and power, Fendt has launched new X-Series and P-Series combines.

Tier 4 compliant, they are equipped with six- or seven-cylinder AGCO Power engines with four-valve technology and SCR to provide a gross output of 379hp (on the 8380 P/AL), 404hp (8410 P/AL) and 496hp (9490 X/AL).

The AutoLevel models are equipped with pivoting front axle portals to ensure optimal, constant output on slopes of up to 12%. Standard and AutoLevel models use tyres that produce an outer width of under 3.50m; the 26in-wide Atrak track drive maintains those dimensions while providing up to 1.23m² of contact area to reduce ground pressure. This also provides a smoother ride at high speeds, ensuring precise table guidance.

The new models adopt the generously sized Skyline cab from the C-Series combines. Optimising visibility to the most important areas, they also offer the latest in comfortable seats.

A 10.4in Varioterminal touchscreen is integrated into the armrest and can save up to three machine settings for all major crop types. Running in the background, the VarioDoc Pro system logs machine data and transfers it to the field database, where it can be used to create yield maps.

All models are prewired for the AgCommand telemetry system as standard.

THE HEALTHY ELITE

LECCE, ITALY – A complete redesign of New Holland's heavy-duty six- to nine-metre range of LM telehandlers has resulted in greatly improved performance and comfort.

The five-model range, which includes high-performance LM 6.35 and LM 7.42 Elite versions, replaces the LM5040, LM5060 and LM5080 models and has adopted New Holland's new product nomenclature so as to reflect maximum lift height and capacity (now 4,200kg).

The entire chassis has now been stiffened to reduce flexing during delicate tasks, with the integrated oil tank helping to further improve balance. The heavy-duty boom is constructed from high-tensile steel, and uses large pins and pads to enhance durability.

With 131° of tilt (142° on Elite models), the buckets can be completely emptied, even if working with sticky crops.

Impressive cycle times are a result of FPT's NEF engine with EcoBlue SCR solution – which provides up to 121hp (143hp on Elite models) – and an upgraded hydraulic capacity of 120 l/min (140 l/min on the Elite models).

Standard models feature a 4x3 powershift transmission, with the 6x3 version on Elite models providing autoshifting into fifth and sixth gears to ensure that the most efficient gear is always selected. With a maximum transport speed of 40km/h, on-highway fuel consumption is therefore reduced, with an additional improvement in tractive effort.

AGRICULTURAL FOCUS

PETER HILL, *iVT INTERNATIONAL*

CNH GOES INDUSTRIAL

Stock market reporting and other admin matters will be simpler following the merger of the separately listed Fiat Industrial and its farm and construction machinery subsidiary CNH Global.

More importantly, says chairman Sergio Marchionne, CNH Industrial has greater commercial strength and will be more attractive to international investors as a unified global leader in capital goods listed on the NYSE and the Borsa Italiana in Milan.

The new CNH Industrial encompasses diesel engine maker FPT Industrial and the Iveco commercial trucks and buses operations, as did its predecessor.

It stands at number four behind Caterpillar, Volvo and Deere & Co, with revenues of €26bn in 2012.

MORE VARIATION AT ZF

Transmissions specialist ZF is developing its family of CVT transmissions as more tractor OEMs put their own designs into production.

Among ZF's newcomers is the Terramatic TMG 45, a development of the Eccom 3.0 structural CVT that can cater for sub-450hp tractors. Its launch customer will be Same Deutz-Fahr; the new transmission will be used in its 350-440hp tractor which uses an MTU Mercedes-Benz engine for the first time in an SDF product (see *iVT* Sept/Oct 2013, p98).

More of ZF's customers are building their own CVTs, though. While Claas uses the supplier for its 180-520hp Axion CMatic and Xerion tractors, the OEM's technology division Claas Industrietechnik is building its first CVT – the EQ 200 – for the 145-184hp Arion CMatic range (see p6).

Similarly, Argo Tractors will feature ZF CVTs in its newly launched 143-188hp tractors next year – the McCormick X7/Landini Series 6/7 – and also in a planned newcomer in the 250-300hp range. But the OEM is also producing its first in-house CVT for new 111-143hp models.

BIG IN BRAZIL

Deere & Co is to invest US$40m in its Montenegro tractor factory in Brazil, to begin production of the John Deere 8R models (currently 280-395hp) from late 2015.

Many of its customers in the region are investing in higher-horsepower tractors in the range covered by the 8R model. Manufacturing in Montenegro should qualify the tractors for FINAME financing – the public programme that targets investment in the country's economic development, said Mark von Pentz, president of Deere's agriculture division.

The Montenegro factory was built in 2008 for tractor production but will require more capacity to add the bigger 8R Series tractors, which are manufactured at the OEM's headquarters in Waterloo, Iowa. The project will also increase the use of suppliers in the region.

TWICE AS NICE

A bigger R&D centre, along with a new transmissions production line designed to build its new-generation T10 transmissions handling up to 120hp in several configurations, have been opened by Carraro Drive-Tech in India.

The Carraro Technologies R&D facility is designed to house twice the number of engineers as the current centre built in 2008, and represents 45% of the capacity of the division's engineering and innovative drivelines global team.

HANDLING FOCUS

MICHAEL LEU, *FORKLIFTACTION.COM*

QUALITY ASSURANCE

Kalmar has denied claims it is encountering problems after transferring container handler production to Poland.

Sources told *Container Management* that the OEM was facing the "quality control problems anticipated by some industry observers when the move was announced", and that Kalmar had to urgently reschedule over 50 units to be built in Sweden.

Dan Pettersson, SVP for mobile equipment, said there was no truth to the rumour: "We do not have any quality issues related to machines assembled in Stargard and we are not rehiring people in Sweden. We do not have any market credibility issues related to the transfer of production to Poland. If any customer has the slightest question about the topic, once we have taken them to the factory, there will not be any doubts concerning the capability in that factory."

TICO TO SHIP OUT AGVs

Toyota Industries Corp wants to sell its container handling AGVs outside Japan. Kenichi Ito, chief of port business development, said: "We'll be selling this system overseas in future."

He added that customers' needs for greater efficiency in port logistics operations are expected to rise. "To respond to these needs, we will develop systems that create new values. This will involve combining our meticulous attention to detail, flexibility and the machinery's stability and accuracy, and delivering these systems to customers together with our logistics know-how."

Its first AGV system was launched in 2008, followed by the second generation in 2012. The 30.5-tonne capacity AGVs are 14.3m long with a diesel-electric drive, a top speed of 25km/h and 20mm positioning accuracy.

The system consists of an AGV that transports TEUs between piers and storage yards at container terminals, and software that controls vehicle allocation operations.

SMOTHER RUSSIA

TMHE has invested heavily in the Russian market with the formation of OOO Toyota Material Handling RUS. This was established to strengthen existing operations in Russia via two exclusive dealers – Toyota Tsusho Tekhnika and Sumitec International. The company, which will start operation with 15 people in April 2014, will provide technical backup, training and marketing support, as well as product and parts supply via the two dealers.

Headed by general director Hans Gehlen, the company will streamline the supply of trucks and parts to dealers and take care of education and service development which, in turn, will allow dealers to work even more closely with customers and increase sales volumes.

BRAND NEW LIFE

Anthony J Salgado has assumed duties as president of UniCarriers Americas as the 'challenging' transition of the Nissan, TCM, Barrett and Atlet brands over to the UniCarriers brand continues.

"We have a good plan in place, seek to maximise the dealer network and anticipate at least two more years to complete the changes," he said. "Many of our dealers are asking us if they can accelerate the identity change for themselves."

Salgado said that UniCarriers Americas also plans a formal entry into the market in Brazil "sometime in the next quarter" as part of a realignment.

Global materials handling online: www.forkliftaction.com

STRADDLING TECHNOLOGIES

STARGARD, POLAND – Kalmar has introduced what it says is the world's first real hybrid straddle and shuttle carriers, as opposed to the traditional diesel-electric systems. The new models use a regenerative energy system to convert electrical braking and spreader lowering technology into electric power, which is stored in a battery.

In association with an automated start-stop system which chooses the optimal balance between engine and battery power, this works to reduce fuel consumption by up to 40%, leading to halving of CO_2 emissions by over 50 tonnes per year. Engine and generator lifetimes, as well as maintenance intervals, can also be extended.

With four steering modes, the new, individually controlled wheel setup greatly enhances the speed and precision of manoeuvres. The notable increase in agility enables shorter work cycles, which leads to reduced congestion in the terminal.

By continuously monitoring travel speed, turn radius and spreader position, the new active stability control feature, which is fitted as standard, ensures safe operation by automatically slowing the vehicle when necessary.

The redesigned spacious cabin features new window geometry to reduce night-time reflections and extend visibility through all directions. More ergonomic seating, an intuitive user interface and reduced noise levels are further benefits.

Remote connection and monitoring enables diagnostic applications featuring remote problem-solving ability to be adopted, and by seamlessly integrating with Kalmar SmartPort, the new models are effectively future-proofed for automation.

WE LIKE THE MOVIT, MOVIT

MJÖLBY, SWEDEN – In focusing the main areas of improvement around operator comfort, productivity and safety, the enhanced generation of BT Movit N-series towing tractors and order pickers from Toyota Material Handling Europe (TMHE) are set to deliver even higher efficiency.

With operator presence control applying over the entire (vibration damping) floor, the driver is 'forced' to assume a safe working position.

The truck-driver interface has also been optimised, with a new handgrip and travel control, ergonomic backrest, and emergency switch within hand's reach.

The addition of LED lights to the front of the machine increase its visibility, while the maximum travel speed has been increased to 12km/h for greater productivity. The larger motor used by the N-series is also quieter.

The battery can now be changed in under a minute, for smooth and uninterrupted goods handling.

"The optimised BT Movit N-series tractors and order pickers are built for a 1.5-tonne maximum towing capacity and have a 70mm low step-in as a standard," Magnus Senneryd, senior applications manager at TMHE, explains.

"Their small dimensions and simplicity of use make them suitable for a variety of indoor applications in offices, small stores and warehouses, hotels and hospitals, for example."

HYUNDAI
HEAVY INDUSTRIES CO.,LTD.

MOVING YOU FURTHER

250D-7E

New standard of big forklift truck.
Excellent power and performance makes your business more profitable.
Safety and durability are priorities in design of the equipment,
An ideal arrangement of component parts ensures easy access and convenience for maintenance. A design based on human engineering relieves fatigue and increases operator's efficiency.
HYUNDAI Forklift trucks are made to meet your needs.

www.hyundai-ce.com

Head Office 14th FL., Hyundai Bldg. 75 Yulgok-ro, Jongro-gu, Seoul, Korea
Tel. 82-2-746-4753, 4609 / Fax. 82-2-746-7444, 7445 / E-mail. sisky20@hhi.co.kr

TYRES AND TRACKS TO THE RESCUE

XINYI, CHINA – Perhaps the most visually arresting vehicle on display at BICES 2013 in Beijing, China, last month was Bada's BDJY38F. Designed for rescue work/disaster relief, this 37.8-tonne operating weight hybrid wheeled/crawler excavator has already been successfully used by the Chinese emergency services to aid rescue attempts after a recent earthquake. The machine is the result of a five-year government-sponsored research project involving 11 companies.

Its unusual traction system enables it to travel around a disaster zone at speeds of up to 30km/h on its 6,474mm wheelbase, which provides a 9,000mm turning circle.

When more extreme terrain – i.e., mountains of rubble – is encountered, the wheels are hydraulically raised and the machine switches drive to its 3,739mm tracks so as to take advantage of their enhanced stability while tackling grades of up to 58%.

Rather like the Hitachi Astaco that appeared in *iVT* June 2013, it boasts another particularly notable feature – the use of twin booms that together provide a carrying capacity of 8 tonnes. They each have an 8m reach.

They are also extremely manoeuvrable; when fitted with a rotating steel wrist, up to seven independent movements can be enabled. A remote control option also enables the operator to get closer to the task at hand, and provides even greater selectivity. This has been theatrically demonstrated by pouring water into a beaker and even 'sewing', using a rather large 'needle'.

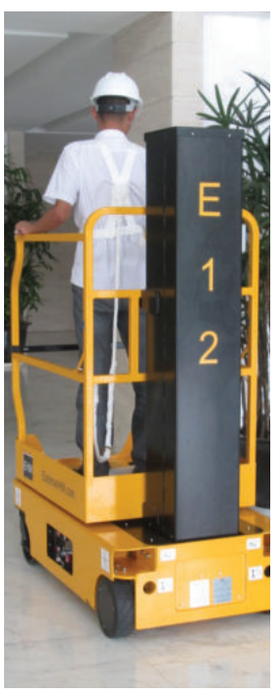
Fitted with grabs, shears or other attachments, the dual boom enables debris to be handled far more safely and selectively than the use of other machines would allow – for instance, holding the end of a concrete slab with one arm and shearing through it with the other attachment – reducing the risk to survivors who may be trapped in the rubble below.

The optional hydraulically rising cab ensures there are no blind spots, enhancing safety even further.

The main power source is a 142kW Cummins QSB6.7-C190-T3 diesel engine. However, another notable feature of the machine is that once it is in position, it can switch from operating with diesel to electric motors, with the power supplied from an external source.

Options include a CCTV system, self-diagnosis and a foam firefighting system.

THE SHAPE OF THINGS TO COME?



KUNSHAN, CHINA – *iVT* does not usually devote much space to access equipment – it seems like there are invariably more complex or interesting vehicles that demand our attention – but we had no excuse for not stopping to take a closer look at Eastman's intriguing E12 mast lift at BICES.

Proclaimed to be the world's first completely electric self-propelled mast-type aerial work platform, could this be a taste of things to come in certain other off-highway areas – such as the materials handling sector, in particular?

With no hydraulics, the consequences of a fluid leak can be avoided completely, making the machine a safe and efficient tool that easily meets the high environmental requirements of hospitals, food processing and electronic component manufacturing enterprises, etc.

Propulsion, steering and lifting are therefore all carried out electrically, drawing on the lead-acid batteries in the base of the work platform that provide a low centre of gravity to ensure stability.

The system runs on 24V DC, with a Zapi controller, and provides up to nine hours' autonomy; or enough for approximately three shifts.

Two models are available – the E8 provides a 2.44m platform height (1.75m when stowed) with 227kg platform capacity; the E12 provides a 3.66m platform height (1.9m when stowed).

Both work platforms provide a 4km/h drive speed when stowed, or 0.8km/h when raised, and offer 25% gradeability. The lift and lower speeds of the platforms are 13 and 16 seconds respectively.

Jiangsu Eastman Heavy Machinery (EHM) is a Sino-American joint venture backed by the US partner Technology International Co (TIC), with a design team led by American experts who hold multiple technology patents.

As well as producing scissor and boom lifts, the company also manufactures trailers and a series of electric pick and carry cranes ranging from 3.26 to 8.4 tonnes in capacity (reaching 16.3 tonnes when on outriggers).

EHM president Mike Zhou told *iVT* that he would be keen to co-operate with a western/international manufacturer with access to an established distribution/servicing network to offer the machines under a rebadging deal.

MAKING MODERN LIVING POSSIBLE

Sauer-Danfoss is now Danfoss

The experts you know
Have grown their network to meet your local challenges

You need power solutions that are perfectly adapted to your off-highway machine, its working environment and the expectations of your market. With the full integration of Sauer-Danfoss into Danfoss, we are still the global partners with the expertise to solve your local challenges. The difference is that our experts now have access to a network of 16,600 new colleagues worldwide.

6,400

hydraulic experts

now have access to even more engineering and electronics know-how

powersolutions.danfoss.com

20 YEARS OF IVT: COLUMNS

SINCE 1993, WE'VE OCCASIONALLY TAKEN SIDESWIPES AT THE INDUSTRY AND ITS CONCERNS VIA COLUMNISTS. HERE'S A BRIEF SELECTION OF HIGHLIGHTS FROM MAGAZINES NOT IN OUR DIGITAL ARCHIVE – THE FULL ARTICLES CAN NOW BE FOUND ONLINE AT WWW.IVTINTERNATIONAL.COM

Stressed about the forthcoming strict engine emissions legislation? Worried that while you may be able to develop industrial vehicle hearts that meet the new rules, you have no hope of keeping up with any further exhaust reductions? Well, sit back, relax and allow me to mop your bothered brow – god knows you've worked hard enough to cut harmful emissions already. There was that direct injection project the other month, and the research project that looked at multivalve heads and new materials. Let's not forget about the catalytic converter bolt-on supreme. With such commitment to cleaning up the environment, legislation should not worry you. Feel better? Good.

WAKE UP and smell the exhaust fumes. Worked hard? If you wanna see commitment to cutting exhaust emissions, look across the hallway to see what your colleagues in the automotive R&D labs have been doing.

However, if the commitment and success of the auto industry does not provide enough 'inspiration' to clean up, try this fact for size: car manufacturers are working so hard to reduce emissions that soon the men from Brussels will get bored with hassling them. Then who do you think they'll turn their emission-bashing attentions to?

If the bonus of impressing customers and improving their children's health with clean, innovative powertrains does not attract you, try forward thinking and laugh in the face of your competitors as the regulators put them out of business. Put simply, pull your pants up from around your ankles before you get caught in a rather compromising situation.

OCTOBER 1999

We gave an automotive journalist acquaintance of ours the chance to write a piece on the subject of emissions reduction – but he was rather scathing about the industry's progress...

Despite what some of my office-bound colleagues might think, attending trade shows around the globe isn't all it's cracked up to be. A page from my diary, albeit one loosely compiled from a plethora of shows visited in my four years on *iVT*, might arouse some sympathy...

0600: Get up, stretch, take off nightdress. (Not a personal predilection – luggage got lost yesterday, so was 'accidentally' given a lady's overnight bag to tide me over.)

0705: Arrive at first of three daily breakfast press conferences, still pondering why they hold an exhibition in Vegas and then expect us to get out of bed 20 minutes after getting back from a nightclub. Won't be so bad if there's a genuine reason for the early start, eg, guided tour around new models before potential customers are admitted, so reserve judgement for now.

Determined to make the best of it, tuck in to first of my traditional four courses. Three minutes later, the speeches – none of which reveal anything new or, dare I say, of interest – begin. And maybe I'm just being paranoid, but having given up my beauty sleep to attend, would like to be able to continue eating my three varieties of melon without feeling like I'm committing some sort of gross social faux pas.

The Insider has been ever-present since 2001 – except on this occasion when he was 'unwell'. The current editor stepped in at the last minute to save the day with this tale of travelling travails

I now routinely refuse to attend such ill-timed events and often encourage others to do the same...

MAY 2005

had really lost the plot. "She's the account manager for our hydraulics supplier. She just told me they're giving our capacity to another manufacturer where they can make more profit!"

Actually, when we talked it through, it turned out she wasn't quite leaving him in the lurch. He had his forecast quantities and she'd even managed a 4% increase on his original orders. But Gordon's company had seen a large unexpected increase in demand for its machines and Rachel's people had not been able to cope. She had not exactly sold off to the highest bidder either – his rival for the attention of the lovely Rachel's hydraulics kit was a bona fide existing customer and she was just being fair with what spare capacity she had.

I first got a whiff of this at this year's bauma while talking to colleagues who had noticed that most of the enquiries from prospective customers were prefaced by questions on lead times – the talk was in terms of not when, but how, supplies might become available. Some companies have seen demand increase by 45%. Set this against budgets that reflected a pretty flat year; preface this with the fact that, for years, 'smart' management decisions have been leading most component manufacturers on a downward spiral, interspersed with mergers, acquisitions and relocation to countries with low-cost alternative production facilities and it is hardly surprising that we have a potential disaster situation on our hands.

NOVEMBER 2007

Just a few months later, we were all looking back with fondness at these halcyon days of spiralling demand the Insider was bemoaning...

Is it at all surprising, then, that the really productive innovation in the development of many vehicle types seems to be somewhat stifled? In this world of 'smart working', 'downsizing' and 'outsourcing', isn't there a better use for our dwindling resources of experienced design engineers than to have them constantly chasing the elusive butterfly of vehicle emissions?

Environmentally, though, the concept is hard to criticise – a global industry working towards lower emissions from a common agenda moving to a pre-set timetable. I am still, however, trying to work out the common agenda bit!

Why is it so important that a tractor in Texas needs an emissionised engine, while a similar unit in Mexico can carry on oblivious to any requirements for super-clean exhaust emissions?

The bottom line is that end-users are – in most cases – ordinary people just getting the job done. Legislation – which is being driven by an entirely different agenda just passes them by, yet is forced down the throat of our industry until it chokes on its own very special piece of environmental pollution. Sadly, it is still the manufacturers and ultimately the end-users who foot the bill.

OCTOBER 2001

The first appearance of the mysterious Insider saw him tackle one of his pet topics – the need to meet apparently incongruous emissions regs

Agriculture | Construction | Material Handling | Powergen

We're working every **second, minute, hour, day** and **year** around the world.

Our engines make a difference.

Perkins®

THE HEART OF EVERY GREAT MACHINE

www.perkins.com

FLIGHT CLUB

HERE'S OUR PICK OF THE NEW VEHICLE HIGHLIGHTS FROM INTER AIRPORT 2013, HELD IN MUNICH, GERMANY, THIS OCTOBER. (WE JUST HAD TO TALK ABOUT IT...)

■ At almost 12m long and with a GVW up to 39 tonnes, Ziegler's **Z6** aircraft rescue and firefighting vehicle (ARFFV) is built on a Thomas 6x6 chassis and features a Euro 5 Volvo Penta 700hp engine and Twin-Disc six-speed automatic gearbox to enable 0-80km/h acceleration in 31 seconds, and a top speed of 120km/h.

Its superstructure is built from Ziegler's aluminium panel system, ALPAS, with the spacious aluminium/GRP cab seating a driver and five colleagues in some comfort.

Pneumatic bus-style doors, which quickly and quietly slide back at the press of a button, provide efficient access to the cab, which also features heavily tinted windows to ease the load on the air-conditioning during the long hours spent sitting on the tarmac in temperatures that can reach over 50°C. The seats also feature integrated compressed air breathing apparatus.

With a 14,000-litre tank capacity for water/foam, and 500kg dry chemical powder, the Z6 provides output speeds of up to 6,000 l/min from the roof turret and up to 2,200 l/min from the bumper turret, each at 10 bar.

■ Aside from the TBDUK Jet Tug featured on page 42, the most eye-catching vehicles on display at Inter Airport were undoubtedly those from Øveraasen's next generation of high-performance runway snow-removal equipment.

Known as the **Performance Line**, this includes the RS 400 runway snow sweeper and RSC 250 compact snow sweeper which were launched at the show, as well as the RS 200 runway sweeper and TV 1000 high-capacity airport snow blower.

It would be quite easy to make these machines square, boxy and unappealing – which is no doubt why the striking, futuristic design was achieved in conjunction with leading Norwegian design agency Eker Design, which is perhaps best known for its work with the Swedish Koenigsegg supercar brand.

As Eker's sales manager Tom Erik Kristiansen told *iVT* at the exhibition, the highly stylised fibreglass cowling at the rear also creates benefits in shedding accumulated snowfall.

The Mercedes-Benz Arocs and Actros tractor units now incorporate MTU Stage IV engines, making Øveraasen one of the first European OEMs to install this engine generation. Other major systems of the machines have been redesigned too, with the brand-new models featuring the latest H1 series hydraulic components and Plus 1 control systems from Danfoss Power Solutions.

The first TV 1000 snow blower will be delivered in December, although snow sweepers will not be available until mid-2014.

Something from these fine examples of 'Norwegian snow how' will almost certainly appear in far greater detail in a forthcoming issue of *iVT* however…

■ As a joint development between Doll Fahrzeugbau, Gategroup and German E-cars, the **ecat** is claimed to be the GSE industry's first electrically powered highloader.

The 18-tonne GVW vehicle relies on four lithium-ion storage batteries providing 260V with a total capacity of 60kWh to provide all necessary power. Boasting a load limit of 13 tonnes, ZF's rear-axle-drive system with two asynchronous three-phase traction motors provides 2x120kW, resulting in a top speed of approximately 62km/h on public roads, or 35km/h on the ramp.

A separate electrically driven hydraulic supply replaces the traditional diesel-driven mechanical PTO of the lifting and support system. With a 7.5kW capacity and pressure of 200 bar, it can handle a gross load of 7,000kg – including 4,500kg payload – at a lifting speed of 0.1m/sec.

By charging the battery while the cooling unit is being loaded, infrastructure requirements can be simplified and remove the need for a separate stop at a refuelling station. Safety is also claimed to be improved, with smoother movements of the vehicle during start-up as well as positioning at the aircraft, in conjunction with a proximity warning system.

As well as reducing airside CO_2 emissions, this increased efficiency is also projected to result in reduced running costs – figures are likely to be available soon after full testing on the tarmac begins in April 2014.

inter airport europe

■ Bringing back a few memories of the RampSnake, Mallaghan's **Bendi Belt** showcased an innovative method of baggage loading that enables the operator to be in control from inside the hold. From the outside, the vehicle may appear to be a typical loader, but its 7.5m-long conveyor belt features an adjustable, curvature design on rollers that enables its 5.5m extension to be pulled deep inside the hold, enabling baggage to be placed far away from the hold door with the minimum of effort. As the hold fills up, the belt is simply repositioned by hand to the next most optimal area.

Stop and start controls are located on the end of the main conveyor, just inside the hold, enabling bottlenecks to be prevented.

There are three belt speeds, which enable uploading to be achieved at 9, 17 or 24m/min and downloading at 9, 17 or 27m/min. The flexible belt can be extended or retracted at 4m/min, and has a maximum load of 400kg.

With its ability to reduce manpower requirements to just two, the Bendi Belt is now proving to be a popular choice in European ground-handling operations.

The base vehicle features a Deutz D2011 engine in conjunction with a hydrostatic transmission from Poclain Hydraulics, which is particularly useful for enabling a creep mode, to avoid damage as it approaches the aircraft. The use of a Plus+1 CANbus system from Danfoss Power Solutions takes care of the electrical system.

■ With a 39 tonnes GVW, the Iveco Magirus **Dragon 6x6** aircraft rescue and firefighting vehicle (ARFFV) has been built according to a modular principle that enables the implementation of the same twin-engine power pack design used in the 8x8 model.

The pair of electronically controlled Cursor 13 engines provide up to 1,120hp when in their Euro 5 configuration, so as to enable simultaneous driving and pumping operations in either forward or reverse gears. ARFFVs with just one engine might have a maximum achievable speed of just 20km/h during pump and roll conditions, but the twin-engine concept enables pumping to be carried out at travel speeds of up to 70km/h.

Under these circumstances, the PTO of the Power Divider couples the left engine to the fire pump, while the right engine is used to drive the truck independently. Because maximum pump power consumption is just 272hp, this ensures ample power reserves for rapid acceleration, while flow rate is adjustable independently of ground speed. Maximum water flow of 10,000 l/min is available once engine speeds of just 900rpm are reached.

Using both Cursor 13 engines, acceleration up to 80km/h is achievable in less than 23 seconds, with a top speed of 135km/h.

■ In addition to its new Comet 8, Mulag had a handful of teasers on show, including the **Comet 3 FC** towing tractor, now in its second-generation prototype.

Like the tug's batteries, the 20kW H2Logic fuel cell unit has also been increased in capacity, meaning a full tank of hydrogen is now enough to last for a whole work shift, providing drive speeds up to 25km/h and powering the 2kW motor for the hydraulics.

In conjunction with the new mobile refuelling system, the tractor is set to go into production next year.

Also on display was the **Comet 4 DK** serial electric hybrid towing tractor (below), described as a 'preprototype' by marketing director Oliver Kesy. Its high-performance 370V DC 7.6kWh lithium ion batteries work in conjunction with Bosch traction motors and generator, and it uses a 41kW Deutz 2011 engine as a range extender – said to be the first time a diesel engine and lithium ion have been combined in a hybrid.

John Deere engines are built to meet a higher standard — yours

JOHN DEERE

You expect reliable performance from your engines — and nothing less. That's why John Deere always puts engine performance first. PowerTech™ Final Tier 4/Stage IV engines, with our optimized Integrated Emissions Control system, let you focus on your work and get the job done. Push through the tough spots without losing speed. Respond immediately when you need more power. And do it all while maximizing fuel and fluid economy.

John Deere PowerTech engines. The right technology. Right now.

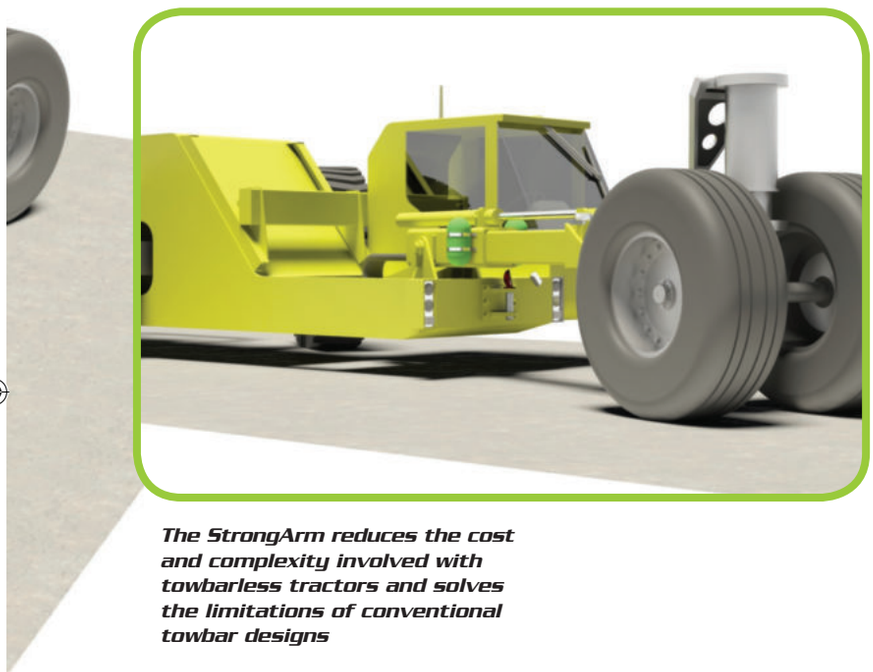
John Deere Power Systems
Tel: +33 2 38 82 61 19
Fax: +33 2 38 84 62 66
Email: jdengine@johndeere.com
Johndeere.com

JohnDeere.com

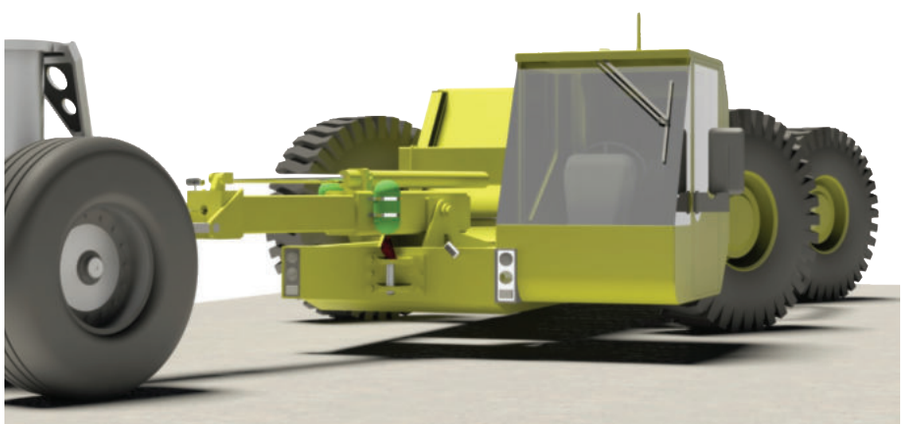
DC DESIGN

DESIGN A VEHICLE THAT WILL MORE EFFICIENTLY CARRY OUT A TRADITIONAL AIRPORT GROUND SUPPORT TASK

STRONG-ARM TACTICS



The StrongArm reduces the cost and complexity involved with towbarless tractors and solves the limitations of conventional towbar designs



Motive Power

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

Commercial aviation is a difficult business, and as it becomes increasingly competitive, aviation companies will begin to take more notice of their ground support equipment. Aircraft towing tractors have traditionally been over-specified because of management fears they will pick too small a unit. Alongside this, many of them have been fitted with lots of accessories, most of which do not improve performance.

To provide more cost-effective tractors, operators will be forced to move towards simpler vehicle designs based on construction and agricultural vehicle components, and deleting much of the traditional bodywork and accessories*. To improve productivity, they will move away from the use of separate towbars, towards an integral robotic arm capable of attaching to a range of aircraft. Separate towbars can often be a real problem operationally, particularly when handling different models of aircraft, because the right towbar needs to be found and connected before the tractor arrives at the aircraft. This involves additional personnel, and often another vehicle just to handle the towbars. Towbarless tractors have certainly solved this problem, but at a high cost of purchase and complexity.

Tractors not only tow aircraft, they also handle the steering too, and conventional towbars incorporate sacrificial shear pins that are designed to fail if the steering torque or drawbar pull exceeds a specified limit. Our StrongArm design therefore incorporates sensors to advise the driver when these limits are approached, enabling it to detach from the aircraft if a jackknife is imminent. Jackknifing is often a result of wet conditions and tail-heavy aircraft loading, and presents a real danger in conventional aircraft haulage.

The StrongArm would extend from the tractor and attach to the aircraft tow points without the need for any outside assistance. In operation, it will guide the driver to impose minimum loads on the nose gear and help prevent dangerous conditions from arising.

The off-centre cabin is configured to hydraulically lower for under-fuselage towing, and to assist vision when connecting. During most towing or push-back operations it can be raised to provide an improved view of the work environment. Crab steering is already common on tow tractors as it is purported to move the vehicle sideways more quickly than normal steering, and in turn steer the aircraft more quickly. However, most operators don't really understand it, so it is rarely used – except perhaps at particularly cramped airport gates.

Together, simpler tractors and better towing connections will permit more efficient and cost-effective aircraft handling.

www.motivepower.com.au • lance@motivepower.com.au

** Lance talked about some of these issues in a blog for* iVT *in 2011. Read more at: www.ivtinternational.com/industry-blogs.php?BlogID=474*

THE MIGHTY THOR

Pope Design

Jon Pope has designed heavy equipment for more than 15 years. He has worked for a variety of off-highway OEMs, as an independent design consultant or employed by Teague

Snow removal has always been an issue at airports. You can only pile up so much snow before you run out of space or cause visibility issues for taxiing planes and GSE. Trucking it off-site can send fuel costs soaring. More importantly, it's also becoming illegal because much of the snow removed from airports is saturated with de-icing chemicals. So dumping it into rivers and ponds, like a lot of municipal authorities do with their overburdened snow piles, is no longer acceptable for airports. Too much serious and costly environmental damage could be caused with this practice.

So a lot of airports are using snow-melting machines, melting the snow so that the water drains right into the airport drains, where the contaminated water will be properly treated. But even though these units are mobile, they still have to be centrally located. So the snow has to be loaded onto dump trucks, driven to the snow-melting machines, dumped, and then loaded into the snow-melting machine. It takes a lot of extra time, fuel, equipment operators and more equipment to maintain.

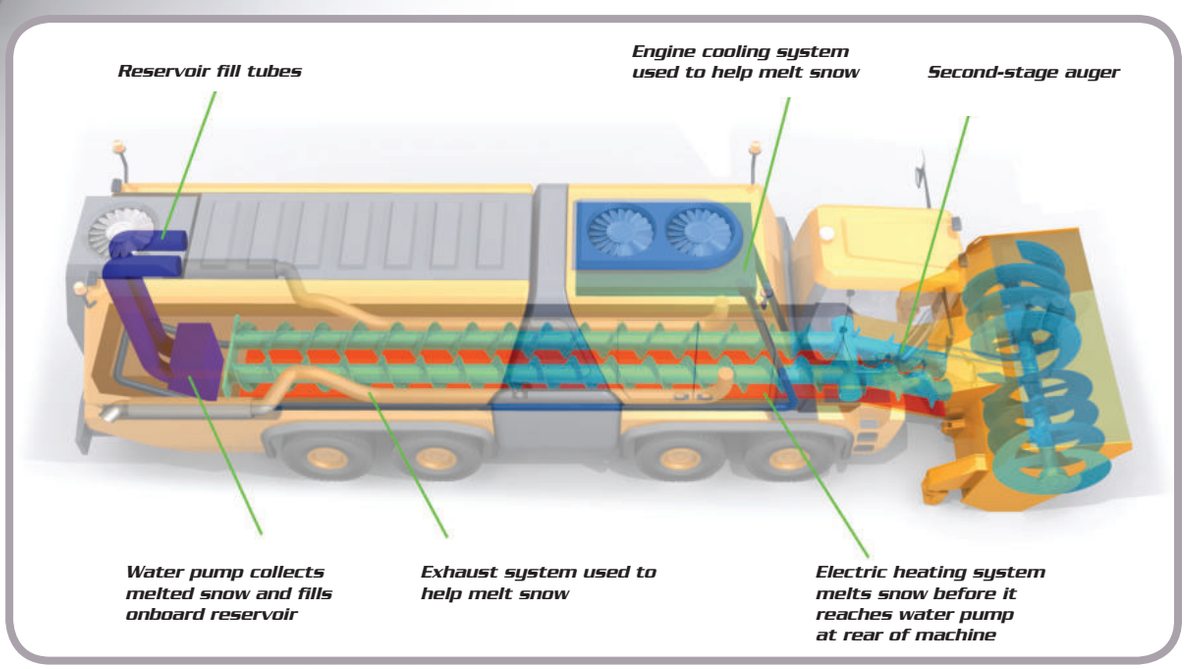
My solution to make this system more efficient is a snow blower that instead picks up the snow, melts it, and carries it in an onboard reservoir in the form of water. The truck has an auger to pick up the snow like a traditional snow blower. A second-stage auger removes the snow from the main auger. The chassis is a large closed box frame, with a set of augers running along the entire length of the machine inside the chassis. The chassis is heated up with electric coils that completely melt the snow by the time it reaches the back of the machine. The water is then pumped into a large reservoir. To make the system more efficient, when the machine is picking up snow, the engine cooling system (and exhaust) bypasses the radiator and runs the entire length of the chassis to help melt the snow. When the reservoir tank is full, there are drain tubes in the rear of the machine that allow the operator to empty the contaminated melted snow water into the airport drains, where it will be properly contained and treated. A GPS system helps the Mighty Thor locate storm drains buried in snow to simplify emptying of the reservoir.

Average snowfall has a 10:1 ratio with water, while dry snow can consist of up to 30in of snow to every inch of water. Snow can dry out when being blown over large open areas, like airports. The onboard reservoir that holds the melted snow water can hold from 10 to 30 20-yard dump trucks full of snow before it has to be emptied (all depending on the type of snow being removed). For long stretches such as runways, a tandem bogie and tanker trailer could be added for extra reservoir capacity. This machine could also be used for markets outside of the airport sector, such as local authorities removing snow on public roads.

Instead of having a diesel engine driving a hydrostatic pump, a generator and a mechanical drive, the entire system is diesel-electric. Traction motors in each wheel assembly eliminate the need for differential axles, making more room for the closed box chassis. This also eliminates the entire mechanical drive system. The pickup auger is raised and lowered by electric actuators, and the snow melting process uses electric heating coils. The machine has all-wheel steering for better manoeuvrability, with crab steering and rear wheel steering-only functions, all controlled by a joystick.

jpope@pope-design.net • www.pope-design.net

Sliding cab provides the operator with an optimum view to the runway edges



RICHARD CARR, iVT INTERNATIONAL

The beautiful game

DOUGLAS EQUIPMENT MD RON COWLEY MAY HAVE ONLY JOINED THE GSE SECTOR THREE YEARS AGO, BUT IT IGNITES THE SAME PASSION INSIDE HIM AS HE HAS FOR HIS FAVOURITE FOOTBALL TEAM...

Given that Ron Cowley, MD of Cheltenham, UK-headquartered Douglas Equipment, is a lifelong fan of Sunderland Association Football Club, you could easily be forgiven for expecting him to view the concepts of creativity, innovation and success with all the fear and suspicion of an Amazonian tribesman encountering an aeroplane for the very first time.

Nothing could be further from the truth, however. In terms of market share in the GSE sector, his company believes it stands at number two in towbarless tractors and number four in conventional models – but several projects currently underway suggest that Douglas Equipment may occupy an even more prestigious position in terms of innovation.

Ron set the creativity barometer very high at the outset, stating that the OEM will deliver 12 innovations or developments focused on markets and customers each year. You may have seen his forecasts for the year 2033 in *iVT* Sept/Oct (page 71), where he predicted the dominance of hybrid pushback tractors as a viable means of slashing fuel consumption.

However, due to *iVT* putting him in touch with Maxwell Technologies just a few weeks earlier, patents on the drive technologies for Douglas's own new hybrid machine were still waiting to be filed at the time, so he'd had to choose his words quite carefully. Now there's no longer any need to keep it under his hat, and it's safe to say that the latest of his innovations will be based on the cunning use of supercapacitors to provide the initial burst of energy required to overcome a jumbo jet's inertia. It does make perfect sense though – why specify an enormous engine to provide the peak power that's only needed for a tiny part of the duty cycle when a supercap can deliver that instead, with the aircraft's momentum then maintained using a smaller engine?

"The use of supercaps will be a game changer for us," Ron boasts. "The technology road map states there's a 4:1 ratio, so we could drop from a 750hp engine to 200hp or so in our TBL 600.

"This year we've taken out five new patents, including an innovative cradle for use on the TBL 25 and TBL 50, and we've also developed the Supercool, an air-conditioning unit specifically designed for our tractors. We recognised that on our TBL 600, for example, its 750hp engine was often ticking over just to provide air-con for the driver, and clocking up unnecessary hours.

"So now it's able to use a separate small engine with high-performance compressors operating separately from the main engine – not only does that save a lot of fuel but the performance curve is very good too, meaning you can very quickly drop from 52°C down to 27°C. Our beta site customer estimates that payback will be under 14 months."

On the nose

Another concept that Douglas is working on could reduce costs even more dramatically for the ground handler, given that the implications of damaging an aircraft can make fuel savings look like petty cash in comparison. So rather than relying on visual hook-ups, the company is exploring the use of surface

"I LOVE THE GROUND SUPPORT SECTOR TO BITS, ALTHOUGH IT'S QUITE BACKWARD COMPARED WITH THE CONSTRUCTION EQUIPMENT INDUSTRY"

VALUES FIRST. FASTER®

INNOVATION TECHNOLOGY RESEARCH SAFETY COMMUNICATION LEADERSHIP

FASTER®
think faster

CHINA - FASTER HYDRAULICS CO, Ltd.
200233 SHANGHAI, P.R. China
n° 1289, Yishan Road, Caohejing Hi-tech Park
(+86) 021-6082 3060 - Fax (+86) 021-6082 3080
info@fasterchina.com.cn

INDIA - FASTER HYDRAULICS Pvt. Ltd.
410501 DISTRIC PUNE, MAHARASTRA, India
Plot n° 10, gate n° 108 Ambethan, Taluka Khed
(+91) 21 356 7800
info@fasterindia.com

HEADQUARTER:
ITALY - FASTER S.p.A.
I-26027 RIVOLTA D'ADDA (CR) Italy
Via Ludovico Ariosto, 7
(+39) 0363-377211 Fax (+39) 0363-377333
info@faster.it

www.faster.it

BRASIL - FASTER DO BRASIL
R. José Franklin de Moura, 25
Independência Taubaté - SP CEP: 12031-290
(+55) 12 3026 9699
info@fasterbrasil.com

USA - FASTER Inc.
MAUMEE, OH 43537-9505
6560 Weatherfield, Ct.
(+1) 419-868-8197 - (+1) 800-231-2501 Fax (+1) 419-868-8360
info@fasterinc.com

"THE USE OF SUPERCAPS WILL BE A GAME CHANGER FOR US. WE COULD DROP FROM A 750HP ENGINE TO 200HP OR SO IN OUR TBL 600"

topography for the precise scanning of aircraft nose landing gear (NLG) under all kinds of lighting conditions, accurately creating a model displaying time and distance and juxtaposing it on a head-up display.

"The idea of automatic coupling then comes in, rather than relying on the operator," Ron explains. "The technology is already out there with reverse sensors, but we're also getting intelligence from them, enabling the tug to drive right on to the nose."

At this point it strikes me that all of the company's innovation seems to be focused on the more profitable, technologically advanced towbarless tugs that are typically destined for western markets, but Ron quickly sets me straight.

"Not at all – in fact, we're adding a detachable ballast solution to our DC range of towbar tractors. Lugging 70-80 tonnes of excess weight around isn't always necessary, so lightening it up means we can create a more multipurpose vehicle. We're highly conscious of utilisation, so we're also doing some surveys using a Lean Six Sigma tool called OEE [Overall Equipment Efficiency], analysing machine uptimes to understand how we can sweat the customer asset to create more added value. If they're only pushing planes around for 20% of the time, what about the other 80%? Better utilisation means you can run a smaller fleet.

"Our hybrid concept will also soon end up in the DC models, and we'll launch an all-electric model next year, covering the DC 4, 5 and 6 sizes."

MAIN IMAGE: **Sneak preview of the hybrid TBL 600, featuring supercaps from Maxwell Technologies**

ABOVE: **The all-electric TBL 25 is well positioned to take advantage of the growing business from regional airports**

Playing to percentages

So much for the vehicles then – but are airports really using their GSE as efficiently as they could do? "Even western airports could make really significant savings if they optimised their ground handling more," he says. "Heathrow, for example, has been developing a system they call zonal working, where one single team is responsible for managing a couple of gates. So a tow tractor driver will be performing other duties until it's time for pushback – which is very different from standard procedure.

"We have worked closely with the operators, unions and management of British Airways to enable best practice and product utilisation. This collaborative approach to teamwork on the ramp has been monitored by several international airports and will soon be replicated."

That certainly sounds far more effective than employing someone to sit under-utilised for 80% of the working day, I agree, but what about a tug driver's role in general? For instance, when I interviewed Mike Doane, Douglas's long-serving (now recently retired) sales manager, for the 'Next Big Thing' feature in the 2007 *iVT Lift-truck Annual*, he had suggested that tractors should also take care of the whole taxiing phase

"WE'RE ADDING A DETACHABLE BALLAST SOLUTION TO OUR TOWBAR TRACTORS. LUGGING 70-80 TONNES OF EXCESS WEIGHT AROUND ISN'T ALWAYS NECESSARY"

MAIN IMAGE: **Although towbar tractors are not as technologically advanced as their towbarless counterparts, they're set for considerable growth as emerging markets expand**

ABOVE: **Douglas Equipment's TBL 600 is an established choice for wide-bodied aircraft around the world**

rather than just pushback. So why hasn't that happened yet?

"It's hard to say," he muses. "It would certainly save fuel [in the aircraft], but I suppose it's a similar reason to why Taxibot [a cockpit-controlled tug concept] will never take off. Pilots already have a heavy workload and time pressures to turn things round, so they don't want to have to drive a tractor too – and a remote-controlled vehicle adds health and safety issues to the mix.

"I've talked to union people and they say there's no way anyone will buy into remote-control vehicles – it's a cultural safety thing.

"Then there's the risk of Taxibot – or even just an ordinary tractor – breaking down on the way to the runway. You'd then have to send another tractor to decouple it and there'd soon be a queue of aircraft building up behind it. You'd also have to create an infrastructure so that the vehicle can come back from the takeoff area, so there are a lot of issues to solve.

"Anyway, once an aircraft has been turned around and pointed in the right direction, it doesn't need a massive amount of fuel to reach the runway, and pilots are happier with pushback than they are with long maintenance tows."

A grass roots approach

So is automated dispatch towing in general a non-starter then? I'd have thought that, given such a generally predictable and repetitive operation, this might be an area that could benefit from the lead being set by automated mining trucks…

"It's an infrastructure thing as much as anything – you'd need to start from scratch with a purpose-built airport. If so, you could use a similar system to what our sister company Indal Technologies designs for aircraft carriers – you could build a runway with a built-in carriage that holds onto the NLG and delivers the aircraft to the point of take-off.

"I'll give you a caveat though – we have produced a remote-control tug just to show we can do it. We've modified one of our standard tugs with cameras so we can control it remotely from a workstation. But we haven't talked to customers about it yet though, as we think it's still a little bit too 'out there'.

"We have also had considerable success in designing and developing a remote-handling system used for

handling fighter jets and helicopters currently being deployed on all US aircraft carriers and the latest littoral combat ships."

One recent idea that could provide another threat to tow tractor sales is the WheelTug, a system of electric motors that is fitted into the main landing gear of a narrow-bodied aircraft, providing it with full mobility without recourse to the jet engines.

"It's a good concept, so we are keeping an eye on it," Ron admits. "However, it needs an awful lot of computing power, would require a change to the landing gear, and there's no retrofit capability. In fact, one of our sister companies within the Curtiss Wright family provided the hardware that will enable the technology to be tested. However, the development costs are in the millions so, relatively speaking, the vehicles we sell are cheap in comparison. So I really can't see it being launched within the next decade."

International fixtures

So the immediate future seems rosy for tow tractors and all associated GSE. There may be an incessant march towards high-tech solutions in developed regions, but the humble towbar tractor will still be around to meet strong demand from emerging markets; areas where labour is cheap and the need to employ three or four people is not a sticking point.

Asia and Latin America will be the areas seeing the strongest growth in passenger traffic, while the world fleet of aircraft is expected to double by the year 2030.

"It's cheaper to build an airport than it is to build railways and roads, so we're witnessing big growth from India and China," Ron elaborates. "Africa is a continent that will do well over the next 10 years too – but North America represents 41% of the movement of aircraft passengers. But the target area isn't the large tractors – the biggest volume is in regional jets."

With those emerging markets in mind, remanufacturing is currently providing some very healthy profit margins. "Not everyone can afford the most advanced piece of kit, but they still want the very best tractor. We can take any model in our range – it may have been in service for 20 years – refurbish it, and it will do the business. We've just taken two TBL 400s from a customer and upgraded them to hybrids, so we can retrofit some of the biggest models too."

As with almost all off-highway machinery, there is a huge difference in the spec levels in tugs destined for western and emerging markets. "There's a huge market out there that doesn't understand new technology, or would find maintaining it very problematic. They can struggle with CANbus, for example, and their lack of understanding or training actually ends up creating more downtime. So simplification, standardisation and rationalisation are key focal points for us – how exactly can we make maintenance simpler?"

Towards this end, Douglas has built a centre of excellence in Pune, India, which works closely with a handful of domestic universities to provide a non-European perspective of the industry and provide optimum solutions for local products. All the company's senior recruits now come from international backgrounds, to provide a greater understanding of these issues. "Long gone are the days when the UK was at the centre of the world," Ron declares. "We now have to compete on an international platform and be outward-facing rather than inward."

A promising new signing

Having joined Douglas Equipment three years ago, this is Ron's first 'real' job in the GSE sector, after having worked for US corporations for 25 years, including the running of Regal Beloit's European operations: "That was good preparation for GSE, though, as we supplied gearboxes to a wide range of vehicles, such as small drive lines for Tug.

"Then Curtiss Wright was looking for a British managing director to run several divisions, including its new acquisition, Douglas Equipment. It wanted someone who understood US culture but was sympathetic to the idiosyncratic issues of the Brits! So having a good understanding of both cultures helps me to be well placed to lead the business to its next stage of strategic development and growth.

"I love the ground support sector to bits, although it's quite backward compared with the construction

ABOVE: **The towbarless operation concept. New innovations have recently been made to cradle design at Douglas Equipment**

equipment industry, which is very well honed. The working practices of the likes of JCB, Doosan and Cat are very good, and they have a great understanding of Lean Six Sigma.

"I think GSE has been so niche it hasn't benefitted from some of those world-class strategies, so building on operational excellence is one of the things I'm bringing to the group."

It strikes me that, for all of GSE's complexity, companies in the sector are generally much more specialised than those in other off-highway areas, with many concentrating on just one or two product types. In contrast, even small construction equipment OEMs will often make a fair stab at supplying a diverse range of kit, so is there a desire – or is it even realistic – to be a full-line GSE supplier?

"Yes, it's 100% desirable, though as yet there's no one out there that produces every piece of kit needed. But one of the strengths of Curtiss Wright is its critical mass – it's a

Here's another exclusive sneak preview of a Douglas Equipment innovation: having dropped out of the container handling sector a few years ago, its new NS8 RoRo and dockside vehicle – developed for BNFL – features all-wheel drive and steer, with a choice of axle configurations. It is due for official launch next year

£2bn operation covering many different sectors with factories all round the world.

"That can really boost our buying power, give us the working capital to develop products, help open up markets quickly and give us access to a whole team of experts that handle acquisitions for a living."

Maintaining formation?

Despite having spoken of expanding his company's portfolio, Ron then mentions another quite astonishing development that almost flies in the face of that. It seems that a move towards a standardised, modular approach could one day replace an entire range of vehicles with just two common platforms, with clients then deciding on the most suitable engine pack and other options.

"Fleet managers do often tend to overspecify," he says in response to my mentioning of Lance Procter's observation from page 22. "If you look at a car these days, under the bonnet there's one standard wiring loom, whereas 20 years ago there were potentially 10 different looms across a whole range. Now you get the redundancy built in for better volumes and discounts, so we are actively driving forward to rationalise and standardise our range.

"That should also enable us to create a product that's a lot easier to build – so if we wanted to build a knockdown kit, perhaps as a way of circumventing South American import duties, for example, we could send out a container with the chassis and running gear in it, and then it's just a case of plug and play."

A pleasure to watch

"Another thing we haven't done very well as an industry is styling," he continues. "Operators definitely now expect a more glitzy vehicle, and that's something we should be doing more of in future – with the use of external sources like the ones we've found through *iVT*."

One particularly noteworthy ergonomic development is the use of double glazing in the cab. "It's expensive," he admits, "but it cuts down noise and glare, and helps with defrosting and insulation. I don't know of any other company that is doing that!

"In a previous life, I used to build bits and pieces for medical devices," he continues. "We could mould an insert to sense the loadings on the human body, helping prevent sores for tetraplegics. So we're now developing a system to mould an insert exactly to fit the operator's shape. He carries it in at the start of his shift and clicks it into the seat – when he's more comfortable, he'll enjoy the job a lot more."

I stop short of suggesting that Ron should take one of those with him on his next trip to Sunderland's 'Stadium of Light' to help make the 90 minutes pass by more bearably. Given the range of innovations and potential to expand the business he has at his fingertips, it will take a lot more than the imminent threat of relegation to wipe the smile off his face in a few months' time… **iVT**

WORKS HARD IN EVERY CONDITION

YOUR SOLUTION for TIER 4 REGULATION

Sealed, High Performance, Heavy Duty Brushless Fans & Blowers

Spal provides the market with a wide range of high performance brushless fans and blower, specially designed to meet new generation cooling systems requirements in the off highway industry.
Spal can be a strong and reliable partner in order to increase the systems efficiency in your advanced vehicle design.

Main applications:

- Engine cooling
- Auxiliary and After Threatment cooling
- Engine bay ventilation
- Multi-fans array solutions
- HVAC
- Battery and Electronic cooling

Product features:

- Heavy Duty design
- High vibration and shock resistance
- IP6K9K and IP68 sealed motors
- Integrated fully sealed electronic board
- Extreme lifespan

SPAL AUTOMOTIVE

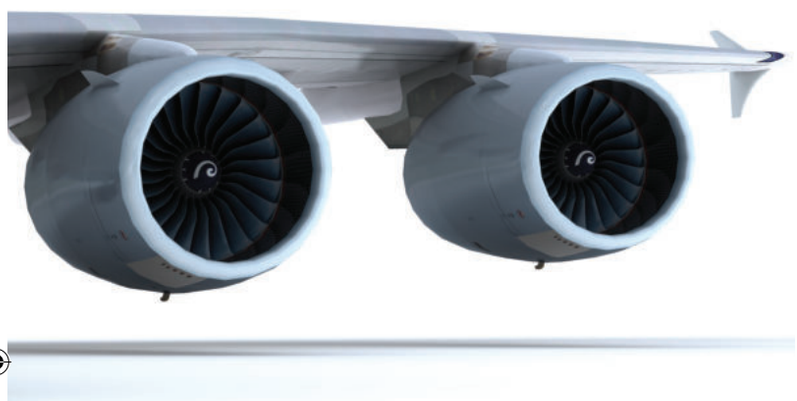
INNOVATION & TECHNOLOGY

SPAL AUTOMOTIVE
Via Per Carpi, 26/B - 42015 Correggio - Italy
info@spalautomotive.com - www.spalautomotive.com

JOHAN SJÖBERG, iVT INTERNATIONAL

GREEN GIANT

IN ANNOUNCING THE TBL 800 – A HUGE HYBRID TOW TRACTOR FOR WIDE-BODIED AIRCRAFT – AT INTER AIRPORT LAST MONTH, KALMAR CLAIMED A WORLD FIRST. BUT HOW EXACTLY DID IT DEVELOP ITS PULLING POWER?



A revolution is taking place in the aviation industry. With the introduction of new wide-body aircraft such as the Airbus A380, A350 and Boeing 787, airlines are able to introduce new business models for themselves and new travel patterns for their passengers. Turnaround times at airports are becoming shorter too, which in many cases makes it rational for operators to refuel and make the plane ready back at the hangar overnight, minimising time at the gate.

This all translates into more work for the towing tractors. Towing large aircraft puts a lot of mass into motion, up to 500 tonnes, and towing from the hangar to the gate may involve a distance of several kilometres. In addition, many airports – as well as airlines – now advocate towing to and from the runway, rather than taxiing solely under the power of the aircraft engines, in an effort to save fuel and reduce emissions.

It was with these challenges in mind that Kalmar Motor (not to be confused with the Cargotec brand of materials handling equipment) began development of the TBL 800 hybrid tractor for towing wide-bodied aircraft. TBL stands for 'towbarless', a concept that was pioneered by the company in the 1980s. This is now the dominant tractor design at most European airports, while in the rest of the world, towbarless solutions have about half the market.

"Hybrid drive is something we've been very successful with over the years in our smaller TBL 50 and TBL 180 tow tractors," says sales director of Kalmar Motor, Magnus Johansson. "So with all the developments now taking place in the aviation industry, the time seemed right to develop a larger vehicle."

First come, first served

The TBL 800 is claimed to be the world's first hybrid tow tractor for wide-bodied aircraft, with the aim of improving efficiency, reducing costs and slashing emissions for ground handling operations. It is being designed in co-operation with Lufthansa LEOS, the ground support subsidiary of the aviation giant.

Because towing tractors of this size have a limited market, Kalmar Motor has decided to work with an industry partner. This is partly to ensure that the vehicle will meet the requirements of a demanding operator and partly to secure initial sales – meaning the first machine will be operational at Frankfurt Airport by the end of next year.

"Lufthansa LEOS has been an ideal partner throughout the entire development work," says Johansson. "The company has very exacting requirements, which have resulted in some extremely valuable feedback. In addition, Lufthansa has a variety of aircraft based at Frankfurt Airport, one of Europe's leading aviation hubs. This has given us the opportunity to carry out tests with many different types of aircraft. Frankfurt is also an airport with long transport stretches, which the TBL 800 is ideally suited for. Additionally, Lufthansa operates both tractors and aircraft, unlike most other companies that normally have one or the other. All this has made Frankfurt the perfect test site."

Towbarless movement of aircraft improves the control of the load and the forces involved during towing. For this reason, it is the preferred method of aircraft manufacturers. As the tractor simply picks up the nose wheel of the aircraft, there are no unexpected stresses in the landing gear, while the forces that are exerted on various parts of the structure can be easily controlled too. Towbarless connection also improves safety, as it meets the aircraft at just one point. In contrast, the towbar has two joints, increasing the risk of jackknifing.

Nice save

Towing great weight over a long distance requires a great deal of power, so the ideal scenario is to keep going at a steady pace until the destination is reached. However, stopping and starting is often unavoidable, due to control tower instructions or just the general layout of the airport.

This makes hybrid propulsion ideally suited for towing at airports. Over short tows with frequent stops and starts, cost savings could be as much as 75%. In applications with long tows, such as the operation at Frankfurt, the savings are more in the region of 50-60%, but then the running hours are longer. In fact, at Frankfurt, the aircraft are towed 7km from the hangar, where fuelling takes place, to the gate.

The savings mainly come from the combination of reduced energy consumption during the tow, no transmission losses and eliminated energy use when idling. In addition, airports that are subject to emissions

During dynamic braking, the electric motors go into generating mode and feed energy back to the system

The TBL 50 was Kalmar's first hybrid towbarless tractor development

trading can reduce their costs for emission rights.

Braking energy is recuperated during deceleration – although the travel speeds are fairly low, at up to 25km/h, the weight of the vehicle and its load represents a substantial moving mass. Therefore, braking can produce between 500kW and 1,000kW, which is absorbed by the dynamic braking system.

Our friends electric

The driveline is supplied by BAE Systems, with the front wheels being driven by the company's TorqE front axle with integrated electric motor. Each rear wheel is fitted with an electric hub motor. The four-wheel drive configuration was selected to provide sufficient traction and it also ensures that enough power is available when travelling at speed.

In most electric traction motor applications, the priority lies in providing high torque at low revs for a smooth takeoff from a standing start. However, because the payload can be extremely heavy in aircraft towing applications, high torque is also required at high speed. As the torque drops off at higher revs, like it does with all electric motors, the two hub motors at the rear ensure that sufficient torque is available throughout the speed range.

The motor on the front axle produces 450bkW while the two motors at the rear chip in with 150bkW each, using asynchronous AC motors that have been selected for their ruggedness and ability to deal with any overspeed currents. When braking, the electric motors go into generating mode and feed energy back to the battery, under the supervision of BAE's control system.

The motor control system is interfaced with Kalmar's overall vehicle control system. This makes requests for output in terms of motor speed, torque and direction, which the BAE system then delivers. The control system endeavours to make maximum power available to the driver while taking into account restrictions imposed by the load at

The vehicle was developed in close co-operation with Lufthansa LEOS and can tow aircraft weighing up to 500 tonnes

September 16-18, 2014
Detroit | Michigan | USA

electric & hybrid vehicle technology expo

America's first exhibition dedicated to the engineering of hybrid & electric vehicle technology & innovation

Co-located with THE BATTERY SHOW
The Expo for Advanced Batteries

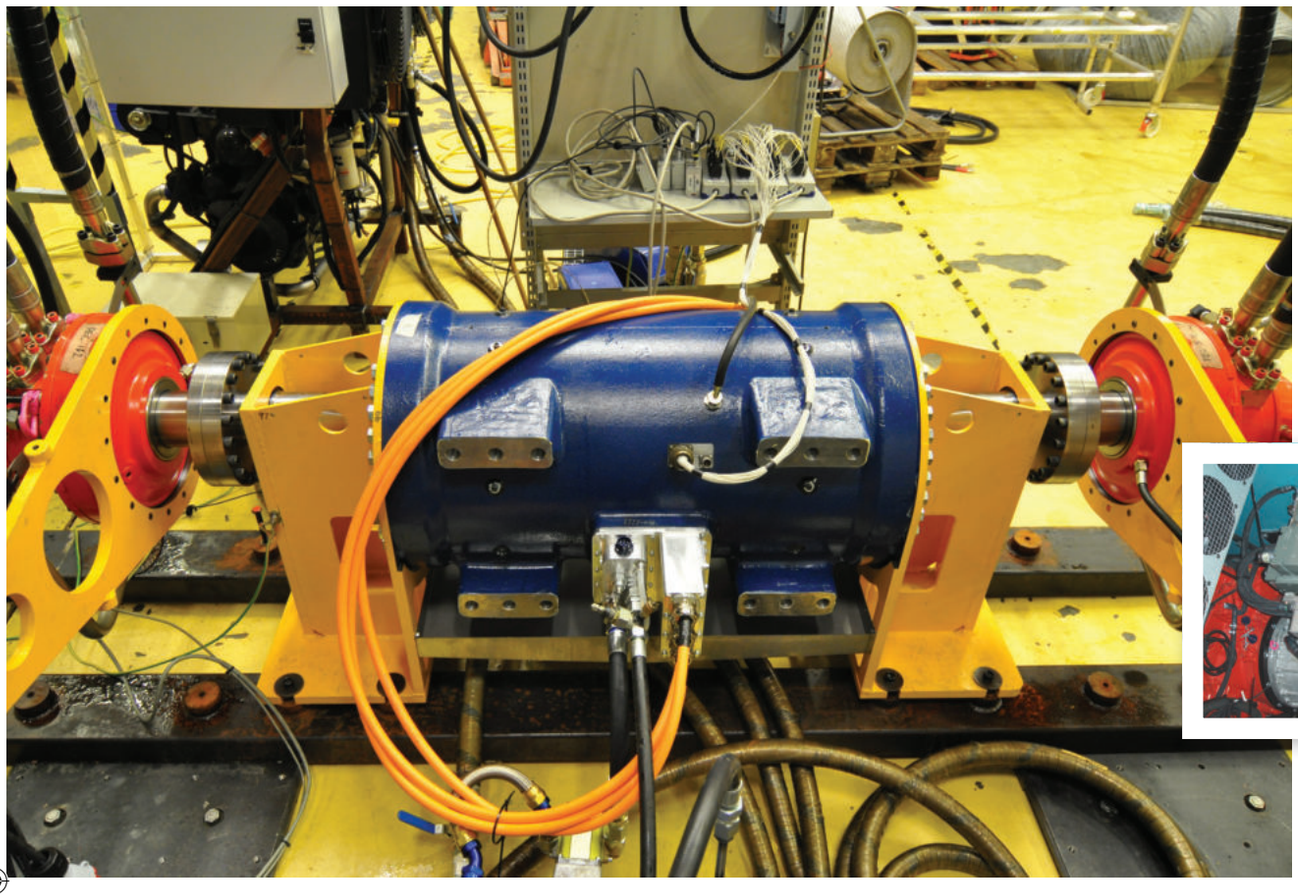
2014 exhibition & sponsorship opportunities available

BOOK NOW

Exhibition space limited

www.evtechexpo.com

info@evtechexpo.com



Front axle assembly undergoing testing

ABOVE: **The onboard 24V DC current is converted to 800V AC for use by the traction motors**

the time. Different forces apply for each aircraft type, and restrictions – which vary with the type of aircraft – are kept in a database.

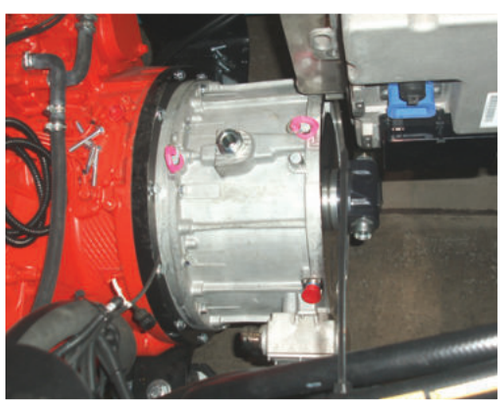
The control system responds to forces exerted by the movement of the load. Kalmar has developed a system with load cells that register the forces in the towing cradle in terms of acceleration, deceleration, torque and angle. These forces are measured in real time, to which the control system responds by modifying the movements of the vehicle.

The onboard electrical system is 24V DC, however the motors run on 800V AC, with the current converted by the BAE motor control system.

Taking charge

The dynamic braking system has been complemented by mechanical brakes for additional braking power. The inclusion of mechanical brakes is also a legal requirement.

"On this vehicle we chose dry disc brakes to make the most of this opportunity," says Johansson. "Wet discs save space but there was enough room for dry discs on this occasion. They give longer service life, make brake maintenance easier and also eliminate the need for oil cooling."



A permanent magnet generator provides high output from a small package

Energy storage takes place in a 200kWh lithium-ion battery from Saft. Lithium-ion technology was selected primarily for the battery's ability to absorb energy quickly. Other advantages include its high energy density, no memory effect and slow loss of charge when not in use. Complete recharge takes five hours.

"The battery will deliver its best performance if charged daily, while partial recharge is also possible. This is another great feature in favour of li-ion technology," says Johansson.

Although the vehicle is primarily intended for charging from mains electricity, it will also feature a small diesel engine (likely to be a Cummins model) for charging. This starts up automatically when required and only shuts down when charging is complete. The size of the engine is only 150bkW, comparing favourably with the 600-700bkW engines that are normally used in this application.

If only being used for pushback operations at the gate, the TBL 800 can be used without the diesel engine. The electric power is generated by a permanent magnet generator, selected for its high efficiency and small size (20-30% smaller than a standard generator). Service life of the battery is about six years, which is also the estimated life of the vehicle before refurbishment is due, based on 3,000 hours of use per year.

Creature comforts

Because of the potentially long work shifts with these vehicles, Kalmar

has gone to great lengths to ensure high levels of driver comfort. The vehicle is fitted with the company's own hydropneumatic suspension system with a gas spring reservoir and suspension spheres. Offering a 360° field of vision, the cab has its own suspension with coil springs and hydraulic cylinders from Öhlins.

"The working environment needs to be quiet and relaxing to prevent tiredness and lapses of attention. There's a great deal of responsibility resting with the driver, who may spend up to eight hours in the cab if they're towing over long distances to the hangars," explains Johansson.

The HMI is Kalmar's own system and is based on the company's own software. Ease of use and avoidance of clutter were the priorities when designing the system. The display initially shows state of charge, temperatures and traction power. Any new information is added to the display as it becomes available. In addition, information from the load cells in the towing cradle is displayed to enable the driver to make correct driving decisions.

The hydraulic system comes from Danfoss Power Solutions and helps lift up the nose wheel – which can represent a weight of 50 tonnes – into the cradle. Despite this, the TBL 800 is relatively light, at 30 tonnes.

TOP: **The driver's cab is designed to be simple yet comfortable**

ABOVE: **An uncluttered view helps the operator make the right decisions**

BELOW: **A complete recharge of the batteries takes about five hours, but partial recharge is also possible. In addition, the vehicle has a small onboard diesel engine for battery charging**

Tractors for conventional towbar towing, on the other hand, need to have a weight of 70-80 tonnes to ensure they have sufficient traction.

With the towbarless design, the nosewheel of the aircraft provides the required ballast, enabling the weight of the vehicle to be reduced. This in turn has a positive effect on its energy consumption, service, tyres and other consumables.

"When designing this vehicle, every aspect has been focused on performance, as the load is so valuable," Johansson concludes. "Coupled to this is the ergonomic design of the driver's cab. We simply have to enable the operators to do their best work and prevent any possible errors we can from our end. In addition, everything had to be made larger to accommodate the greater loading. On top of all that, we had to fit in the hybrid drive system as well!"

A tall order, indeed. But with the help of its colleagues at Lufthansa LEOS, it seems Kalmar Motor is on track to ensure the world's first hybrid towbarless tractor for wide-body aircraft is operational by the end of next year. After all, with all other aspects of the project aiming for the highest standards, it would be odd if the schedule were any less than perfect. **iVT**

elobau
sensor technology
made in Germany

JFT – Finger Tip Joystick

+ simple "on top" installation in control panels
+ customised control functions
+ soft-touch finger rest
+ single axis miniature joystick
+ colour coded caps
+ sealed, IP 67 above the mounting plane
+ space saving installation
+ angled and contoured activation handle

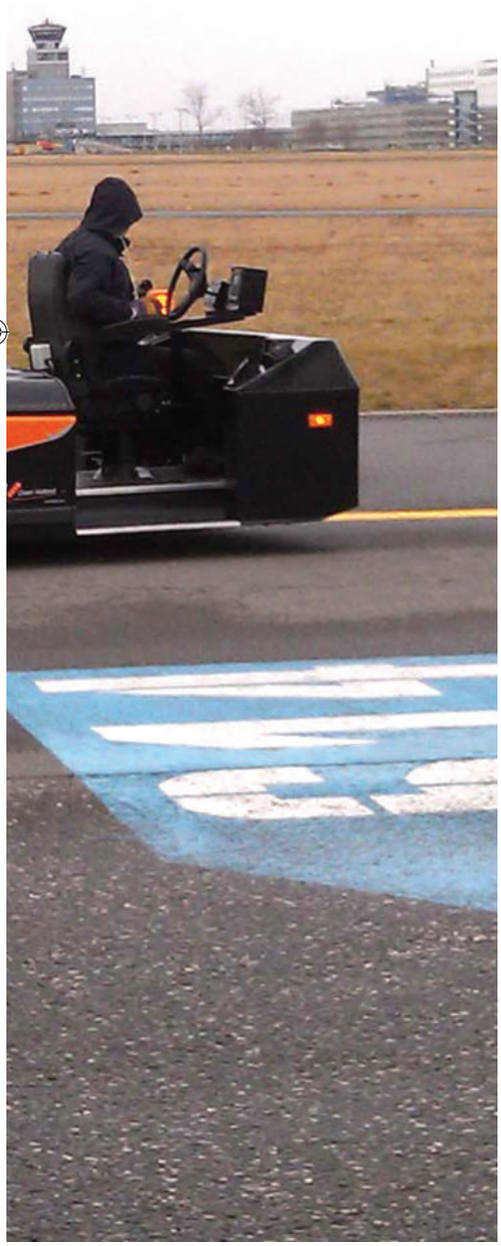
elobau sensor technology
www.elobau.com

JON LAWSON, iVT INTERNATIONAL

TUG OF PHWOAR...

EYES WERE OUT ON STALKS AT INTER AIRPORT WHEN TBDUK UNVEILED THE JET TUG. IT MIGHT LOOK MORE LIKE A SEXY SPORTS CAR, BUT THE EYE-CATCHING DESIGN OF THIS NEW ELECTRIC AIRCRAFT TUG HIDES SOME TECHNOLOGY THAT ENGINEERS WILL DROOL OVER

LEFT: **One of TBDUK's first designs for the open-cab version of the Jet Tug 35-50**



Words like 'sleek' and 'stylish' have rarely been synonymous with aircraft tugs, but the Jet Tug 35-50, TBDUK's new offering that pulled in the crowds at Inter Airport last month, may be set to change that.

The project started in late 2011, as Phil Summers, technical director, explains: "This is our first tug, as well as our first venture into electric vehicle production. The company has historically specialised in towed and chassis-mounted equipment using commercial vehicles chassis for toilet trucks, potable water trucks, scissor-lift maintenance trucks and the like. However, we saw a gap in the market for a general aviation electric tug."

TBDUK therefore examined the market carefully so as to identify exactly who the end product should be aimed at.

Summers explains: "We are entering a market where there is a lot of money and some customers are very image-conscious, so they are quite comfortable spending a lot of money on their private aircraft. So it was clear that we had to differentiate ourselves from our competitors; just performing the task was not enough.

"We wanted a visual impact, with a vehicle that even looks great beside a multimillion-pound business jet. It is not a sports car, but it does look a bit like one – and that's what we are aiming for!"

Autodesk Inventor 3D CAD was used for the concept work. A series of scale models was then produced and refined, and some trial mouldings created in GRP. The general structure of the new machine was set in stone quite early on in the process.

"We wanted to use a combination of steel for the chassis and GRP for the upper body," explains Summers. "For the body, we considered other materials, but we ruled out Kevlar as it was not required from the strength point of view, and we felt aluminium would not give us the lines we were looking for."

As well as the focus on aesthetics, careful consideration was also given to operational practicality. During TBDUK's assessment of the daily working lives of these vehicles, it was observed that items such as strops and chocks are frequently tossed onto any flat surfaces that fall to hand. To accommodate this practice, a chequer-plate aluminium deck was designed to slot into the front section, with a pair of easily accessible steel side lockers built into the chassis.

A cab has been designed and the necessary fixings are in place, should one be specified by the client. This could be a fully enclosed unit or even just a roof section, depending on the prevailing local weather conditions. "But we don't have a convertible yet," jokes Summers.

The chassis itself is in effect a large steel box, divided into sections that are welded together. TBDUK is a specialist fabricator, so it is able to manufacture this item in-house.

Back and forth

Another issue for the design team that needed to be resolved very early on in the process was the driving

WHATEVER YOUR APPLICATION
WE HAVE YOUR VIEW

Being a trusted leader in displays and controls, Murphy provides the application view you are searching for in displays. The PV300 series offers innovative solutions to satisfy your needs.

- ***Manage mechanical to final Tier 4/Stage IV engines***
- ***Customize screens and controls for your application***
- ***Create intelligent machine interlocks***
- ***Setpoint triggered output for alarm and shut-down***
- ***Track service reminders***
- ***Multi-language support***

POWERVIEW™
PV350-PV380 Displays

Find out more by visiting:

www.fwmurphy.com/ad/pv350-380_ivt
or call USA: +1-918-317-2654
UK: +44-1722-410055
China: +86-571-8788-6060
India: +91-91581-37633

1311299 8-2013

Visit us at EXCON
November 21-24, 2013,
Bengaluru, India
Hall 3 ML, Stand # 882/883

Visit us at CONEXPO
March 4-8, 2014,
Las Vegas, NV
Booth # 83911 South Hall 3-4

MURPHY®
by ENOVATION CONTROLS

"WE DID ALSO CONSIDER JOYSTICK STEERING. HOWEVER, AFTER MUCH DISCUSSION, WE FELT THE INDUSTRY WASN'T QUITE READY FOR THAT YET"

MAIN IMAGE: **Some admiring glances for the Jet Tug following its unveiling in Munich**

INSET: **The striking display was customised to include data regarding runtime, state of charge and position of the steering wheels**

position. The very nature of aircraft tow tractors means they spend just as much time going backwards as going forwards, and Summers did not like how other manufacturers tackled the problem.

"Historically, when reversing, tug drivers have had to lean over to look behind," he explains. "Sometimes, these vehicles have two completely separate driving positions, facing in opposite directions. We rejected both of these ideas."

The company opted instead for a single rotating driving position, designed with ease of operation in mind. When a change of direction is required, everything spins through 180°, including the controls.

"We did also consider using joystick steering," reveals Summers. "However, after much discussion, we felt the industry wasn't quite ready for that yet. It would've actually been easier to design, but we settled instead for a more conventional steering wheel and a joystick drive control, with the system built into the right-hand-side seat arm. The system is fully proportional, and forward means forward, whichever way the driver is facing."

A CANbus system supplied by Curtis Instruments was developed to control all functions. "It had to be tailored to our requirements, as there was nothing available off-the-shelf," states Summers.

"We also wanted a bespoke display that featured speed, battery condition and steering wheel position, which is vital because the operator won't be able to see the steering wheels – this is particularly important when starting off."

In addition to these fundamentals, there are system warnings to indicate whether the bucket is up or down, whether it is loaded, and displays for lights and indicators. Everything associated with driving rotates with the driver's seat; the only immovable controls on the bulkhead are those for raising the nose wheel bucket, and the on/off switch.

Specifying the tyres was easy – they are simply stock press-on band Trelleborg items. On the other hand, specifying the wheels was not quite so straightforward, because of the limited production runs.

THE BATTERY SHOW

September 16-18, 2014 **Detroit | Michigan | USA**

The fastest growing exhibition focused on next generation advanced battery technology

2014 exhibition & sponsorship opportunities available

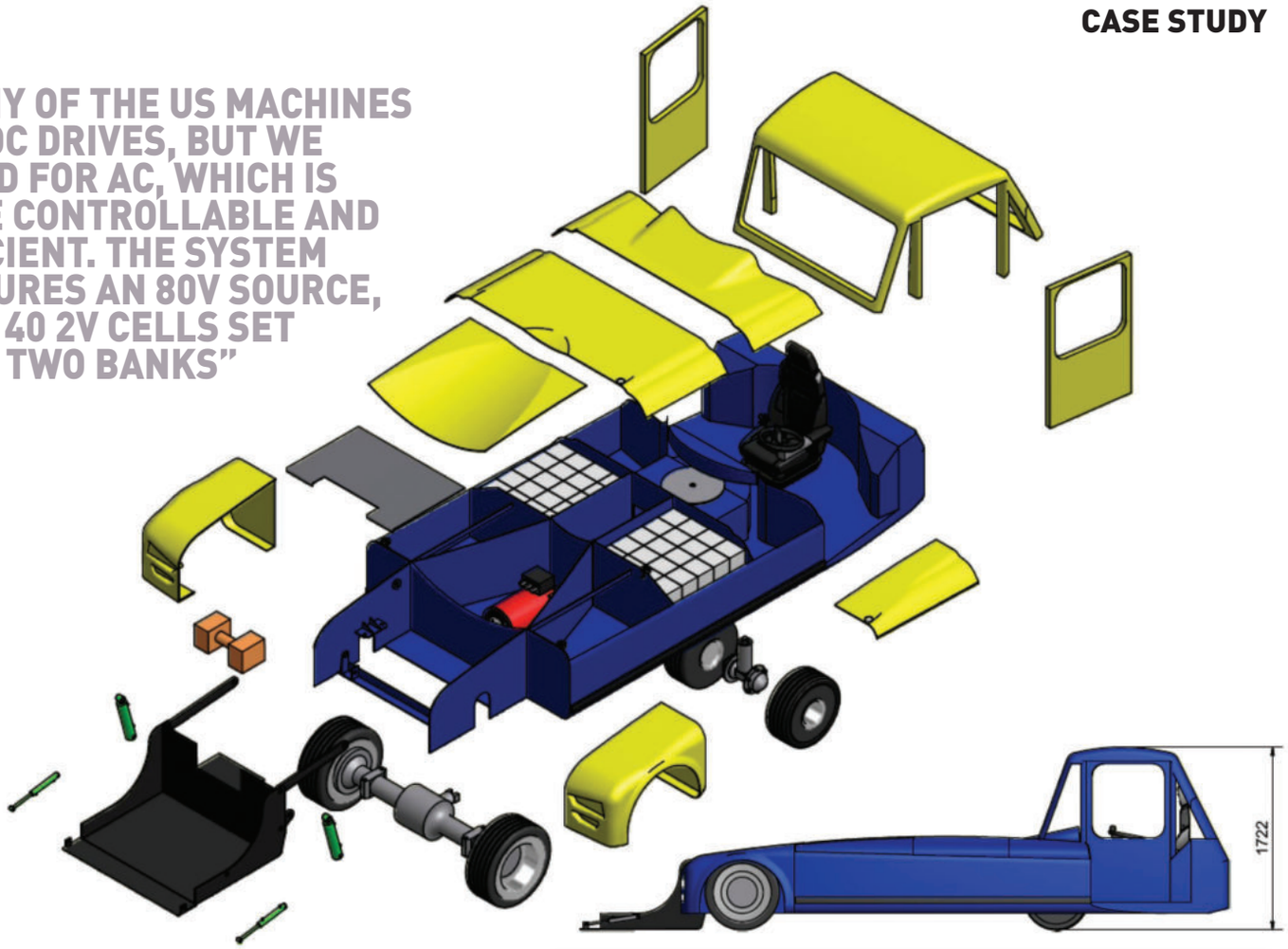
BOOK NOW

Exhibition space limited

35% ATTENDANCE INCREASE IN 2013

info@thebatteryshow.com **www.thebatteryshow.com**

"MANY OF THE US MACHINES USE DC DRIVES, BUT WE OPTED FOR AC, WHICH IS MORE CONTROLLABLE AND EFFICIENT. THE SYSTEM FEATURES AN 80V SOURCE, WITH 40 2V CELLS SET UP IN TWO BANKS"



MAIN IMAGE: **An exploded view of TBDUK's design for an 80/100-tonne tug with cab. Parts in yellow will be manufactured from GRP; those in blue from steel; and those in grey from aluminium. The steel bucket is highlighted in black**

INSET: **Some passengers might be affronted by seeing an ugly tractor on the walk between their Bentley and executive jet – hence the beautiful styling of the Jet Tug 35-50**

Summers notes, "It is not cost-effective to have an axle made to your exact requirements when you are building only a handful a year, so we had to use an off-the-shelf item from JCB Drivetrain Systems. To get the load ratings we needed, we ended up with a particular hub size, so we had to source a custom wheel to fit our desired load-bearing figure. Ideally, we would have liked a smaller hub – and I think in the future these will become available."

Range finding

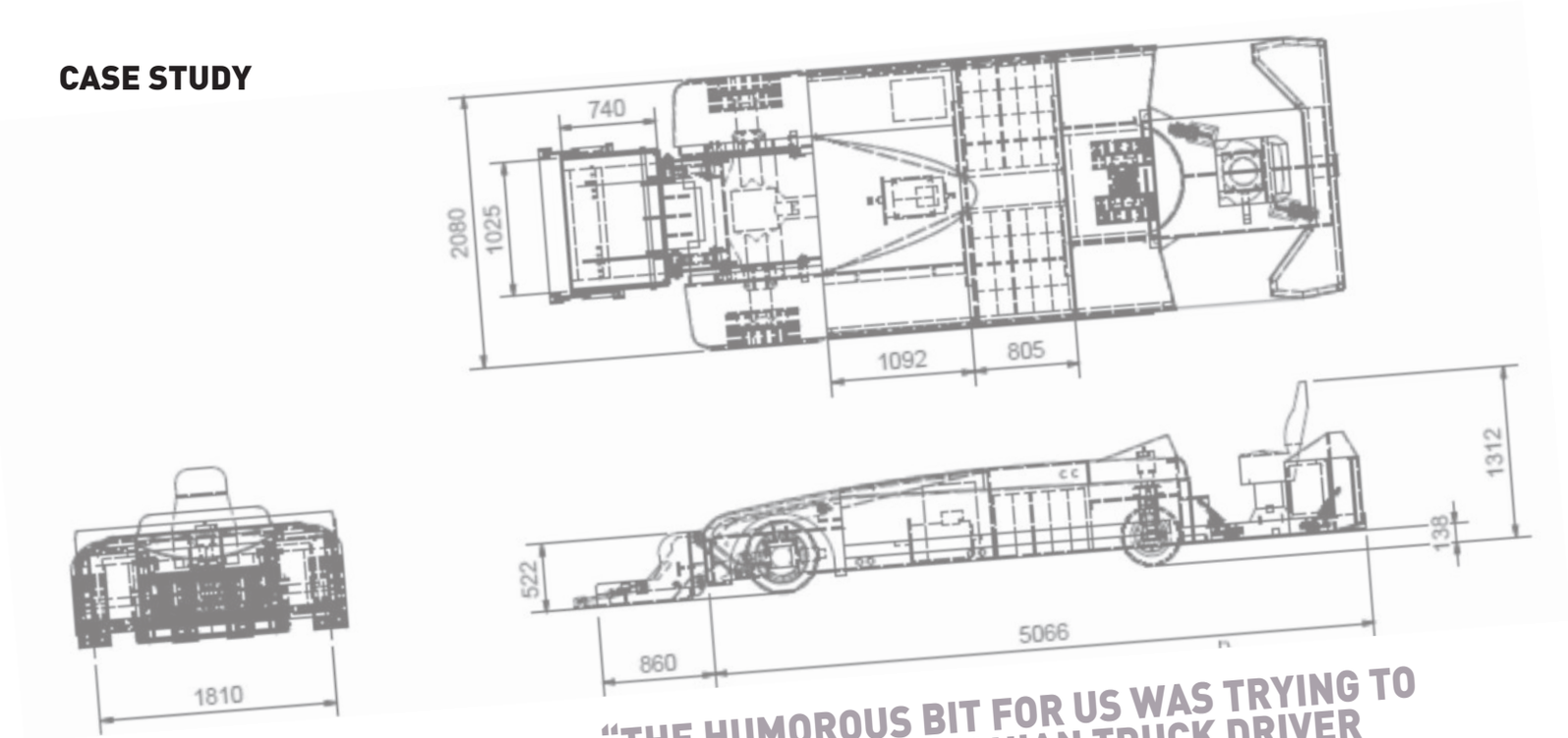
TBDUK plans to eventually build several variants; currently it offers two options: a so-called medium-sized one for aircraft up to 30/50 tonnes and a larger one for aircraft up to 80 tonnes. Prototypes are out in the field and working hard, though Summers cannot yet reveal who the customers are.

"What I can say is that we have had continuous feedback and it has been interesting! One thing that we thought initially might be a major selling point was onboard charging, but it now seems this may not be the case – it could be preferable to have the charger off the machine. This could enable us to use a larger unit with a quicker charge cycle.

"So rather than trying to make a selling feature out of having an onboard charger, we will be offering it as an option in the future. My suspicion is that more customers may opt for static charging."

Pondering the reasoning behind this, Summers concludes that it is all about vehicle size. Smaller vehicles can be easily charged in a variety of locations using a standard power socket, but larger machinery tends to be brought back to the same place due to the size and type of power supply required.

Curtis Instruments was also a partner in the development of the Jet Tug propulsion system. Summers explains the philosophy behind it: "Many of the US machines use DC drives, but we opted for AC, which is more controllable and efficient. The system features an 80V source, with 40 2V cells set up in two banks. The steering works on 48V, and there are various 24V auxiliary systems. The technology behind the motors is developing rapidly, so over time I can see these changing."



"THE HUMOROUS BIT FOR US WAS TRYING TO CONVINCE THE ROMANIAN TRUCK DRIVER WHO CAME TO COLLECT THE TUG THAT IT WAS A TRACTOR AND NOT A SPORTS CAR"

Electric may dominate the field at the moment, but Summers can see a time in the future when some form of hybrid system could be used, such as a small diesel charge engine.

Regarding future evolution of the driveline, Summers hopes to see improvements across the vehicle. "We would like to bring the loaded centre of gravity back, which will enable us to make it lighter and more efficient. We are aiming to get more distance between charges as well as eventually using smaller motors. The options are changing the axle configuration or going for integral wheel/hub motors. When we looked at the motors in 2011, there wasn't the load-carrying capacity, but that is changing all the time."

The current design uses a central single motor, with a conventional heavy power transmission axle and an electric parking brake. There is also an emergency hydraulic system incorporated in the axle disc brakes, although the joystick is designed to electrically brake and control speed in normal use. Built into this is a dead man's grip safety feature which automatically applies the handbrake when it is released.

ABOVE: **The chequer-plate aluminium deck above the bucket provides operators with a place to toss chocks without damaging the GRP shell of the Jet Tug**

In terms of range, the ability to successfully opportunity charge is an important feature of this type of vehicle. It is designed for intermittent use, and although it is difficult to gauge precise figures due to different aircraft weights and distances driven, TBDUK claims the tugs should last a shift without needing a charge.

Summers is full of praise for what Curtis did with the drivetrain: "One of the great things about the drive control system is the way it can be configured. Getting the theory right is one thing, but once in use it may need fine-tuning.

"Take basic speed control for instance: depending on the bucket position and load, we've set a normal drive mode and a creep mode. These are pre-selectable, so if we start with 4km/h for slow and 12km/h for fast, and then find we need to adjust these parameters, the control software can be easily reprogrammed. This has formed part of the customer trial, so during the commissioning process we can precisely adjust these things for each customer."

The design certainly seems to have raised a few eyebrows anyway. One unexpected problem occurred when trying to ship the tug over to Munich for Inter Airport Europe. Matt Hill, business development manager, says, "The humorous bit for us was trying to convince the Romanian truck driver who came to collect the tug that it was a tractor and not a sports car. It took over an hour on the phone, with company data sheets and photos being sent to his head office before he was happy…" **iVT**

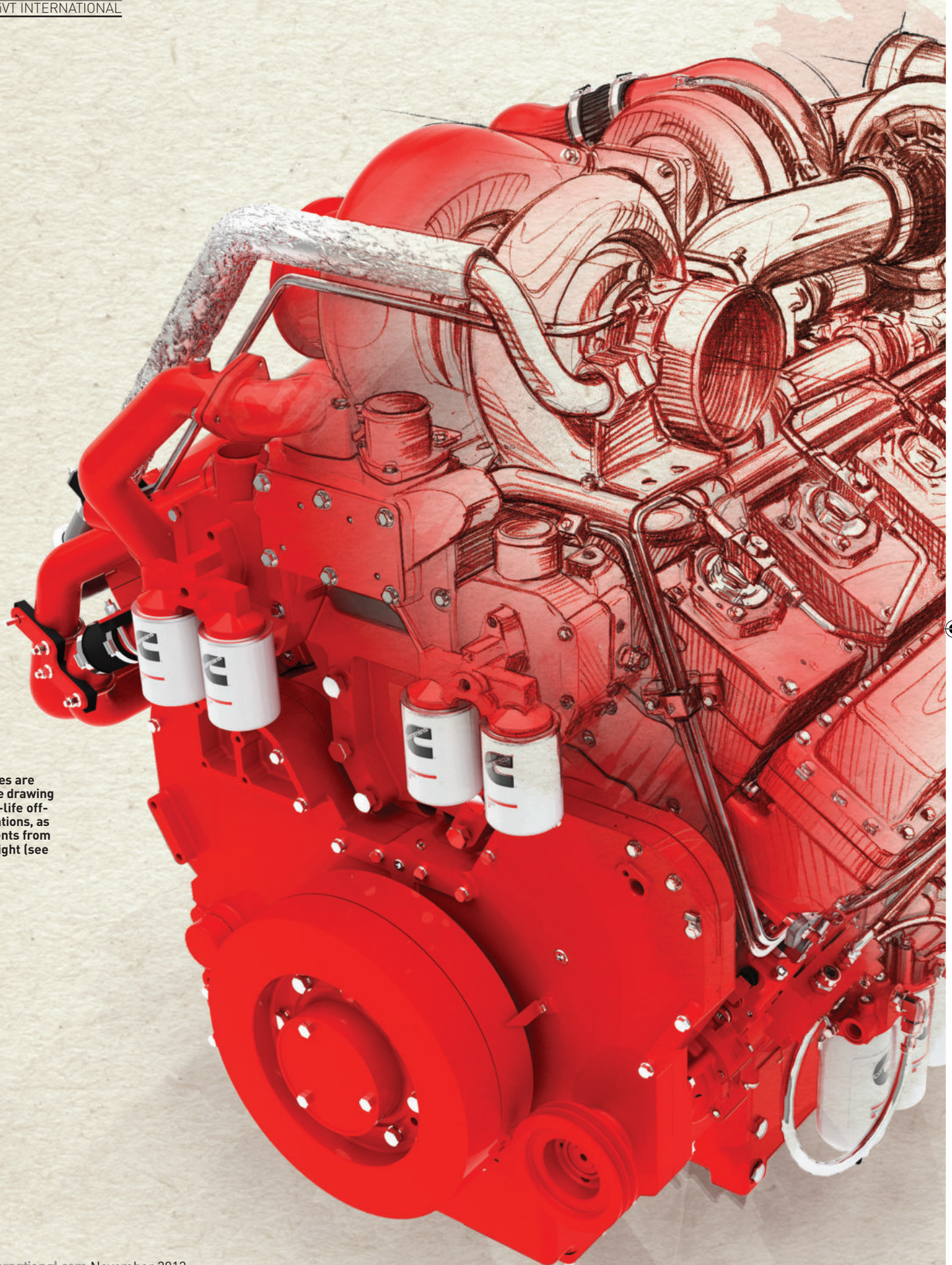
ACUITY®
BATTERY MONITORING SYSTEM

acu·ity [ah-kyoo-i-tee] *noun* [from Old French, from Latin *acūtus* acute]: keenness of perception: sharpness; acuteness: a quick and penetrating intelligence: in battery monitoring the newest, most accurate, most advanced CAN system to capture true Battery State-of-Charge and Battery Condition intelligence to improve vehicle productivity and provide a battery warranty-witness: only from Curtis.
See for yourself. Go to the video: **http://tiny.cc/acuityvideo**

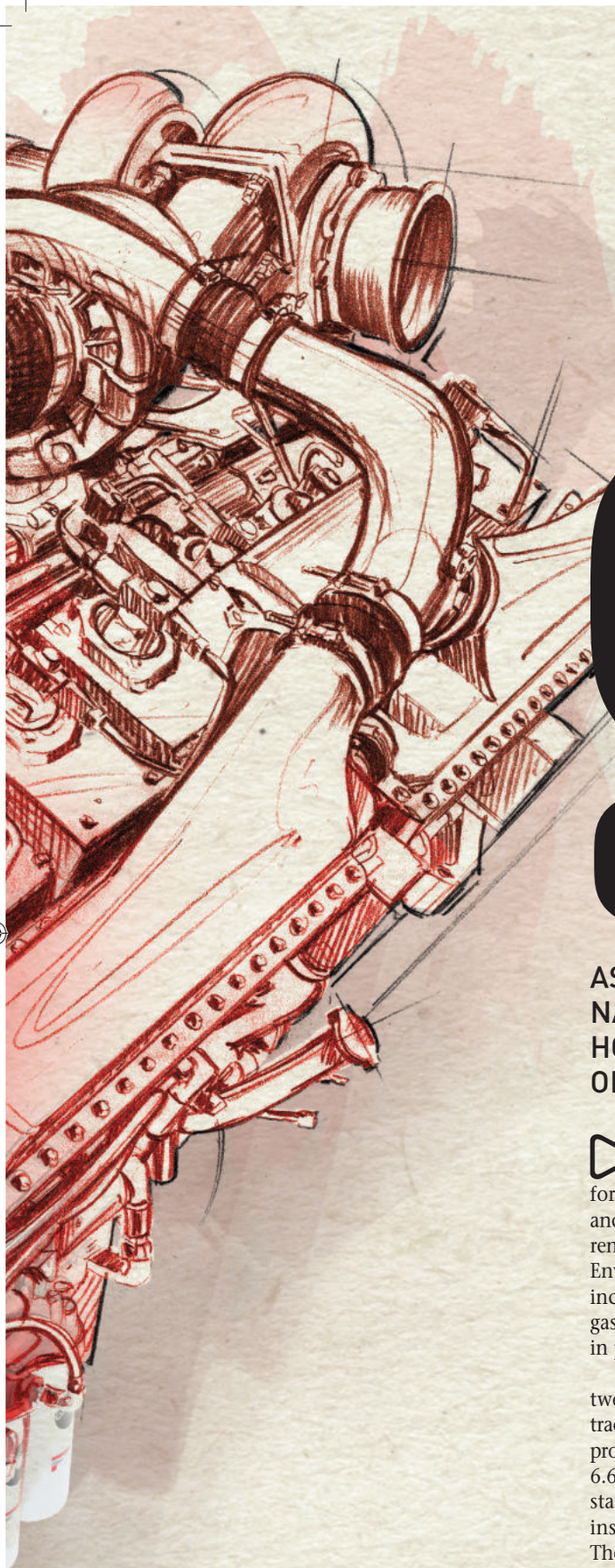
curtisinstruments.com

CURTIS

JON LAWSON, iVT INTERNATIONAL



Dual fuel engines are moving from the drawing board into real-life off-highway applications, as new developments from Cummins highlight (see page 60)



GAS GUZZLERS

AS OIL RESERVES DWINDLE WHILE THE RESERVES OF NATURAL GAS APPEAR TO GROW LARGER EVERY DAY, HOW LONG WILL IT BE BEFORE ENGINES DRINKING GAS OR DUAL FUEL BECOME THE NORM IN OFF-HIGHWAY?

Dual fuel engines have been on the fringes of popularity for decades, but spiralling diesel and petrol costs have now triggered renewed interest across the industry. Environmental factors are becoming increasingly important, and natural gas and biogas can offer reductions in particulate matter as well as CO_2.

Valtra, for instance, already offers two dual fuel engine options in its tractors: a four-cylinder, 4.4-litre unit producing 120bhp, and a six-cylinder, 6.6-litre unit with 145bhp. The story started in 2005, when the company instigated a research programme. The following year, a prototype was built for field testing and to enable the OEM to gauge market interest. Then, in 2010, its first generation of diesel/gas tractors was launched.

Pekka Ingalsuo, director, product management at Valtra, takes up the story: "We went with the dual fuel approach because we knew that there may be times when the gas would not be available, so the new engines also had to be able to run on diesel alone. The gas can be compressed biogas or CNG, as long as it is a 'traffic quality' level, with a 98% methane content."

The likely fuel used depends on the country. For example, in Russia there is an abundance of natural gas, but not much biogas. The situation is the reverse in Sweden, where large amounts of biogas have led to a keen interest in dual fuel.

Ingalsuo views the Swedes as pioneers. "There is the political will, which really helps," he says. "We are currently involved in a two-year development project called Meka, where we are trying to prove that dual fuel tractors can work under any conditions. It started at the beginning of 2013, with tractors

performing a variety of jobs for the municipality. This is because the gas refill stations are more popular in urban areas."

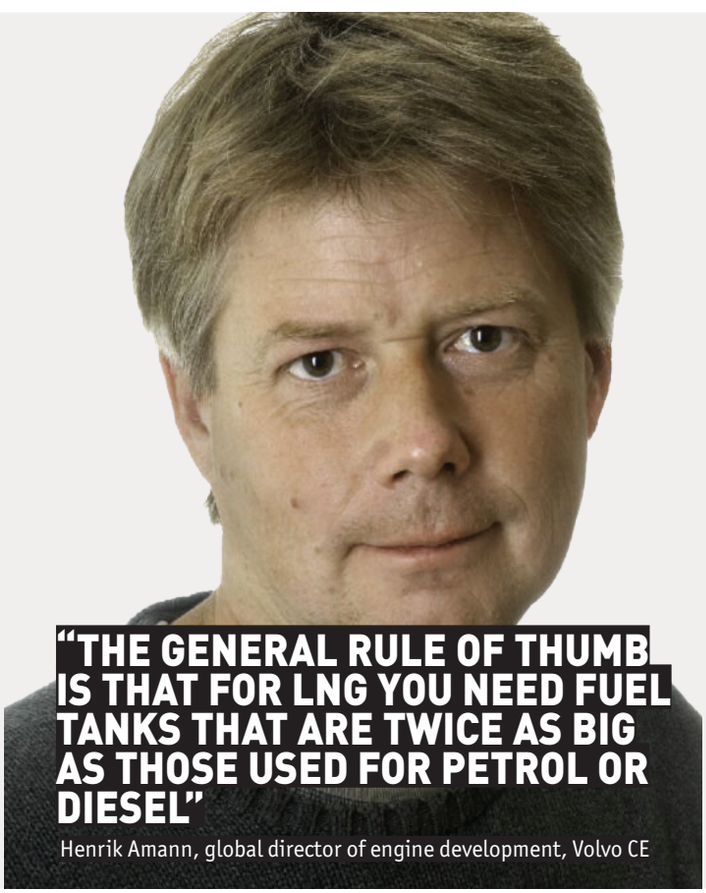
The favourable tax situation in Sweden can cut operating costs by up to 25%. According to Ingalsuo, though, the difference is even starker in Russia, where they can be cut by up to 70%. The engine's characteristics remain unchanged when run on gas, and there are no changes to service intervals. The only difference that Ingalsuo has noticed is that there is a slight reduction in noise levels.

The gas injection system is housed in the intake manifold, with extra injectors in the head to deliver it. A pilot diesel injection of about 15% is used to ignite the mixture. This, along with the tweaked ECU, are the only changes from the standard engine. A mode switch in the cab can be used to override the electronic control, which optimises combustion.

"The biggest challenge was to find a robust installation for the gas tanks," Ingalsuo adds. "Mindful of ground clearance, we decided to fit them under the corner of the cab,

in accordance with the only available regulation – ECE R10. It's an on-road regulation, but for the time being that is all we have."

In fact, regulation, or the lack of it, is an issue that is hampering the development of the sector. Ingalsuo explains: "Emissions legislation is effectively the showstopper for this programme. We need approval on each individual tractor we sell. The European Union rules recognise only diesel – there is nothing on gas. So we are working hard to convince everybody that the legislation needs to be amended to include dual fuel."



"THE GENERAL RULE OF THUMB IS THAT FOR LNG YOU NEED FUEL TANKS THAT ARE TWICE AS BIG AS THOSE USED FOR PETROL OR DIESEL"

Henrik Amann, global director of engine development, Volvo CE

THE OEM VIEW (#1)

iVT grabbed 15 minutes with Volvo Construction Equipment's Anders Larsson (VP Technology), and Henrik Amann (global director of engine development) at Bauma in April and asked a few questions on the subject of natural gas.

What's Volvo CE's current stance on natural gas?

AL: We are examining potential alternative fuels while developing relevant machine technologies and systems. At this time, natural gas is one of the most promising alternative fuels we are investigating.

We have the strength of the Volvo Group behind us and all the benefits this brings for sharing technology. Several different gas engine options have been developed, and we are working closely with Volvo Trucks, which has a lot of experience with different gas solutions. Biogas is one of the alternative fuels we're looking at too.

HA: The Volvo Group has lots of experience with different gas solutions, and lots of on-the-shelf solutions. So if the market is there, we can move very quickly.

Would the approach be mainly dual-fuel or full gas engines?

AL: Currently diesel-methane is our main area of investigation.

SDLG was just one of four or five Chinese OEMs showing an LNG-powered wheeled loader at Bauma China 2012. Did Volvo have a hand in that, and why are the Chinese taking the lead in advancing this area of off-highway technology?

AL: SDLG is our JV company so we are obviously working quite closely together. China has huge domestic reserves of gas and they see this as a fantastic opportunity for an alternative fuel.

Would different types of applications or vehicles get more benefit from different forms of gas, or is it purely a case of what's the most convenient to store or purchase?

AL: The real challenge is infrastructure and distribution; a market needs to be established and connected to a supply of natural gas. Stationary applications such as huge mining sites that will be around for more than 20 years and require a lot of fuel would be ideally suited for gas-powered machines.

LNG has to be stored at -162°C in special cryogenic tanks that act just like a thermos to prevent it evaporating. So once the gas is in the machine's fuel tank it needs

LEFT AND FAR LEFT:
AGCO Power's biogas engines adopt SCR to enable dual fuel Valtra tractors to meet diesel exhaust emissions requirements

All in all, this is quite a bizarre situation, as Valtra's own tests have confirmed that the exhaust CO_2 is reduced by 25% using gas, and there are considerable reductions across the fuel supply chain. It is clearly slowing the growth of the sector: Valtra currently sells around 100 of these dual fuel tractors a year, but Ingalsuo is convinced the number could be 10 times this many. "But it's not just tractors. We should be running all sorts of industrial vehicles with a dual fuel capability," he adds.

On/off relationship

FPT Industrial is also observing the market closely. A seasoned supplier of natural gas engines for on-highway applications, the company currently produces 3-, 6- and 8-litre models specified to Euro 5/6 for medium/heavy commercial vehicles and bus applications. FPT's customers favour CNG for buses, and LNG for trucks.

Oscar Baroncelli, FTP product marketing manager, explains, "This is based on the emissions profile that is required, and also the available refuelling options locally. We are

to be used fairly quickly – the machine could probably remain inactive over a weekend but longer than that and the gas will start to evaporate.

The same also applies when the gas is in storage at filling stations. Although these tanks will be considerably larger – meaning the gas will take longer to evaporate – a continuous internal fuel turnover would still be essential. Of course, if you are working in an isolated area or frequently changing your location, it could be very challenging to get access to gas.

Does gas have to be stored in canisters or could you build-in a traditional-style fuel tank if you started with a clean-sheet design?
HA: The shape of the fuel tanks is defined by the need to keep LNG cold and by the high-pressure environment required for CNG. The majority of gas vehicles today use CNG and the general rule of thumb is that you need fuel tanks that are five times as big as those used for petrol or diesel. With LNG that ratio falls to 2:1. Because the required volume is so much bigger, it's difficult to store the gas under the hood. However, it is important that the location of the tank does not affect the operator's visibility.

What other engineering changes would have to be made apart from the fuel tanks?
HA: The degree of engine alteration will depend a lot on the choice of technology. If we take a diesel base engine, diesel-methane technology would require the least amount of adjustments. For spark-ignited and High Pressure Direct Injection (HPDI) engines, greater modification would be necessary.

What implications would natural gas have regarding aftertreatment and meeting current and potential future off-highway emissions regs?
HA: It's hard to say as there are currently no regulations for gas engines. Diesel-methane engines need to be certified running in pure diesel mode meaning the same aftertreatment system that we use today would need to be in place. The real challenge when it comes to emissions for gas engines is methane-slip. Spark-ignited engines can tackle this with a three-way catalyst, similar to those used in petrol engines. Methane catalysts will require extremely high temperatures to work effectively.

Are there any differences in terms of explosion prevention?
HA: Natural gas is a combustible substance. To ensure safe and reliable operation, measures are taken in the design, construction and operation of LNG-powered vehicles and machines.

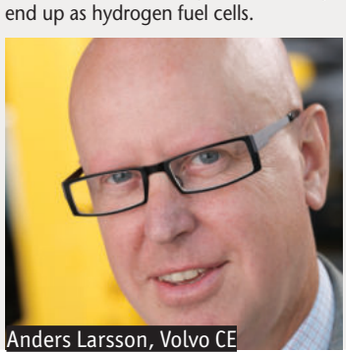
In its liquid state, LNG isn't explosive – it must first vapourise, then mix with air in the correct proportions (the flammable range is 5-15%) and then be ignited.

Are there any performance advantages for construction equipment switching to gas?
AL: It's more about the environment and making use of alternative fuels – performance-wise, I don't see anything. But there can still be volatility surrounding fuel prices – you can be heading in one direction, then the government changes the way it subsidises these fuels and you're off-track once again!

CNG is common in Automotive in India – could that sector in the West set a lead that off-highway follows?
AL: Technology often starts in passenger cars and then is used in trucks before it ends up in construction equipment – this could be valid here. However, a completely different infrastructure to deliver gas would be required, and that's where the challenge lies.

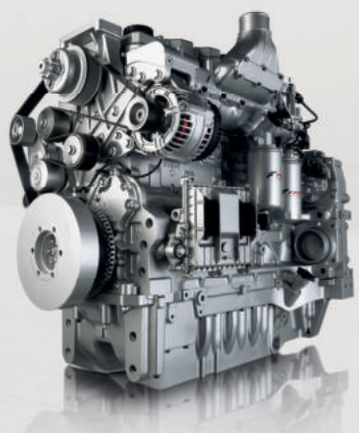
Could we soon regularly see spark-ignited off-highway engines?
HA: We can already see some products with spark-ignited gas engines, such as the SDLG wheeled loader. Both ignition technologies have their advantages and disadvantages, so we are likely to see them both on the market in the future.

Could hydrogen be a potential off-highway fuel as well?
AL: Our SfinX excavator concept was designed with hydrogen fuel cells so this is something that is in our minds. But I think this technology is still quite far away from the market. Electrification will probably start with the traditional downsizing of diesel engines, but in the future this could develop and eventually end up as hydrogen fuel cells.


Anders Larsson, Volvo CE

www.fptindustrial.com

NO WORK IS TOO HEAVY
FOR FPT ENGINES.



FPT INDUSTRIAL ENGINES. DESIGNED TO GO BEYOND.

FPT Industrial takes every project as a challenge. This is why we put our passion and experience in developing engines that set the standard of excellence. Equipped with innovative HI-eSCR technology, our specifically designed engines for agricultural equipment match maximum power with low fuel consumption and reduced emissions, without Exhaust Gas Recirculation (EGR).

MARINE | ON ROAD | **OFF ROAD** | POWER GENERATION

FPT POWERTRAIN TECHNOLOGIES

POWERING THE FUTURE.

offering only pure gas at the moment. We are testing an on-road dual-fuel design, although currently it is just a prospect." FPT takes the view that if its customers ask, it will be ready.

This on-road experience could be about to filter through to the off-highway business, and Baroncelli confirms the company is working with a prototype at the moment.

"The only major doubt we have concerns autonomy. With tractors, for example, we are reluctant to compromise vehicle usage because of limited range. However, we can see great potential for where biogas can be produced on the farm."

Another issue to be included in the overall specification, of course, is performance. Baroncelli observes, "Any gas engine running on the Otto cycle will require greater displacement to achieve the same torque, and with

ABOVE: **XCMG showcased its LNG wheeled loader at BICES last month**

current technology, this is a factor when it comes to intensive or open field use. So development must be focused on increasing torque at low revs to improve vehicle productivity. However, natural gas engines can offer lower costs compared with Tier 4B engines, thanks to their simpler exhaust aftertreatment system."

Deep in the FPT laboratories, the new off-highway engine is now being put through its paces on a testbed. Baroncelli is unable to go into much detail, but what he can say is this: "Like with the on-road development, we want to be ready if customers ask us for this type of engine. So we have a Euro 6/Tier 4-rated engine, which runs on pure gas. It is true that dual fuel can offer greater flexibility but, with greater interest in biogas, there could be a market there.

WILL THE BENEFITS STACK UP?

Kalmar has started a project, as the primary external industrial partner of the GreenCranes pilot action, for the engineering and realisation of a reach stacker prototype that uses dual fuel technology (diesel and LNG).

To achieve this ambitious project, the manufacturer signed a partnership agreement with its customer Global Service, the leader of the pilot and one of the most important players in the Italian equipment rental business.

Kalmar and Global Service are working closely on the creation of this prototype, which is expected to deliver some significant results in terms of environmentally friendly operation. The prototype was expected to be ready as *iVT* November went to press, with GreenCranes staff being invited to assist in the test phase. A public demonstration of this pilot will take place on 4 December 2013 at the Port of Livorno, Italy.

The pilot and demonstration will be based on the adaptation of a Kalmar reach stacker as a means of reducing environmental impact and energy consumption. The project's pilot phases are:

- The design of a reach stacker that adopts alternative environmentally compatible fuelling and a dual fuel (LNG/diesel) engine;
- Integration and realisation of a prototype according to the design;
- Functional testing of the prototype;
- Pilot of the prototype and analysis of performance in a real port container terminal.

The engine being incorporated into the reach stacker is a Cummins QSM11 converted to run on LNG power. Liquefied natural gas is natural gas – mostly methane – which has been cryogenically super-cooled and condensed into liquid form for easier storage and transport.

Because LNG is lighter than air, should gas leak out, it evaporates quite safely into the atmosphere. By contrast, LPG (liquefied petroleum gas) is heavier than air and falls to ground level when released.

RIGHT: **Valtra's N101 tractor. The OEM initially introduced the biogas concept in Sweden on 30 June 2010**

"Looking further ahead, over the next decade or so, everything is up to state politics and incentives. For example, in China there is increasing interest in LNG in the construction market. Also there are rumours swirling around Stage 5 concerning CO_2, which could lead to natural gas engines suddenly becoming even more popular."

Port story

Cummins Engines is also keen to take advantage of the recent growth in interest in gas-fuelled engines. John Burgess, general manager of on-highway natural gas, says, "This has been in the background for some time, but over the past six to twelve months we have certainly seen an increase in activity – for example, in the port sector. It seems to be connected with a wider focus on improving the green credentials of the shipping industry as a whole, especially where main propulsion engines are concerned.

"In the past, infrastructure and availability issues have held gas back, but as gas supplies are put in place in ports, customers are starting to get more imaginative about using the fuel for materials handling."

Burgess points out that Cummins' main thrust with natural gas remains on the automotive side, and that the industrial applications are a small – yet growing – side of the business.

"The easiest installations for us to deal with are the ones that operate like on-road applications, and port terminal tractors are a particularly good example of that. Gas engines do not currently feature in European off-highway legislation and so it is appropriate to use highway-certified natural gas units in these types of application."

Looking forward, Burgess firmly believes that this sector will expand. "To what extent it will grow is not quite clear, but there are certainly opportunities there, both for engine makers and the end users to get the benefits of natural gas.

"Gas engines can also make a significant contribution to reducing greenhouse gas (GHG) levels. Studies have indicated that, on a well-to-wheel basis, GHG reduction can be as high as 15-20%, and if biomethane is used, then the GHG savings are much higher. Biomethane is a really effective fuel – the methane molecule is identical to methane from fossil sources, so engine operation remains largely unaffected."

GO BIG OR GO HOME

Westport and Caterpillar have announced an agreement to develop natural gas technology for high-horsepower off-highway equipment, with an initial focus on mining trucks and locomotives. They will combine technologies and expertise, including Westport's High Pressure Direct Injection (HPDI) technology, to develop the natural gas fuel system. Cat will fund the development programme. When the products go to market, Westport expects to participate in the supply of key components.

"This is a significant opportunity that has the potential to transform important segments of the global off-road equipment industries," declared David Demers, CEO of Westport Innovations. "We are working with the global leader in engines, locomotives and off-road equipment to develop an attractive natural gas offering for its customers. The substantial price difference between natural gas and diesel fuel is resulting in a strong financial incentive to enable off-road applications to take advantage of low natural gas energy costs without sacrificing operational performance. There is also a clear environmental incentive because of the reduced carbon emissions. Adding to the solid business case for this programme is the potential to convert existing field units to natural gas – opening up a whole new market opportunity."

While the agreements initially focus on engines used in mining trucks and locomotives, the companies will also develop natural gas technology for Caterpillar's own off-highway engines, which are used in a variety of electric power, industrial, machine, marine and petroleum applications worldwide.

"Many of our customers are asking for natural-gas powered equipment in order to reap the financial and environmental benefits," Steve Fisher, VP of Caterpillar's Large Power Systems Division, said. "The programme positions Caterpillar to become the first manufacturer to bring HPDI technology to the high horsepower off-road market, offer the broadest product line of natural gas-fuelled machines and equipment, and capitalise on the attractiveness of natural gas as an alternate mobile fuel – all within the shortest time frame for our customers."

Development programmes will start immediately for both new and existing engines, combustion technology and fuel systems. Commercial production is expected to begin in about five years.

ABOVE: **Yet another LNG wheeled loader from a Chinese OEM at BICES 2013 – this time, new startup Ensign**

It's a syn

The bulk of the development may be focused on natural gas or biogas, but these are not the only options. Synthesis gas – or syngas – may be a historical footnote at the moment, but the concept of running a fleet of vehicles on what could essentially be a waste product has an inevitable economic appeal.

Also known as producer gas, or sometimes wood gas (should that be the chosen fuel stock), syngas is created by a biomass gasifier unit. The fuel is broken down by pyrolysis, releasing its constituent gases and leaving charred ash behind.

According to the Federal Emergency Management Agency (FEMA), in its surprisingly readable 1980s publication *Construction of a Simplified Wood Gas Generator for Fueling Internal Combustion Engines in a Petroleum Emergency*: "In occupied Denmark during World War II, 95% of all mobile farm machinery, tractors, trucks, stationary engines, and fishing and ferry boats were powered by wood gas generator units."

FEMA even went to the trouble of building and testing a gasifier for a spark ignition tractor.

As soon as liquid fuels became more readily available after 1945, gasification was placed on the back burner, and FEMA's dissemination

RIGHT: **SEM, Caterpillar's Chinese operation, is already on the ball with LNG, as this exhibit on its booth at BICES showed**

THE OEM VIEW (#2)

As part of the Caterpillar Bauma Round Table discussion featured in *iVT* June, Richard Carr questioned Tana Utley, Cat's vice president responsible for the industrial power systems and growth markets division on the topic of natural gas…

Why could natural gas be the future for off-highway engines?

If you look at the long term – regardless of whose projections you look at – everybody says, "Petroleum-based products and diesel fuel prices are going to go up". It will be like a guy walking up stairs with a yo-yo – the yo-yo will go up and down but it's still going up. So that's what's we think's going to happen to diesel fuel prices.

With natural gas, the guy still has a yo-yo but he's basically walking a flat path, maybe going up a little bit. That's due to the fact that there's so much natural gas, especially in North America. So there's no doubt that there's a huge long-term future in natural gas. That said, it will only come to market as the ecosystem for it develops.

You're going to see it first in mining, where you can put in the infrastructure to be able to use that. It's not going to be first to go to market in places where you have to have multiple fuelling points. So you'll start to see some increase in adaptation for that as the infrastructure develops and as diesel prices continue to rise.

What are the problems, particularly regarding integration within the machine? And what about its effect on aftertreatment?

It's not as energy dense as diesel, so your tanks have to get a bit bigger if you're going to be able to run the same kind of shift. Then you also have to have a way to contain it. So there's a storage challenge. You can usually classify two challenges in product development – sometimes there's a science challenge, where you're trying to defy the laws of physics; other times it's purely an engineering challenge where it's just good hard work. Getting it on the machine is more a case of the latter.

You also have to have the engine tuned especially for it – everybody likes a diesel engine because it has a nice torque rise, so you have to be able to tailor the performance accordingly. Many of Caterpillar's current applications, especially locomotives or mining, involve gensets, so it's likely to involve dual fuel. So as you're using a little bit of diesel to ignite the natural gas, you have to be able to meet the diesel emissions regulations. That said, we really don't see that as a challenge.

"THERE'S SO MUCH NATURAL GAS, ESPECIALLY IN NORTH AMERICA. SO THERE'S NO DOUBT THAT THERE'S A HUGE LONG-TERM FUTURE IN NATURAL GAS"

Tana Utley, Caterpillar VP responsible for industrial power systems

efforts were really only intended for emergencies, rather than a serious attempt at stimulating research into alternative fuels.

Fast-forward to today – when, in addition to capturing the interest of the survivalists and eco-warriors that populate YouTube, syngas is now increasingly being viewed as a credible fuel by some multinationals. There are, however, serious obstacles to be overcome before it turns up powering a dump truck or dozer any time soon.

Clarke Energy has been working with GE syngas engines for years, but only in stationary applications such as power generation. Alex Marshall, Clarke Energy's group marketing and compliance manager, outlines some of the issues: "Some gasifiers work well and so do the engines. However, due to certain difficulties in the gas conditioning stage, a compelling commercial argument is only just emerging."

Progress is being made, though, and Marshall cites one promising recent application in Northern Ireland, where there is an engine using wood chip syngas for power generation purposes. He continues, "There is a huge potential market, and there is no shortage of people willing to put money into it."

The syngas used by the GE engines consists of methane (CH_4) and hydrogen (H_2). The rapid speed at which the hydrogen burns means the engines are derated from normal natural gas output so, for an engine that could fit on a large dump truck, for example, this could effectively result in a power output drop of around one half to a third for a 1,500rpm unit, although this could still provide ample power.

If packaging constraints mean it would be difficult to incorporate an onboard vehicle gasifier, might it not therefore be plausible to generate the syngas remotely and bring it to the construction site, mine or forest?

Perhaps a lesson could be learned from a project Clarke Energy carried out with Nestlé in Nigeria. Marshall explains, "Because of the high cost of diesel, by taking CNG (compressed natural gas) for the generator engines in by truck, the company is saving 30% on its fuel costs.

"Regarding whether syngas will ever be compressed and transported to power industrial applications, it will really all boil down to a cost, technology and safety analysis. There are challenges – but it's not beyond the wit of man to do it." **iVT**

Smallest to Largest

Ultra-Low Emission Engines – 49 hp to 4200 hp.

We have one of the strongest Tier 4 Final capable engine line-ups available today. Cummins engines range from the QSF2.8 at 49 hp (37 kW) up to the QSK95 at 4200 hp (3132 kW).

This unique range enables us to offer the most advanced power solutions and to meet the most stringent low-emission standards. Contact us today to find the best Cummins engine for your equipment.

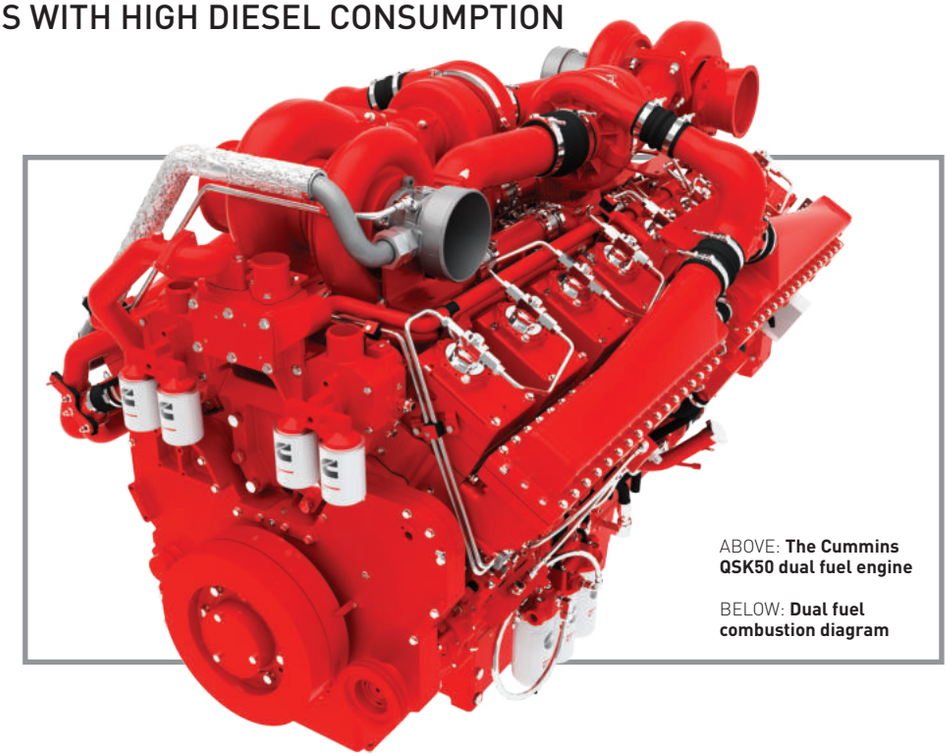
Contact telephone: +44 1325 554829
Email: enquiries.engines@cummins.com
Website: www.cumminsengines.com
Twitter: @cumminseurope

Cummins®

SAMANTHA GRAVELLS

Gas giants

THE COST ADVANTAGES OF NATURAL GAS ARE BEGINNING TO MAKE DUAL FUEL ENGINES AN INCREASINGLY ATTRACTIVE CHOICE, ESPECIALLY FOR LARGE MOBILE APPLICATIONS WITH HIGH DIESEL CONSUMPTION



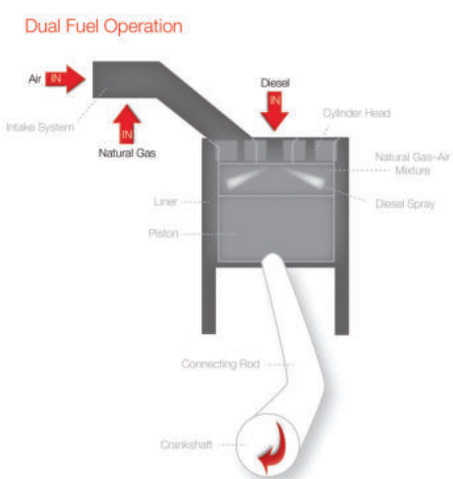
ABOVE: **The Cummins QSK50 dual fuel engine**

BELOW: **Dual fuel combustion diagram**

Cummins dual fuel engines are enhanced with specific hardware that enables the unit to run on a mixture of diesel and natural gas – with the flexibility to run on diesel alone. A dual fuel engine provides an economic benefit to the operator, via the substitution of diesel fuel with lower priced natural gas, particularly in markets such as mining and well servicing, which are consumers of a considerable amount of diesel fuel.

The rapid expansion and abundance of shale gas in some areas of the world is driving a dramatic cost advantage of natural gas over diesel fuel, making the former a very economical fuel source. For operators of high-horsepower equipment, where power density is particularly critical and large quantities of fuel are burned, Cummins' dual fuel technology provides an opportunity for impressive reductions in total fuel costs, while generating a cleaner exhaust output. With a lower carbon footprint, natural gas substitution therefore provides an opportunity for diesel engines to become even cleaner.

When operating in dual fuel mode, the Cummins engine works by introducing natural gas into the air intake system. The air-to-natural gas mixture from the intake is drawn into the cylinder, just as it would be in a spark-ignited engine, but with a leaner air-to-fuel ratio. Near the end of the compression stroke, diesel fuel is injected, just as it would be in a traditional diesel engine. The diesel fuel ignites, and the diesel combustion causes the natural gas to burn. A dual fuel engine can operate either on 100% diesel fuel or the substitution mixture of diesel and natural gas, but it cannot operate on natural gas alone.



Dual fuel engines deliver the same power density, torque curve and transient response as the base diesel engine does. One critical parameter for dual fuel operation is the substitution rate, which is defined as the fraction of the total fuel energy that is provided by the natural gas. Substitution rates vary by load, fuel quality and other factors, so overall fuel cost savings vary, and are higher for applications with high load factors. A maximum substitution rate of 70% or more can be achieved with Cummins dual fuel engines.

New additions

The first engine in the Cummins dual fuel portfolio for mining is the QSK60, with additions to follow, including models capable of meeting EPA Tier 4 Final legislation. The 60-litre engine uses integrated controls to optimise the substitution rate based on operating conditions, and is able to seamlessly and automatically transition between diesel fuel and dual fuel mode, giving the customer flexibility depending on natural gas availability at the mine site. With an output of 1,782-2,850bhp (1,329-2,125bkW), the QSK60 is capable of considerably reducing fuel costs by using dual fuel technology.

"Our investment in dual fuel technology reflects the demand from our customers wanting to take advantage of the favourable price spread between natural gas and diesel, while employing the reliable and durable engines they have come to expect from Cummins," says Srikanth Balasubramaniam, the company's director of high-horsepower natural gas business. "Cummins is committed to advancing the use of natural gas in off-highway engine applications."

Cummins also provides dual fuel engines for well-servicing applications, delivering optimum solutions for fracking equipment. The first engine in its dual fuel portfolio for this application is the QSK50, delivering 1,400-2,500bhp (1,044-1,864bkW), and there are other engines to follow, including engines capable of meeting worldwide emissions regulations. **iVT**

Samantha Gravells is marketing communications manager at Cummins Engines

CONTACT
www.cumminsengines.com
enquiries.engines@cumminsengines.com

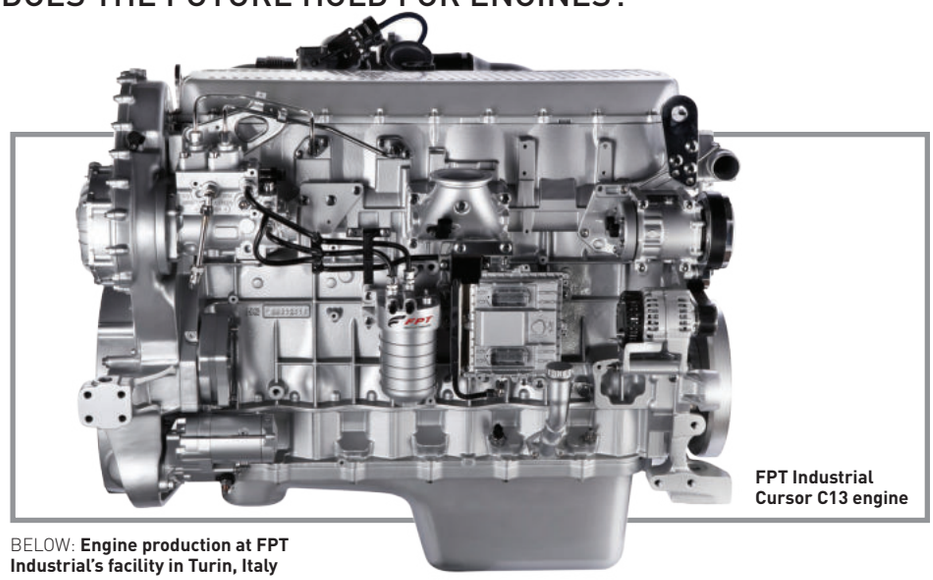
MASSIMO SIRACUSA

Whatever next?

THE ENFORCEMENT OF EMISSIONS REGULATIONS TYPICALLY LEADS TO PEAKS IN TECHNICAL INNOVATION. BUT, WITH NO FURTHER LEGISLATION EXPECTED UNTIL 2020, WHAT DOES THE FUTURE HOLD FOR ENGINES?

For the past two decades, engine manufacturers have been all but obliged to focus their R&D attentions on tackling emissions. The increasingly stringent regulations, particularly in Europe and the USA, have been a catalyst for major leaps in technical advancement and harmful emission particulates have reduced by 95% in two decades.

From exhaust gas recirculation to selective catalytic reduction, the powertrain market has revolved around meeting these regulations. FPT Industrial has been no different, and most recently introduced HI-eSCR, a system that uses clean air in the engine rather than EGR and converts nitrogen oxides (NOx) to diatomic nitrogen and water, reducing NOx emissions by 95%. But what's next on the agenda?



FPT Industrial Cursor C13 engine

BELOW: **Engine production at FPT Industrial's facility in Turin, Italy**

Take a deep breath

The next instalment of emissions regulations are expected to come into play in 2020 or 2021, with the focus anticipated to be a reduction in CO_2 levels. With this some way off and the new restrictions not yet confirmed, engine manufacturers have an opportunity to change their focus and review other developments in engine technology.

For some time, due to the focus on emissions, the needs of the end user have been forced into second place. In the upcoming period, the major players are expected to look more closely at these requirements and move them to the fore. At FPT Industrial, the change is already well underway and is leading to two main avenues of development – a reduction in fuel consumption and an increase in performance for any kind of mission.

In all the sectors where FPT Industrial's solutions can be found, from construction and agriculture to commercial vehicles, the difficult economic climate remains and total cost of ownership is now of major importance to the end user. Fuel prices continue to rise, meaning efficient equipment that offers excellent performance and productivity is high priority. The company is therefore looking to address this by focusing generally on an overall improvement in efficiency, which will both reduce fuel consumption and increase performance.

Although there is potential to make an internal combustion engine more efficient itself, the greater efficiency increase is to be achieved across the entire vehicle. Simulation results show a notable decrease (more than 10%) in fuel consumption if the energy sources and energy demands of an industrial on- or off-highway vehicle are governed through the actual duty demands rather than through predetermined datasets. Switchable auxiliaries that adapt their output to actual needs, energy buffers to equalise the engine's dynamic load, and the use of additional information, such as GPS, with an intelligent control system are key factors for highly efficient future products.

As well as optimising the interaction between the powertrain and vehicle, FPT Industrial's innovative plan is grounded on pillars such as the base engine, combustion efficiency, auxiliary management, air handling and energy recovery. This is a plan to which the company has committed through 'FPT Virtual Development'. This new system will help save money and time, increasing the implementation speed of new innovations in the final product, and will see the integration of model-based control.

FPT Industrial will be working closely with its customers, such as sister companies Case IH, Iveco, New Holland and Steyr, and Caterpillar, Claas and Ford on sector-specific requirements as it moves towards improving the overall efficiency of the equipment.

Such notable technological developments in recent years mean that upcoming enhancements will not be in the form of one major innovation but the sum of several technologies, enabling the evolution of the industrial diesel engine. There will be 'tweaks' to the engine and the aftertreatment systems, rather than complete new developments: the technology will be an evolution not a revolution. The real revolution will be in managing the various elements that use or create energy within the equipment as a whole.

With the powertrain landscape so emission-focused, the competition will potentially increase between the major engine players as they strive to make the most significant changes to reduce total cost of ownership. 'Energy management' will not only provide significant benefits for the end user, but will also ensure a competitive edge for those employing it. **iVT**

Massimo Siracusa is FPT Industrial's VP of product engineering. More info can be found in 'From clean diesel to clean energy, CO_2 emissions will change the game', which he presented at 7th AVL International Commercial Powertrain Conference

CONTACT
www.fptindustrial.com
sales1@fptindustrial.com

HANNAH KITCHENER

Made in heaven

KONECRANES' LIFT-TRUCKS HAVE BEEN PREDOMINANTLY POWERED BY THE SAME ENGINE SUPPLIER FOR SEVERAL DECADES. WHAT'S THE SECRET TO A LONG AND HAPPY MARRIAGE OF OEM AND COMPONENT SUPPLIER?

Konecranes has been a leading international provider of premium forklift trucks, container handlers and reach stackers to the container handling and industrial sectors since it was founded in the 1950s. For the past few decades, Volvo Penta has played a significant role in the company's global success, in supplying more than two-thirds of the engines across the OEM's entire lift-truck range – from the TAD-560-series engines used in smaller forklifts (10-18 tonnes) and container handlers (8 tonnes) to the TAD-1360-series engines used in the larger forklifts (37-70 tonnes), container handlers (37-52 tonnes) and reach stackers (40-80 tonnes).

"When we first started working with Volvo a long time ago, it was the natural choice," says Konecranes general sales and marketing director Patrik Lundbäck. "We are Swedish, they are Swedish – we speak the same language." Volvo Penta's headquarters in Gothenburg is located just two hours' drive from Konecranes' factory in Markaryd, easily allowing face-to-face consultations as well as reliable delivery. But the convenience of partnering with Volvo Penta goes far beyond linguistic and geographic advantages.

Custom care

"At Konecranes, none of our lift-trucks are 'off-the-shelf'," Lundbäck explains. "Our customers choose from a wide range of power ratings and emissions certificates to suit their requirements – and no single brand covers as many of our engine options as Volvo."

Through the use of clever aftertreatment systems and software programmes, Volvo Penta can offer four emissions levels – EU Stage II, Stage IIIA, Stage IIIB and Stage IV – for different parts of the world and up to 15 variations in power from the same basic engine. "Why source engines from five different suppliers when you can have all your needs met by one? Volvo has a very good understanding of what we want, and is always willing to accommodate our wishes," Lundbäck adds.

Konecranes still offers its customers two alternative brands in the spirit of choice – a competitor brand may fit better with a customer's existing fleet or have service technicians in closer proximity – but the majority opt for Volvo. Volvo engines are among the most durable and reliable around – they are designed to last the entire lifetime of the machine they power. For Konecranes lift-trucks, this is around 25,000-50,000 operating hours and, with a major engine overhaul at 15,000-25,000 hours, a Volvo engine will typically outlive many of the other components, even in extreme climates.

ABOVE: **From the D5 to D11, Volvo Penta's Stage IV engines are already being put through their paces in Konecranes' forklifts**

"Still, we often find that customers want to replace a Volvo engine with a newer model before it has reached the end of its usable life," Lundbäck says. Second-hand Volvo engines can then be resold to customers in Africa or Asia, for example, where age is less of a concern than price and reliability. "With the correct care, they just keep on going," he adds.

Preventative maintenance and oil changes are simple to carry out, and on the rare occasion that a fault occurs, Volvo Penta technicians are on hand to provide maintenance support, even after the original warranty period has ended.

Culture of collaboration

The relationship between Konecranes and Volvo Penta is a collaborative one. Volvo representatives pay regular visits to Markaryd to ensure the engines are optimally integrated and to advise on oils, insulation and cooling packages for customers all over the world. In turn, Konecranes plays a key role in the testing and optimisation of new Volvo engine models.

"Whenever there is a new model or emissions level coming, we produce a prototype and work together with Volvo to design the mountings and installations. Being involved at this early stage is instrumental in guaranteeing the best overall performance for our customers," Lundbäck says.

The two companies are currently collaborating on Volvo's Stage IV/Tier 4 Final-compliant engines to be launched in Europe and North America in early 2014. The new engine series in Stage IV configuration, from the D5 to D11, have been installed in one of the OEM's factory forklifts, as well as in a large reach stacker for the European market, and they are being thoroughly put through their paces.

"We have been running the engines as hard as possible over the past three months, and although we don't have any real results yet, our expectation is that they will be cleaner, quieter, more fuel efficient and have much longer service intervals. We can't wait to see what customers make of them," says Lundbäck.

"Of course, it's not just the quality of the engines that impresses us, but the overall service that Volvo provides," he adds. "Volvo Penta is a company that's willing to work with you rather than for you. So for me, the secret to a successful partnership is to find a supplier whose vision and values align with yours, and who can provide you with the same range and quality of products and services as you strive to offer your customers. After all, the end product is only as good as the sum of its parts – and thanks to Volvo Penta, our product is outstanding!" **iVT**

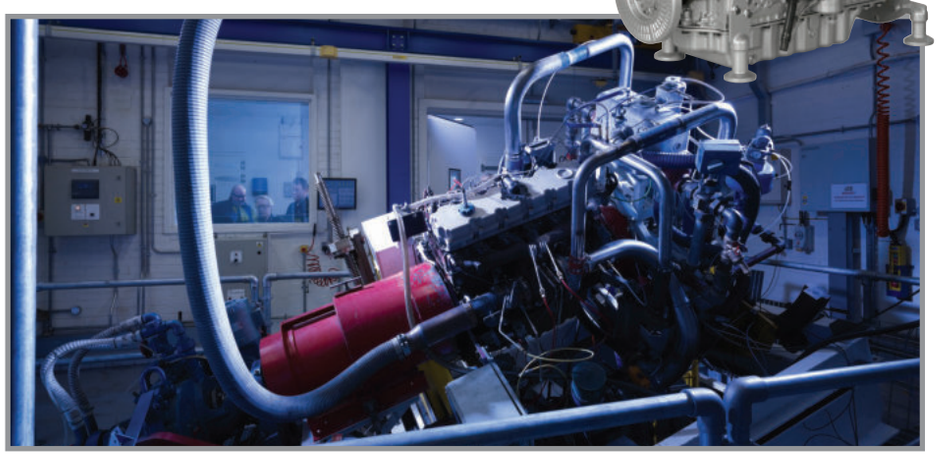
Hannah Kitchener works for SE10, the UK-based PR company that handles press relations for Volvo Penta

CONTACT
www.volvopenta.com
info.volvopenta@volvo.com

MIKE CULLEN

Work together

THE ADVANCED INTEGRATION OF EXHAUST AFTERTREATMENT SYSTEMS DELIVERS REAL BENEFITS FOR BOTH OEM AND END USER – JUST LIKE THE EXPERIENCE GAINED FROM TECHNOLOGY INTEGRATION WORKSHOPS



MAIN IMAGE: **Perkins engines go through the most stringent of validation tests, such as this tilt testbed, which replicates the way machines are used in the field**
INSET: **The Perkins 1206F-E70TA produces up to 151bkW at 2,200rpm**

For Perkins, the arrival of Stage IV/Tier 4 Final emission standards for the 130-560bkW (174-751bhp) power band in 2014 heralds a new era of engines with fewer emissions that will be more closely aligned with specific applications than ever before. From the initial concept of helping OEMs successfully deal with the integration of aftertreatment to meet emissions standards, the company's Technology Integration Workshop (TIW) programme has helped advance engine/machine integration to new levels. So far, the TIW programme has overseen more than 500 engine/machine installation projects for more than 150 global OEMs, but the benefits are being seen and felt beyond the engine bay. Today it is on-site where the improvements are being delivered and experienced.

Better fuel economy, more productive duty cycles and sharper engine response are just a few of the outcomes resulting from the TIW process, enabling OEMs to offer their customers a more competitive machine. Key to the process is a deep understanding of the duty cycle across many specific applications – knowledge that has been gleaned from more than 100,000 hours of datalogging of real-world machines.

During the TIW, Perkins engineers can call upon this data to gauge and assess how best to meet the specific demands of the application and review ways of enhancing performance. For example, its work with hydraulic excavators has driven several improvements in terms of offering OEMs a greater number and coverage of engine ratings to increase productivity yet maintain a competitive specific fuel consumption (SFC). Better understanding of the engine/hydraulic interface has been arrived at, enabling the engine to meet duty cycle demands more responsively. Operator comfort, itself an enabler of better productivity, has been improved by reducing fan noise.

So whether it be boosting torque availability for hydraulic excavators or improving SFC for dumpers where idling can be a major part of the work cycle, every opportunity is taken to match the engine to the actual machine operating cycle. Gains in fuel economy are unsurprisingly a main area of focus. In one TIW, working with a construction OEM on a 1206F installation, total fluid consumption was improved by a substantial 9% over the gains already made at Stage IIIB/Tier 4i. In fact, the actual saving on diesel fuel was greater as the total fluid consumption figure takes into account both the fuel and Diesel Exhaust Fluid (DEF) required for Stage IV/Tier 4 Final.

The joy of six

The experience behind every one of its power solutions means the Perkins range of 1206F engines will deliver the performance and productivity required by OEMs. The six-cylinder models, meeting Stage IV/Tier 4 Final emission standards, have been developed to provide a solution across many diverse applications.

For OEMs wanting a lot of torque at low speed, the single-turbo Perkins 1206F-E70TA is a six-cylinder, 7-litre unit that produces up to 151bkW (202bhp) at 2,200rpm with 870Nm of torque at 1,400rpm. The six-cylinder range also includes the twin-turbo 1206F-E70TTA, which delivers 225bkW (300bhp), giving OEMs who may have previously used a larger engine the choice of the same power from a smaller package. It features twin turbochargers – one small, one large, mounted in series – to provide extra power density, low-speed torque and faster transient response.

In developing the range, Perkins sought to minimise the impact of the required aftertreatment, in particular for the major reduction in NOx. It has achieved this by packaging the DOC/DPF canister and SCR system into one integrated module, which can be positioned remotely in a machine chassis or directly on the engine. The lightweight yet compact dimensioned aftertreatment module minimises space claim in the engine bay and eases installation via features such as flexible inlet and outlet options, pre-installed electronics and DEF line hook-ups.

The DPF now uses passive regeneration, which is totally transparent to the operator and service-free, reducing maintenance costs during the machine's lifetime. This also facilitates easier installation, as no direct access is required for ash removal.

The 1206F range builds on the success of the award-winning Stage IIIB/Tier 4i engine range. Their third-generation SCR technology has been proved and validated for off-highway use, meeting legislative requirements without penalising the OEM or end user. In fact Perkins is working to make things even more advantageous, including better SFC, lower lifecycle costs and improved productivity, while working towards a cleaner environment. In an industry where there is huge competition, this can provide OEMs with clear differentiators in terms of overall machine performance. Ultimately it's about allowing the end user to get more done, faster and with lower operating cost – and Perkins and its TIWs are helping achieve that end. **iVT**

Mike Cullen is 1200 Series product marketing manager

CONTACT
www.perkins.com
+44 1733 583000

PATRICK THIL

Up, up and away

RELYING ON A POWERTECH E 6.8L ENGINE, HOUCHIN AEROSPACE'S LATEST GROUND POWER UNIT ENJOYS REDUCED FUEL CONSUMPTION AND MAINTENANCE – ENSURING AIRCRAFT UPTIME IS MAXIMISED, TOO

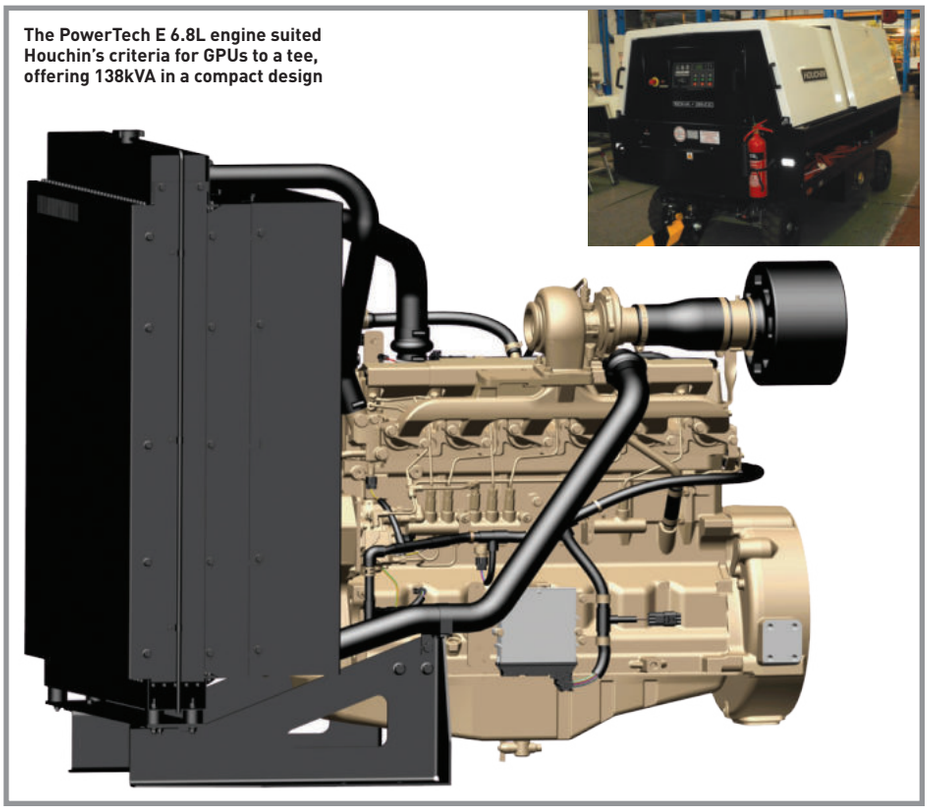
As the B787 touches down, around 250 passengers disembark from the jet. As it empties, the ground-support team connects a Houchin J690 ground power unit (GPU) to the aircraft. They know – all too well – the importance of having a reliable, easy-to-operate machine, as time is crucial in the aviation industry.

ITW GSE Group UK has been manufacturing the Houchin brand of diesel-driven 400Hz GPUs for more than 50 years. Offering units in 90, 100, 140 and 180kVA versions, its GPUs have proven reliable in airline, ground handling, airport, leasing and military applications. The company's latest development is a quality, cost-efficient GPU capable of producing 180kVA for the A380 Airbus and B787 Boeing aircraft.

Houchin's J690 model GPU already incorporated the company's innovative sliding steel canopy, providing easy access to all of the major components, as well as a new, innovative control panel for easy operability and maintenance. But the GPU needed a powerful, fuel-efficient engine as well as the expertise that comes with it. This was where the air-to-air aftercooled John Deere PowerTech E 6.8L diesel engine, producing 202bkW at 1,500rpm, and its distributor, E P Barrus, came up trumps.

The PowerTech E 6.8L engine suited Houchin's criteria to a tee. "It has a good power-to-weight ratio, thereby offering us a compact engine in comparison with those from other engine manufacturers. One of the benefits of using this engine is excellent fuel economy," says Simon Mortimer, ITW GSE Group UK's sales and marketing manager. "We had to modify the chassis to accommodate the engine, but it was well worth it, as the unit is 'performing very well', according to the customer."

The company prides itself on providing excellent customer satisfaction. "For various reasons, it is not unusual for other GSE to be delivered late. We take pride in offering a quick turnaround on orders, backed up with second-to-none after-sales support," Mortimer adds. "E P Barrus shares these values, and is always quick to respond to any service, commercial and technical queries we may have."



The PowerTech E 6.8L engine suited Houchin's criteria for GPUs to a tee, offering 138kVA in a compact design

Performance without sacrifice

PowerTech E engines meet emissions regulations without sacrificing peak torque, low-speed torque, or transient response time, while providing improved performance from the same package size as Tier 2/ Stage II engines. They also feature electronically controlled fuel systems with improved cold-start performance, precise engine speed control, torque curve shaping, and more. Because these systems have less need for redundant sensors, add-on electronic governors and shutdown devices, they result in a lower total installed cost.

These engines are equipped with the CAN communication link to utilise input from existing sensors and to communicate with other machine systems. They monitor important engine and auxiliary component data, so as to warn the user about high temperatures and low oil pressure, and control air intake grid heaters (4.5L and 6.8L). In addition, electronic controls enable the selection of droop or isochronous engine governing. They boost equipment uptime by derating or shutting down when necessary.

In addition to engine-mounted or remote-mounted ECUs and full-authority electronic engine controls, John Deere's PowerTech E engines feature two-valve cylinder heads, fixed geometry turbochargers, self-adjusting poly-vee fan drives, 500-hour oil change intervals, and are available in turbocharged and air-to-air aftercooled aspirations.

The PowerTech E 4.5L and 6.8L engines feature a dual fuel filter low-pressure system with water-in-fuel sensor, a low fuel pressure sensor, and HPCR fuel systems, which increase fuel injection pressure for more efficient combustion.

PowerTech E engines also offer programmable parameters for specific applications. Snapshot diagnostics record and store up to seven different sets of engine data, while the display panel shows continuous data on engine hours, load factor, engine rpm, and critical operation conditions. Electronic controls increase productivity, improve fuel economy, lower total installed costs, and reduce ownership costs. The PowerTech E 4.5L and 6.8L comply with Tier 3/Stage IIIA emissions regulations. **iVT**

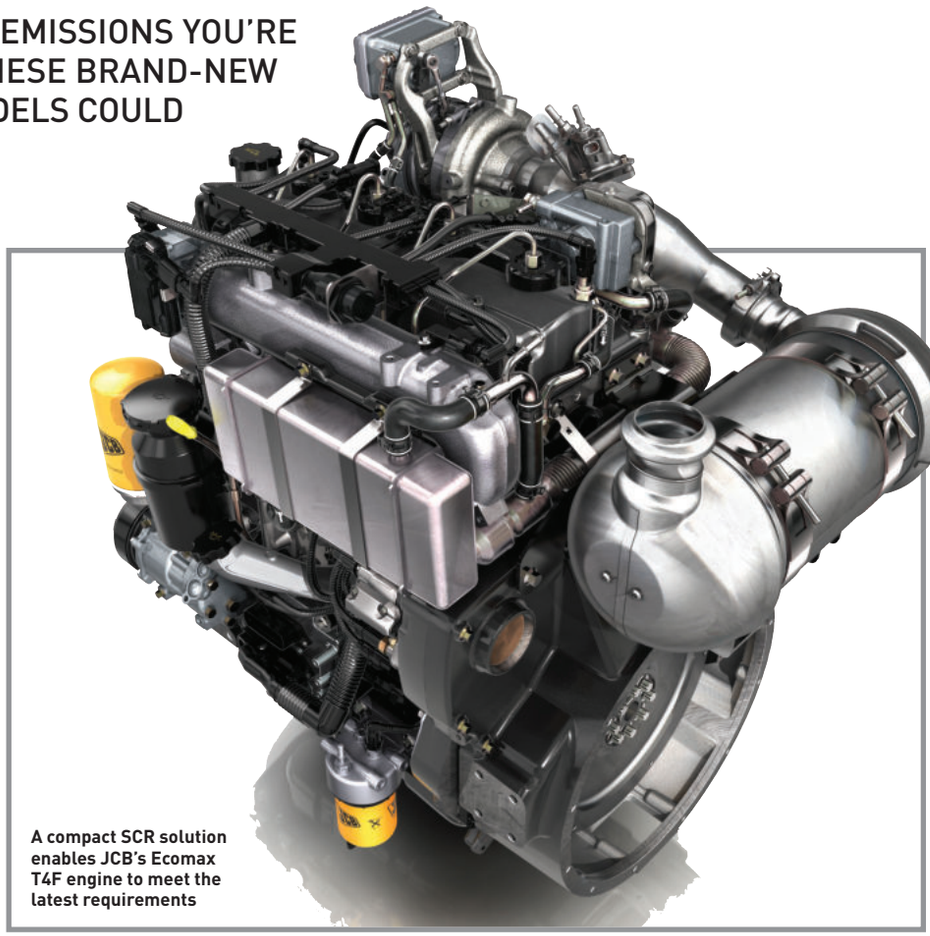
Patrick Thil is manager OEM engine sales EAME Asia Australia for John Deere Power Systems

CONTACT
www.johndeere.com/tier4
jdengine@johndeere.com

ALAN TOLLEY

Search engine

WHATEVER LEVEL OF ENGINE EMISSIONS YOU'RE LOOKING TO COMPLY WITH, THESE BRAND-NEW SIX- AND FOUR-CYLINDER MODELS COULD PROVIDE THE ANSWER



A compact SCR solution enables JCB's Ecomax T4F engine to meet the latest requirements

In the past eight years, JCB has produced more than 250,000 engines, announced several industry-leading and innovative solutions to emissions legislation, and become a global producer of engines with plants in the UK and India.

Building on that momentum, the company has this year announced the introduction of its first-ever six-cylinder engine – the JCB Dieselmax 672 – as part of a £45m investment. The new engine is based on the hugely successful four-cylinder, 4.8-litre Dieselmax, and the new 7.2-litre product follows much of the same proven design philosophy and will also share a considerable amount of key parts commonality. The new engine will utilise Delphi's electronic common rail fuel system and standard fixed geometry turbocharging system.

The Dieselmax 672 will be produced to meet Stage II emissions for export markets and will debut in JCB's larger crawler excavators and various OEM customer applications. The engine is offered with ratings of 140kW (188hp), 165kW (221hp), 190kW (255hp) with a maximum output of 225kW (302hp), peak torque figures of up to 1,200Nm and with notable fuel efficiency gains (up to 8%) over previous engines used in JCB's excavator range.

The six-cylinder Dieselmax 672 is initially being offered for Tier 2 applications

Innovative additions

This year, the company also began production of the JCB Ecomax T4i engine, a highly innovative addition to its range which meets those emissions standards despite incorporating no aftertreatment. This has been achieved purely through the use of in-cylinder technologies alone, rather than resorting to external exhaust aftertreatment or a diesel particulate filter (DPF) and offers fuels savings of up to 11%.

As these engines went into production, JCB also unveiled its Ecomax T4F range at the Bauma exhibition in Germany. The company has continued to innovate with the development of a compact, highly efficient SCR solution contained in a single canister. Like JCB's Stage IIIB/Tier 4i engines, the legislation is met without the need for DOCs or costly diesel particulate filters, which are difficult to package.

The Ecomax T4F engine can also provide a further 5% improvement in fuel efficiency over and above that of JCB T4i engines.

With many OEMs skipping Stage IIIB/Tier 4i emissions legislations and moving straight to Stage IV/Tier 4 Final, the JCB Ecomax T4F engine has been developed with packaging and installation benefits for the OEM as a key consideration of the programme, to ensure minimal disruption to OEMs' own machine development when moving from Stage III/Tier 3.

The JCB Ecomax T4F engine has been extensively tested in hot and cold climate environments, as well as undergoing vigorous altitude and vibration tests, leaving vehicle manufacturers with a minimum of work to complete on installation.

The JCB Ecomax engine, which ranges from 55kW (73hp) to 129kW (173hp), already has installation sign-off criteria, and with the support of a highly experienced application engineering team, is ready to be tailored to OEMs' requirements. **iVT**

As director of engine programmes at JCB Power Systems, Alan Tolley headed their development from launch

CONTACT
www.jcbpowersystems.com
robert.payne@jcb.com

RIKKE JUEL ERLANDSEN

A breath of fresh air

FOR ALMOST HALF A CENTURY, THERE HAS BEEN LITTLE CHANGE IN THE WAY THAT ENGINES HAVE BEEN COOLED. BUT NOW, A NEW TYPE OF MIXED-FLOW FAN LOOKS SET TO BLOW AWAY THE COBWEBS

The shift in emissions and engine cooling requirements drove axial fan manufacturer Multi-Wing to develop a unique type of mixed-flow fan. But how does a company that produces axial fans make that transition?

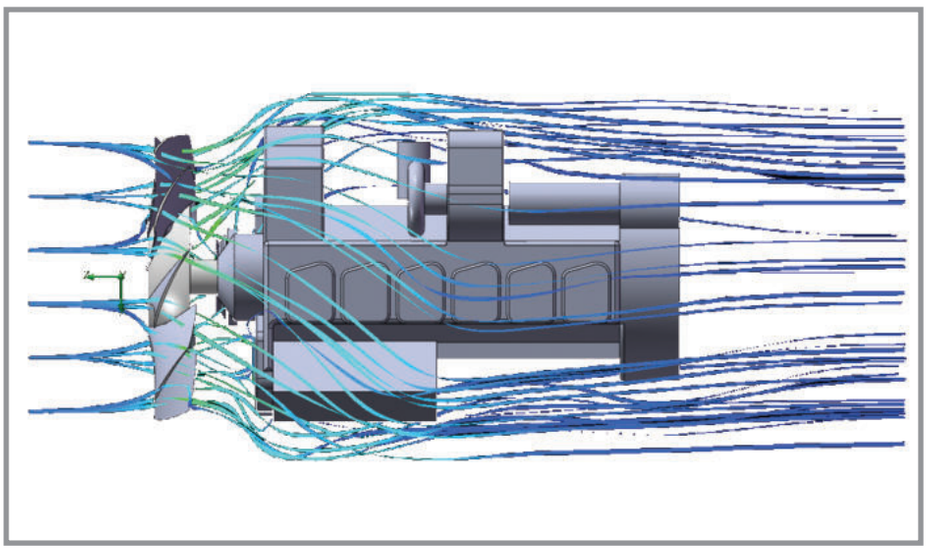
"Out of necessity," responds Victor Silbermann, Multi-Wing development manager. "We had kept stretching the capabilities of axial fans for Tier 4 cooling packages, so we had to rethink our strategy, because there was obviously a need for additional approaches. Engine manufacturers were calling on us to build a mixed-flow fan, especially for their clutch applications. In order to create the best possible air-moving solution, we needed to be particularly thorough in our development process. The MxFlo is the result of two years of dedicated research, development and testing."

The idea for the MxFlo design was born from the need to draw benefits from the flexibility of a modular axial fan and traditional centrifugal fan performance without the usual one-size-fits-all limitation of fixed-diameter, mixed-flow fans. Taken a step further, the ideal solution would fit both clutch applications and standard mounting configurations.

"That's the difference between the MxFlo and ordinary mixed-flow fans in the market: it provides the versatility of a modular fan with the pressure capabilities of some centrifugal fans," Silbermann says, highlighting the new fan's dexterity. "Many mixed-flow fans in today's market come in one or two fixed diameters, while the MxFlo has a true diameter range of 550-735mm, meaning we can trim the blades to create custom diameters. And with the fan's range of pitch angles – 22°, 26°, 30°, 33°, 37° and 43° – you have multiple design options."

The MxFlo's innovative blade design delivers better performance and provides an ideal airflow pattern around engines while generating notably higher pressures. The new fan's hub design also allows the airflow to cool a clutch without interfering with the optimised flow pattern created by the hub's shape. Tailored for a clutch mounting, the MxFlo's 152mm steel hub plate can also be drilled and machined for a seamless fit in shaft, flange, bushing or tapered hydraulic mounting configurations.

That fit also extends to the MxFlo's axial depth for its nine-bladed launch. With a range of 115-157mm in axial depth, the fan should easily drop into the compact engine compartments typical of most Tier 4 installations. Its hub uses glass fibre-reinforced nylon, reducing the weight of the fan while maintaining the required mounting strength. And that translates to reduced wear on components, higher efficiency and, ultimately, lower fuel costs.



ABOVE: **Maximum cooling capacity due to both axial and radial air discharge**

"The MxFlo was designed with the rough conditions experienced in off-highway applications in mind, and it performs amazingly well," Silbermann continues. "It provides high efficiencies – more than 50% – in the part of the performance curve where you would see 30-40% efficiency from an axial fan. And most important, it is generating up to 50% greater pressures than standard axial fans."

Well blade

Those results were driven by adopting a creative approach to both the blade and hub designs of a modular mixed-flow solution. Built for the most demanding conditions, the MxFlo blades are a hybrid of Multi-Wing's existing high-efficiency blade profile designs. With a reinforced base and a tapered foot, this new blade is also wider than standard axial fan blade profiles.

The MxFlo was engineered to work in orifice plates with large tip clearances: common for engine-cooling applications. And the MxFlo's design provides a wide range of pitch angles with no lost airflow between the hub and the blade, unlike many conventional mixed-flow fans. This flexibility is a bridge of sorts between Multi-Wing's line of modular axial fans and the innovative approach that led to the MxFlo's creation.

"We recognised that we had to engineer an air-moving solution that delivered considerably greater pressures for engine cooling without making sacrifices in efficiency," concludes Silbermann. "And because there are plenty of fixed-diameter, mixed-flow fans available, we knew we also had to provide the modular flexibility for which Multi-Wing is renowned. The MxFlo is a unique offering that provides engine manufacturers with the tailor-made fans they have come to expect from us, along with much higher performance levels from a fan that will fit easily in existing engine compartments." **iVT**

As brand manager at Multi-Wing International, Rikke Juel Erlandsen has worked at the company since 2008

CONTACT
www.multi-wing.com
info@multi-wing.com

MATTEO MICHELIN

A turn for the better

CONTROL IS NOTHING WITHOUT SAFETY. BY OFFERING CONTINUOUSLY VARIABLE DISPLACEMENT ACROSS A WIDE SPEED RANGE, WHEEL MOTORS CAN HELP DESIGNERS IMPROVE BOTH ASPECTS WHENEVER THEIR MACHINES ARE AT WORK IN DIFFICULT CONDITIONS

The most technologically advanced self-propelled machines are capable of reaching very high speeds even when they are working in the most arduous conditions. This creates a continuously increasing demand for high-quality products as part of a safe vehicle design layout.

How is SAI, a leading manufacturer of wheel drives, able to get around this and make safe transmissions? Several factors must be taken into consideration – including lowering the centre of gravity (CoG) to prevent overturning. The wide range of products that SAI offers the market enables its customers to select the best solution for powering the vehicle – and its wheel drive units enable its CoG to be lower, resulting in more stability, even when operating on very steep slopes. As well as reducing the risk of overturning, overall vehicle performance is thereby improved too.

Furthermore, as a result of the use of SAI wheel motors in place of a mechanical axle transmission, the redefinition of the vehicle layout and its dimensions provides more flexibility in terms of cabin design and engine position, increasing comfort and safety. One application example is that of orchard tractors: these compact vehicles benefit from a lower cabin, enabling access and operation under low-hanging trees.

Better traction

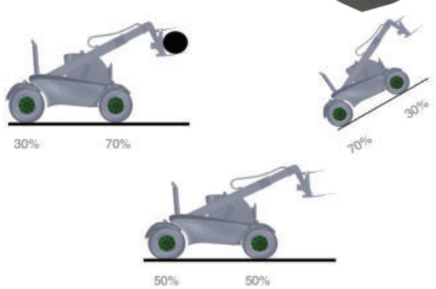
Traction distribution and the enabling of anti-spinning features is another benefit. Controlling the traction means simply transmitting the available torque to the ground in the most efficient way possible.

When vehicles do not operate safely as a result of wheel spin, the introduction of alternative circuitry, such as the inclusion of flow dividers or by connecting motors in series, is not the most efficient solution – nor does it give the fastest reaction times. The best solution is to balance each individual wheel torque output to the torque transmissible to the ground. SAI's variable-displacement technology means a motor can vary its displacement continuously under full power, to reach every single wheel torque limit, even down to 0cc/rev, to prevent the wheel spinning.

Safety is another major factor affecting traction distribution. The company's variable-displacement wheel drive units enable fine independent output torque distribution from every individual motor. By using a continuously variable wheel motor, the machine makes the most efficient use of the power available for the specific soil conditions.

When manoeuvring on extremely steep areas, the operator must be protected to ensure safety; in such cases, by using variable-displacement motors, it is possible to increase the displacement on the more heavily loaded wheels, thereby guaranteeing safe traction, even on slopes and when heavily laden. Therefore it is possible to use the same power or the same flow setting on the vehicle, but to split it more to the front axle or more to the rear axle, as best required by the working conditions. All of the above result in much more efficient performance and a safer operating machine.

ABOVE: **Compact five-piston variable-displacement wheel drive unit with integrated gearbox and brake. Supplied with a complete electronic control package, the sturdy unit also features heavy-duty bearings and high-speed capacity**



ABOVE: **An example of distribution traction**

Assisted braking torque

Every continuously variable displacement motor produced by SAI boasts extremely high mechanical efficiency and supplies high levels of braking torque from the moment the vehicle starts to decelerate, thereby guaranteeing rapid and controlled stopping. What is more, the operator can continuously – and with full control – reduce or increase the displacement as required, thereby boosting the braking torque on any individual wheel, depending on specific needs.

SAI motors used for auxiliary traction are able to work at high speeds by modulating the displacement. They can therefore be used for driving torque at low and medium speeds, and they can be set to 0cc/rev when being towed.

The motor can continuously vary its displacement while running, conveying variable power to the auxiliary wheels. The SAI speed capability makes it possible to work at the maximum speed limits allowable by law. **iVT**

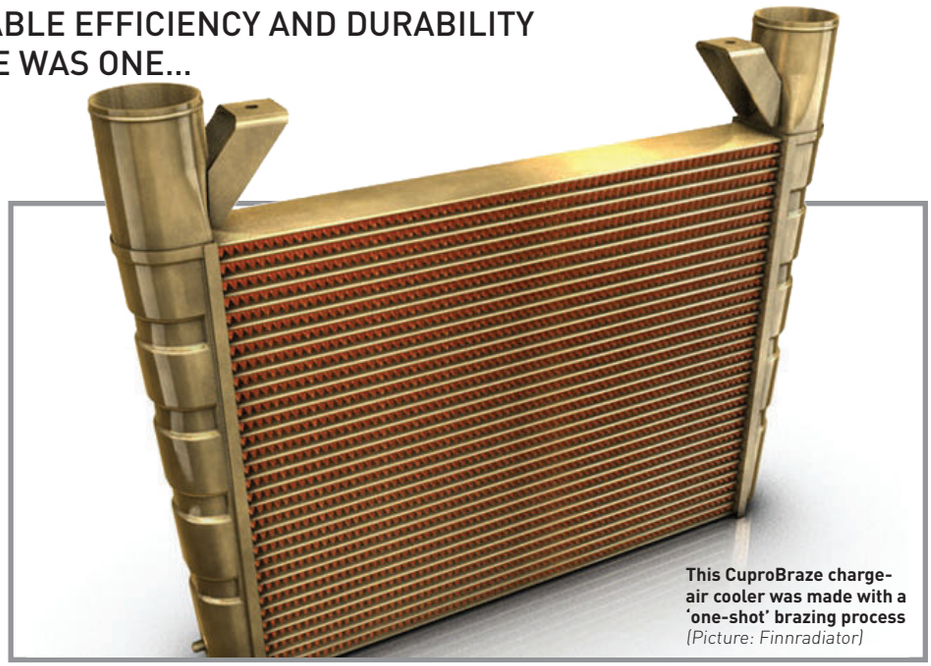
Matteo Michelin is sales manager at SAI Hydraulic Motors

CONTACT
www.saispa.com
saispa@saispa.com

ANDERS FALKENÖ

Exchange rate

COPPER FINS BRAZED TO BRASS TUBES OFFER COMPACT HEAT EXCHANGERS WITH REMARKABLE EFFICIENCY AND DURABILITY – A GOOD DEAL IF EVER THERE WAS ONE...



This CuproBraze charge-air cooler was made with a 'one-shot' brazing process *(Picture: Finnradiator)*

CuproBraze may have been born in the 20th century, but it is a child of the 21st century. Not too long ago, only a handful of heat exchanger manufacturers were serious about CuproBraze. Today, the technology continues to gain market share as OEMs discover its advantages over the alternatives.

Beginning in the 1990s, the International Copper Association sponsored research on the development of a brazing process for copper and brass. This was directed at developing anneal-resistant copper and brass alloys that would not weaken at the relatively high temperatures required for brazing. The process resulted in stronger joints, enabling the use of thinner fins, and hence new radiator and cooler designs.

Prior to the development of CuproBraze, four other materials technologies were available for use in heat exchanger cores: soldered copper/brass plate fin; soldered copper/brass serpentine fin; brazed aluminium serpentine fin; and mechanically expanded round aluminium tubes with flat fins. Each had advantages and limitations, depending on the particular application in the specific market served.

CuproBraze has now moved out of the laboratory and into production facilities worldwide. It has been established as a viable manufacturing technology and is steadily gaining market share, especially for many heavy-duty applications.

One-shot brazing

A major milestone in the development of CuproBraze processes was one-shot brazing. One of the biggest challenges with CuproBraze production was learning to braze different types of joints simultaneously – that is, during one pass through the furnace. One-shot brazing is possible with CuproBraze because there is enough process latitude to enable the brazing of different geometries simultaneously.

An excellent reference point is the *CuproBraze Brazing Handbook*, which is continually updated as the technology improves. Updates are available from the author and the handbook can be downloaded from the website of the CuproBraze Alliance. The handbook covers topics such as materials and properties; the application of brazing filler materials; fabrication and assembly of components; brazing of cores in a furnace; key factors for good results; and troubleshooting.

Experience has shown that CuproBraze heat exchangers are especially well suited for locomotive applications and heavy equipment such as bulldozers, mining equipment and diesel power generators.

This new technology has already made a significant impact around the world because heat exchangers built with this process can provide excellent cooling efficiency and durability. When measuring cooling efficiency in terms of heat removal per unit volume, no other materials system is more efficient than copper for dissipating heat.

Copper fins are recommended over aluminium fins because they are much harder and consequently are more resistant to sand erosion and impingement by stones. The stiffness and durability of the copper fins also facilitates washing by pressurised water or air. In addition, CuproBraze heat exchangers maintain their performance for especially long periods of time because the brazed joints between the copper fins and the brass tubes are extremely strong.

New developments

Compared with aluminium, copper's superior thermal conductivity allows for greater cooling capacity per unit volume, enabling more compact designs. These space savings result in more compact power gensets, which is important for stationary power generators and particularly important for gensets built in containers, and for locomotives where space is at a premium. CuproBraze heat exchangers are also highly resistant to corrosion and fatigue, providing the durability needed for mining dump trucks and locomotives operating in harsh environments.

Power gensets today often run on fuels such as natural gas and consequently operate at higher temperatures compared with traditional designs. The efficiency of the gensets increases, but the heat exchangers they use must be able to withstand elevated temperatures. Neither brazed aluminium micro-channel heat exchangers nor soldered copper-brass heat exchangers are suitable for use at such elevated temperatures.

It is only CuproBraze brazed copper-brass heat exchangers that can deliver the performance required for these 'next-gen gensets'. This year, in fact, the CuproBraze Alliance introduced a new modular heat exchanger for use in gensets.

This breakthrough in heat-exchanger technology provides the best combination of durability and performance that is on the market today. Advanced radiators made of corrugated copper fins brazed to brass tubes deliver the level of reliability, cleanability and long service life that is essential in locomotives and other heavy off-highway equipment. **iVT**

Anders Falkenö is product development manager at Aurubis AG, a member of the CuproBraze Alliance; and managing director of the CuproBraze Alliance

CONTACT
www.cuprobraze.com
info@cuprobraze.com

STEFFEN CRONAUER

Heroes with a half-shell

THERMAMAX CEO MICHAEL BECKER DISCUSSES THE LATEST SIMPLE BUT EFFECTIVE INNOVATIONS IN INSULATION SOLUTIONS AND EXHAUST AFTERTREATMENT – AND GETTING THEM TO THE CUSTOMER IN TIME

Whether it's Euro 5/6, EPA 10, Tier 3B/Stage IV or IMO regulations in the marine industry, it's clear to all concerned in the various market sectors that demands on exhaust aftertreatment are getting ever stricter. These demands affect not only the OEMs but their Tier 1 supplier base too.

So how does this affect a niche sub-supplier? Michael Becker, CEO of German thermal and acoustic insulation specialist Thermamax Group, has his own thoughts. The self-styled 'temperature designers' are producing clever ideas all the time, and what makes them all the more impressive is their simplicity.

Your company deals with the leading OEMs and Tier 1 suppliers in the on- and off-highway sectors as well as in the marine industry. Competition is getting tougher – how do you see things currently?

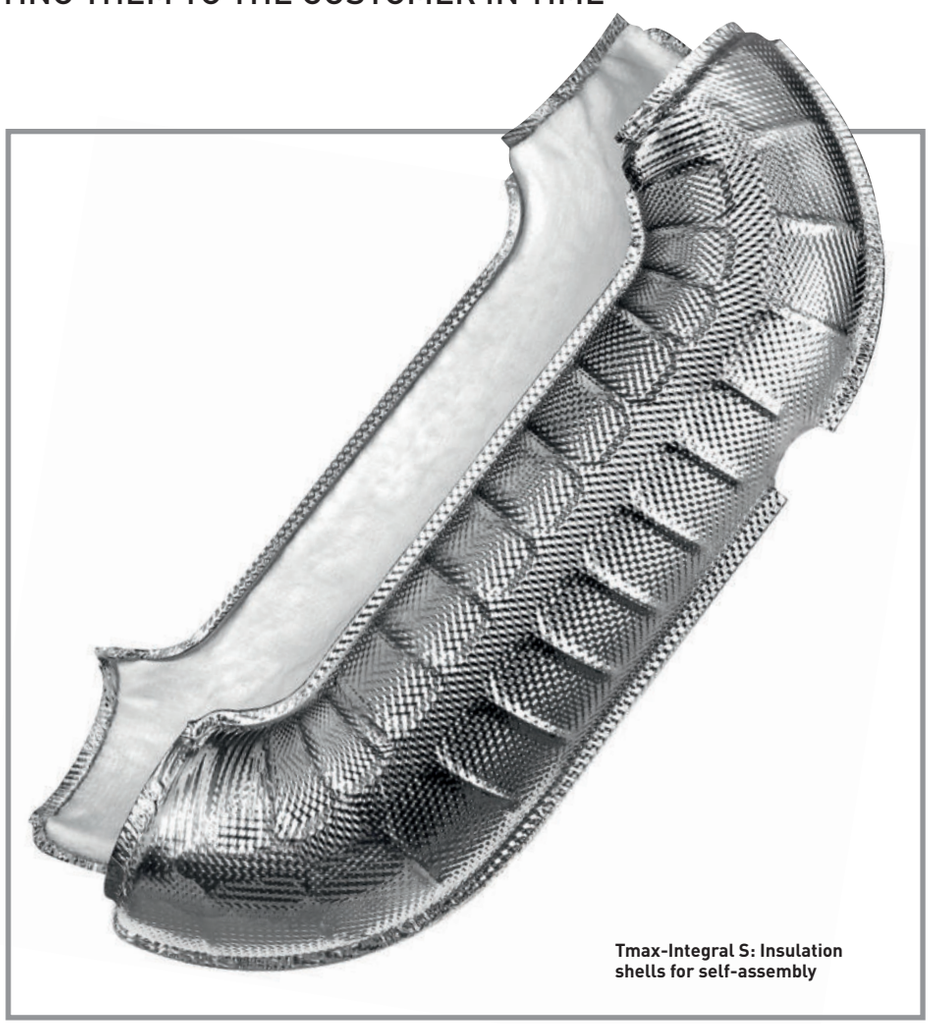
We recognise that achieving the difficult targets in reducing harmful emissions is vital for us in these markets. But we can't just stand still as a niche sub-supplier. Our customers tell us there are two key factors here for them: total costs and time-to-market. So we're not just looking at the technical performance of our various technologies, but are making sure the processes that are used to develop our ideas, products and services are efficient too.

The thinking behind that makes sense, but what does it mean in practice?

We can make two major contributions to exhaust aftertreatment and compliance with new standards such as Euro 5/6, EPA 10 or Tier 3B/Stage IV. First, our insulation systems can control the temperature in the exhaust line and thereby reduce harmful emissions and fleet fuel consumption. Second, and currently of particular interest, we can create synergies within the overall process to effect cost reductions from the 'hot end' through to the 'cold end' of the system.

What sort of insulation technologies come into play with exhaust aftertreatment?

When designing insulation systems for an engine space, for exhaust aftertreatment or for controlling exhaust energy in the exhaust line and the related components (SCR, DOC, DPF, etc), we recommend sitting down with our temperature designers as early as possible. They will act as a development partner, bring their experience from other market sectors, and develop designs that can be tested in our own laboratory. Clients just need to give us the overall parameters and we can translate those into effective, series-production products with simple installation and maintenance features.



Tmax-Integral S: Insulation shells for self-assembly

Can you provide an example of the impact of an innovative insulation concept?

We've recently shown what's possible with a complete insulation of turbocharger and exhaust manifold for truck engines. When the heat generated is maintained throughout the system it's not just a question of easier Euro 6 and EPA 13 compliance; field tests showed a considerable reduction in fleet fuel consumption too.

What are your current technical priorities?

In our opinion, the technical performance is an absolute must. But what about the weight aspect? Can it be made lighter? What features can be combined with the insulation? These are the sorts of simple questions that have led us to develop our Tmax-Sonetherm acoustically optimised integral insulation. The product has proved ideal for complex

geometric profiles and restricted space situations, and links a high-temperature-resistant, sound-absorbing fibrous material with a metallic outer shell.

The results amazed our customer: static noise measurements on a diesel-powered truck showed a reduced sound pressure level of up to 3dB(A) compared with a traditional direct insulation – just by using Tmax-Sonetherm on the component to be insulated! There was the added bonus of being able to reduce other areas of insulation if necessary.

Can you explain how the combination of thermal and acoustic insulation works?
The sound absorption effect of the insulation system is achieved by a calculated micro-perforation of the metallic outer shell. We developed the perforation ourselves, and already manufacture the foil in-house.

You seem to place great importance on having your own test laboratory, in-house toolmaking and prototype manufacturing capability…
You have to think seriously about vertical integration, because it's not just added value – it can give you much greater scope for development. Prototype manufacturing is a good example: we prefer to make and test them ourselves. And the prototypes we make are more than 90% identical with the final series-ready product. That saves time and money.

How do you see the future? What new designs can we expect to see from Thermamax?
Well, the future lies in an optimised logistic approach! That's a subject where there's some real scope for improvement. For example, we've just developed a reusable, recyclable transport tray for one of our customers with worldwide operations. That simplifies the assembly and, above all, saves on material. But that's just a start.

Where do you see further potential with logistics?
We're currently asking our customers a question: we are developing and manufacturing effective products for you in all sorts of volumes, we're fitting them on your turbochargers and that's all well and good – but, sometimes you have to ship them to us over long distances with the attendant insurance costs, etc. Wouldn't it make sense if you were able to fit those insulation shells yourselves in your own factories?

So the customer actually fits the insulation components?
Exactly. That makes a lot of sense when we're talking about long distances.

We're telling our customers: if you prefer, we'll put together a complete system that you can start using straight away, from the installation workstation through to the training package. That all costs money, clearly, but in the long run it will reduce costs for the customer and increase the added value. As I said, it makes sense particularly where long distances are involved – and at Thermamax we are serving customers pretty much worldwide! **iVT**

Based in Mannheim, Germany, Steffen Cronauer is sales and marketing director at Thermamax

CONTACT
www.thermamax.com
info@thermamax.de

MIKE MILLER

The secret life of batteries

A BREAKTHROUGH IN BATTERY MONITORING TECHNOLOGY IS DELIVERING MAJOR BENEFITS ACROSS THE ELECTRIC VEHICLE INDUSTRY, FROM BATTERY MANUFACTURERS AND VEHICLE OEMs TO THE END USERS

Battery management is a complex issue for fleet managers and other end users. For reasons of productivity, safety and cost control, it is essential to know how long the battery life will be, what the state of charge is, how healthy the battery is, and other key aspects of battery functionality. Damage, premature depletion and improper battery maintenance can lead to vehicle downtime or costly battery replacement.

Concerning the science of battery life, Eugene Finger wrote *The Battery Book*. Finger was a Curtis Instruments engineer whose comprehensive analysis of battery functionality became the standard industry reference. His book is still available, and can now be downloaded from the Curtis website.

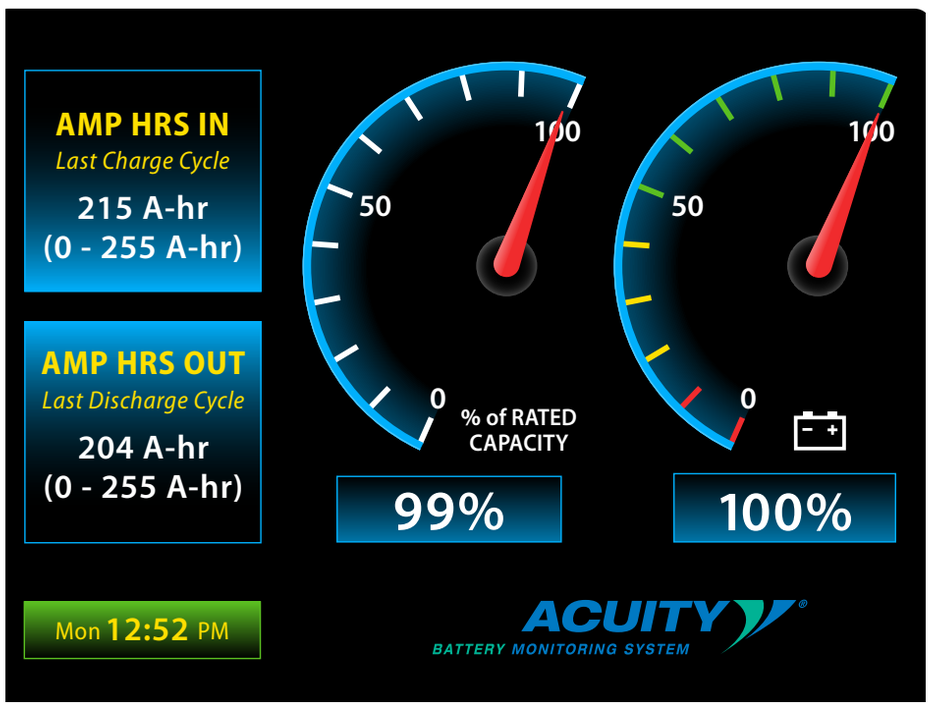
Battery monitoring

Historically, Curtis Instruments – a global leader in integrated systems technology for electric off-highway vehicles – has also been a leader in battery monitoring. Founded in 1960, Curtis patented Battery Discharge Indicators (and coined the term BDI) in the 1970s. However, while these early battery fuel gauges were the state-of-the-art in battery charge measurement, they only indicated discharge.

Early-generation BDIs were mostly used on forklift trucks that typically ran in three shifts. These gauges rode on the vehicle, measuring only the voltage of the battery. The management method was to use the battery almost to the point of depletion, then drive the vehicle to a battery-changing station, where a crane would lift out the drained battery and replace it with a fully charged one. An expensive, awkward and time-consuming system, to say the least.

Finger dreamed of a better solution. He foresaw more accurate measurements and readings by understanding not just the voltage, but also the current of the battery, and what specifically happened during the charge cycle. He realised that if you could measure both current and voltage, and if the device travelled with the battery, then you would achieve the most accurate assessment of the state-of-charge (SOC).

Now Curtis has achieved that goal, and made it affordable for the marketplace. The Acuity battery monitoring system is a revolutionary step in modern vehicle battery monitoring. It is a highly intelligent battery monitor that delivers considerable benefits



Battery information is displayed in real time on the Curtis enGage VII or any other CAN-based display

right across the industry, to battery manufacturers, vehicle OEMs and end users alike.

During the Acuity development process, Curtis engineers sought to fulfil three key value points:

- Provide the highest accuracy SOC information possible, clearly quantifying the amount of energy remaining at any given time;
- Serve as a warranty witness (validating that the battery has or has not been operated within its conditions of warranty);
- Function as a productivity tool, indicating the condition of the battery in addition to SOC.

The new Curtis Acuity mounts directly onto the battery for exact readings of both voltage and current, delivering the most accurate SOC possible. As the industry's most reliable battery monitoring tool, Acuity is a viable warranty witness and productivity tool, providing detailed information on battery life, state of charge, maintenance and abuse incidents. Many decades of battery expertise have enabled its development.

Acuity resolves the ongoing debate between vehicle manufacturers, battery manufacturers and end users as to when battery performance is not as guaranteed. It provides proof positive of compliance or non-compliance within warranty guidelines.

The technology also enables end users to manage their fleets with far more efficiency. They can get the most work out of each charge and each battery; can know in advance what will need replacing, and when; identify abuse patterns that can be rectified; and, in general, achieve more control over fleet performance.

In order to technically solve the problem of a more complex, comprehensive battery reading, a new algorithm was needed. The old maths calculated SOC by integrating the battery voltage over time. As work

The Curtis Acuity device connects directly to the vehicle battery, where it collects and transmits accurate battery state-of-charge and battery-condition information.

was done by the vehicle, the battery voltage decreased and the time that the voltage was below a reference voltage was accumulated, with the resulting SOC being displayed on the gauge.

The new algorithm to calculate a more accurate SOC takes into account multiple charge and discharge scenarios. Acuity calculates SOC by integrating current, voltage and temperature (using an integrated temperature sensor) at multiple discharge rates. It is far more precise than previous algorithms and is what Curtis engineers like to call 'the secret in the sauce'.

Each Acuity device mounts onto the battery, has a unique serial number, and is intended to spend its life on the battery. It provides a full and constantly updated history: how long the battery has been in service, how often it has been charged, and to what level discharged. Any discrepancies in usage are noted. There are about two dozen data points – see the box overleaf for a sample listing.

Longevity and ease of use

Acuity connects to the vehicle's CANbus system, integrating seamlessly into the Curtis drive system. It also communicates effortlessly with all standard Curtis products and tools, including all enGage displays, all CAN-based motor controllers (including AC), and is accessible with Curtis handheld programmers via Curtis's Vehicle Control Language (VCL).

Installation could hardly be more simple, without any hardware or brackets involved. You basically just put the battery cable through the Acuity current sensor, connect the CAN wires, and tie it into place for plug-and-play performance.

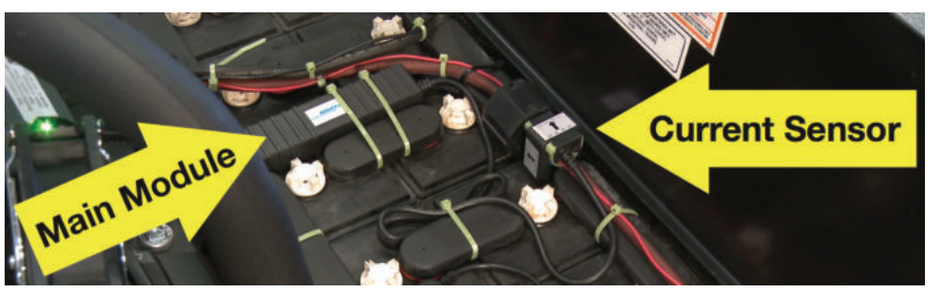
All solid state, Acuity has no moving parts, and is designed to last at least 10 years – the average life cycle of a forklift truck. It is equally at home on golf cars, aerial lifts, sweeper/scrubbers, scissor lifts, etc.

Although the device attaches to the battery and is meant to stay connected for the life of that battery, Acuity is not averse to remarriage. It can be remounted on a new battery if it outlasts its first companion.

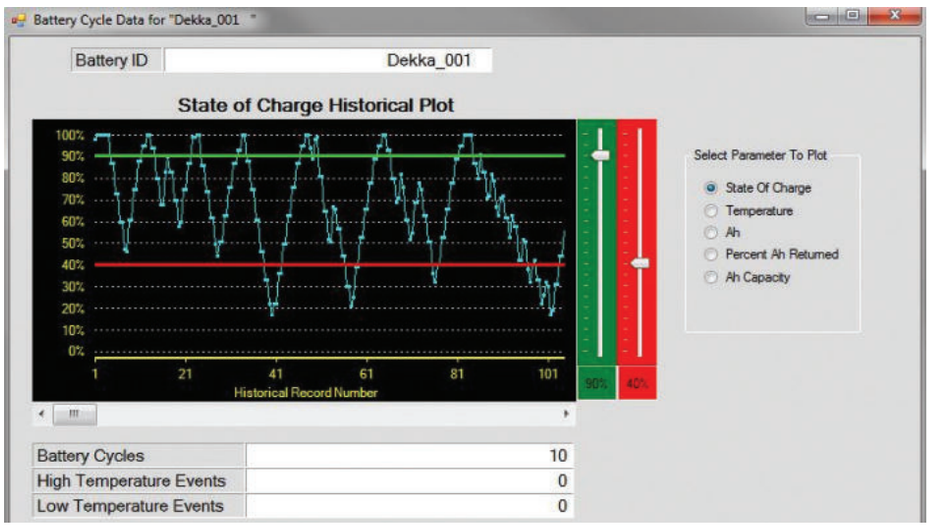
The standard Curtis Acuity system enables users to access battery data from the vehicle's CANbus either via the on-vehicle display or via the handheld programmer or equivalent device using VCL. Once the device is in place, you get information, not just data. Tools to program, read, interpret and apply the information include an on-vehicle display, PC software tools and a handheld programmer connected to the controller.

Rich information

Curtis has created a standalone software program – an optional Acu-Set software kit that greatly enhances this process. The kit consists of software and a dongle which allows the Acuity data to be read by a PC. This proprietary software reads the data and translates it into clearly accessible and actionable information.



The Curtis Acuity Battery Monitoring System is easy to install. Shown is the Curtis Acuity on the battery of a Class 3 powered pallet truck



The Acu-Set software translates the Acuity battery data into easy-to-read performance data. It also calculates Percent Rated Capacity (PRC) – the actual energy the battery can deliver as compared with its rated capacity

The Acu-Set tool also allows easy programming of the Acuity, the ability to read instantaneous battery data and store battery data into the PC. Matching Acuity parameters to a specific battery brand and model is easier than ever: most models can be selected from a comprehensive pull-down menu, or a custom battery profile can be manually entered.

Reading battery information for productivity, maintenance and warranty witness is extremely simple with this software tool. The user can see instantaneous or historical data of the measured values in comprehensive displays, including in chart format. Fleet managers can easily access the full range of battery data points via wired or wireless means. The Acu-Set software also stores the data collected by the Acuity battery monitoring system.

With battery costs running in the range of US$5,000-7,000, the economical Acuity can very quickly pay for itself by identifying faulty batteries and preventing abuse that shortens battery life. It therefore presents an extremely affordable battery monitoring solution with excellent ROI by saving abuse and forcing warranty terms.

Looking ahead

Curtis Acuity presents the possibility of a new business model: a rental approach to EV usage. Dealers can approach their customers and say: "Only pay for the energy you are using" – similar to paying for mileage on a rental car or truck.

Also to be seen in the near future, a working model of a wireless communications version is now in the Curtis engineering lab. This variation will enable Acuity to communicate via Zigbee, WiFi or Bluetooth. Any time the device is in range of a WiFi hotspot, the operator or manager can access and 'talk to' the vehicle from anywhere in the world. Readings can be made from the fleet manager's office, warehouse or company HQ, supplying vital data for superior battery management and optimal fleet performance. **iVT**

Mike Miller is director of product management, Curtis Instruments, Inc.

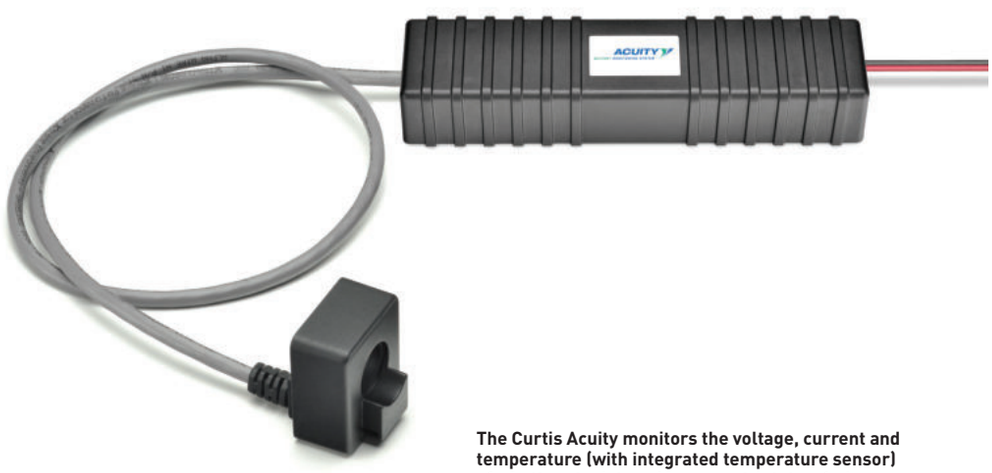
Keeping track

Based on Acuity readings, operators can avoid the leading causes of battery damage:

- True accuracy in measuring depletion avoids usage below 80% depth of discharge, the recommended recharge level;
- Because batteries are strongly affected by temperature extremes, Curtis Acuity includes a temperature sensor integrated into the harness.

Acuity provides data – translated by Curtis software into readable information – on the following points:

- Battery voltage;
- Battery current;
- Battery temperature;
- Ampere hours in;
- Ampere hours out;
- State-of-charge (SOC);
- State-of-health;
- Battery serial number;
- Highest voltage measured;
- Lowest voltage measured;
- Highest temperature measured;
- Lowest temperature measured;
- Current measured at highest voltage;
- Current measured at lowest voltage;
- Highest SOC measured;
- Lowest SOC measured;
- Date;
- Time;
- … and more!



The Curtis Acuity monitors the voltage, current and temperature (with integrated temperature sensor) of a battery to determine accurate state-of-charge, battery warranty status and battery productivity

CONTACT
www.curtisinstruments.com
www.evbatterymonitoring.com

JOSEPH D BOLEWITZ

With great power...

...COMES THE NEED FOR INTERCONNECTION TECHNOLOGY THAT IS ABLE TO HANDLE THE HIGHER VOLTAGES AND CURRENTS OF THE ELECTRIFIED POWERTRAINS AND ACCESSORIES OF INDUSTRIAL VEHICLES AS SAFELY AS POSSIBLE

In the industrial vehicle market, just as in most other transportation markets, there is an ever-increasing desire to reduce emissions, improve fuel economy and lower noise levels via the electrification of powertrains and accessories within the vehicle. Given the sheer size and scale of industrial vehicles, more power is required to electrify such applications. This higher power means that system voltages and currents are increasing. Therefore, when using such high-voltage and high-current systems, one important consideration should be the interconnection technology between various components such as energy storage systems (batteries), motors, inverters and pumps.

Power connections must be designed to not only carry the required current, but also to meet the higher voltage requirements and the resulting safety implications. In the design phase of a high-voltage interconnection, appropriate thermoplastic materials must be selected according to typical application voltages, as well as environmental conditions, so as to avoid leakage currents or dielectric breakdowns. These inputs also dictate the proper geometry and features to meet high-voltage design criteria.

Separable high-voltage interconnection systems are those where the end user can mate or unmate the connection with relative ease. Touch-safe design features should be inherent within the separable high-voltage interconnection system to prevent inadvertent touching of the high-voltage surfaces and avoid any potential significant harm to users.

Such separable interconnection systems should also consider the inclusion of a safety High Voltage Interlock (HVIL). An HVIL is a signal connection that has a staggered mating sequence to the power connection. This HVIL signal connection is last to mate/first to break. It is used to signal 'OK' for power-up of the systems when mated, or to have the systems power-down when unmated.

FIGURE 1 (ABOVE): **TE Connectivity's HVP 1100 AMP+ plug and header, shown in mated condition**

FIGURE 2 (BELOW): **TE Connectivity's IPT (Internal Power Terminal) AMP+ product family**

Safe operation

An example of how such safety considerations are incorporated into a separable interface product is the HVP 1100 AMP+ connector from TE Connectivity, (Figure 1). It is an 11mm-diameter pin/socket, single-position device header to plug interface, that is fully shielded, touch-safe, and HVIL protected. It is rated for 750V applications, can carry current up to 300A, and handles cable sizes up to 70mm^2. It features an integral HVIL connection system and includes protective plastic touch-safe caps on the 11mm pins. The sockets are recessed below plastic surfaces to ensure touch-safe requirements are met.

Other important considerations are solutions with packaging options that provide design flexibility in the vehicle architecture. This simplifies integration/application of the interconnect product and can reduce the total applied cost for the end user. For example, the IPT (Internal Power Terminal) AMP+ connector from TE Connectivity is a ring-tongue, high-voltage/power solution that covers a wide range of shielded cable sizes from 25mm^2 up to 120mm^2 (Figure 2). It is rated up to 800V and can carry current up to 500A with 120mm^2 cable when using the single-position variant. The IPT family also includes two- and three-position variants to reduce total applied cost for the user. Use of the two- and three-position variants will help ensure proper coding/application of three-phase and polarity of cables during installation.

The IPT product family provides an elegant high-power solution for rugged, high-vibration situations where a pigtailed, direct connection is desired to a battery, inverter or motor.

For high-power connection systems, proper design considerations and selection of components that offer the most flexibility in the system architecture are key to providing cost-effective, safe, reliable interconnects. TE Connectivity has the proven high-voltage design and manufacturing experience, along with a wide portfolio of high-voltage interconnection products, to meet the demanding application needs within the industrial vehicle market. **iVT**

Joseph D Bolewitz is director engineering, industrial and commercial transportation, TE Connectivity

CONTACT
www.te.com
germany-pic@te.com

BULLETIN BOARD

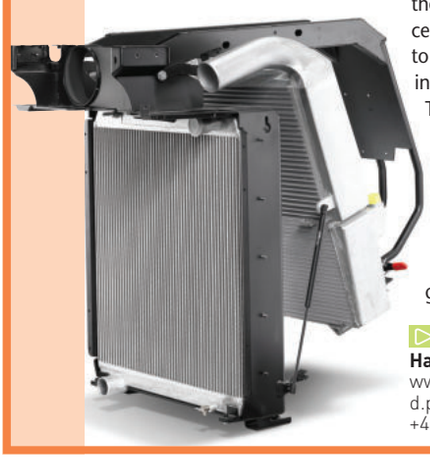
COOLING SOLUTIONS WITH MOBILITY IN MIND

Having developed high-quality thermal parts for 90 years, the Germany-based Haugg Group is one of the most experienced European companies in the area of thermal management.

Founded in 1923, the group operates four manufacturing plants and seven distribution outlets in Europe. Boasting specialised product properties and a wide range of cooling systems, Haugg is able to design tailor-made solutions focused on the development, engineering, manufacturing and distribution of heat exchangers for engine cooling and air conditioning of mobile machinery. Its typical customers are manufacturers of agricultural machinery and construction/mining vehicles.

New cooling systems are internally developed and tested with the target of providing high-end solutions. Besides tailor-made solutions, the first specialised parts catalogue for thermal spare-parts for off-highway and agricultural vehicles was published this year.

Keeping the future of the mobility sector firmly in mind, Haugg Group is pushing the development of high-quality components for electric and hybrid vehicles. The latest development, a cooling plate for batteries and inverters, keeps the temperatures of the battery cells at the ideal level. In order to cool the battery, it may be integrated into a chiller circuit. The system includes a plate heat exchanger, on which the battery cells are placed. It can be adapted to all battery types, as well as inverters and power electronics. The patented design provides temperature gradients below 3K.

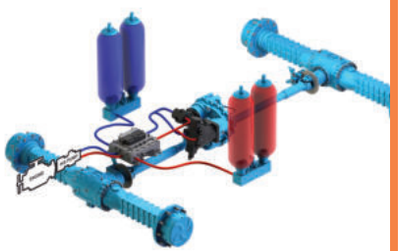


ENQUIRY No. 501

Haugg Group
www.haugg.net
d.pinter@haugg-group.com
+49 241 94629 20

INTEGRATED HYDRAULIC-HYBRID POWERTRAIN

The Spicer PowerBoost System is a new line of integrated hydraulic-hybrid powertrain concepts for off-road vehicles that support the recuperation of excess working and braking energy.



Deployed through series or parallel hybrid configurations that fit into existing vehicle designs with minimal adaptation, the Spicer PowerBoost System supplements all types of vehicle transmission architectures.

In capturing kinetic energy otherwise wasted throughout the drivetrain and working hydraulics, and using this recuperated energy to help power the vehicle, it can reduce fuel consumption by 20-40% over conventional drivetrain concepts, depending on duty cycle and vocational application.

Spicer PowerBoost can also reduce the total owning and operating costs by increasing vehicle productivity, reducing maintenance, and allowing for the use of a downsized engine.

This technology uses an advanced energy-management system to evaluate the levels of power needed in the entire vehicle system, predict operating demands, and determine the most efficient means of operation. Hydrostatic energy is captured in an accumulator from the powertrain during low-power operation of the engine as well as being recuperated during braking and working.

When additional power is required, such as accelerating from a full stop, lifting a load, or driving into the pile, the advanced energy-management system uses the stored energy in the accumulator to provide an extra source of power for improving performance and productivity, while reducing fuel consumption.

ENQUIRY No. 502

Dana Off-Highway Driveline Technologies
www.dana.com/offhighway
info@dana.com
+1 704 878 5886

COUPLINGS WORK WELL UNDER PRESSURE

PVVM couplings have been designed by Faster in order to be safely used at high pressure, while simultaneously ensuring a very high safety level to the industrial vehicle user.

They are very consolidated products and were created many years ago for heavy-duty service in applications where it is necessary to withstand the very high static pressure on hydraulic jacks, rams, clamping devices, hand tools and cylinders.

After a few years of discussion in technical committees, a new ISO standard (ISO 14540) was set to be published around the time of *iVT* November going to press, specifically dedicated to these particular couplings in terms of dimensional and performance requirements.

The current Faster PVVM series couplings already meet the dimensional requirements and exceed technical performances specified in the new ISO, due to the incorporation of very robust components, hardened poppet valves and reliable connection system.

Faster PVVM series coupling are available in sizes 6.3 (¼in) and 10 (⅜in) and fully comply with new ISO 14540 standards for worldwide interchangeability.

ENQUIRY No. 503

Faster
www.faster.it
faster@faster.it
+39 0363 377211

DAMPENING SYSTEM BOOSTS WORK LIGHTS

The new Nordic Scorpius LED N4401 QD work light offers superior illumination with an evenly distributed light pattern. With a theoretical output of 5,900 lm and an operational lumen output of 3,700 lm, it gives a very strong light – and with power consumption of 50W, it offers a high lumen/watt efficacy. The work lamp is offered in four light patterns: high beam; low beam; wide flood; and flood. With a size of just 108x104x116mm and a weight of 1.6kg, it gives an impressive light in a reasonably small package.

The Quake edition is equipped with the revolutionary Quake dampening system, which distributes vibrations and shocks uniformly. As the system can withstand more punishment, so can the work light and the application on which it is mounted, enabling even bigger and stronger lights to be mounted on the application.

Among its features, the lamp has an optically even distribution of light pattern; it demands minimum maintenance due to its heavy-duty construction; and it has a long lifetime, multi-voltage, replaceable lens that is waterproof, with extensive EMC. It is also well protected against load dumps, over voltage, reverse voltage and overheating.

The light's IP rating covers IP68 and IP6K9K, as well as SAE J1455, and it withstands salt mist according to ISO 9227 for over 240 hours. The Nordic Scorpius LED N4401 QD fulfils the EMC standards of ISO 13766, ISO 14982, ISO 7637-2 and CISPR 25 Class 3. It is available with five different lens colours.

Based in Finland, Nordic Lights develops and manufactures LED, HID (Xenon) and halogen work lights for heavy-duty on-and off-highway use in harsh working environments. Its products ensure that darkness, vibration, shock, dust and humidity will not affect visibility when productivity, safety and performance depend on effective lighting.

ENQUIRY No. 504

Nordic Lights
www.nordiclights.com
nordiclights@nordiclights.com
+358 6781 5100

CUSTOMISABLE CLUSTERS

Specialising in instrument panels for off-highway utility vehicles, Bauser offers several affordable yet flexible instrument clusters that can be easily customised to user requirements.

Capable of holding up to 16 LEDs, the Type 807 comprises a semi-circular arch and rectangular LC-display. Two optional buttons can also be added.

Its 21 segments can be contained as a full display or divided into two bar-graph sections. A six-digit, seven-segment indication for further values provides a variety of visualisation possibilities, like error codes coming from the ECU of the machine or speed indication in mph or km/h.

With Type 807, which can use digital and analogue sensors and/or communicate via CAN, it's possible to indicate fuel level and temperature separately.

Operational in environments with an ambient temperature range of -40° to +85°C, Type 807's optional extras include a custom front foil, custom LCD indication, LCD backlight in white and a real-time clock.

Also available with digital and analogue sensors and/or with CANbus communication, the

Type 808 instrument cluster is a rectangular design containing an optional backlit semi-circular arch display. Its 21 segments can be used for one single indication or split into two separate indications.

An acoustic signal alert and the addition of two front buttons are optional extras. In addition, it is possible to use the available digital outputs of these two instrument panels to control further features of the machine – for instance, to drive an external acoustic signal alert for higher signal alert requirements (>85db) or to drive other parts of the machine in case of errors.

Furthermore, it's possible for the LCD to be backlit in white, for buttons to set the time and scroll the menu, and to work within standardised CANbus protocols, CANopen and SAE J1939.

ENQUIRY No. 505

Bauser
www.bauser-control.de
mail@bauser-control.de
+49 7485 18111

COMPACT JOYSTICK FOR SIMPLE OPERATION

elobau has launched the JFT, a small single-axis joystick that can be operated simply with just the touch of a finger. With its compact form and simple top mounting, this fingertip joystick is ideal for use in control panels and armrests.

A particularly attractive feature is the ergonomic design with an angled controller, equipped with a soft-touch finger rest.

The controller handle is available in various colours. It can also display an individual symbol up to 9x13mm. As a result, the JFT can be customised to clearly indicate the particular functions of the joystick.

The JFT is available with one- and two-channel ratiometric analogue output signals. The controller lever stands 35mm high from the pivot.

Featuring three latching or momentary signal positions at a 20-30° angle, various functions can be indicated in materials handling vehicles, agricultural and construction machinery, as well as in numerous industrial applications.

Contactless shielded Hall-effect technology makes this joystick extremely reliable and durable. It is fully sealed above the mounting panel (IP67 rated) and is therefore suitable for use in extreme conditions.

ENQUIRY No. 506

elobau
www.elobau.de
info@elobau.de
+49 7561 9700

INDEX TO ADVERTISERS

THE INSIDER DRONES ON A BIT ABOUT HOW REMOTE CONTROL TECHNOLOGY COULD HOLD THE KEY TO A COMPLETELY NEW WAY OF WORKING IN THE OFF-HIGHWAY INDUSTRY

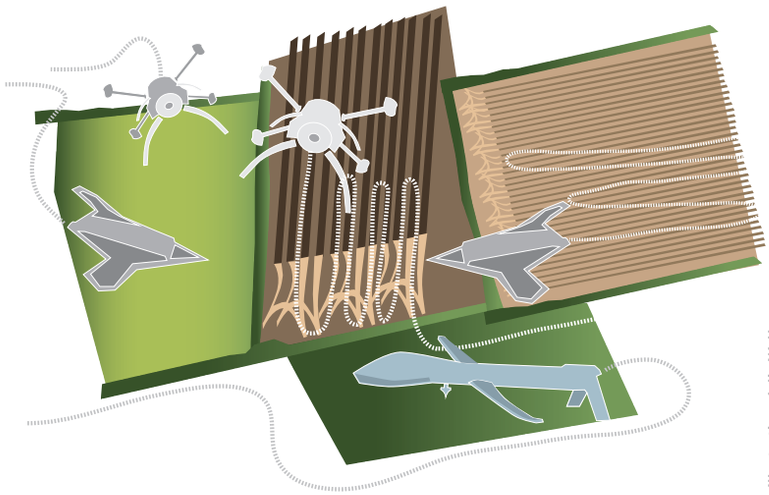


Illustration: Julie Welby

Long-term readers will be familiar with my obsession with aircraft, so it will come as no surprise to discover that, in my formative years, I built and flew model aeroplanes. To me at the time, restricted to a pocket money budget, the luxury of radio control was totally unreachable; even more so was the then new-fangled concept of digital radio signals allowing 'proportional' movement of the control surfaces for finite control.

This was the sole preserve of the grown-ups in the club who enjoyed a substantial income – and chose to waste a considerable portion of it on their hobby. So imagine my disdain when, returning to the hobby a few years ago, I found that the systems that were my nirvana as a teenager are now so cheap to produce that they have become throwaway items being knocked out by the thousands somewhere east of Saigon.

ONCE DRONE TECHNOLOGY BECOMES ECONOMICALLY VIABLE, WE WOULD NOT NEED TO EMPLOY A DRIVER AT ALL

It is clear that these concepts have been driven by demand to reach the point where they have now become 'everyday' technology to be commercially exploited in the mass market, rather than being the hallowed property of a few nerds who liked playing with model aircraft. I suspect, though, that our defence industry may have had a hand in all of this somewhere, as these days – in combination with that well-known student accessory, the webcam – sorties that involve fighter aircraft, ground attack and even freight services are being flown way into hostile territory with the use of model aircraft.

Okay, so a drone is a highly sophisticated model aircraft, and to make it sound more grown-up we refer to it as an unmanned aircraft, but how else can you define it? Basically it's a model. Therefore, the big advantage of a drone (low running costs and cool paint job aside) is that the pilot who controls the machine sits in a control centre well out of harm's way playing a sort of animated computer game in a virtual reality cockpit. If he completes the mission, he packs his briefcase at the end of the day and goes home for tea. If he fails in his mission and his aircraft crashes and burns, he… well, packs his briefcase at the end of the day and goes home for tea.

Like the numerous times my own models crashed yet left me unhurt, the pilot is not personally involved in the sortie; he is just sitting in an office somewhere convenient so he can pop home for lunch between operations.

Now don't let me delude you into thinking that virtual reality flying of these machines comes cheap. Take a peek at any YouTube video on the subject and you are looking at serious money and futuristic concepts – but remember the days when science fiction films showed video phones? These days lots of people have one – so, just like the model systems, like the webcam and the video phones, these military concepts will someday be widely commercialised.

Imagine what we could do with this technology in the off-highway industry! Tractors are already being steered along virtual lines in the fields drawn by GPS, and wheeled loaders already report the amount of dirt they have carried. Once this drone technology becomes economically viable to install into our off-highway vehicles, we wouldn't even need to employ a driver at all! Okay, you would – but he does not have to be anywhere near the vehicle; in fact, he does not even have to be in the same town or even on the same continent.

It would become the ultimate outsourcing exercise. Contractors could bid for a job in Madrid but the work could be carried out by 'drivers' situated just outside Philadelphia. Farmers could employ contractors to carry out the autumn ploughing just by logging in to a website with a plan of the field. The drivers would then just log on at their workstations and away we go! No hiring, no firing, no inconvenient long-term employee commitments, and best of all, no benefits or pensions to be paid – just the cheapest rates for the job.

We could even roll out the 'call centre' concept to a huge chunk of the worldwide machine-operating population. Bangalore, for instance, could become the largest (virtual) agricultural area in the world. Many people would probably never have to move from their homes to 'go to work', and wages could be driven down globally to the price of the lowest bidder from a giant global labour pool that has got nowhere else to run to.

If, however, you think this is pure speculation and that globalisation protagonists would never actually be able to consider this, just remember how the virtual office has spawned the growth of massive call centres on the subcontinent, condemning many to a virtual existence.

And no matter how or from where it's controlled, imagine how real it feels when a missile from a drone is headed in your direction! **iVT**

Comments: theinsider@ukipme.com