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IVT Industrial Vehicle Technology International

September 2012

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INTERNATIONAL
INDUSTRIAL VEHICLE TECHNOLOGY

PLUS

William Heath Robinson

Designing for visibility

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Fendt 700 Vario SCR

Diverto QS 100

Seen and not hurt

5 fantastic solutions for
increasing visibility and
avoiding accidents



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DESIGN CHALLENGE

Develop an innovative way to improve visibility for the operators of industrial vehicles that typically have at least one restricted field of view



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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
Deputy Chief Sub Editor Nick Shepherd
Sub Editors Sue Fenton, Sarah Lee, Lynn Wright
Proofreaders Aubrey Jacobs-Tyson, Frank Millard, Mary Russell

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, Robyn Skalsky

International Advertising Co-ordinators
Kevin Barrett (kevin.barrett@ukipme.com)
Michael Briant (michael.briant@ukipme.com)

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

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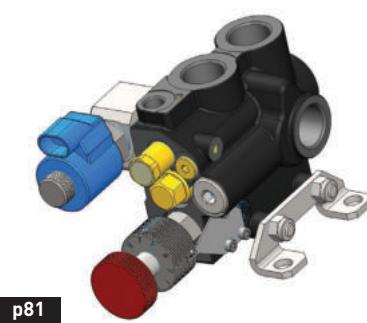
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FOREWORD

As I write this, it's mid-January, and I'm taking the unusual step of producing my foreword for an issue that's still eight months away. That's because last night I watched a most extraordinary documentary on the topic of synthetic biology and felt compelled to jot down a few idle ruminations about what this might mean for the industrial vehicle sector, and the composite materials industry in particular.

It began with a report from a farm that was rearing what it half-jokingly termed 'spidergoats' (not to be confused with Homer Simpson's SpiderPig). These goats can't (yet) do whatever a spider can; the ability to spin webs, terrify timid people and become trapped in the bath still remains somewhat elusive. But in a nutshell, by messing around with the genetic make-up of both organisms, the goat's milk could be processed to extract proteins that could then be spun into silk. I'm not suggesting that this potentially scalable mass-market product – and one of the world's strongest natural materials – will eventually become incorporated into tractor hoods, but it does make you wonder if one day the equivalent of carbon fibre or other such materials could somehow be produced from a living factory.

The scientists involved in this research have a whole pick list of special genes to choose from – blue proteins, fluorescence, etc. – and decide how they'd like to 'improve' nature's handiwork, in the space of just a few months. It's like taking those contrived old 'What do you get if you cross a centipede and a parrot?' style of jokes (a walkie-talkie) to their logical extreme.

The extent for crossover into the largely inorganic structure of a tractor, forklift or excavator is presumably limited, though – which is a shame when mountain goat genes could have perhaps helped avoid tipovers – but when biodiesel can now be produced from doctoring yeast, there will surely be implications for the industry in coming decades. Perhaps this will mainly affect cabs and operators – maybe genetically altered humans with eight limbs will be better able to operate the notoriously difficult motor grader, or worklights will become an unnecessary optional extra given our cat-like night vision or bat-derived radar.

Hmm, I'm creeping myself out here. I must admit that while the topic was absolutely fascinating, the concerns about Playing God (the title of the documentary) and the creation of Frankenstein organisms certainly gives pause for thought. Sometimes you can just go too far with what's possible – just because you can do something doesn't mean you should...

Anyway, I can't promise that our Materials feature this year will be quite as 'out there' in terms of blue-sky thinking. It does however, tie in perfectly with the important theme that has been ongoing in *iVT* this year – reducing fuel consumption. So while few off-highway or materials handling OEMs subscribe to the same weight-weenie ethos of the automotive or cycling world, a bit of judicious material substitution can work wonders in reducing operating costs. And the name of this miracle substance, I hear you ask? Would you believe me if I said 'steel'?

Richard Carr, editor, iVT International

Coming up in the November issue of *iVT*

Mining Special – the latest vehicle case studies • Design Challenge • Atlas Copco RocX concepts • Electric drives • Engines and emissions – cooling focus



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CURTIS





ROCESTER, UK – Following the recent integration of in-house engines into many of its JS series excavators, JCB has continued the process with its Loadall telehandlers. This time, however, it is JCB's own Dieselmox models that are being replaced – now, Tier 4i Ecomax engines with ratings of 55, 81 and 93b kW are standard across three categories of construction models, although the 81b kW rating is available as an option for most of those, with 93b kW an option in four of the larger models.

Contractors and owner-operators will benefit most from the greater performance enabled by the 15% rise in torque and 10% increase in low-rpm power from the 81b kW models that replace the 74b kW Dieselmox Tier 3 units, while providing up to 3% fuel savings.

Like the 93b kW models (previously 97b kW), they feature a variable-speed cooling fan as standard, reducing fuel consumption while enabling the engines to warm up faster in colder conditions.

Although delivering less outright power than its 63b kW Tier 3 predecessor, the new 55b kW engine provides 6% more torque and 5% more power at low (1,400) rpm. Aimed at the plant hire market, this will still provide the same performance, but with greater efficiency. Fuel savings of 10% are said to result from the downsizing.

The company has taken the opportunity to look at every other aspect of machine

Doing more with less

Downsizing two of the engine offerings on JCB's Loadalls has enabled fuel savings of up to 10% – but with no negative impact on productivity



performance, with some small, yet important, driveline tweaks being made. High back-off brakes, which pull the pads away from the disc to prevent drag, have now been made standard on four of the 55b kW Loadalls. Already standard on the 550-80, JCB's largest model, these add a further 2% gain in efficiency.

The PS750 Powershift gearbox now requires 1 litre less of oil (1.5 litres less with the PS764), which cuts churning losses and drag within the transmission to contribute a further 1% efficiency gain.

Breathe easy

The internally managed emissions treatment of the engine also pays dividends in terms of

manoeuvrability. While some telehandler manufacturers have been forced to extend the wheelbase or chassis length to provide enough room to squeeze in a DPF or other aftertreatment, the new Loadalls maintain their previous dimensions.

It has also enabled a more aggressive styling of the engine canopy and pod that has enhanced airflow without sacrificing visibility to the right-hand side. In fact, on previous models, the air could potentially create a dust cloud while being expelled through the side of the pod. Now, however, clean cooling air is pulled in through the top of the front of the canopy before being circulated, exiting through new vents at the top of the rear of the canopy.

LEFT: The JCB 535-125 Hi-Viz Loadall runs on a 55kW engine

TECHSPEC

The new 55kW engine provides 6% more torque and 5% more power at 1,400rpm



Comfort zone

▶ The new JCB Loadall cabs provide a much more ergonomic place from which to work. The front dash installation has been restyled for a clearer layout, with a completely new instrument cluster and high-resolution LCD monitor. The displays have been offset to provide greater forward visibility.

The heating and ventilation system now features a seven-speed fan, providing greater control and comfort for the driver, while the top half of the door now comes with a revised slam-latch mechanism and door-ajar facility to ensure the window stays open if required.

Site safety has also been improved, with the incorporation of an operator-presence switch in the driver's seat as standard.



Emissions accomplished

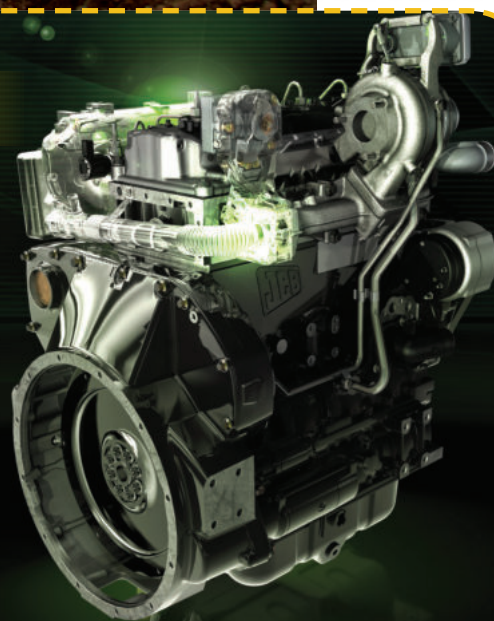
▶ JCB has been able to comply with the latest stage of emissions compliance without the need for external aftertreatment. The use of innovative in-cylinder combustion technologies, along with cooled exhaust gas recirculation, a high-pressure (2,000 bar) common-rail system, and variable geometry turbocharger for rapid response at low rpm have been relied upon instead.

The engines do, however, require upgraded fuel and air filters as well as a 5µm water separator and fuel filter for the supply line to supplement the 2µm engine filter. A crankcase ventilation filter must also be used. But unlike engines using aftertreatment, the Ecomax models are

able to run on standard oils, rather than the more expensive CJ4 variety.

This lack of aftertreatment also means that new JCB vehicles can still be sold into the used equipment market in lesser-regulated countries. "By recalibrating the Ecomax engine, turning off the EGR and reducing fuel-injection pressures, it is possible for the engine to be run on higher sulphur content fuels," says Alan Tolley, JCB's director of engine programmes.

"This process can be carried out by any of our dealers around the world using standard JCB service tools, offering a flexible, straightforward solution for our customers in the used equipment market."



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CONSTRUCTION FOCUS



JIM MANFREDI, MACHINERY OUTLOOK

SALES ON THE RISE

According to CECE, Europe's construction equipment OEMs are expecting a 6% increase in sales this year. Growth is coming mainly from north of the Alps, while the outlook for the Iberian Peninsula remains gloomy. Poland, the Czech Republic and Italy have developed below the EU average, while the opposite trend was seen in France, Germany and Scandinavia.

Compared with 2010, 2011 was a positive year for the industry, with total sales increasing by 19% to €24bn.

One third of the companies interviewed in the CECE survey said that in 2011 they had an increase in turnover of above 20%, regardless of their size, while only 7% of them noted a drop in sales.

TRYING TO KEEP UP

Manitex International has announced an order backlog of US\$133m as of 31 March, a 179% YoY increase that represents another all-time high for the company and its eighth successive quarterly increase. Demand for its boom truck cranes continues to grow the backlog, although the company is also seeing strong demand for its other specialised products.

In Q4 2011, Manitex began activity to increase output at its key facilities in conjunction with its supply chain for further expansion in 2012 to support growing demand. The current backlog calls for products to ship right through to early 2013. Demand, particularly for higher-tonnage cranes, is being driven by continued activity in the North American energy sector.

INVESTING IN OZ

Komatsu has opened its US\$55m Wacol facility, the largest investment it has

made in Australia. The new facility will act as its mining equipment division national HQ, a manufacturing and assembly facility, regional HQ for Queensland and service branch for Brisbane.

Construction of the 61,000m² facility began in late 2010 and will also incorporate service workshops and parts sales, oil laboratories and a remanufacturing centre for electric wheel motors.

HOW TO CUT CARBON

The UK's Business Secretary has chosen the Caterpillar ADT factory in Peterlee, County Durham, for a €50.8m research programme into reducing carbon emissions from heavy-duty vehicles. The vehicles incorporating the new technology are tentatively planned to be available by 2020. The Energy Technologies Institute said that heavy vehicles account for 8% of the UK's CO₂ emissions.

Q1 A CURATE'S EGG

Construction equipment sales declined 6% in Q1 2012 compared with Q1 2011, as declining demand in China drove the APAC region down 24%. The North American market saw a substantial YoY improvement of 45%.

EAME and CIS markets continued to improve, up 14%, while Latin American demand grew by 9% for light equipment but dropped 1% for heavy equipment.

CNH Construction Equipment's sales in the quarter grew 41% as a result of market improvements in every region and especially in North America, where sales more than doubled compared with the same period last year. Increased sales and production volumes led to an operating result of US\$34m, up from a loss of US\$17m.

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TWO SIZES FITS HAUL

NEWPORT NEWS, VA, USA –

In addition to two new large hydraulic excavators, Liebherr is to launch two diesel-electric haul trucks at MinExpo 2012.

The T 284 will be the follow-up to the long-established T 282 C in the 400-ton class. Said to offer the highest payload in the industry, it adopts the latest generation of the Litronic Plus AC drive system to determine the optimal way to extract power from the engine. More power is made available for acceleration and climbing grades, while conserving fuel during engine idling.

Using many other in-house components and systems, the truck will become the platform for future advances in Liebherr mining technology.

It will also be re-entering the 240-ton payload class with the T 264, which has been designed to match its R 996 B and R 9800 hydraulic excavators.

Its advanced Traction Control System, which the OEM has designed exclusively for mining trucks, draws on a four-wheel speed-sensing capability. This automatically adjusts torque to the rear wheels to maximise traction

when cornering, accelerating from a standstill or travelling down wet or icy roads, helping maintain truck stability and steering control.

An anti-rollback feature keeps the truck stationary when stopped on grades in either forward or reverse mode. Payload and overload warnings will help to ensure a safe working environment.

The integrated electronic system monitors, records and outputs vital truck health and performance data, supporting predictive maintenance to minimise downtime.

GOOD LOOK CHARM

ZWEIBRUCKEN, GERMANY

– Terex Cranes has been working very closely with automotive ergonomic experts and Porsche Design in an effort to provide a family feel across its product lines.



The first models to benefit from improved visibility and ergonomics have been the Challenger all-terrain cranes. In the carrier cabins, the B-pillars have been removed to provide a better view of the mirrors, which are now heated and electrically adjustable. With new, enhanced lighting systems, safety has also been improved as a result of the addition of daytime running lamps, fog lamps including curve lights, and an integrated rotary beacon.

A new ergonomic, heated seat design features automatic height adjustment, while the air-conditioned glove box can also be used as a cooler.

Visibility improvements in the crane cabin, which boasts an infinitely variable tilt to 20°, include a sliding window in



the door, a fold-out front window, laminated roof safety glass with wiper, 'position out of window' wiper system, and tinted safety glass. And the 2.05m-tall operator pictured on the left claims this is the first cabin in which he feels truly 'comfortable', without having to have modifications made.

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AGRICULTURAL FOCUS



JIM MANFREDI, MACHINERY OUTLOOK

M&M GOES BIG

Mahindra & Mahindra claims it has now overtaken John Deere's tractor sales over the past two years. Anand Mahindra, MD of the group, said that this achievement was possible due to a rise in demand from rural parts of India as well as penetration into China and elsewhere.

To strengthen its growth plans and presence in the global market further, it will be considering major international acquisitions in the near future.

The company has recently launched Mahindra Research Valley, a US\$130m centre for innovation designed to facilitate its varied needs and requirements for future growth plans.

CNH OPTIMISTIC

CNH projects worldwide agricultural equipment retail unit demand will vary from flat to up 5% on the back of firm agricultural commodity prices.

Agricultural equipment sales decreased 2% over Q1 2012. Global tractor and combine sales were down 2% and 5% respectively in the quarter, although North American sales of +40hp tractors were up 5% and combine sales were down 40%, mainly due to limited equipment availability.

Latin American sales of tractors and combines decreased by 8% and 1% respectively, as a result of the drought conditions, but EAME and CIS markets saw tractor sales rise by 9% and combine sales by 21%. APAC unit retail sales were down by 4% for tractors and 33% for combines.

CNH's sales in the ag sector increased 18% for the quarter, with North American demand being heavily influenced by an earlier than normal planting

season. Its Q1 market share performance for tractors was in line with the market, with global market share flat in tractors and up in combines. Market share for tractors was up in the EAME and CIS region and flat in every other region. Combine market shares increased in North America and Europe.

AGCO EXPANDS PLANT

AGCO has opened a 75,000ft² expansion to its Jackson, Minnesota, manufacturing centre, and added a visitor's centre next door.

The Jackson plant will now manufacture Massey Ferguson MF8600 Series and Challenger MT600D high-horsepower wheeled row-crop tractors. These were previously built in AGCO's plant in Beauvais, France, which was already nearing maximum capacity. With Jackson taking on the North American production, the move will free up extra capacity to meet Europe's demand for these tractors.

MUTUAL SELF-LOADING

Caterpillar Forest Products has entered into a marketing agreement with Palfinger Inc to distribute a line of knuckle boom self-loaders produced by Epsilon Kran GmbH under the brand name Prentice/Epsilon.

The line will initially include multiple models and will be marketed exclusively through select distributors experienced with truck-mounted loaders.

The marketing agreement for self-loaders becomes the second collaboration between Caterpillar Forest Products and Epsilon. The latter also produces the loader for the 20-ton Cat 584HD forwarder and will continue to supply loaders for other Cat cut-to-length (CTL) equipment.



The Farmall A's new engine hood with headlight cluster completes the Case family appearance

THE BRAND THAT TIME FORGOT

JESI, ITALY – The world-famous Farmall name has made a welcome reappearance with the launch of three new series from Case IH. Designed to offer high levels of reliability and versatility, the models cover the 55-115hp range.

A completely new design, the Farmall U Series is the premium-package, all-round performer, with a choice of 95, 105 and 115hp models. Transmissions can be tailored to the desired use, although a 24x24 powershuttle and two-step powershift is standard for the UK market.

The shuttle's response speed can be altered via a three-

stage rocker switch on the B-pillar, improving driver comfort or enabling quicker direction changes for short cycle times and greater productivity when using a loader.

HVAC components are located under the premium cab, providing a flat deck and exceptional visibility despite limiting the overall vehicle height. The integrated roof window provides an optimum view of the front loader.

This premium cab is shared with the Farmall C, which replaces the former Quantum C series with three models of 55, 65 and 75hp. The 3.2-litre four-cylinder

FPT engine combines with the compact vehicle dimensions to deliver an impressive power-to-weight ratio and a 3.8m turning circle.

In the UK, a standard 12x12 synchromesh or optional 20x20 creep speed transmission enables speeds right up to 40km/h or down to 123m/h.

Replacing the JX models, the Farmall A Series is all about economy and efficiency, with three- and four-cylinder turbocharged FPT engines providing 65-113hp. Their high torque rise results in fewer gearshifts, high efficiency and low fuel consumption.

MAKE IT PERFECTLY CLEAR

GRANBY, QC, CANADA – AHWI-Prinoth's Raptor 800 is ideal for difficult tasks such as heavy clearing, vegetation management around power lines, creation of firebreaks and recultivation tasks.

Oscillating around a pivot that allows them to closely follow the terrain, the new Delta tracks reduce vibration,

while boasting excellent self-cleaning abilities. Combined with the optimum weight distribution, low centre of gravity, 5.7psi footprint (with the low ground pressure track option) and ability to drive through water up to 20 inches deep, this makes the Raptor 800 capable of tackling all terrain conditions.

The six-cylinder Tier 3 Cat C18 produces 630bhp and a maximum torque of 2,042 lb-ft at 1,400rpm, delivering more power to the mulcher head via the newly patented Powerbelt system. Replacing the PTO, its two belts provide direct mechanical power transfer and allow for a wider range of vertical movement even at full power output. Connected to the vehicle with a four-point lifting gear, the attachment can be raised higher than most other mechanically driven models, even at full load.

As well as being highly manoeuvrable, it delivers high-quality shredding through the efficient combination of its large-diameter drum and special teeth arrangement.



WHAT'S NEW

HANDLING FOCUS

MICHAEL LEU, FORKLIFTACTION.COM

TRUCK ORDERS UP...

Orders for industrial trucks worldwide grew by 22.7% in 2011, from 794,452 units in 2010 to 974,582 units, the latest WITS figures reveal. On the American continent, orders jumped 24.1% from 2010, to 224,773 units in 2011. In Europe, orders grew 23.6% to 330,616 units; they rose 20.4% to 379,969 units in Asia; Africa saw a 13.2% increase to 17,587 units; while sales in Oceania leapt 44.8% to 21,677 units.

...AND SET TO CONTINUE

Global demand for materials handling products is forecast to climb 4% per annum up until 2016, to US\$123.6bn, according to a new study by The Freedonia Group Inc.

Although opportunities will be more favourable for the sales of equipment such as automated conveyors and AGVs, energy-efficient products such as electric forklifts are also expected to see solid gains as end-users seek to cut costs.

India and China will see the fastest gains, the report says, largely due to rising manufacturing output that is set to spur demand for equipment to facilitate distribution and production.

However, the US market, which accounted for 22% of global sales last year, is expected to remain the leading consumer nation up until 2016.

Japan and Germany are forecast to post stronger gains, although both have performed poorly compared with the global average in recent years.

NEW JV HAS BIG PLANS

UniCarriers Corp, the forklift JV of Hitachi Construction Machinery and Nissan Motor, aims to make acquisitions in its bid to compete with Toyota Industries Corp and Kion Group.

Global materials handling online: www.forkliftaction.com

Hidetoshi Shibata, MD of Innovation Network Corp, the JV's largest shareholder, told Bloomberg that size matters, adding: "There is also momentum towards consolidation in the industry."

Although not naming any potential targets, he said that warehouse equipment makers might have to unite as slower demand growth in China raises concerns about overcapacity.

HOMESPUN WISDOM

Nacco Industries intends to spin off its materials handling business, launching Hyster-Yale Materials Handling Inc, an independent public company that will own and operate the NMHG subsidiary.

No stock will be issued in connection with the spin-off, so Nacco Industries will not receive any proceeds from the move.

NMHG accounted for US\$2.54bn (76%) of Nacco Industries' sales for the year ended 31 December 2011. In geographic terms, US\$1.57bn of NMHG's sales were in the Americas, US\$751.7m in Europe and US\$218.4m elsewhere.

SAFETY AUTOMATIC

ANSI has approved a revised guide to safety requirements for driverless automatic guided industrial vehicles (AGVs) and the automated functions of manned industrial vehicles.

The standard becomes valid on 1 March 2013, and has implications for system suppliers, manufacturers, purchasers and users involved in the design, construction, application, operation and maintenance of the vehicles.

ANSI/ITSDF B56.5-2012 is now available as a free download via the website of the Industrial Truck Standards Development Foundation (ITSDF).

GIFT OF SIGHT

MJÖLBY, SWEDEN – Cesab's R300 reach truck range has been enhanced with the addition of the R212, R318 and R325 models, expanding

capacity to 2.5 tonnes and lift height to 12.5m.

Visibility is a key feature, with the low front panel enabling an unobstructed view around and through the mast to the load, while a window behind the driver ensures safe reversing. A fan-shaped roofguard made from thin, angled crossbars provides excellent overhead views and protection.

But vertical performance hasn't been forgotten, with a lift-control system that enables lifting or lowering continuously up to 0.7m/sec, without stops or even slowing down when switching from free lift to main lift. This provides smoother movement and

reduced power consumption, and enables lift-and-reach movements to be executed simultaneously, even while the truck is moving.



THE ADVANCED GUARD

ASCHAFFENBURG, GERMANY – A prototype Linde E25 L Roadster is providing increased flexibility, efficiency and safety while on test at Frankfurt Airport.

The main benefits stem from the increased visibility enabled by the new overhead guard that replaces the A- and B-pillars; a design only made possible by the typical Linde

construction technique of mounting tilt cylinders on top of the lift mast, which redirect load stresses into solid cast supports at the truck's rear.

The improved forward field of vision that this design has enabled means an assistant is no longer required to issue instructions to the operator when he is loading bulky air-freight pallets.

A curved steel tube joined to the front plate, inspired by stair banisters, maintains the ease of access, with the step's visibility remaining unchanged.

The two panes of special laminated safety glass in the roof move back and forth with the movements of the mast, providing an unobstructed upwards view and protection from falling loads.

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FRANK MANFREDI, PUBLISHER OF *MACHINERY OUTLOOK*, SAYS SOME CHINESE OEMs HAVE A LOT TO LEARN IN TERMS OF REPORTING UNIT SALES

"In our trips to China we have often heard Chinese companies say that their markets always grow and never decline.

So how are they responding to the domestic downturn? Two of the largest companies, Zoomlion and Sany, have publicly traded stock and so offer some amount of transparency. There are other publicly owned companies in China, but many of them are controlled by national or provincial governments and, in our experience, there is a lack of available information. Public ownership requires companies to disclose to shareholders how they conduct their business – and those disclosures reveal surprising contrasts between Chinese and western companies.

Sany has announced it will postpone its planned Hong Kong listing because market conditions remain weak. The company was trying to launch its first IPO in early 2012. The recent filing was for the sale of the equivalent of US\$2bn in exchange for 10% of its total ownership – 40% lower than the US\$3.3bn it planned to raise last year. In Q1, it pumped up its domestic Chinese business by renting and selling machines to customers for little or no money; by Q2 it was unable to convert the rentals into permanent sales, which resulted in it having to make retroactive adjustments to its Q1 sales.

Zoomlion reported impressive growth in 2011 with revenues reaching US\$7.3bn and a profit surge of 73% to US\$1.3bn. But its share price has declined as a result of investors' concerns about the company's plan to raise debt of US\$22.2bn in the Hong Kong market. The company plans to use the funds for cashflow loans to its customers, mortgage financing, equipment financing and leasing, and other services such as guarantees and endorsements. Investor concern was further fuelled by news that about half of the concrete pumps sold by the company in Q1 are still lying idle in East Jiangsu. Zoomlion has also strongly denied a rumour that it was considering making a bid for CNH.

Many investors are concerned about whether Zoomlion will be able to collect all of its receivables after selling its construction equipment, having also sweetened the deals by allowing buyers to postpone the first payment. The plans by Sany and Zoomlion to boost sales reminds us of the programmes that many publicly owned US OEMs used in the 1960s and 1970s to improve their sales and share price, a practice that has since stopped due to Security and Exchange Commission regulations and active shareholder groups. It was easy to boost sales and revenues if you count shipments as sales and book the profits as well.

China, which represented 50% of the global market for construction machinery in 2011, may not be able to prop up world machinery markets in 2012. With demand soft in China, there is a risk that production and inventory there will show up in other markets. We believe it likely that Latin America will see a surge of Chinese-built machines. In fact, during June's M&T show in Brazil, there was a strong rumour that Cat was shipping 2,000 of its Chinese-built excavators to Latin America, where most countries are at Tier 2 and 3 level. There is little threat, however, that we'll see a flood of Chinese machines showing up in North America or Europe due to our strict emissions regulations." **IVT**

NEWS FROM THE EAST

Seoul, S. Korea – Doosan Group remains willing to engage in mergers and acquisitions that could expedite its growth and diversify revenue streams, said new chairman Park Yong-mann.

Park, 57, took the helm at South Korea's 10th largest conglomerate at the end of March and also oversees its construction equipment unit, Doosan Infracore. He has orchestrated 17 M&A deals since 1998, most notably the 2007 takeover of Bobcat for US\$4.9bn, for which he was later criticised after Bobcat's financial troubles due to declining demand.

Park has stressed that the financial soundness of the group's main affiliates is improving, one key area being the improvement of Bobcat.

"Bobcat will reap over KRW200bn won (US\$176m) operating profit by the end of this year. Bobcat is stabilising," he predicted.

Park also expects global conditions to improve in the coming months: "Three major risks: elections, the Eurozone debt crisis and high oil prices, appear controllable. This year, however, the recovery will be milder than the rebound expected for next year. The US economy is improving and the risks facing the Chinese economy are easing too," he clarified.

As a group, Doosan expects to earn US\$26bn in revenue this year, representing an annual 11% increase. The forecast for operating profit is up 29% from last year. *(MOE)*

Jiangsu, China – Rainbow-Cargotec Industries (RCI), a JV of Cargotec and Jiangsu Rainbow Heavy Industries (RHI), has broken ground on

its new 265,000m² facility on a 30ha site in Taicang. The JV will focus on STS cranes, RTG cranes, RMG cranes and other heavy crane products.

In other news, Cargotec is evaluating the listing of Cargotec Marine on the Singapore Exchange. The company says the listing would strengthen its business presence in Asia and secure profitable growth. More than a third of Cargotec's sales comes from the APAC region. *(Forkliftaction.com)*

Thiruvallur, India – Cat has opened a new backhoe loader manufacturing facility near Chennai. Close to its existing off-highway truck factory, this is the company's second major facility in the region, and its fourth in India, and is expected to strengthen the company's growing presence in the country. *(MOE)*



Henan, China – Caterpillar has completed its tender offer for ERA Mining Machinery Ltd after receiving approval from China's regulators.

ERA primarily designs, manufactures, sells and supports underground coal-mining equipment in mainland China through its wholly owned subsidiary, Zhengzhou Siwei Mechanical and Electrical Equipment Manufacturing Ltd, which has approximately 4,300 employees including engineering, manufacturing, sales, services and other management functions.

The Siwei brand will continue to be used and will become a part of Caterpillar Global Mining. *(MOE)*

Shanghai, China – Sany has opened what it says is the

world's largest and most advanced excavator factory, which is able to produce an excavator – primarily those in the 20- to 30-ton size range – every five minutes.



The Lingang Industrial Park boasts 10,700,000ft² of total space, with 5,900,000ft² of manufacturing space. The facility cost US\$818.5m to build, and uses a computerised production-management system for maximum efficiency, managing the entire process from raw steel plate and structural welding right through to components and final assembly. Excavator structures and components are transported automatically from underground tunnels to optimise production.

Anhui, China – Anhui Heli has signed an MOU authorising Siam Sun Autosales, the Thai-owned importer and distributor of several Chinese machinery brands, to distribute its forklifts in Laos, Cambodia and Myanmar.

Company chairman Zhang Dejin said Heli is interested in assembling forklifts in Thailand if sales in the Thai market and those of its neighbours hit 3,000 annually. Akradech Wongpituchroj, Siam Sun's MD, forecasted new forklift sales in Thailand of 2,500 units for 2012. *(Forkliftaction.com)*

Maharashtra, India – Perkins is to invest about US\$150m to set up a manufacturing facility in India. The company intends to manufacture its 4,000 Series diesel and gas engines, which are used in power generators. The project would be granted a mega project status, with the plant having the capacity to produce 3,000 engines per year. *(MOE)*



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Design Challenge

DEVELOP AN INNOVATIVE WAY TO IMPROVE VISIBILITY FOR THE OPERATORS OF INDUSTRIAL VEHICLES THAT TYPICALLY HAVE AT LEAST ONE RESTRICTED FIELD OF VIEW

AC² – ACTIVE CAB COUNTERWEIGHT



Kevin Wilson

Kevin works as a machine designer for Entegee Engineering Services at John Deere's Seeding Group, specialising in the conceptual visualisation of vehicles, machinery and industrial environments

The AC² ScissorHandler is a materials handling and transport vehicle that has been designed to address many of the shortcomings inherent in current telehandler design. With its long wheelbase, cargo can be set on top of the boom and guide rail for transport.

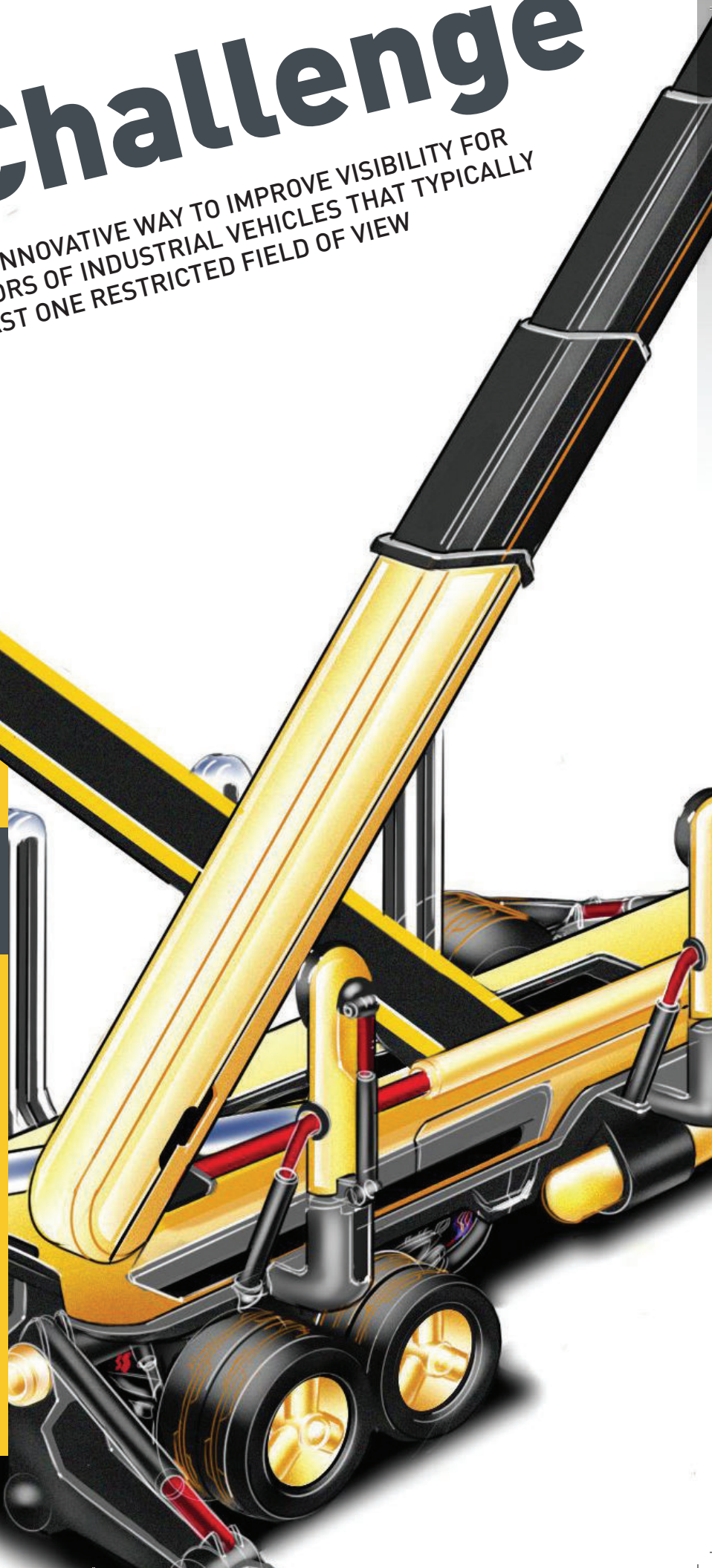
The guide rail and boom pivot about each other, around a central pin, like the links on a scissor lift. Opposing hydraulic cylinders move the boom and rail as a unit. The elevated cab has a higher moment of inertia, which effectively helps to serve as a counterweight to heavier loads, so with no boom to obstruct vision, the operator has a clear line of sight in a variety of positions.

With no physical connection to the steering system, the cab itself can move along the guide rail to any position. Similar to a Maglev train, frictionless electromagnets embedded in the guide rail allow the cab to move along its length at virtually any angle. Computer-controlled gyros are used to maintain the cab's proper orientation relative to the work. Fibre optics in the cab turn the cockpit glass into a giant head-up display and monocular/magnifier for increased visibility and clarity on demand.

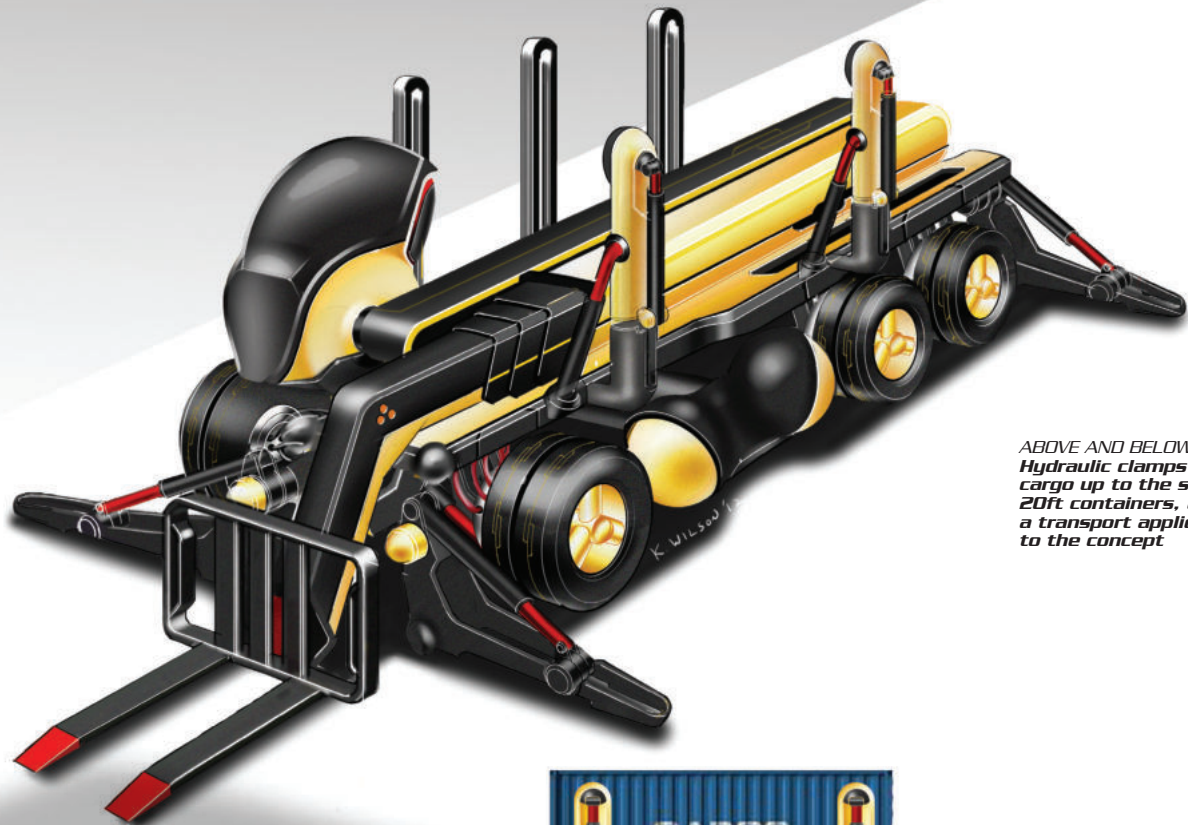
A set of hydraulic clamps can be used to secure cargo, while a set of removable ramps can be used for loading and unloading. These vehicles can also operate in pairs with a smaller forklift to aid in that process.

Brushless high-torque DC hub motors, the drive-by-wire steering system, onboard computers and hydraulic pumps are all powered by hydrogen fuel cells, resulting in an environmentally friendly zero-emissions platform.

WilsonKevinB@johndeere.com



DESIGN CHALLENGE



*ABOVE AND BELOW:
Hydraulic clamps secure
cargo up to the size of
20ft containers, adding
a transport application
to the concept*



*BELOW: Using Maglev-style
technology, the cab is able
to move along the guide
rail to the desired position*



DESIGN CHALLENGE



AGGREGATION OF MARGINAL GAINS



Chris Wyeth

Chris graduated in Automotive Design from Coventry University before working freelance under the guise of Husky Design. Since January 2011, he has worked as an exterior designer, visualiser and outfitter for Palmer Johnson Sports Yachts

Based on the same dimensions as a JCB 550 telehandler, the HD-01 concept boasts a series of small improvements that result in a considerable increase in overall visibility. Firstly, the standard front wheels have each been replaced with two smaller ones to provide an increased viewing angle from the seated position when moving the load below the horizontal level. This also serves to increase the footprint under heavy payloads. The front wheels are jointed on travel arms, allowing the wheelbase to extend, and then the main chassis to pivot upwards with the arm and the payload, providing the operator with a clear sightline without the need to lean forward. The incorporation of all-round hydraulic motors also eliminates the central drivetrain from impairing views directly in front and beneath, while the tyres simply follow up recent developments in airless construction for greater use and less wear and tear, while providing a more comfortable and stable platform. This is important as a traditional telehandler can bounce around a lot when carrying large loads.

The main vehicle body sits on a small rotating joint that is linked directly to the steering and is able to move up to 15° off-centre, clockwise and anti-clockwise; the intention being that when the telehandler is turning on full lock, the cab and the boom travel the additional 15° without requiring user input to improve the loading angles and views over the wheels.

The boom itself is curved, because the typical straight extension creates a solid blind spot. The curvature works in a similar way to an excavator's arm, allowing you to view over small thresholds, and removes the fixed degree of impaired vision that a straight arm provides. The boom is directly powered by the largest hydraulic pump, which is fixed into the boom around its pivot point at the rear, so that no hydraulic pistons obscure the view to the right-hand side when the arm is raised.

At the end of the arm is a double-knuckled pivoting joint, which provides more flexibility and enables the operator to see over or under the beam. The same joint also offers greater options when transporting items where a bucket or payload may otherwise block views.

As for the cab, the glass is replaced by a plastic that enables a pillar-free frame construction for clear frontal views. The plastic is triple laminated on both sides with a 2mm armourite vinyl, which prevents scratches or inclement weather obscuring the view, while the inner layer has a graded tint for polarising light diffraction into the cabin. The steering wheel is removed to create a clear view directly in front – controls are mounted in a similar way to those in an excavator as all joints and motors are hydraulic and can be controlled via fly-by-wire.

www.huskydesign.co.uk / husky_design@me.com



LEFT: The curved boom design removes the fixed degree of impaired vision created by a telehandler's traditional straight boom

BELOW LEFT: The main chassis can pivot upwards for a superior view to the raised load, meaning the operator is no longer required to lean forward





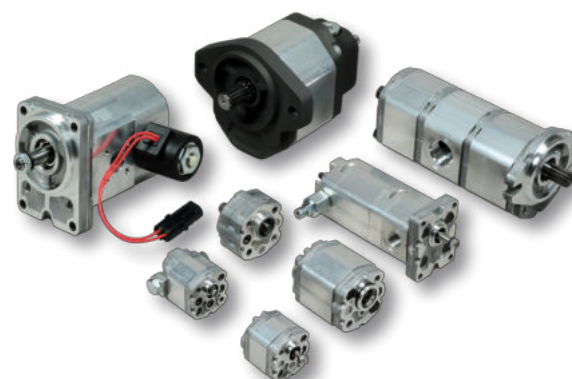
The President and us

Sometimes a smile could have several meanings:

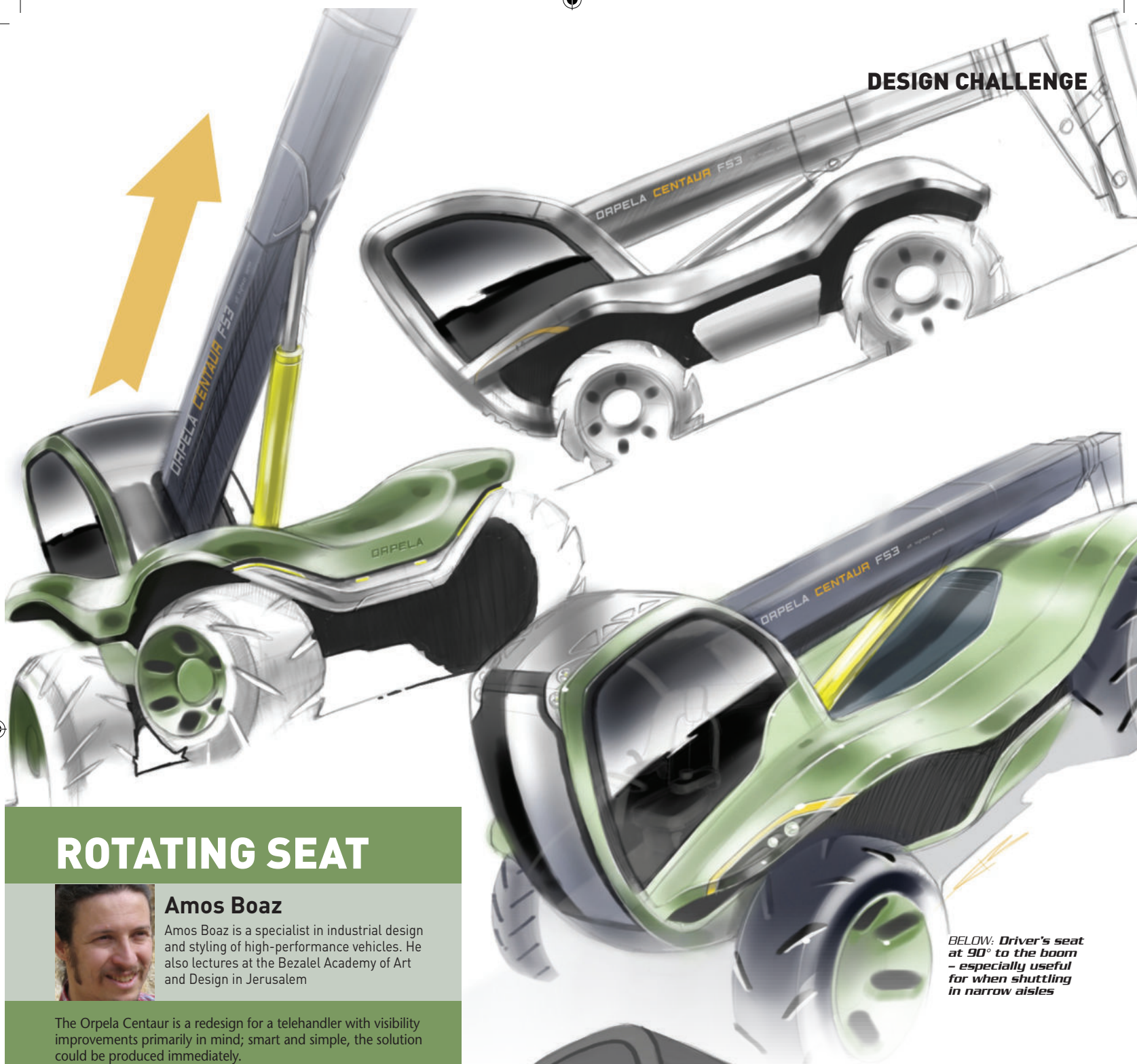
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ROTATING SEAT



Amos Boaz

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

The Orpela Centaur is a redesign for a telehandler with visibility improvements primarily in mind; smart and simple, the solution could be produced immediately.

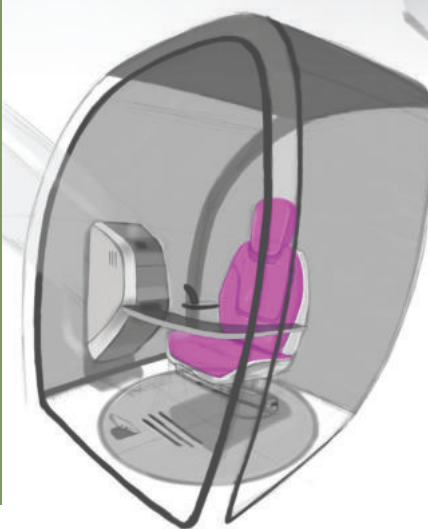
At the heart of the concept is a seat that, together with the controls, rotates to either 90° or 180°. The cab is positioned on what is traditionally deemed to be the rear of a telehandler, so the initial setting of the seat – i.e. with the boom directly behind it – provides the operator with unparalleled views of the road or jobsite, both in front and to the sides, when in travel mode.

Moving the seat 90° greatly facilitates operations that require lots of moving backwards and forwards in a confined place, while the 180° (traditional) setting is better for the tricky work of loading and unloading. And because the cab is positioned right at the back, the view to the raised load is also a little easier on the neck.

With hub motors at each wheel powered by a generator, the Centaur is able to travel in either direction equally well. You can therefore choose to drive while carrying the load in front of you, as with a traditional telehandler or forklift, or drive it like an on-highway truck, with the load at the rear and the view ahead unencumbered.

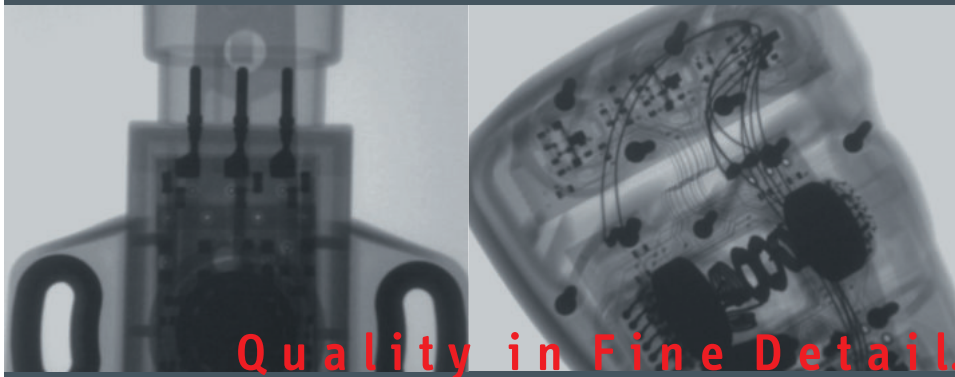
www.amosboaz.com / amosboaz@netvision.net.il

BELOW: Driver's seat at 90° to the boom – especially useful for when shuttling in narrow aisles



ON THE WEB

For extra images and a previously published hi-vis forklift design from Amos Boaz, visit: www.iVTinternational.com



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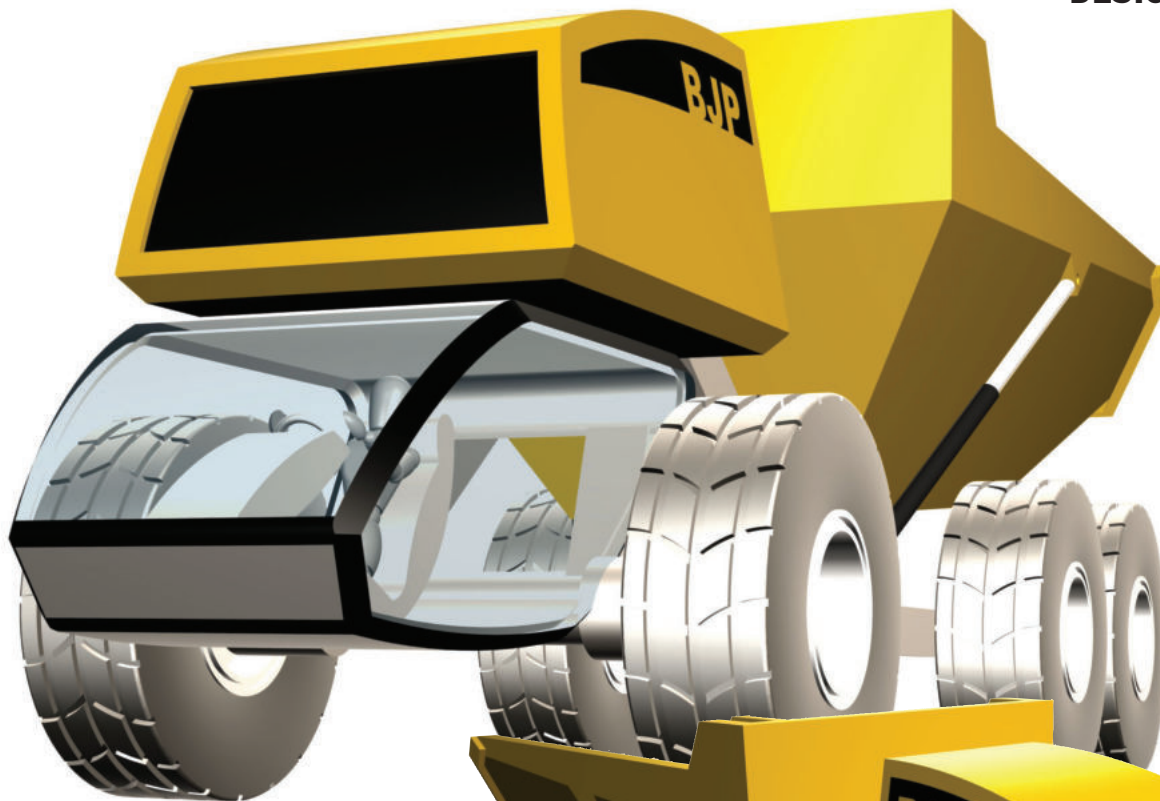
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'UPSIDE DOWN' CAB



Bert-Jan Pastoor

Bert-Jan is senior product engineer at Lely Technologies. He has an MEng in Mechanical Design Engineering, and an MSc in Industrial Design from Technical University Delft

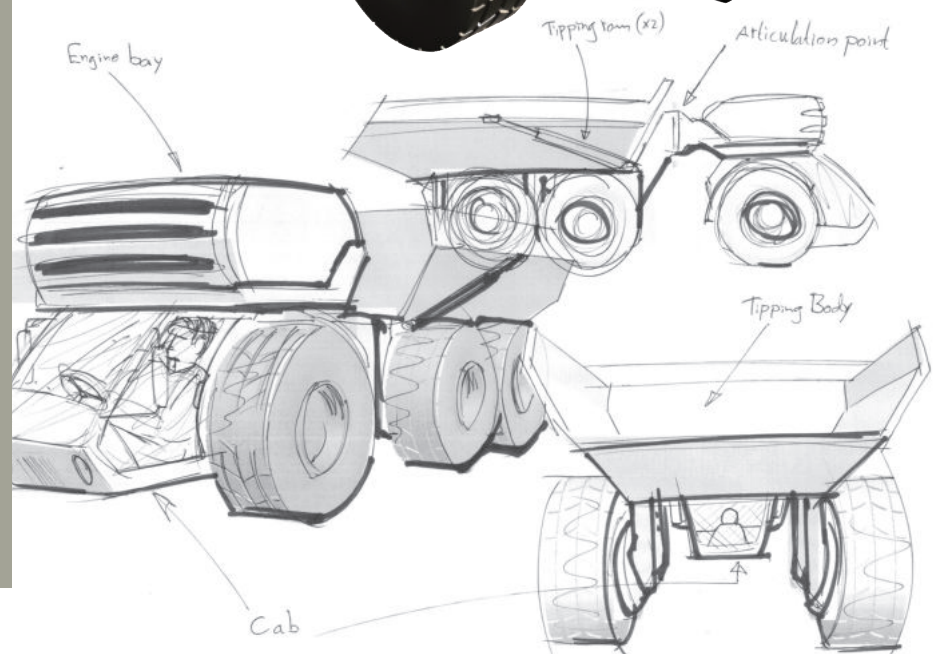
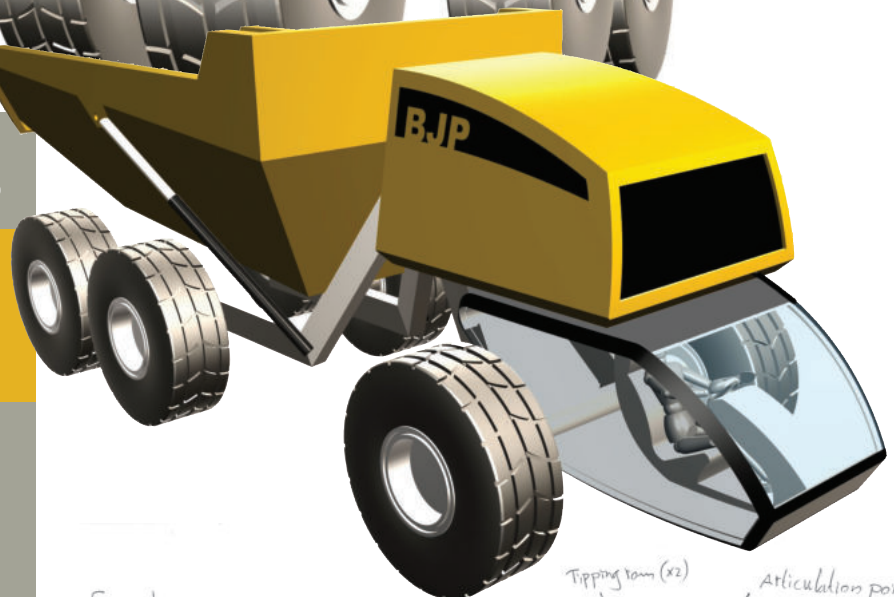
My concept for improved visibility on an articulated dump truck focuses on enhancing the view to the rear, which is very limited on existing trucks and is a major cause of accidents. Having grown up on a dairy farm, the idea comes from my own experience with driving large tractors with dump trailers. Whenever I wanted to drive backwards into the barn, I would lift the telescopic cylinder of the trailer just a little bit, so that I would be able to see the wheels of the trailer and avoid hitting doorposts or other objects.

With this new concept, which involves switching the traditional locations of the cab and engine, the driver is able to see under the body, providing a better view of where to park or dump, which should make it much easier to drive backwards accurately. However, checking the sides of the vehicle now becomes more of a challenge, creating a huge blind spot because of the large wheels.

Therefore it would be even cooler to leave out the front wheels and have a 'floating' articulating cab. The four rear wheels would therefore have hub motors and steer individually, but while that would be easy to draw it would be far more expensive and difficult to build – so I tried to keep things a little more down to earth.

The cab would be well insulated and placed in rubber dampers, avoiding excess engine noise and vibration. The new concept has the average dimensions of a typical 40-tonne articulated dump truck, and is therefore no taller and has the same capacity and ground clearance. The challenge then becomes to move up the articulation point and turning ring and incorporate a tandem bogie that does not block the rear view but is strong enough to carry the payload in a very dynamic environment without tipping over.

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DESIGN CHALLENGE



THE 'ROLL' CAGE

Burak Yesildurak

Burak Yesildurak works as an industrial designer at Hattat Tarım Agriculture Corp in Çerkezköy, Turkey

When I designed the Trex-cavator, the excavator driver's comfort became my priority. My research showed that drivers encountered several problems when working on sloping terrain; the main one being that the cabin's direct, fixed connection to the excavator body reduces the visual angle due to the slope.

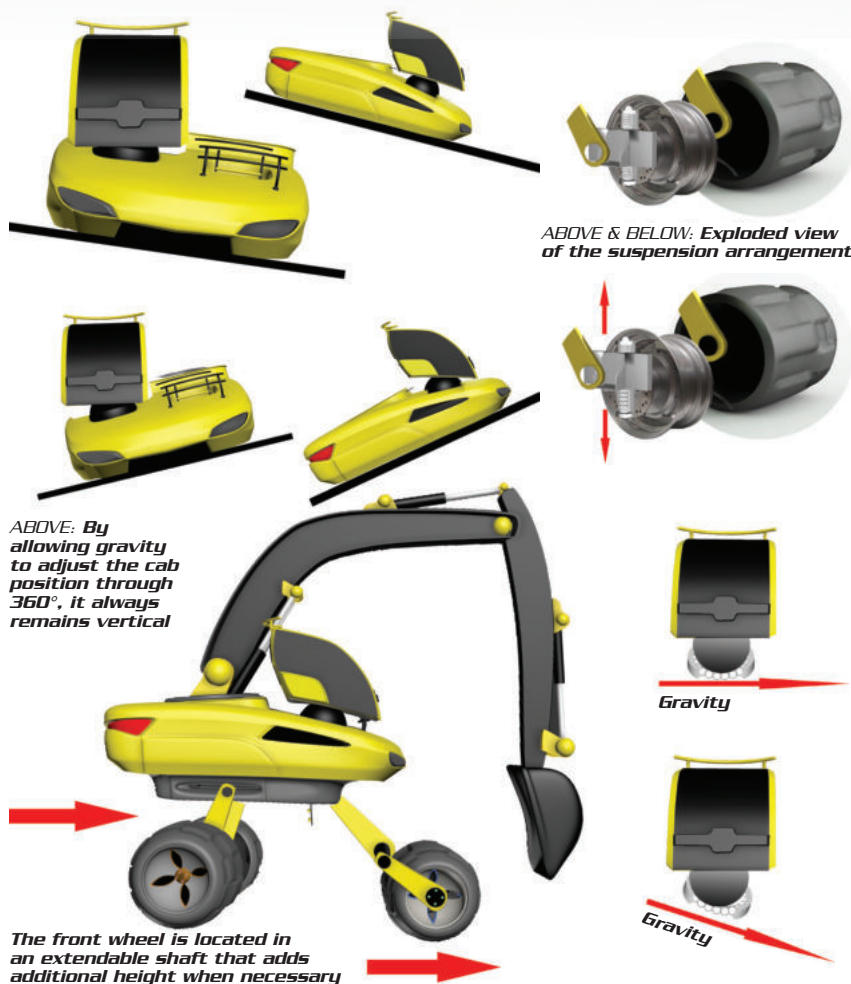
So in my design, I set about enabling the undercarriage and cabin to move independently from one another. Underneath the cabin is a large sphere that connects it to the body, and by using smaller spheres underneath that, the big sphere is able to rotate in all axes. This system acts like a major bearing, so that the cabin will always be perpendicular. This is enabled purely by the force of gravity, rather than requiring any of the electrical energy that powers the machine.

Therefore, when the operator drives up a hill, he will see the same sort of front view as he would when on level terrain – rather than the sky, as is the case with traditional excavators – making operation much safer and easier.

Three large and independently suspended wheels, rather than four wheels or tracks, were chosen to better maintain the balance of the centre of gravity when on sloping terrain. These wide wheels provide high stability and comfort, with the front one being steerable and the rear ones being powered.

Visibility to the right-hand side has also been vastly improved, by relocating the boom's mounting point to the rear counterweight. I'd like to thank Hakan Çokal for his technical support with the design of the Trex-cavator.

www.hattattarim.com / burakyesildurak@hattat.com.tr





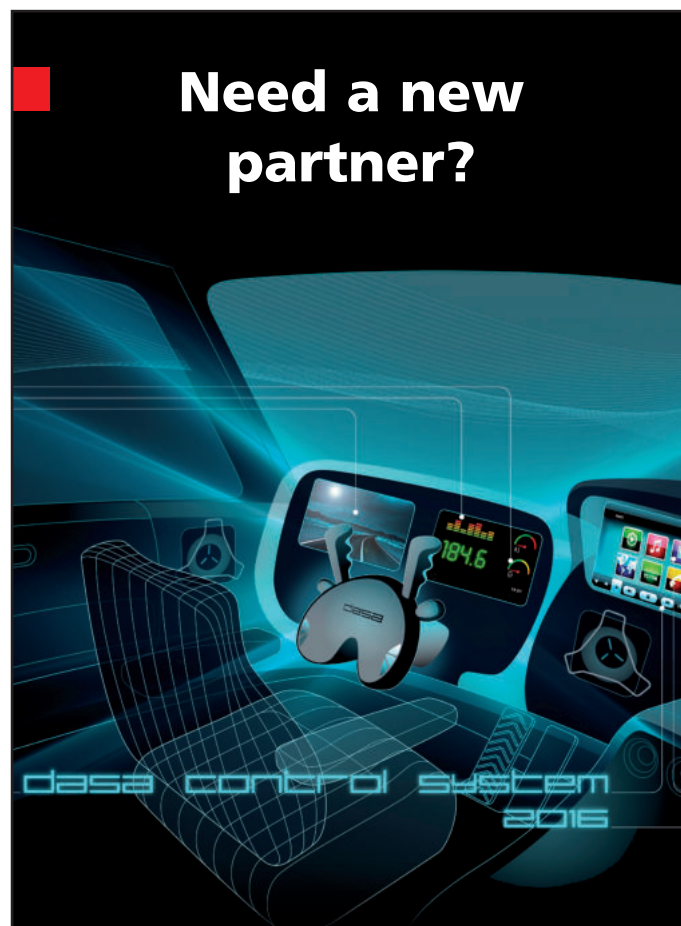
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SEEING IS BELIEVING

JUST TAKE A CLOSER LOOK AT THOSE SHELVES, FOR EXAMPLE. BUT WHILE MOST BYSTANDERS WON'T BE QUITE SO HARD TO SPOT, DESIGNING A CAB FOR OPTIMUM VISIBILITY REQUIRES MUCH MORE THAN ROUTINELY MEETING THE REQUIRED STANDARDS

▷ “Visibility?” an industrial vehicle operator once said to me. “Well, it’s everything, isn’t it?” This was his response to a question I had asked about his requirements in terms of visibility for a new machine under development. We were talking while he put his 3.5 million lb electric mining shovel through its paces, expertly extracting giant shovel loads of oil sand bitumen and filling one of the largest haul trucks in the world in four quick passes.

He was looking down at the ‘floor’ three storeys below us, where he precisely placed the teeth of the shovel on the ground ahead of the machine’s massive tracks. Then, looking at the face of the high wall ahead, he raised the huge bucket and watched it fill with 70,000 lb of sticky black soil. He then glanced over to the haul truck below and to the side, expertly judged its position, rotated the machine with his joysticks and aligned his load over the truck’s bed.



RIGHT: Chinese artist Liu Bolin specialises in painting himself to hide in plain sight, such as in this work: *Hiding in the City No. 83 - Supermarket*. For something a little more industrial vehicle-related, check out his confusingly entitled *Forklifts*, paying close attention to the front wheel of the ZL50 (left)





VISIBILITY

Buisard developed an optimised four-pillar design to reduce visual obstructions in the cab of the new Claas Axion range

Once over his target, he hit the button on his joystick, opening the bottom door of the bucket, and watched as the load fell through it and the haul truck bounced from the impact.

So, 'visibility is everything', I mused. Well, almost everything, but certainly more important than any other sensory channel – in fact, more important than all the other sensory channels put together.

My thoughts drifted to a recent image I had seen of the cockpit of the first private spacecraft to fly into space: SpaceShipOne. No doubt famed aerospace designer Burt Rutan and his associates at Scaled Composites out in the barren Mojave Desert back home in Southern California thought that 'vision was everything... or perhaps almost everything' when developing their unique solution to a visibility challenge for man's first private spaceship.

Faced with the need to create an airtight pressure vessel with a shirt-sleeve operating environment that would withstand the vacuum of space and the high pressures of flight and re-entry in a lightweight vehicle, Rutan and his team came up with a cost-effective solution that certainly did the job, although in a somewhat unconventional manner (see page 37).

Indeed, visibility is almost everything, and I knew that on my



COMFORT IS KEY

► Driver comfort is a key factor in machine usage, so French cabin manufacturer Buisard is particularly focused on this aspect when designing new products.

Of the major comfort features (suspension, HVAC, ergonomics, etc.), visibility is the area in which the company's years of expertise in structural design is showing the most evidence. When developing products for the widely different off-highway markets, customer needs are different, but visibility improvement is always a must.

For instance, strong ROPS and FOPS structures often result in the incorporation of numerous, bulky pillars topped with a full metal roof. These vital safety features are an obstacle to optimising lateral and upper visibility.

Buisard's development and industrialisation teams always set out with the aim of finding the best compromises, and significant improvements in visibility have been achieved on several of its latest cabin developments. As an example, the recently launched

Claas Axion offers perfect visibility together with ROPS resistance for tractors up to 400hp and more.

In this tractor cab design, the challenge has been to develop an optimised four-pillar type structure rather than the classic six-pillar design. This has been achieved through the right combination of creativity, resistance calculation, specially designed front and rear pillars, and glass shapes that have pushed the limits of existing manufacturing processes.

Buisard's innovation values drives the 35 staff in its research and development centre to always deliver the required solution and production methods for the next project. With that forward-looking philosophy in mind, the company celebrated its 70th anniversary last year by investing in a fully robotised welding line for high-volume cabins. In the Sablé factory, nine latest-generation robots now fully MAG-weld in-line the cabin structure, at a production rate of up to 20 cabins per shift.
www.buisard.fr

own particular project, like almost all other industrial vehicle projects, I needed to develop a thorough understanding of what the operator wanted to see in order to perform every facet of his work.

Visibility in analysis, design and testing

Designers of an industrial vehicle – be it a mining shovel, haul truck, agricultural tractor, combine, motor grader, street sweeper, or any other of the dozens of types of vehicles found in the sector – are always concerned with visibility.

What must the operator see, at least in terms of standards such as those published by ISO? What do operators tell us they need to see? What can they not see that they need to see? What does the designer want them to see? What do they not need to see? What are the ways in which the designer can make things visible or more visible? How does one verify whether the resultant



ABOVE: The top photo shows a tractor with a particularly wide front console; the lower photo shows how a tapered front console provides a clear line of sight to the ground around the front tyres – an especially important consideration in row-crop applications

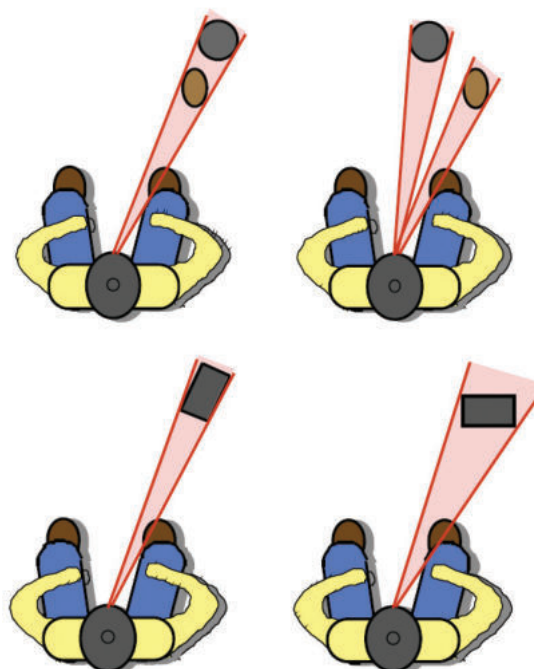
framework for ensuring that the operator's visibility requirements are served by the design of the vehicle.

Analysis

Filming operators while they work, eye tracking studies and visibility modelling in CAD are all useful methods for studying what the operator can see or needs to see.

Understanding the operator's task, and the visual requirements associated with it, is particularly important. Focused interviews with operators as they work enables them to discuss, in real time, what they are looking at, why they are looking at certain things and not others, and perhaps any visual needs that are not being met by the machine they currently operate.

The posture of an operator in a vehicle can often serve as a clue that visibility is inadequate. For example, a 'low' line of sight where the front windscreen meets the roof of a cab may cause an operator to frequently lean forward and look up in order to see a raised bucket, forks or load. Similarly, an operator of a motor grader, shovel or excavator may be seen leaning forward to look around the forward floor of the cab to see the ground and implement. This may suggest a need to improve lower lines of sight for the cab, to improve awkward operating postures.



TOP: Align objects in the visual field to reduce masking effects

ABOVE: Orient objects in the visual field to reduce masking effects

The visibility requirements for agricultural tractors are surprisingly broad. In addition to the over-hood requirements for operating safely on the road, tractors must be designed to operate with pulled implements, pushed implements, and even other vehicles. So, for example, can the operator see the rear hitch in order to link up with an implement? Is there an unobstructed view out of the sides and back of the cab to the implement? Of particular importance in many row-crop applications is the need to see the area inside and behind the front wheels. Wide front consoles can sometimes hinder the operator's ability to see this vital area. Visual requirements such as these should therefore be identified at the outset of each and every vehicle development programme.

Visibility requirements may well extend beyond the immediate realm of the machine being operated. In many environments – such as surface mines, warehouses and construction sites – an operator must be able to see other vehicles and co-ordinate activities with their operators. Pedestrians can be expected in some work environments and on public roads. Vehicles of different sizes can present special visibility problems and safety concerns that should be anticipated, such as small pickups working around giant haul trucks.

BELOW: Windshield height should be determined by the visual task, such as running a front loader at height, and the cab designed accordingly



design does indeed meet the operator's visibility requirements?

In addition to simply complying with the guidelines and standards that have been developed for most classes of industrial vehicles, designers need to go beyond the technical basics and thoroughly analyse all visibility requirements if they are to develop purposeful and innovative vehicles that push the state of the art. They must analyse the tasks of the operator, the flow of all types of information associated with the tasks, and the visual information needs associated with those tasks.

Next, they must actively design for visibility by employing various techniques and technologies. Lastly, they must evaluate visibility in the new design through the use of 3D computer modelling, old-fashioned shadow-cast techniques and actual evaluations with actual operators.

These three phases of system development – analysis, design and test/evaluation – should serve as the

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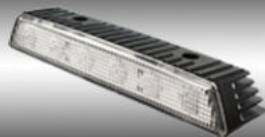


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Design

Simple cab visibility studies can be conducted with a single representative eye point. An often used reference point is 150mm forward and 760mm up from the Seat Reference Point (the intersection of the plane of the seat pan and the plane of the backrest).

More sophisticated visibility studies may involve an eye ellipse, essentially a 'cloud' of eye points representing the wide population of operators and all their anthropometric variations in body size, sitting eye height, seat position and posture.

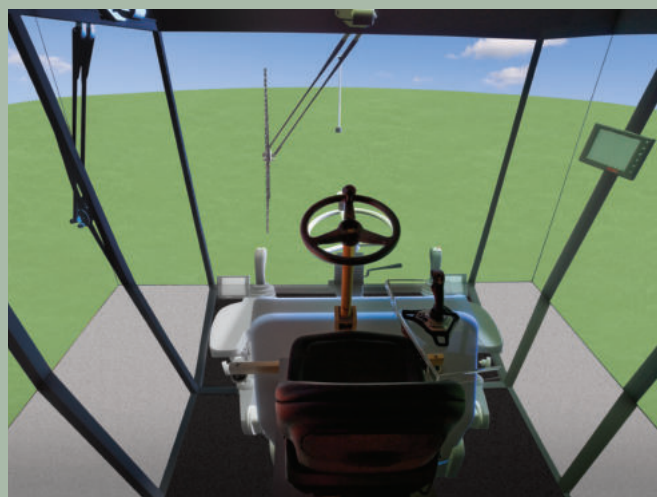
The eye ellipse cloud can be particularly useful when attempting to determine what percentage of the population will be accommodated by a particular visibility design parameter. The vehicle designer may determine, for instance, that all but the shortest 1% of operators could be accommodated by a particular line-of-sight out over an engine hood or through a window.

STRENGTH UNDER PRESSURE

► Operators of industrial vehicles are constantly demanding greater cabin visibility, which the OEM can achieve by increasing the window surface of a cabin. At the same time, productivity requirements and emissions regulations are making these machines heavier.

From the cabin perspective, this means growing demands on ROPS weights – but increasing the ROPS classification of a cabin usually results in more rigid, thicker pillars, which limit visibility. This equation is not easy to solve.

Ruukki has solved the problem by using Optim high-strength steels in its cabin structures. High-strength steels mean less material is required for greater cabin structural strength; this in turn enables a greater cabin window surface than is the case when conventional structural steels are used. Structural optimisation starts with an FEM analysis to simulate



cabin structure deformations and stress under the required ROPS weight. Various potential steel options are simulated before the optimum solution is chosen.

The use of high-strength steels also reduces weight, which translates into lower fuel consumption and emissions, resulting in better energy efficiency. www.ruukki.com



LEFT: The live video displays from the interior 'house', rear and sides of a 16 million lb walking dragline. Aids to direct viewing, including cameras and mirrors, should always be considered for special applications



LEFT: There's plenty of glass in the cockpit of SpaceShipOne

The proportion of the visual field occluded by an obstruction in the field will reflect the object's width (or length) as well as its distance from the observer. For binocular vision using an inter-ocular distance of 65mm, the masking effect (x) of a component is calculated with the following formula. Units are in millimetres, where:

$$x = \frac{r(b-65)}{a} + 65$$

when a is the distance between the component and the eye position, measured along the visual radius joining the eye position, the centre of the component and the perimeter of the semi-circle of vision;

b is the width, in millimetres, of the component, which is measured horizontally and perpendicular to the visual radius;

r is the prescribed radius, in millimetres, of the semi-circle of vision (ISO 5721). In other words, r is the distance at which the occlusion is being assessed with the formula.

There are numerous techniques for minimising obstructions in the visual field of a cab. One of the simplest is to align objects one behind the other. An exhaust stack on the hood of a tractor (if it can't be eliminated altogether) might be aligned with a cab pillar, for

VISIBILITY

example, thereby reducing by half the obstruction created by the two objects if they are not aligned.

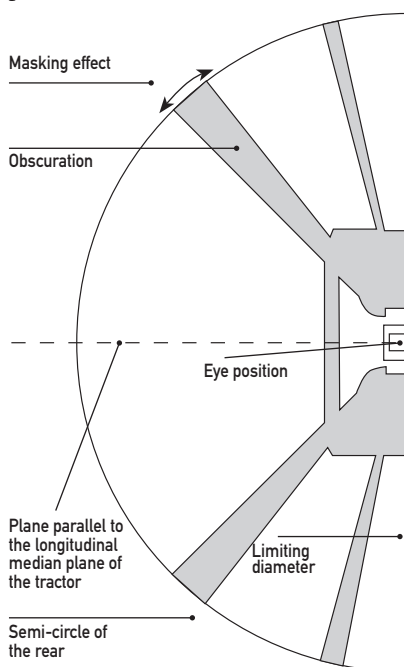
The orientation of objects relative to the operator's line of sight can often be modified to reduce masking effects in the visual field. Wide columns or posts can often be turned sideways to reduce their visual restriction, yet still retain sufficient structural strength. Large-diameter round posts (or large square posts) might be reshaped to lessen their visual impact but retain the necessary strength. Giving careful attention to object alignment and orientation can have a significant impact and make an otherwise visually 'busy' cab look surprisingly tidy.

Direct viewing by the operator of some areas in and around an industrial vehicle is not always possible. Visibility design studies should therefore include the use and effectiveness of mirrors as well as remote cameras and in-cab video displays. Back-up cameras on vehicles are a good example of this application.

Visibility design activities must also consider the operator's need to block direct sunlight which, in addition to hindering vision, can create glare on screens and displays. The presence of improvised sun screens may point the way to a desirable feature of a new cab.

Testing

Testing, or test and evaluation, is the third phase of systems development, and visibility assessments should be a part of these activities as well. Test



HOW TO IMPROVE VISIBILITY WITHOUT CHANGING THE CAB

There are numerous ways to improve visibility for the operator without a full-blown redesign calling for major structural changes to the cab and the machine. Dozens of technologies – ranging from the simple to the complex – are readily available and can be added on to a vehicle or integrated into the overall system at the time of manufacture.

But as with a broader cab overhaul, it is still necessary to understand what it is that the operator needs to see and why, when it needs to be seen, and what he needs to do in response to the information that is presented.

At the simplest level, small windows can be surprisingly effective in providing the operator with an occasional but desirable view. For example, a tall narrow window in a door enables a person inside an elevated cab to see out and down, perhaps down a connected platform or stairway outside. Small windows to the side or to the rear of a cab, overhead, or even along the floor, can provide direct visual access to

vehicle components, other vehicles and structures, or even pedestrians.

Mirrors of all shapes and sizes can be positioned to enable an operator to see down passageways, around corners, or the view to the rear. They are inexpensive, reliable, and easy to maintain – as long as access for cleaning and maintenance has been considered in their placement.

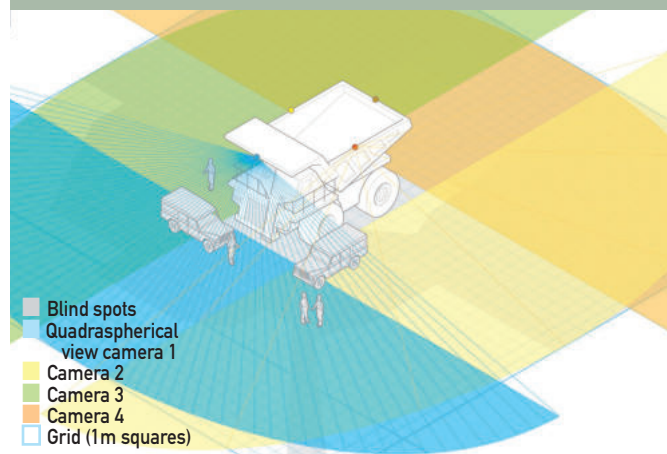
The price and dimensions of video cameras and related hardware have continued to shrink over recent years – even while image quality and overall system reliability has skyrocketed. Wired and wireless systems are being used for a wide variety of purposes. Views that are otherwise very difficult – if not impossible – for an operator to see directly can be obtained and displayed in real time. Several different views can be presented simultaneously on a single monitor when space is tight in a small cab, or on separate monitors in a larger cab with plenty of room. Remote views can enhance safety, assist with



vehicle movement and also provide essential feedback for positioning the vehicle, load, or implement. There may even be a need for the operator to have control over the direction of the view, zooming in and out for a narrower or wider field-of-view.

At the far end of the technology scale are systems possessing some form of image or sensor processing with the purpose of sorting out or emphasising certain elements within the scene. Image processing can be combined with warnings, alarms, or other forms of feedback for the operator.

For example, Honda's Intelligent Night Vision System for automobiles relies not only on two far-infrared cameras in the forward field of view, but also on considerable computer processing of the images with the intent of aiding the driver. The software is able to not only identify and highlight any pedestrians in the field of view, but also to determine their path of motion relative to the path of motion of the driver's car, and alert the driver to an impending collision at night.



ABOVE AND TOP: Spillard's Optronics 360 surround-view system uses multiple ultra-wide angle cameras mounted in strategic locations around the vehicle to synthesise a quadraspheric bird's eye image of the surroundings

LEFT: Semi-circle of vision from a machine showing typical obscurations

findings should be used as a basis for comparison to benchmark vehicles, a current product and the original visibility design objectives.

Visibility maps for the final design can be created with CAD applications, or with traditional shadow-casting techniques. These can be especially useful as a sales or demonstration aid, particularly when such maps demonstrate a major improvement in visibility with a new product.

Because humans are once again the ultimate focus of all visibility design activities, they should be part of the test and evaluation effort too.

Actual operators should have the opportunity to assess and critique overall visibility, pointing out any necessary final improvements to the design. If the vehicle is to be operated at night (which is most often the case), then illumination and lighting must also be part of visibility testing.

Finally, it is easy to forget about testing visibility and illumination for activities not directly associated with sitting in a cab and operating the machine. Examples include the visibility needed for safe cab ingress and egress, as well as common maintenance activities. **IVT**

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The second-generation Fendt 700 Vario has been rejuvenated with fresh styling and the all-new VisioPlus cab

▶ Hold in the trigger button and push the joystick forward – on the face of it, that's all there is to getting a Fendt Vario tractor on the move. But one look at the array of buttons, switches, dials and joysticks – not to mention the touchscreen display – suggests it will take more than a few minutes' familiarisation to make the most of the tractor's multitude of features.

However, the armrest console housing these controls is designed to make quite complex transmission and hydraulic functions accessible within a working environment that has been transformed on the best-selling 700 Vario.

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Yet while popular for its combination of performance, versatility, economy and compact overall size, drivers of the previous generation had become disillusioned with a cab generally regarded as cramped by modern standards. Although Fendt had kept moving forwards on the technology front, it had fallen behind in this highly influential area.

The Bavarian manufacturer's response – the VisioPlus cab – should dispel any such concerns. It's a five-post design that gives a pillar-free view to the right; interior volume is up 15% to 2,520 litres; and there is 6.1m² of glazing – a 25% increase over the previous design thanks to the more generous overall dimensions and slimmer pillars.

It also has a novel windscreen configuration that extends into the roof – a little bit like the panoramic screens seen on some cars these days, although not quite so extreme. So, thanks to the VisioPlus, operators who like the sophisticated features of a Fendt mid-range tractor must

no longer look enviously at their counterparts driving tractors with modern, spacious cabs; they now have one of their own that in several key respects is ahead of the field.

So what else is new?

The new 700 Vario range will play a crucial role in maintaining Fendt's volume sales in a key market sector. The line-up has now been extended to half a dozen models, all powered by the latest-spec Deutz TCD 2012 L06-4v six-pot engine.

Unlike the previous power unit, which ran with a cooled external EGR system, the newer model uses selective catalytic reduction to meet Stage IIIB/Tier 4i emissions standards. Power outputs from the 6,056cc engine are a straight 145-240bhp for the 700 Vario (there is no 'boost' for specific operations), fed through the ML140 and ML180 versions of the Vario stepless transmission.



MAIN IMAGE: The unrivalled upward view is a boon when using a front-end loader

INSET: Windscreen glass manufactured by St Gobain cuts deep into roof panel

Unlike other tractor CVTs, the Vario uses a wide-angle hydraulic pump and motor to cover the entire speed spectrum in field and road ranges, rather than standard pumps and motors and four auto-shifting ranges. The mix of hydrostatic and mechanical propulsion goes from 100% hydro to 100% mechanical, as the two pathways are combined by a planetary gear set. Ultimately, drive goes to the ground via Fendt's own front and rear axles built, along with other major components, in the Marktoberdorf factory in Germany.

The front beam features a new suspension design with a leading 'A' arm pivoting from the underside of the one-piece cast half-frame. Vertical hydraulic cylinders act as springs, as well as the self-adjusting mechanism maintaining a consistent ride height.

A tighter steering angle for improved manoeuvrability and 'Fendt Reaction' to improve straight-ahead steering characteristics are also part of the front-end package. With the assistance of a hydrostat, the latter brings the front wheels



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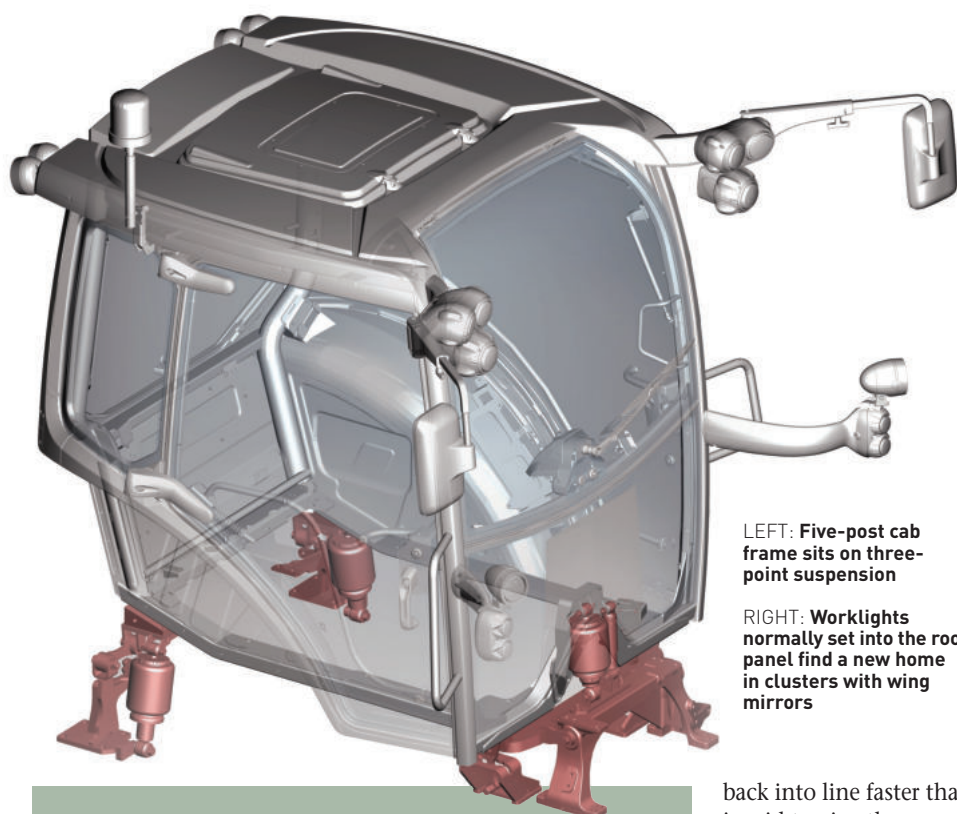
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LEFT: Five-post cab frame sits on three-point suspension

RIGHT: Worklights normally set into the roof panel find a new home in clusters with wing mirrors



INNER SPACE

► Inside, the cabin is hugely bright, light and airy, with the dark grey fitted floor mat and fabric on the Grammer seats contrasting with the light-coloured interior cladding. The increasingly popular all-in-one steering column and instrument panel assembly simplifies installation on the production line, while also ensuring the driver can always see the complete digital display regardless of where the telescopic and angle-adjustable steering wheel is positioned.

Seemingly little things can make a big difference to the person who occupies this space, possibly for as much as 12 hours a day in peak season. For example, moving the lever for the air parking brake – from next to the seat base to the side of the steering column surround – has liberated enough floor space for a holdall or decent-size toolbox.

There are several more lidded compartments for storing manuals and loose essentials such as nuts and bolts, spare mower knives and other such items, as well as a cup or flask holder. One of these is connected to the air-conditioning system to keep cold drinks and snacks from warming up. The passenger seatback folds to form a perfectly level table for lunch breaks or to update farm records on a laptop computer.



back into line faster than usual and is said to give the operator greater feedback to make it easier to steer precisely at the 50km/h top speed.

Steering assistance in the field comes with VarioActive, a variable-ratio mechanism that provides up to 43.3° of wheel angle from one rotation of the steering wheel, rather than the regular 26.6°. Drivers wanting tight headland turns or using a hydraulic loader will no longer have to twirl their arms in a frenzy to bring the tractor round.

Screen test

Loader work is also the prime reason for developing the innovative new windscreen configuration because it enables the driver to see a raised bale grab, manure fork or grain bucket more easily without having to peer under the header rail of the cab frame.

The more common solution is to install a roof window; however, the toughened materials required to comply with falling object regulations tend to give a distorted view of the great outdoors. But on the 700 Vario, the specially shaped glass windscreen manufactured by the Transport division of St Gobain Sekurit cuts deep into the roof of the cab with no visual distortion.

Fendt engineers calculate that the upwards line-of-sight angle is three

times that of the old cab design, with a 77° uninterrupted view from top to bottom. It's 'widescreen', too, with broad, low panels giving an improved view of the front wheels for accurate positioning.

Fendt's engineering team has even managed to give this radically modern design an old-fashioned twist, by having an optional top-hinged split opening windscreen so beloved of farmers who prefer direct fresh airflow to the piped variety.

When the one-piece windscreen is installed, buyers can also choose to fill the right-hand side of the frame with a door rather than fixed glazing – although it's of little value given that the large control console makes it quite difficult for even the slimmest of operators to use the resulting entry and exit!

There is even a choice of windscreen wipers – a conventional arm giving a semi-circular sweep that parks more or less out of sight, and a pantograph that sits in the driver's sight-line somewhat but clears a larger, higher area of glass for operators who make use of the upward visibility gains of the new window design.

Good with colours

They may look complex at first sight, but the array of controls on the large

CASE STUDY



ABOVE: The Variotronic terminal is operated by touchscreen or keypad

INSET: Colour coding on the armrest console helps identify related controls

LEFT: High-tech controls will not suit all users, but operators who like all the bells and whistles will delight in the latest Fendt array

armrest console, which is easily adjustable forward and back as well as for height, is logically laid out with clear colour coding to match controls with similar functions. The rotary engine throttle, speed restrictor dial, cruise-control memory buttons and shift pattern decal are all in bright orange; green relates to drive functions, such as front axle and diff-lock engagement; while yellow is the familiar colour used for power take-off functions.

The frequent presence of blue highlights just how many hydraulic functions there are on a modern tractor, and particularly on the new Fendt Vario. It appears on the spool control rocker switches on the joystick, on the stubby joystick alongside, on the quick lift/lower

switches, and on the stacked depth/height setting dials for the implement linkage assemblies.

It also colours the four push-pull switches that operate more remote valves – of which up to seven can be installed in total, with couplings located at the back of the tractor, in the middle for a loader and at the front for operating implements carried on the built-in three-point linkage.

Ingrained in the membrane

Before setting to work, many of the functions available are first selected or activated using the membrane buttons arranged on an accessible but out-of-the-way panel to the right of the armrest pad. Once selected, they can then be set up or adjusted by using the Variotronic

display supported on aluminium-effect curved arms sprouting from the front of the console.

Fendt produces these displays itself in keeping with its in-house manufacturing philosophy. Two versions are available – the 7in version is standard; a 10in variant adds a GPS guidance display or the feed from a pair of remote cameras.

Both are ISOBus-compliant touchscreen displays that, unlike most similar units, have a firm grab handle to one side which is topped by a keypad and scroll/select dial. At standstill, it is easiest to navigate the icons and use an index finger on the touchscreen. But on the move, especially along a rough track or field surface, gripping the handle and using a thumb and forefinger to operate the system is a whole lot easier and more accurate than stabbing a moving target.

Among all this high-tech stuff, some beautifully simple solutions are also employed, not least the rubber rings that grip the guide rods sufficiently to prevent the essential windscreen blind from ping-pong-ing up. There are thoughtful touches, too, like the cable grips clipped to the side of the right rear pillar cladding so that wiring plugged into the many ceiling sockets does not flap about.

The overall impression of Fendt's newest cab design is of practicality and comfort – with style. Operators will enjoy spending a day here! **IVT**

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DUTCH ARMY KNIFE

MAIN IMAGE: The industrial vehicle equivalent of a shotgun shack: two doors either side of a spacious, flat floor provide superb and speedy access to and egress from the cab



▷ You can't beat a good double-take to pique the interest at an exhibition, and this was exactly what happened to me at Intermat this April. Passing through Hall 5A, I clocked an unusual, yet beautiful, machine on the stand of Diverto, a name that had promised much when it first came to public attention with Sunward, before abruptly falling off the radar a couple of years later. Yet the vehicle in question was nothing like those original SWEL concepts that were rather like a squat compact crawler excavator.

So what was going on, I asked Diverto managing director Leonard Huissoon? "We got to know Sunward in 2006, and there was a good 'click,'" he explains. "But it later began a public offering on the Chinese stock exchange and things became more difficult in terms of priorities, etc. It was also very hard to persuade them of the need for a European finish and quality level in terms of ergonomics,

D.BOWLER • 12

CASE STUDY

The QS 100 boasts three patents on the folding boom alone



finishing and using the most suitable materials for corrosion resistance.

"Then, after Bauma 2007 where we presented the prototype, the financial crisis happened and Sunward refocused its attention on China, where the market was still booming. So then I made a Plan B, where we designed and patented a three-point hitch and PTO function on a machine as a rough concept and, rather than just elaborating on the compact excavator platform, we created a new concept where all functions would deliver a much higher performance. So it all ended amicably – it just didn't work out quite the way we planned."

The result was the four-wheeled QS 100, with Q standing for 'quattro' due to the four main functions – tractor, mobile excavator, wheeled loader and boom mower (although approximately 200 attachments are suitable for use) – and S for 'synchro', or the synchronisation of those. Dubbed 'a superfunctional tool carrier' and boasting a higher power to weight ratio than an equivalent-

Call me a cab

A COLLABORATIVE DESIGN APPROACH SPEAKS VOLUMES, AS CHIEF DESIGNER FOR BSI, DAVID BOWLER EXPLAINS

► At the Bosal-Sekura Industries (BSI) production facility in Randers, Denmark, no two cab lines look the same. This is normal, because the company is a specialist in designing and producing bespoke safety cabs. BSI's cabs are designed to meet the unique functional requirements of its customers' needs. That said, however, there are sometimes similarities between cab revisions, as customers often see a certain value in keeping some DNA from the old model, whether functional, technical or visual. That is, of course, product evolution over time.

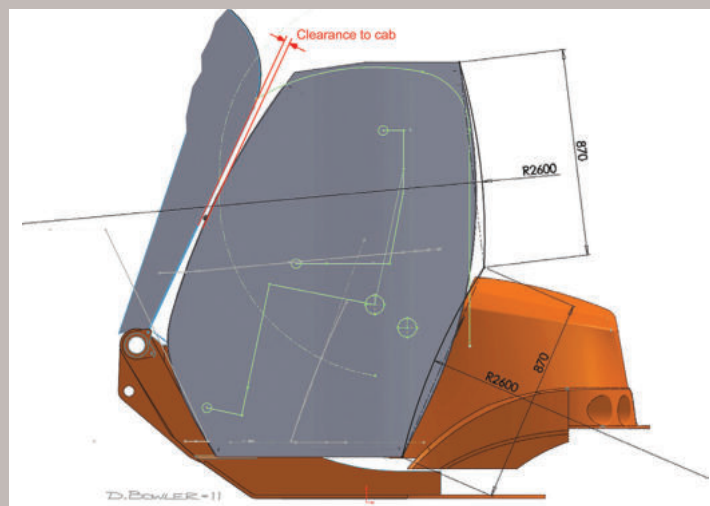
Evolution is one thing, but what about a completely new machine concept? These are particularly exciting projects for the designers at BSI as they form the basis of a new line of evolution. One such project came with the forming of a working partnership with the Dutch company Diverto Technologies BV, when

BSI was asked to design, develop and manufacture the cabs of its radical and completely new Diverto QS machines.

The Diverto QS has many worldwide patents and model rights granted, including the cabin. Diverto also has many patents pending, so what's so special about the QS?

"There are four main factors we're very proud of," says Leonard Huissoon, the company's founder. "Firstly, the super tool carrier concept, with its 'synchronous tool' operations, has been designed and engineered to be a zero-compromise solution, using the features of the four functions – tractor, mobile excavator, wheeled loader (both sides) and boom mower – to strengthen the other functions.

"For instance, the power-to-weight ratio and road speed are exceptionally high for an excavator and a loader. The full boom and cabin rotation offer



Early 3D concept sketches exploring the cab geometry and construction

size wheeled loader, it is even possible to simultaneously dig with the boom while running a wood chipper from the 65hp rear PTO.

"Diverto means being different, very versatile, and as it all ends in 'o' it sounds very nice!" Huissoon adds. "People think we're Italian but we're actually Dutch!"

Making the switch

There are certain resemblances between the Diverto QS 100 and the SWEL models, however – the main one being the unusual folding boom that enables a rapid transition from excavating (extending to just under 6m, and 3m deep) to loading (1,800kg capacity to a height of 2.9m). From a distance it might look identical to the boom on the SWEL models, but improvements have since been made, resulting in three exclusive patents on the boom alone.

Switching from excavator mode to loader mode is incredibly simple. Not to mention very quick – in the prototype's manual operation, it takes just 60 seconds to disconnect the

work tool, move the stick inwards, folding it against the middle section of the arm to form a mechanical connection, which then folds against the first boom section and is again mechanically linked. "So the forces taken up by the quick coupler can be withstood by not just one boom section but by all three," Huissoon explains. "On the production models the procedure will be automatic, but with low-speed operation due to safety regulations, so will probably require 90 seconds."

That surprisingly straightforward procedure notwithstanding, surely an operator must find it tricky or counter-intuitive when attempting to lift a load or start mowing right after a few hours of intensive digging?

"It has taken us from our first prototype in 2005 up to now, after adding tractor and mowing boom functions, to discover how to design

the best HMI," he admits. "Those four functions in one machine took us two years to find the right design of the cab and controls. But now the joystick movements and the buttons for the tilt rotator, etc, are the same as for a traditional excavator."

"If you're in wheeled loader mode, you move the right joystick and those operations are equally the same. If you're used to operating a normal tractor, it feels just like moving the three-point hitch and PTO – we use the same colours, and the same positions for your fingers."

"Then comes the most difficult part – a professional boom mower operator will want all the mowing functions on the right joystick while he steers with the left. We couldn't find many options available, but we found elobau's joysticks ideal as they have a lot of functions, so we don't have to use the same button for two

RIGHT: Final cab design (patent pending) by Diverto

significant advantages in, tractor, loader and mower operation with respect to operator visibility to attach tools; faster load-up and dumping actions; and four-side visibility for safety."

The second factor is that the boom, the superstructure and the undercarriage – complete with three-point hitch and PTO – have been engineered to place the operator at the best possible angle for all diverse operations. This design facilitates the space to be able to offer an exceptionally wide and comfortable cab. Other machine standards and product segments (e.g. excavator, boom mower) do not allow for such design freedom. Diverto has therefore made the cab design one of the highest priorities in the total vehicle design, and has included a certified secondary seat.

A further benefit is the folding boom system, which allows for a much lower weight than, for instance, a backhoe

loader with two boom systems. The Diverto concept has been able to keep the GVW low because it always rotates the counterweight with engine opposite the load, offering a compact low weight for all applications with tools and materials hanging on the boom. This agile, compact and low-weight design offers a clear advantage in the market.

Finally, the automotive-style, tough and super-comfortable interior positively reflects both the on- and off-highway characteristics of the machine.

Detailed brief

The brief given to BSI was to propose a cab geometry that fitted the QS's unique architecture. The frame and the glazing forms needed to achieve maximum interior space within the available envelope on the machine and provide maximum operator visibility to work zones. While offering great access into the cab, there had to be a stylish and dynamic form – yet it also had to be cost-effective to tool and produce in the required quantities.

Initially, several cab styles and structures were proposed by the BSI design team and supplied in 3D CAD, enabling both camps to evaluate the pros and cons of these cab forms in context. Diverto was then able to select its preferred solution based on advice offered by BSI and added requests for further features based on these concept discussions. Once the basic silhouette of the cab and machine took shape, the focus switched to adding detail and developing the systems for both the





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functions. So the operator doesn't have to think in a different way when he presses a button; it's exclusively for one function, very straightforward and intuitive. This is really only possible with a CANbus system."

Open-door policy

Of course, I wasn't the only one to get excited about the QS 100. Having immediately earmarked it as an ideal candidate for our September issue, I then had my thunder stolen slightly when industrial designer David Bowler submitted an article on behalf of cab supplier Bosal-Sekura last month, covering its involvement in the project. So I've taken the unusual step of incorporating that into my own feature (see *Call me a cab*, page 44) as the QS 100 is so innovative that there's still plenty left to talk about – even on that cab.

Take the two-door arrangement that enables the operator to enter and leave it from either side, for example. This is something that few excavator operators will be familiar with, but when the cab rotates 360°, just how necessary is that really?

cabin and the machine. This was done simultaneously by both Diverto and BSI's in-house teams, sharing data and technical information on a daily basis in order to ensure that the product met all target criteria and meshed together to form a seamless and stylish design. Supportive assistance from potential component and subsystem suppliers also helped keep momentum in the project.

The cab was required to pivot upwards around its front iso-mounts, thereby providing fantastic service access to many areas on the machine in one simple action. The engine, hydraulic pump and associated holding tank are designed close-in to the rear bulkhead and floor areas of the cab as part of the mass centralisation and compact nature of the machine. This highlighted the need for optimal acoustic and thermal isolation properties over the floor and rear bulkhead areas. Double-density PU mouldings were therefore proposed for those areas of the interior, giving designers the opportunity to incorporate the shape of the buddy seat and some useful 'rattle free' storage areas in a 'one-shot' operation, rather than the usual combination of ABS and foam-backed

"The idea was that because we're looking at the landscaping and tractor markets, we should incorporate it as it's what they're used to," Huissoon explains. "But say, for instance, you are using it as an excavator or boom mower, and you're working on a busy highway. You might have to stop in a certain position, and not be able to rotate fully, so you would have to climb out of the side next to the traffic. That caused quite a packaging challenge, but now when you want to get out, you just tilt the right console upwards – it's very comfortable to exit from either side."

A glass act

Sitting in the prototype at Intermat, I had admired the almost entirely glass (Lexan) doors and the superb visibility they provided, but Huissoon



A fish-eye view through the steering wheel highlights the console's portals, which provide views of the wheels, as well as the bucket when digging right up to the machine

says the production version has done away with the central metal strut – even though the obstruction it caused wasn't a patch on that created by the traditional excavator boom.

"We don't have that problem as our boom is at the front [being offset-mounted on the chassis, there is a clear, unimpeded view to the bucket directly ahead of the operator] but we knew the doors had to be clear all the way to the bottom, so that it gives a safe feeling to operators. Despite them being ROPS and FOPS, we also kept the A- and B-posts really minimal, and



fabric. The interior trim package could therefore be offered as a suitable solution for both canopy-style and full comfort-cab machine options.

Surprise package

The cab floor and bulkhead areas needed to mesh with the complex geometry of the chassis structure in order to give the best possible driver ergonomics and keep the overall height of the machine to a minimum.

In short, this was a very challenging packaging exercise. Every component had to be considered for its shape, size and positioning, in addition to its function, quality and performance.

A collaborative design team is essential to resolve such tricky packaging and performance issues. The QS has many applications, so the operator cab needs

to accommodate all these aspects. Regular brainstorming sessions enabled these complex requirements to be met. A mix of hardworking, fresh-thinking, young design engineers, working closely together with much more experienced engineering and design personnel, has yielded great results.

As the bond and respect strengthened between the two companies during the early stages of the project, Diverto expanded the project with BSI to include the overall styling of the machine, as well as detail design of body parts such as the engine hood and side skirts.

The result of that decision was very beneficial, because the core design team was kept to an optimum level, enabling fast design iterations and keeping the focus on both the technical aspect and the product styling.

It needed to be done this way because many of the core components and subassemblies have been developed with modularity in mind. The cab is just one of the modular subsystems that will be integrated on a number of different-sized models in the revolutionary QS range.

This machine just could not have been created successfully through a 'boardroom-led, design-by-committee' approach. A close-knit team of specialists was needed for a product as radical and feature-packed as this, because it is important that designers are able to relay important aspects in the most direct and quickest way possible, in order to enable key decisions to be made quickly – and for the right reasons.

Thanks to such a successful and close collaboration between BSI and Diverto, the unique DNA of this machine is now firmly established in line with the vision originally set out by Leonard Huissoon and his team. Bosal-Sekura is pleased to have played a key part in bringing the QS to life. Let the revolution begin!

For further information:

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CASE STUDY



because you're sitting in the middle of the cab and are further away from the posts than in a normal excavator, the dead corners on both sides are equal, while the blocked angle of view is also less than with a smaller, narrower cab.

"Then the steering console has an opening so that when you look through the top of the wheel you can look straight down to where you are working, which is vital as you can dig right up to the machine on all sides."

Mounted on the right console, the Parker IQAN colour display provides a clear view of all machine data, with no joystick etc obstructing any part of it. This LCD screen is in line with the A-post, as is the mounting point for a tablet computer. Although the latter would currently only be for personal use or perhaps for scrolling through machine manuals, rather than downloading data, Huissoon is waiting for new developments that could offer some exciting possibilities: "We don't use it to steer or control the machine at this stage, but there is definitely potential for that."

In the upper right corner of the cab is the radio which, if the double-DIN option from Pioneer is taken, comes with a GPS system. A rear-view camera comes as standard with this option, so the radio/GPS doubles up as the video screen for extra safety.

Light on its feet

With municipalities and landscapers a primary target market, weight saving

ABOVE: The innovative cab and engine hood tilting is a patented feature by Diverto. No additional counterweight is required, helping to maintain a low ground pressure

was a major priority. Market research had revealed that an abundance of machine features were welcome – as long as this did not negatively impact on ground pressure.

"Therefore, we don't use castings as a counterweight," Huissoon says. "We've chosen a 4.5-litre engine [a 100bhp Tier 4i John Deere] that's relatively heavy compared to its power but that makes it possible to avoid adding a casting while still having good balance in the machine. Locating the DOC/DPF in one of the stacks behind the driver helped keep the hood short too, so the tailswing is just 25-40cm, depending on tyre choice. We expect gross vehicle weight will be 5.6 to 5.7 tonnes."

With low ground pressure so desirable then, why was a wheeled machine produced – especially given Diverto's tracked origins? "There's always a possibility to go back to crawlers, whether the standard kind or quad-track," he claims. "However, our market research showed that the use of excavator and loader functions, with three-point hitch and PTO, requires higher speeds and more mobility, so we chose to go with wheels first."

As a result, the hydrostatic transmission means that trailers can be towed at up to 40km/h, speeding the time to the job site and yet again reducing the need for an additional machine. "We've limited space in the chassis, so one of the main reasons we chose Linde Hydraulics' pumps and

motors was because of their smaller build-in space. The quality's also very high and they were very willing to help us to tune the components."

These are linked to Dana axles, which Huissoon says were chosen on the grounds of some attractive features that the supplier has yet to announce. The 4WD vehicle has just one steering mode – front-wheel steer – though this effectively becomes rear-wheel steer when, for example, in wheeled loader configuration the load is more suited to the rear fixed axle rather than the oscillating front axle.

Share magic

There are four Parker hydraulic pumps, operating the transmission, boom, PTO, and cooling and steering. And while Huissoon rather casually mentions its load-sensing abilities, the flowsharing that was so vital for a 'superfunctional tool carrier' with 130 l/min auxiliary flow was rather more difficult to achieve.

"We needed a CANbus-controlled valve block with flow-sharing, and it took us about six months to evaluate the different blocks available. We chose Parker for the main valve block, and because it was also very compact, it fulfilled all our requirements. We also tested the IQAN system, and found that it's very comfortable to work with as engineers due to its tuneability. It's very robust too."

"Hydac is really strong in proprietary customised designs, so we used its smaller valve blocks on other features. Again, they're very compact, which was necessary in both the lower and upper chassis. They've given us very good support – in fact, all these companies have really jumped into this project!"

Manufacturing of the QS series – bigger and smaller versions of the modular machine are planned – will take place on a new assembly line set up at the VDL Steelweld facility in Breda, following the announcement of a close co-operation between the two Dutch companies.

Production is scheduled to begin imminently, with several orders having been received from four dealers of A-class-equipment based in the Netherlands, Switzerland and Germany. It is hoped that more dealers will be found to cover most of north-western Europe by 2013. **ivt**



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STATE OF THE ART?

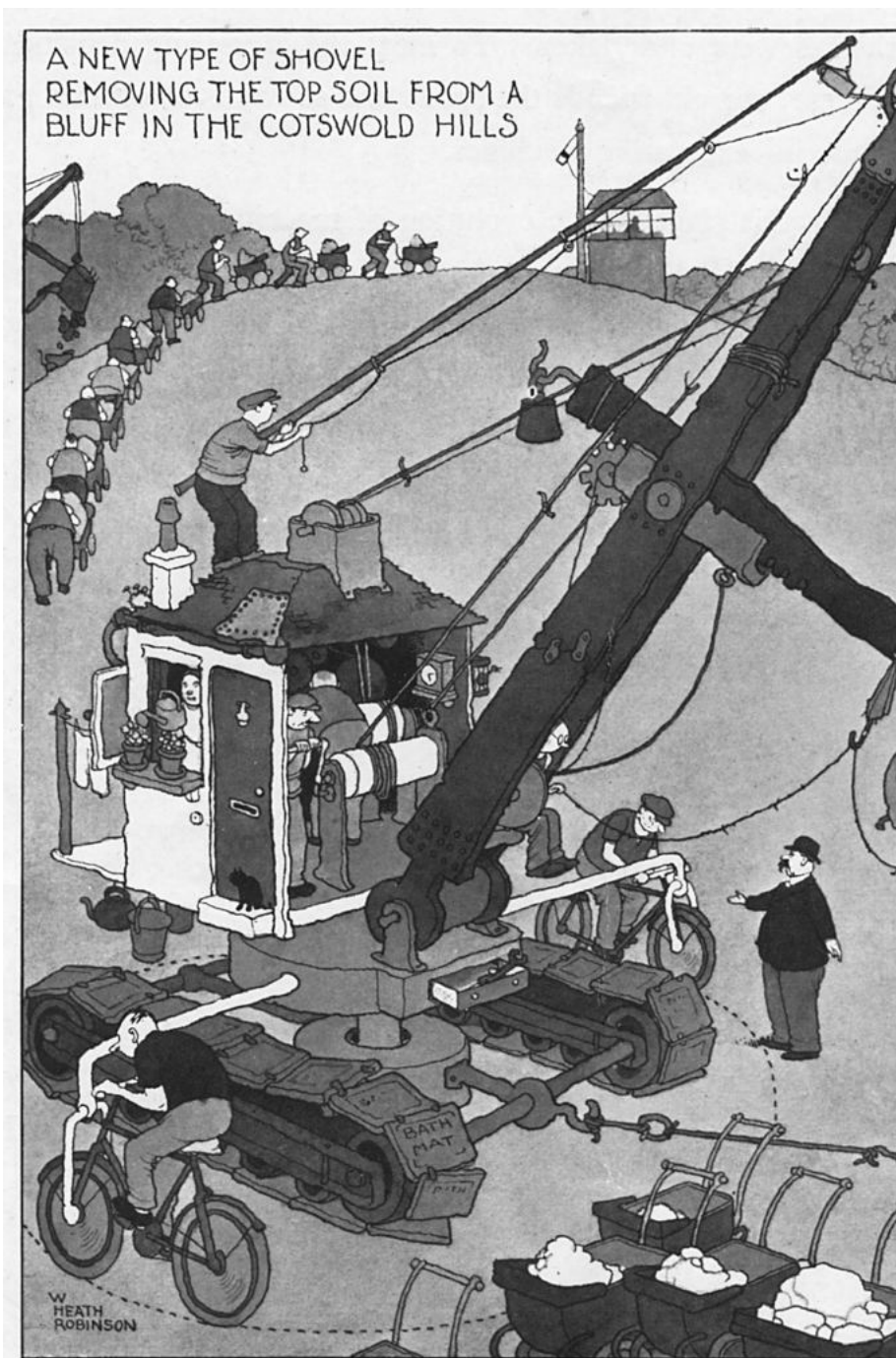
WILLIAM HEATH ROBINSON'S OUTLANDISH INVENTIONS WOULD PROBABLY EVEN BE LAUGHED OFF *SCRAPHEAP CHALLENGE* – BUT HIS DRAWINGS FOR RUSTON-BUCYRUS IN THE 1930s SHOWED AN UNDERSTANDING OF THE ISSUES THAT OPERATORS AND ENGINEERS FACE IN THE 21ST CENTURY

MAIN IMAGE: William Heath Robinson's design for a face shovel required seven operators and dozens of support vehicles

▷ Not long after the death of my dear old Granda, two of my uncles and I set to work clearing out his garden shed, in which we'd each spent many happy hours acquiring all manner of useful skills. One of them picked up a homemade bench grinder attachment designed to fit onto a power drill and chuckled, "It's a bit Heath Robinson, but why not?"

As a teenager, that was the first time I had heard the expression, and the off-the-cuff explanation that followed revealed that William Heath Robinson was a designer of bizarre, overblown contraptions rather like the game Mousetrap.

Although WHR started off as a serious artist/illustrator, he was soon putting his English eccentricity and imagination to good use in a range of magazines and advertising just after the turn of the 20th century. A population becoming increasingly accustomed to seeing cutting-edge, life-changing, mechanical marvels impacting on every aspect of their lives wholeheartedly embraced 'The Gadget King' and his designs, which performed all manner of useful



everyday tasks, from leisure to work and all points in between – though in such a way that the manpower, skill, time or expense required to operate the device made the whole notion completely preposterous.

The name, and his ever more ridiculous designs, continued to appear on my radar over the years, but aroused no professional interest until I received a tip-off about some of his work appearing on the BBC's *Antiques Roadshow* last summer. It turns out that in 1936 Robinson

had been commissioned to produce a humorous promotional booklet entitled *The Gentle Art of Excavating* for Ruston-Bucyrus, the Lincoln, UK-based manufacturer of heavy excavating equipment. One of its employees later acquired the six main original designs for that pamphlet, to discover all these years later they were worth between £2,000-3,000 each – and on making that discovery, William Heath Robinson suddenly made the leap from 'whackjob' to 'artist' in my view.



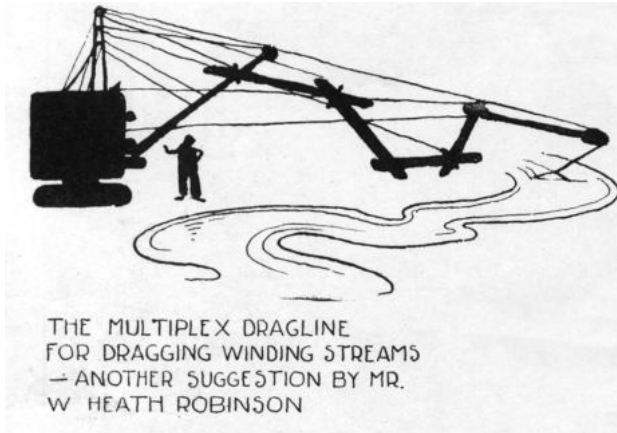
Incredible creations

Assuming the humorous prose that accompanies WHR's designs is to be believed, the commission was merely a happy accident while he happened to be in the neighbourhood: '[While] in search of new data for a work I am compiling on the ravages of the lesser *Lepidoptera* ... I was lured by a rare specimen into the mysterious precincts of the Ruston-Bucyrus works. I was received with open arms by members of the staff, who insisted on my making a tour of

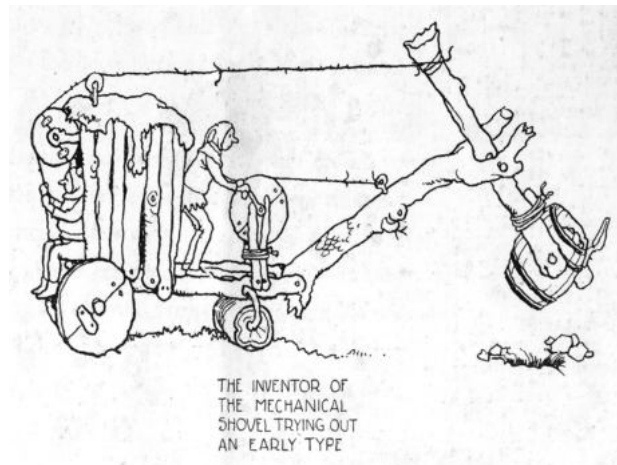
inspection of the works... I meandered as in a wondering dream through the vast playground of their monster and almost incredible creations.'

He obviously caught the bug (by which I mean enthusiasm, not that butterfly) for he went on to cover the history of excavating in his own unique style. Keen for there to be a record of the advances civilisation has made in this area, he 'ventured to produce this small collection of drawings for all of those who are interested in the mechanical triumphs of Homo Sapiens... future generations will be grateful for such a record, and congratulate themselves on their descent from those gifted forefathers who created the wonderful machines here depicted.'

Whether today's Ruston-Bucyrus engineers (now part of Caterpillar) feel their current machines owe any debt to the work of WHR is open to debate, of course. Today's designs are a world apart from what the company was producing 80 years ago – and galaxies apart from the illustrator's crazy creations.



THE MULTIPLEX DRAGLINE
FOR DRAGGING WINDING STREAMS
— ANOTHER SUGGESTION BY MR.
W HEATH ROBINSON



THE INVENTOR OF
THE MECHANICAL
SHOVEL TRYING OUT
AN EARLY TYPE

LEFT: Is this one really so mad? Surely avoiding all that repositioning of the undercarriage could save quite a bit in fuel consumption!

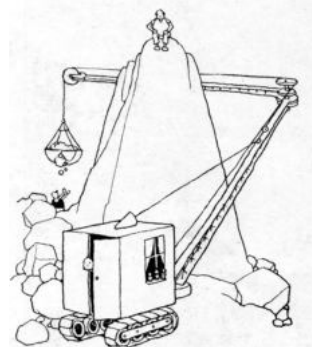
LEFT: Thirty years before *The Flintstones* made human-powered machinery cool, William Heath Robinson was already on the case

Take his design for a face shovel, for instance. While modern mining machinery is leading the charge towards automated vehicles, WHR's 'New type of shovel removing the topsoil from a bluff in the Cotswold Hills' is an incredibly labour-intensive design requiring seven operators. Plus a housekeeper. And, er, a cat.

Although the cab (apparently the transplanted front room of a small house) boasts a chimney, all the horsepower is in fact being supplied by the personnel – two burly guys powering the winches, while boom swing is taken care of by a couple of hardy cyclists attached, mule-like, to the slew ring.

A chap standing on the roof seems to be employed solely to keep everything lubricated with the help of his fishing rod, while another sitting within the boom is poised to open the jaw of the clumsy-looking bucket by yanking on a very frayed string. And although the ground engagement tools (GET) are merely household cutlery and toasting forks, they are obviously endowed with a surprising amount of breakout force.

BELOW: Could today's multijointed excavator booms have taken their inspiration from this design?



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RIGHT: Those cinema patrons are more likely to catch the sequel at this rate...

Don't be fooled into thinking it's making a pass into that car in front either (that's merely for towing the unpowered machine along on its bath-mat trackpads) – look in the background and you'll see fleets of heavily laden prams working their way up the hill in orderly fashion, before rushing back down empty on the other side.

Instinctive controls

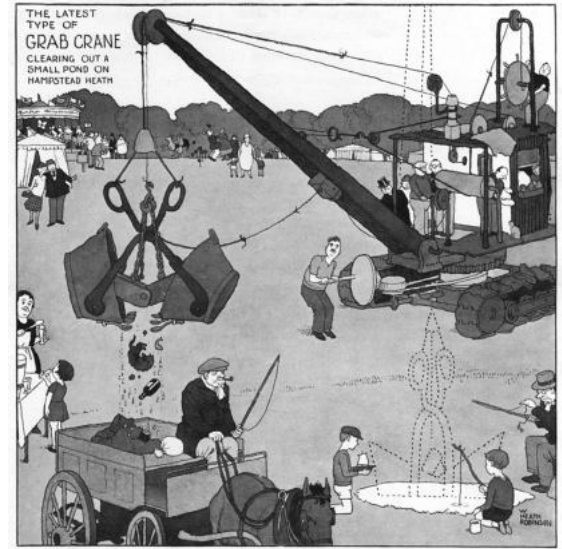
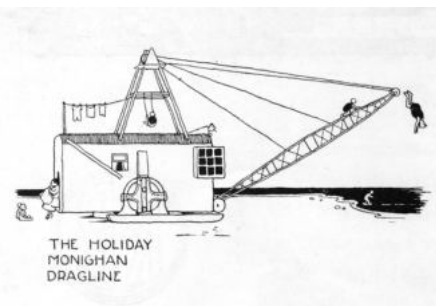
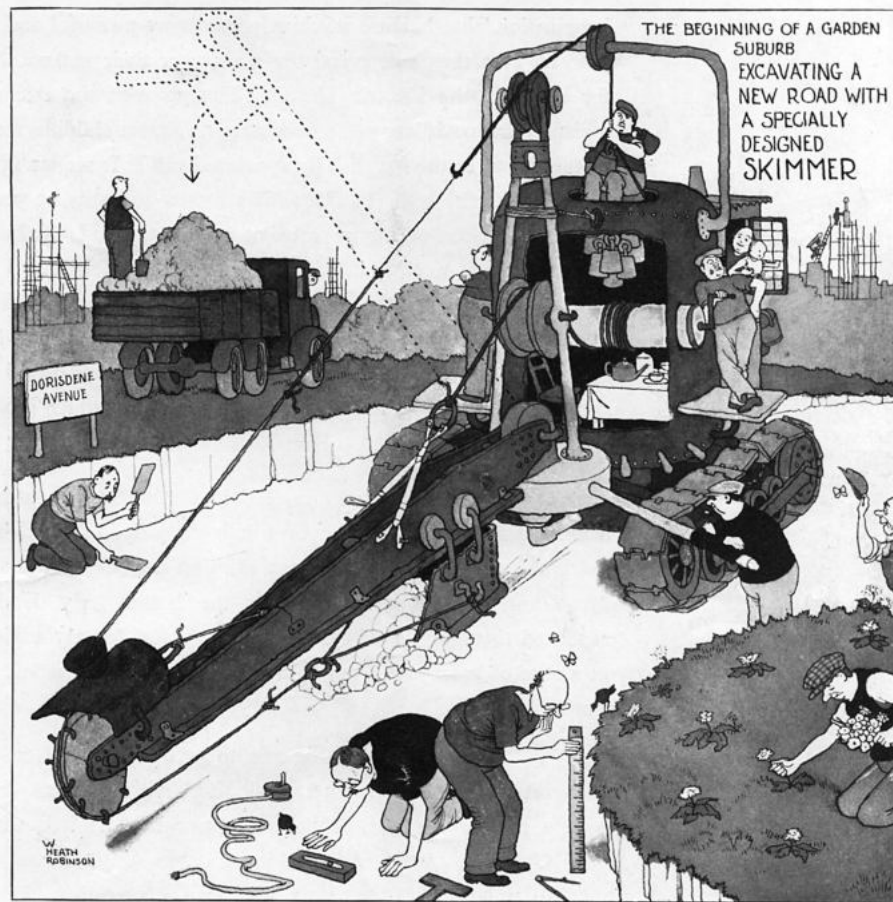
In Robinson's text accompanying this machine, there was however a small nod to the modern topics of automation/artificial intelligence and the importance of an ergonomic workspace with instinctive controls.

'It is quite wrong to conclude, as some writer whose name escapes me

has permitted himself to do in a fit of unbridled imagination, that because machines grow more powerful and vast year by year, they will eventually overpower their makers. Take, for instance, the Electric Shovel. Though with the strength of a giant, what could exceed in obedience its almost childlike response to the driver in the luxuriously appointed cab? It scoops up great masses of earth at the bidding of its master as easily as you or I spoon up our porridge at breakfast ... I felt that I could work the machine myself, and was a little chagrined that I was not invited to do so. The Drag Shovel is also a model of obedience as it bows its long boom to the earth with which it is about to deal.'

Ah yes, the drag shovel. Once again ignoring the old adage 'If it ain't broke, don't fix it,' Robinson's extraordinary 'New multimovement drag shovel excavating for the foundations of a new cinema' showcases some 'unique' ideas.

Let's quickly pass over the dual cabs that are suspiciously reminiscent of outside toilets, and mention that, once again, there are two unfortunate cyclists – on exercise bikes this time – providing the required kilowatts. But what's that emitting clouds of smoke behind the cab on the left? It definitely appears to be some sort of external combustion apparatus – suggesting that this vehicle could in fact be one of the very first hybrid machine designs.



Boom manoeuvrability – if such a thing is possible with that broom pivot – comes courtesy of one chap working a pulley and another chap prodding it with sticks, while the heavy-duty bucket (a tin bath armed with spades as GET) requires a bit of manual help, too.

And in what is already becoming another common theme of these six designs, the half-buried banksman and impatient cinema audience show scant regard for modern health and safety practices.

Bread and butter

Next up for a revamp is the skimmer. Nowadays a museum piece after the advent of motor graders and dozers, these employed a bucket travelling along a horizontal boom to provide a level road surface.

'So true is the action of this delightful machine that, so I was told, it can skim off the jam from a slice of bread ... without disturbing the butter,' wrote Robinson – but was sadly unable to verify this due to being unable to locate the appropriate foodstuffs.

Whether such a skilled feat would even be possible in these days of satellite-controlled roadbuilding is highly debatable. And certainly in 'The beginning of a garden suburb excavating a new road with a specially designed skimmer,' his proposed method of maintaining the boom at the required height (two indolent guys on winch duty) and propelling the bucket (a fat bloke with a bit of added ballast hanging from a rope passing through the cab roof) seems unlikely to manage it at the first pass.

As far as I can make out, there's no obvious source of propulsion with this one, even though the solitary workman responsible for swinging and emptying the bucket looks to have an unenviably strenuous task – and is pictured taking a well-earned breather. I'm just surprised he's not in the roomy operator's compartment having a cup of tea – in fact, this idea of actually 'brewing up' on the job predates Joe Bamford's revolutionary in-cab-kettle idea in JCB's backhoe loaders by almost 30 years.

'Perhaps I was most deeply moved by the Walking Dragline, or Bucyrus-

Monighan ... there is something so playful and even skittish in its peregrinations,' he wrote next, using words that have never been used in a description of today's equivalents; models that would make an arthritic brontosaurus look like Fred Astaire in comparison.

ABOVE RIGHT: In a classic case of over-sizing, a huge grab crane is employed to clear out a tiny pond. (You could say that's using a sledgehammer to crack a nut, but that would be far too simple a solution for Heath Robinson.) He employs a couple of tin baths with spoons for GET, linked via a giant pair of unusual scissors, all powered manually. The work is, of course, carried out with scant regard for the disturbed enjoyment – much less the safety – of the bystanders

ABOVE LEFT: Despite being claimed to be super-accurate, WHR's skimmer design requires a great deal of supplementary personnel to be employed on levelling duties

'An old friend of mine once bought a Bucyrus-Monighan in which, with his family, he spent a summer holiday. He ... found the long boom so useful in bathing and diving when the machine came to rest on the beach. The only drawback was the confinement of the sleeping quarters, due to the presence of the machinery. However, the children found the latter very amusing on rainy days,' he continues, reinforcing the modern notion of a comfortable workplace being a home from home.

Now, that is all rather worrying for those of us who hold caravans and RVs responsible for the worst excesses of holiday traffic chaos, but nevertheless, the 'Early form of the walking dragline stripping rocky overburden preparatory to erecting a new teashop in the Alleghany (sic)

INDUSTRIAL VEHICLE ART



LEFT: Walking dragline: in the days before boom-mounted cameras, a man with a telescope was apparently required to ensure a clear view of the worksite

BELOW: This 'improved' dragline design sees an old pram cunningly put to work for dredging, despite the protests of the irate fisherman and nervous swimmers. A boiler on the counterweight appears to be providing the power, yet there are still four operators in the cab, with another two providing control of slewing. In a case of too many cooks spoiling the broth, a disagreement is underway – perhaps due to the man on the right worriedly pointing at the clock and stating that his shift has finished and it's time he went home

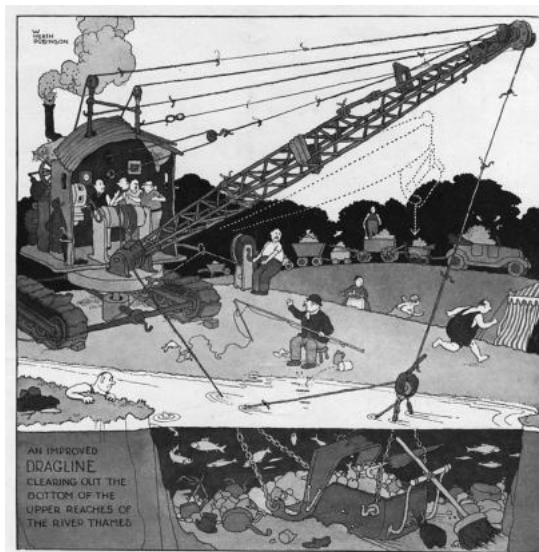
Mountains' does look surprisingly nimble – indeed, one or two in the background seem to have gone on the rampage. Perhaps this turn of speed is related to this design being the only one of the six that appears to be exclusively powered by an IC or EC engine, as there is some quite uncharacteristically 'normal-looking' machinery inside with little human intervention going on outside.

Perish the thought that this could be a viable design, however – Robinson took the 'walking' idea to its logical extreme, delivering that power to the ground in the form of five pairs of sturdy boots.

Judging by the high levels of discarded footwear, however, these are not as durable as his previous bath-mat track designs, and require a service technician (i.e. a small boy polishing the replacements) to be on call at all times.

As much as I've enjoyed getting to know more about William Heath Robinson through his designs for Ruston-Bucyrus, I can't help thinking that if he were still around today, his entries for consideration to our *Design Challenge* feature would no doubt require some diplomatic skills on my part. He's already produced designs that could easily have been supplied in response to the first-ever brief in 2009 – that of thinking up a way of replacing hydraulics – not to mention new propulsion methods.

But as designer David Bowler aptly pointed out, "It's very often easier to make a design complicated than to make it clean and simple." Robinson managed to do exactly that, with nary a hydraulic valve in sight – but then again, who really needs those when you can work with knotted string, wooden wheels and a gigantic pair of scissors? **IVT**



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WEIGHT WATCHERS

LOOKING FOR WAYS TO SHED UNNECESSARY BULK IN INDUSTRIAL VEHICLE CONSTRUCTION HAS NEVER BEEN MORE TOPICAL. LIGHTWEIGHT STEELS ARE PLAYING A HUGE PART IN THE SLIMMING PROCESS, AND THEREBY REDUCING FUEL CONSUMPTION





▷ In Miami this May, I had the privilege to go out for a short sail in Sanya, one of the Open 70 sailboats participating in the 2012 Volvo Ocean Race. That it, like all the other boats, was predominantly constructed from carbon fibre was no surprise, nor were the Spartan conditions that were deemed so necessary to avoid excess weight.

But I was astonished at the extent of the weight-weenie mindset – the use of carbon fibre for drinks bottle cages in the cockpit, for instance, which provide a meagre 15g or so saving over their plastic variants.

So perhaps the subject of 'lightweight' industrial vehicles isn't quite as daft as some might think. Like those 70ft sailboats with a keel weight of up to 7 tonnes, the less bulk there is, the less power needed to move it – a timely topic in these days of oppression under the yoke of the oil companies. The topic of 'lightweight steel' is, however, one of those instances where you wonder if there is a spot of leg-pulling going on.

Get the green light

But that's definitely not the case. Ruukki, for instance, is helping

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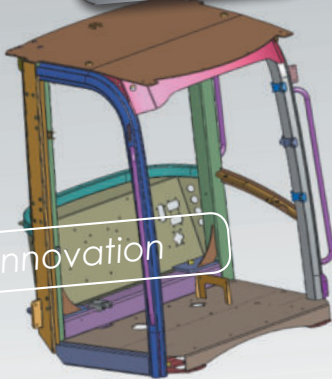
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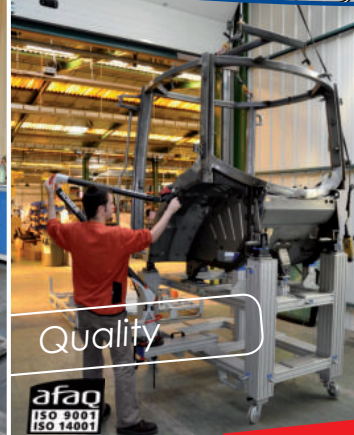
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industrial vehicle OEMs obtain increasingly lighter applications with a range of materials that includes what it says is the thinnest (2.5mm) DQ steel on the market.

Relatively lightweight yet durable products for the most demanding conditions can be achieved through the combination of its wear-resistant Raex steels and ultra-high-strength Optim structural steels in one product; the former being used for components that are the most susceptible to wear, and the latter being ideally suited for use as a structural steel in frames or lifting booms.

By combining these two grades of steel, it is, for instance, possible to build transport equipment with an unusually high payload. High-strength steels enable increasingly lightweight structures and a greater payload without making compromises in terms of durability.

Laser-welding enables sheets of different thicknesses and different grades of steel to be joined together, opening up opportunities to optimise the structures of tipper bodies and tanks, for example. The floor of a tipper body is subject to particularly hard wear and tear – but, if made of hard, wear-resistant Raex steel, can be half the thickness of a floor made



from conventional steel. The sides of a tipper body can be made from even thinner, ultra-high-strength Optim steel.

This saves considerable weight in these structures, which in turn enables higher payloads and cuts fuel consumption. But, just as importantly, the durability of the tipper body remains unchanged – and in some cases is even prolonged despite being lighter.

There are benefits in terms of manufacturing, too. By using thin,



MAIN IMAGE: Tata Steel's strength lies in how to make steel, process it and use it for best results

ABOVE LEFT: Bronto Skylift boom steel parts are made of Ruukki Optim steel grades

ABOVE: Tipper body made of Ruukki Raex wear-resistant steel grades

high-strength structural steels, savings can be made on production costs due to their easy bendability and surface treatment. Additional savings in welding work and filler materials can also be achieved when material thickness is minimised.

Custom care

The subject of lightweighting has proved to be a catalyst for change in the way that Tata Steel approaches the market, with the introduction of a dedicated design support team to

MATERIALS

work alongside OEMs. The early vendor involvement (EVI) approach enables it to work closely with customers to create lighter yet stiffer structures early in the design process, enabling full exploitation of the benefits of higher-strength steels.

EVI work on chassis development has delivered a range of benefits and, by simplifying certain design details, one OEM has been able to reduce tooling costs for chassis production by €75,000. More importantly, the resulting new generation of chassis are over 30% stiffer and 25% lighter than the previous generation. By modifying paint approaches and improving steel quality on the boom, Tata Steel managed to save another leading OEM over €300,000 per annum by eliminating a surface-preparation process.

However, the use of lightweight steel throws up new problems. The limitations of weld integrity can

RIGHT: Tata Steel has worked hard to tailor a range of products and processes, such as laser-cutting, to the needs of the construction equipment market

BELOW RIGHT: Thinner, higher-strength steels are becoming of increasing importance to equipment makers



mean that it's not a case of simply exchanging a conventional material for a high-strength substitute. A more holistic approach needs to be taken, and the true benefits of using these new materials can only be exploited

if a component is redesigned to mitigate any limitations. As a result, Tata Steel is working at understanding weld stresses through detailed finite element analysis. It is also helping develop new welding techniques as a partner in the Nuclear Advanced Manufacturing Research Centre at the University of Sheffield, UK.

So with the rise in interest in lightweight materials, the company is hard at work developing a range of higher-strength steel products. The S700 range of strip products is going through a series of trials in increasing thicknesses, and S960 and S1100 progressions are on the cards too. Abrasion-resistant plates that last much longer in service are also being developed with improved toughness, and all of its operating hubs now have schemes in place to improve steel surface flatness, which will facilitate the use of much more efficient welding techniques. **ivT**

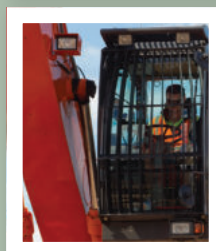
WINNING WEIGHTS

► The SSAB-sponsored Swedish Steel Prize was set up to inspire and disseminate knowledge about high-strength steels and the possibilities to develop lighter, stronger and more sustainable products.

Over the past three years, there have been some notable winners from the industrial vehicle sector, with Deere & Company taking the honours last year. By using high-strength steels, it has been able to improve harvesting productivity while meeting stringent engine emissions requirements. The weight of targeted steel parts in the harvester has been reduced by 50%, in a new design that has helped to reduce the amount of welding by almost 70%. Production processes that were created to enable the use of high-strength steel have generated major advantages throughout the entire production chain.

With this reduction in gross vehicle weight, the header width could be increased. The new draper is more flexible, enabling it to follow uneven ground and improve yield better than conventional solutions – helping farmers increase productivity by as much as 40%.

HT Engineering of New Zealand was a finalist that same year due to its innovative use of advanced high-strength steel to protect excavator



ABOVE: Deere won the 2011 prize after reducing the weight of steel harvester parts by 50%
FAR LEFT: HT Engineering's cab protection grid
LEFT: Van Reenen's truck body reduced weight by 19%

operators from falling objects. The company improved impact strength and visibility in its new design of a cab protection grid, while considerably reducing both the weight and the risk of permanent grid deformation through the use of thinner protection bars with adapted orientation.

The previous year, the prize was won by Van Reenen Steel, which developed a lighter, more durable body for mining trucks. The company uses high-strength, abrasion-resistant steel in an innovative truck body design to create a lighter (by 8 tons, or 19%) structure.

The new design features a raised ridge that divides the floor of the truck body down the middle, offering the clear advantages of less wear and easier unloading. In addition to the stronger and more rigid construction, the lighter design enables the vehicle to carry a larger payload.

In 2009, the prize went to Labrie Environmental Group for the Wittke Starlight front-loader refuse collection truck, which showed the breadth of opportunities high-strength steels offer for precise optimisation of all parts of the vehicle.

"Labrie has come far in the use of high-strength steels," explained Martin Lindqvist, chairman of the Swedish Steel Prize jury, at the time. "Its winning entry consists almost entirely of high-strength steels [put] to successful use and it has applied a clearly holistic view. The designers have been successful in optimising the design in order to reduce weight, but without compromising on strength and functionality."

The truck has approximately 700kg higher payload capacity than Labrie's previous models, and also achieves higher compaction of the refuse in the container. This has resulted in a more efficient vehicle that further reduces fuel consumption by requiring fewer transport journeys.

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Transportation Weight Loss Diet Conference 2012

The Transportation Weight Loss Diet Conference will bring together designers, engineers, program leaders, and heads of industry from the global aerospace, automotive, and rail industries for a two-day conference dedicated to cutting-edge research and technologies aimed at reducing weight without compromising

safety, efficiency, or performance.

Presentations will include real examples of how challenges and compromises can be overcome and avoided through intelligent design choices and initiatives, as well as new materials and engineering practices.

The conference provides an unparalleled opportunity for a transfer

of ideas between transport sectors, highlighting the best new approaches with the greatest potential to reduce weight, save fuel, enhance performance, and lessen environmental impact. Don't delay – make sure you book your place in Boston this October!

PRELIMINARY CONFERENCE PROGRAM



DAY 1 Wednesday, October 24

Setting the scene: the future of mass reduction

The opening session of the conference will highlight key trends and motives for mass reduction in the automotive, aerospace, and rail sectors, as well as examining potential future supply issues for lightweight materials.

Keynote presentation

Matt Zaluzec, manager, Materials Research and Advanced Engineering Department, Research and Advanced Engineering Center, Ford Motor Company, USA

Lightweight rail transportation at Bombardier

Jacques Belley, R&D director, Standardization and Innovation, Bombardier Transportation, USA

Less is more: automotive downweighting opportunities with mixed materials

Greg Schroeder, research analyst, Manufacturing, Engineering & Technology, Center for Automotive Research, USA

Lightweight materials

This session will look at a range of materials for use in vehicle mass reduction applications. New-generation meta and para aramids, intermetallic replacements for Ni-based superalloys, magnesium alloys, metal matrix composites, and 'fuzzy fiber' will all be profiled. The session will also cover manufacturing CFRP parts.

Advanced lightweighting materials: Nomex, Kevlar, and beyond

Dr Ley Richardson, principal application research associate - Aerospace, DuPont Protection Technologies, USA

Gamma Ti alloys: commercial solutions for carbon reduction

Cameron May, director, GfE Materials Technology Inc, USA

How metal matrix composites have been redesigned for more machinability and lower cost

Patrick McGowan, vice president, GT Alloys, USA

HiAnt® Simulation: Simulating structural composite hybrid parts made from continuous fiber reinforced plastics

Vasant Pednekar, Senior Engineer - Application Development, Lanxess Corporation, USA

Passenger environments

Transportation needs to be attractive and easy to use. Transportation operators and manufacturers need to satisfy passengers and customers. Consumers must view mass reduction as an improvement to their transport experience. This session will look at how this can be achieved.

Design-driven innovation and cross-pollination for lightness

José Rui Marcelino, design manager, Almadesign, Portugal

Cabin Concept 2050 based on a bionic structure

Ingo Wuggetzer, vice president Cabin Innovation and Design, Airbus Operations GmbH, Germany

Employing new design techniques to deliver lightweight seats

Alexander Pozzi, vice president Advanced Design Group, Seating Products, B/E Aerospace, USA

Low-calorie light infotainment

Ashutosh Tomar, senior researcher, Jaguar and Land Rover, UK

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FROM THE
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Low-cost multifunctional-use composite to reduce weight

Prof Khalid Lafdi, professor, Department of Chemical and Materials Engineering University of Dayton Research Institute and Wright Brothers Institute Endowed Chair in Nanomaterials, USA

Developing volume manufacturing processes for carbon-fiber reinforced automotive body structures

Donald Lasell, president and chief engineer, Think Composites, USA

Manufacturing with lightweight materials

This session sees presentations covering high-speed automated manufacturing processes and techniques using composites; and looks at how smartphones may deliver new, strong, lightweight glazing solutions to transportation, as well as new mixed materials.

High-volume, high-speed preforming for structural composites

Daniel Buckley, manager of R&D, AGFM, USA

Computer-based tools for designing with new materials

Dennis Sieminski, P.E., NEI Software, USA

Strong, lightweight glass laminates for transportation weight reduction

Phillip Bell, product line manager, Corning Incorporated, USA

EASI: steel cord reinforcement for injection molded parts

Dr Dries Moors, innovation manager, Bekaert, Belgium

Lessons from aerospace: integrating lightweight materials information into engineering workflows

Dan Williams, product manager - Automotive, Granta Design Ltd, UK

Objective composites manufacturing process control: reducing uncertainty, overdesign and weight

Scott Blake, president, Assembly Guidance, USA

Lightening the way ahead

Phil Hall, managing director, Caterham Composites, Germany

Lightweight design of composite structures

Dr Robert Yancey, senior director - Global Aerospace, Altair Engineering, USA

Technologies for lightweight design and performance verification

Ravi Chilukuri, director, EASI, USA & Michael Lee, project manager, EASI, USA

Polyetherimide-carbon fiber as metal substitute in aircraft food tray arms

Dr Mohammad Moniruzzaman, product development engineer, Sabic, USA

Innovative solutions for railway floors and interior panels using cork

Antonio Coelho, R&D director, Amorim Cork Composites, Portugal

Automotive case studies and applications

What are the major vehicle manufacturers achieving in terms of mass reduction? This session looks at specific case studies of vehicles and programs.

VSL Project: sustainable and affordable technology for CO₂ emission

Tomasz Kryszinski, chief engineer, PSA Peugeot Citroën, France

Weight reduction lessons and achievements: product development

Ramkisan Gite, PAT lead - Weight Reduction, Tata Motors, India

The BMW i3: a battery electric vehicle - right from the beginning

Oliver Walter, responsible product manager BMW i3, BMW, Germany

Using alternative plastic materials for weight reduction on heavy trucks

Dr Srikanth Ghantae, senior technology specialist - Plastics, Volvo Trucks North America, USA

Use of composites in bus structures for significant weight reductions

Mukul Mitra, program manager, Ashok Leyland Limited, India. Pradeep Kumar, manager - Global Bus & Coach Programme, Ashok Leyland Limited, India

Weight reduction through value engineering

Manoj Surana, manager - Engineering Research Centre, Tata Motors Ltd, India

Light-duty vehicle mass reduction and cost analysis: midsize CUV

Greg Kolwich, manager, Value Engineering Services, FEV Inc, USA

Reducing vehicle weight with composite materials

James Jones, CCG manager - Americas, Composites Consulting Group, USA

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transportation weight loss diet conference 2012

DAY 2 Thursday, October 25

Simulation and integration

The design and engineering challenges of integrating composite materials into structures and parts is addressed in this session, with presentations focusing on simulation, design optimization and process control techniques.

Intelligent adhesive bonds that provide an early warning system for structural failures

Prof Shaker Meguid, professor and director Engineering Mechanics and Design Laboratory, Department of Mechanical and Industrial Engineering, University of Toronto, Canada

Design and fabrication of multi-material structures

Prof Glenn Daehn, professor, Ohio State University, Materials Science and Engineering, USA

Laser cleaning pre-treatment for bonding of lightweight metals

Georg Heidelmann, president, Adapt Laser Systems, USA

Achieving weight reduction through design, material selection, and application-specific products

Tony Padula, product manager, Amphenol Pcd, USA and Janice Grzywa, Market Development Manager, Victrex USA, Inc, USA

Mechanical performance of friction spot-welded joints in 2198-T8 alloy

Dr Jorge F. dos Santos, head of department, Helmholtz-Zentrum Geesthacht, Germany

Aerospace materials for aircraft lightweighting applications

Dr Ralph-Dieter Maier, manager, Aerospace Technologies, BASF Corporation, USA

Pioneering a sustainable business model

Stuart Jones, VP Research and Development, Interface Americas, USA

Parametric study and topology optimization for platform concepts

Anthony Norton, senior director, Global Automotive & Off-Highway Vehicles, Altair, USA

Lord UltraConductive film and coatings for lightning strike protection

Ross Zambanini, senior global market segment manager, Aerospace & Defense, Lord Corporation, USA

Experiences with the electrical use of carbon fiber

Walter Kiersch, CEO, Carbon Conduction Technologies (CCT) GmbH, Germany

Automotive case studies and applications

Edison2's Very Light Car: a new automotive architecture

Oliver Kuttner, CEO, Edison2 LLC, USA

Half-weight vehicle with new materials: chassis, body, and driveline

Mogens Løkke, CEO, ECOMove ApS, Denmark

Full vehicle lightweight designing based on CAE techniques

Javier Rodriguez, director Vehicle Integration & E/E, EDAG Inc, USA

Prospective view of CFRP as a technology for weight reduction of automobiles

Toru Yamanaka, general manager, Automotive Center, Toray Industries Inc, Japan

Advancements in Cast Magnesium Structural Components

Jeffrey L Moyer, Vice President, Business Development & Engineering, Meridian Lightweight Technologies Inc, Canada

Automotive safety

One of the key concerns in downweighting vehicles is the issue of safety. This session looks at the issue not from the perspective of how far we can compromise safety for mass reduction, but rather how mass reduction actually increases safety and what lessons may be learned from motorsport.

Enhancing vehicle safety and crashworthiness with weight-loss improvements

Byron Bloch, director, Auto Safety Expert LLC, USA

Designing a lightweight body structure meeting federal impact requirements

Gregory Peterson, senior technical specialist, Lotus Engineering Inc, USA

Characterization of crash properties in aluminum extrusions

Jonas Braam, research engineer, Sapa Technology, Sweden

New materials and design technologies for motorsports

Prof Pete Hylton, director of Motorsports Engineering, Indiana University Purdue University Indianapolis, USA

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Aerospace design developments

Looking specifically at aerospace, this session considers specific examples of mass reduction developments and the lessons learned in significantly increasing composite percentages in aircraft structures, as well as some interesting designs for drag reduction and innovative uses of carbon fiber.

Future aircraft composite weight savings opportunities and challenges

Dr John Fish, senior manager Airframe Technology, Lockheed Martin Aeronautics Co, USA

Challenges, and opportunities, of introducing composites into the 787 airplane design

Robert McIntosh, chief engineer - Weights, Boeing, USA

Weight opportunities of wide-body aircraft composite ailerons

Gulsen Oncul, A350 Ailerons EPM, TAI, Turkey

Multimodel structural optimization of commercial aircraft

Prof Santiago Hernandez, professor, University of Coruna, Spain

Understanding weight reduction relationships for rotorcraft

Dr Daniel Schrage, professor, Georgia Tech, USA

Drag-reduction technologies for low-speed applications

Prof Konstantinos Kontis, professor and deputy director, The University of Manchester, UK

Multi-disciplinary optimization of a pylon for mass and drag reduction

Freddie Colsoul, account manager, LMS North America, USA

CLOSE

Lightweight seating

Safe, comfortable seats – sometimes in large numbers – are a key requirement for most vehicles, especially aircraft and trains. Hence seating can add significantly to vehicle weight. This session is dedicated entirely to looking at this critical area for mass reduction with a range of approaches and products discussed.

Weight reduction in seat cushions

Mike Brock, market development manager, Rogers Corporation, USA

The use of high-strength polymers for metal replacement

Gary Seale, managing director, Cobra, UK

Lightweight structural solutions for transportation seating using expanded polypropylene (EPP)

Steven Sopher, technical director, JSP, USA

Weight savings through the use of suspension textiles

Neil Gross, president, Acme Mills Company, USA

Weight-saving possibilities on dress covers

Gerret Suhl, head of Sales, Car Trim GmbH, Germany

Win, win, win: lightweight leather

Nico Den Ouden, sales and marketing director, E-Leather Group, UK



CLOSE

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A COMBINED PROCESS OF ZINC PHOSPHATING, E-COATING AND POWDER COATING DELIVERS TOUGH CABS THAT WILL WITHSTAND CORROSION FOR YEARS – AND PERHAPS GIVE OEMs AN ADVANTAGE OVER THEIR RIVALS

▶ Globally operating OEM customers have often turned to Ruukki's unit in Holič, Slovakia, to meet their needs for ready-to-assemble cabins for mobile machines such as reachstackers and forklifts.

And now the company has made an investment of approximately €3 million in a new paint shop in the unit. The facility has the capacity to paint more than 10,000 cabins every year, with the line meeting the high quality and environmental criteria of both the automotive industry and off-highway OEMs. The company has used a similar coating process at its Kurikka cabin plant in Finland since 2006.

The new paint shop at Holič gives Ruukki additional capability to build cabins with high-quality painted elements, including major components such as cabin frames, or smaller parts. What makes these workpieces different to those used currently in cabin construction is the extra protection they offer against corrosion, due to the innovative process employed by Ruukki.

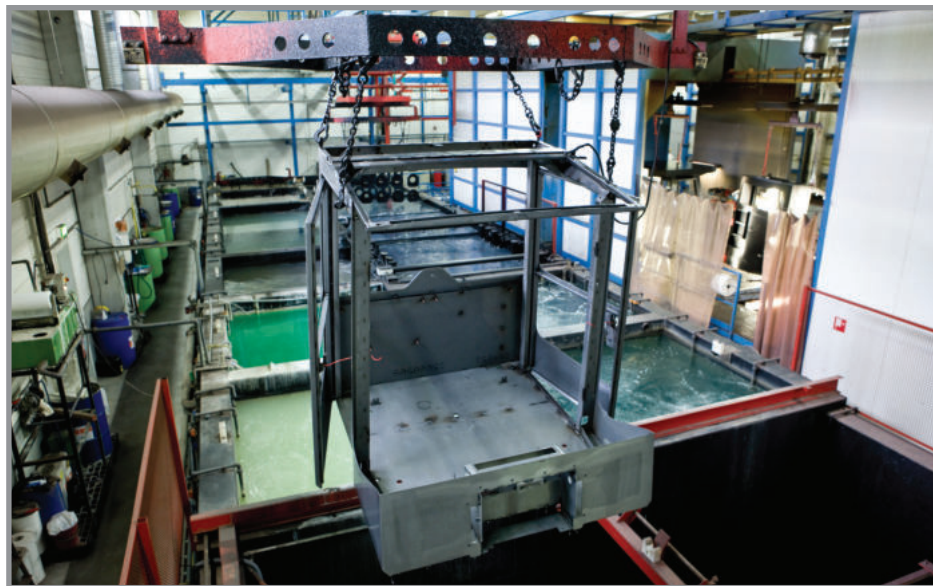
The company has brought together e-coating and powder coating into a combined process capable of delivering tough painted components in any colour. The first step in achieving the highest quality impact- and wear-resistant finish on metal workpieces is chemical pre-treatment. In the Holič paint shop, e-coated components start out by going through a process using zinc phosphate.

The pre-treatment process begins by dipping the metal workpiece into alkaline and freshwater baths to remove any impurities. The next stage is zinc phosphating, in which a thin but extremely tough layer is applied to the metal surface.

The e-coating process involves electrochemical technology. The company uses a black epoxy-based paint in the cataphoresis process. The process is completed with polymerisation, during which the workpiece is cured in an oven. This e-coated workpiece is highly durable and can be used without any additional treatment. The Holič paint shop, however, then takes metal surface finishes to a further stage by powder coating them.

Energy efficiency and sustainability

Ruukki was keen to ensure that sustainability and energy efficiency would be addressed throughout the supply chain, and the processes employed in its new Holic paint shop reflect this. The painting process



ABOVE: The cabin frames are zinc-phosphated and electrophoretically primed before powder painting (photo from the Kurikka paint shop)



Ruukki manufactures high-quality fully assembled cabins for mobile machines for leading globally operating companies

itself results in negligible VOC (volatile organic compound) emissions because the paint does not contain solvents. It generates no waste paint and an

efficient paint-filtering system optimises resource usage for maximum efficiency.

Globally, the company is committed to the promotion of energy efficiency, increased recycling and materials efficiency, plus compliance with environmental systems and the requirements of environmental permits. The bulk of the company's operations are ISO 14001 certified and it has achieved the position of industry leader in two Dow Jones Sustainability indexes: DJSI World and DJSI Europe.

Every aspect of the cabins manufactured at Kurikka and Holič places an emphasis on long-term sustainability. In addition to the way the cabins are produced, the materials used to form the cabin structure and body offer long-term benefits for off-highway vehicle manufacturers. Ruukki Optim high-strength and Ruukki Raex wear-resistant steels, for example, enable the creation of machines with increased longevity and service life, as well as reduced overall weight for lower fuel consumption. **IVT**

Alan Markham is a freelance journalist



CONTACT

www.ruukki.com/cabins
info.engineering@ruukki.com

Cabin pressure

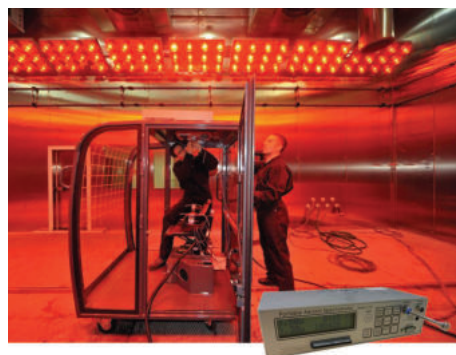
OEMs SEEKING TO COMPLY WITH THE TOUGH DEMANDS OF EN 15695 NEED WORRY NO MORE – THIS SMALL PRESSURISATION MODULE EASILY KEEPS DUST, AEROSOLS AND GAS AT BAY

Since May 2010, manufacturers of industrial vehicles such as agricultural tractors, vineyard tractors and self-propelled sprayers have been subject to EN 15695 regulations, the target of which is to preserve the physical health of farmers. EN 15695 stipulates different levels of protection, from Level 2 (protection only from dust) to Level 4 (which includes protection from dust, aerosols and gas). Level 4 is required for phytosanitary products. The directive also stipulates that the vehicle cabin must be equipped with a dust filter, must be airtight (to prevent polluted air entering the cab), and must be air-conditioned and pressurised.

The French Ministry of Agriculture and MSA, an insurance company that specialises in the protection of farmers, have worked with CEMAGREF, the national research institute of science and technology for environment and agriculture, on finalising this regulation. Other than for a small number of vehicles, most manufacturers will aim for Level 2 classification, where the main problem is airtightness.

Research programme

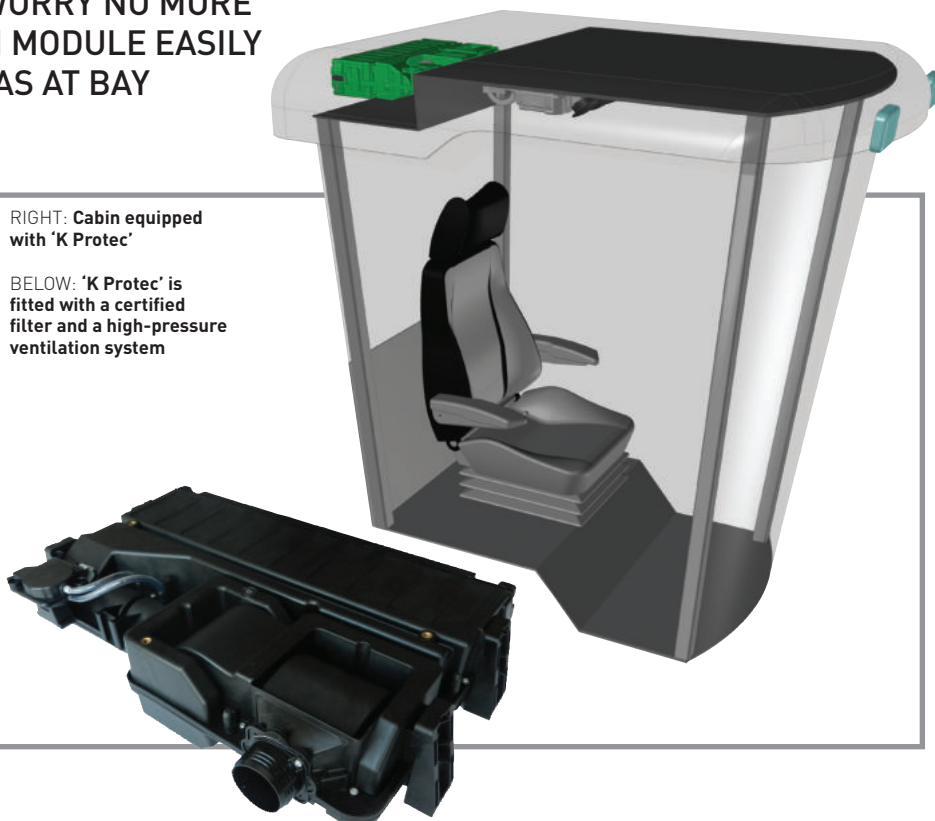
Kalori's research department, with its expertise in plastic-injection and ventilation systems, has made several prototypes and carried out tests to develop the thinnest possible pressurisation module that can be fitted in the confines of a cab roof. The 'K Protec' pressurisation system is the result of these studies, meeting all of EN 15695's requirements. The innovative product is fitted with a certified filter and a high-pressure ventilation system, and is patent pending.



ABOVE: EN 15695 test in Kalori's climatic chamber

RIGHT: Cabin equipped with 'K Protec'

BELOW: 'K Protec' is fitted with a certified filter and a high-pressure ventilation system



The airflow is permanently controlled so that at least 30m³/h is blown into the cab. A maximum airflow can also be set up, according to the specifications of the filter's manufacturer – this is especially desirable because the active carbon in the filter loses efficiency when the speed is too high.

The 'K Protec' is controlled by an electronic control unit (ECU) included in the control panel of the HVAC. An LED blinks when the air pressure goes down by 20pa, or up to a maximum level that can be set up by either the vehicle manufacturer or by Kalori. This ECU drives the speed of the ventilation system to obtain the lower of the two figures of 20pa or 30m³/h. This system ensures that if a seal is damaged or displaced, the driver will remain safe because the airflow will be increased in order to block air leakage.

Laurent Combe, Kalori's research department manager, says, "Like Mr Larra from MSA explains, the protection of the driver cannot be ensured solely by the pressurisation systems. An efficient HVAC system is also necessary to dissuade the driver from opening the windows while spraying."

This is why the technical staff of the Lyons, France-based company have developed an entire system that includes integrated pressurisation and air-conditioning systems. Kalori's climatic chamber has been fitted out with the same equipment as the French and German certification laboratories (i.e. particle generator and particle counter), and this has enabled the company to develop and validate the system before sending the vehicle for certification testing in CEMAGREF or any other official European laboratory.

This means that manufacturers can be sure that their vehicles will achieve certification. At the same time, Kalori's technical staff have set up the HVAC to achieve the best possible performance in terms of comfort, and defrosting and demisting operations.

The icing on the cake is that the 'K Protec' will be also available for retrofitting, ensuring the safety of farmers even before they can afford to buy a new vehicle. **ivt**

Luc Bellemin is technical intervention department manager at Kalori



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RECENT DEVELOPMENTS IN JOYSTICK CONTROLLER TECHNOLOGY ARE OFFERING DESIGNERS AND OPERATORS OF OFF-HIGHWAY VEHICLES MORE FLEXIBILITY IN THE FUNCTIONALITY OF THEIR CONTROL SYSTEMS THAN EVER BEFORE

Electronic joystick controllers offer potentially huge improvements over manual hydraulically controlled versions. Not only are they easier and more comfortable to operate because high-pressure hydraulics are no longer in the cab, but they are quieter and cleaner too. This helps to provide a more comfortable environment for the operator and reduce the likelihood of mistakes. As a result, joystick control can help to improve the productivity of cranes and specialist vehicles and their operators, too.

The latest control systems do more than just carry out an operator's instructions – they actually improve on them by using the command signals from joysticks and feedback from the vehicle sensing systems to optimise any actions.

Current developments

Penny + Giles joystick controllers are utilised in numerous specialised transport applications. From lift-trucks, tower cranes and powered access platforms, to backhoe loaders and airport fire and rescue vehicles, the company has extensive experience in providing solutions for monitoring and control under extreme operating conditions.

Its range of finger- and hand-operated joystick controllers has been designed and developed for smooth, precise control of critical functions where a human-machine interface is required. Available in single-, dual- or multiple-axis configurations, and with ergonomic handle styles to enable superb proportional control, each model has a range of selectable options for the most comprehensive joystick-to-application matching.

An option that is proving popular with many OEMs, and one that Penny + Giles believes to be the future of joystick controller technology, is the use of contactless, Hall-effect sensors. These sensors not only provide reliable and accurate output signals and benefit from a second output to enable error checking of system integrity, but also, for example, triple the operational life of the company's JC6000 from an already impressive five million operations, to more than 15 million.

A relative newcomer to the JC6000 range is a heavy-duty, single-axis version. The new higher-strength, return-to-centre joystick is ideal for use in arduous conditions or applications including 'heavy'



MAIN IMAGE: JC8000 models are compact yet heavy-duty
INSET: JC6000 heavy-duty single-axis joystick

machinery, where high 'across-axis' loads can be a problem. The increased strength of the heavy-duty JC6000 is achieved by redesigning the body casting, which the company claims has increased across-axis fatigue life by a factor of five. The heavy-duty version also uses a new gaiter to accommodate the increased strength of the body casting. The heavy-duty JC6000 is available with long-life potentiometer track sensors with auxiliary contacting directional switch tracks; single/dual non-contact Hall-effect sensors (or a combination of the two); CAN (J1939) and CAN-Extended input interfaces; and is designed to share all standard JC6000 handles and grips.

Another recent introduction is the single-axis JC1500, which has evolved from the JC6000 and is designed for heavy-duty applications such as specialist off-highway vehicles, and aerial platforms and lifts, especially where reliability and strength are required.

Penny + Giles is also introducing the JC8000, a new heavy-duty joystick controller with all-round, high-strength features that will make it ideal for applications where operators typically use hydraulic joysticks.

More compact than equivalent-strength joysticks, the JC8000 will feature under-panel electronics sealed

to IP69K and a choice of analogue or digital outputs, including dual-redundant Hall-effect, CANbus J1939 and digital PWM.

Improved productivity

Developments in control system technology are bringing a new level of sophistication to vehicle control, which is resulting in more efficient operation. High reliability signals from the latest sensor and joystick designs, combined with intuitive control system software, means that vehicles and their equipment can be tuned to optimise performance to individual applications. At the touch of a few buttons, routine operations can be performed at high speed with minimal fatigue, for considerably better productivity from vehicle and operator.

Penny + Giles specialises in both joysticks and motion control sensors, so is therefore uniquely placed to provide advanced control options for the off-highway and specialised vehicle market. **IVT**

Mike Iles is business development manager for Penny + Giles Controls



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Shock value

THE BEST LED, HID (XENON) AND HALOGEN LIGHTING TECHNOLOGY FOR HEAVY-DUTY INDUSTRIAL VEHICLES CAN GO A LONG WAY TOWARDS ELIMINATING THE PROBLEMS ASSOCIATED WITH SHOCK AND VIBRATION

▶ No matter how good a light output or a light source, if it cannot cope with the environment in which it is used, it is useless. Many industrial vehicles and machines are used under extreme conditions, be they hot or cold, dusty or humid. The lights and applications are also stressed by shock and vibration.

The Finland-based Nordic Lights designs and manufactures LED, HID (Xenon) and halogen worklights for the heavy-duty on- and off-highway industry, as well as innovative Xenon driving lights. From the outset, the company has focused on the dampening qualities of these lights. The need for good reliable dampening solutions is underlined even further today as the emerging LED and HID worklights are heavier than the old halogen lights. Those new lights are also more costly than halogen lights so it makes economic sense to invest in durable solutions.

It is also important to ensure that the dampening solution not only protects the light, but also the application on which it is mounted, because it is no use if it keeps the light working, but then breaks something else on the machine.

Nordic Lights has the resources, experience and know-how to develop tailor-made dampening solutions for its customers. For instance, if the vibrations are originating from the engine, they will have a frequent and high wavelength; however, if they are originating from a bucket hitting the ground, the vibrations will be rare, with a low wavelength. For the professional handling of the application, work comfort is further enhanced if the light pattern is not swaying, despite the protection of the dampening, but rather is an integrated part of the vehicle.

Nordic Lights does not skimp on dampening, and its solutions are always dictated by the product and its uses. The materials are chosen so that the conditions of the working environment (such as wear, heat, cold, dust, water, chemicals and fuel) do not affect the characteristics of the product. Even so, the aim is to maintain the same size of worklamp, with or without dampening. The resistance to vibration and shock does not end with dampening – it is also applied on cables and other components inside the light.

Testing procedure

At the Nordic Lights facilities and independent test laboratories, products are constantly being tested,



ABOVE: Investing in a well-dampened worklight is money well spent



LEFT: Nordic Lights has always emphasised durable dampening solutions for its worklights

and different test methods are applied for different approaches to vibration and shock. The company also uses internally developed test methods.

Another key issue is the testing of a large number of units of a particular light model before launching it. After testing has been completed, no changes in the values or characteristics of the lamp are permitted; any weak points for shock or vibration are revealed during the tests and fixed.

Another approach that Nordic Lights implements in the tests is to push the lights to such extreme limits that they break. This is done to ascertain that if something does break, it will not cause any harm to the electronics in the vehicle, or cause a fire. **IVT**

Stefan Sandler is R&D manager at Nordic Lights, where he has worked for 19 years



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Inspect a gadget

FROM A PORTFOLIO OF OVER 2,000 CLEVER DEVICES, HERE IS A CLOSER LOOK AT SEVERAL AWARD-WINNING MODELS THAT HAVE HELPED ONE COMPANY ESTABLISH A REPUTATION AS A RESPECTED AND RELIABLE PARTNER

▶ Motometer has enjoyed a dominant position in the automotive sector since 1912, when the company launched its first product – a cooling water thermometer. “Our products are used worldwide in commercial vehicles and construction machinery – reliability, diligence, continuity and quality have shaped the tradition of the company,” elaborates its CEO, Joachim Bulla. “Our team consistently strives to satisfy customers’ needs; that is our motivation and the driving force for further innovations.”

Award-winning products

The company’s full-electronic battery breaker ensures the reliability of the supply systems of construction and other industrial vehicles. “Since 2011, Motobreaker 2.0 has been listed as one of the most innovative product developments on the Automotive Bestenliste. It enables bounce-free switching; resistance to short-circuits, battery ‘on and off’ in the cabin, controlled rewriting of storage media in control devices, as well as preventing overheating,” says Bulla. No current leakage is caused by complete current interruption, nor is the battery subjected to any deep discharge, even after long periods of being switched off. The device can also be used for anti-theft protection.

In 2008, the Motosonic ultrasonic fuel-level sensor won the Best Product accolade at the Industriepreis Awards. CNH, currently the third-largest worldwide producer of construction machines, began using the product in 2010. “We are always searching for innovative products that can help get the best out of



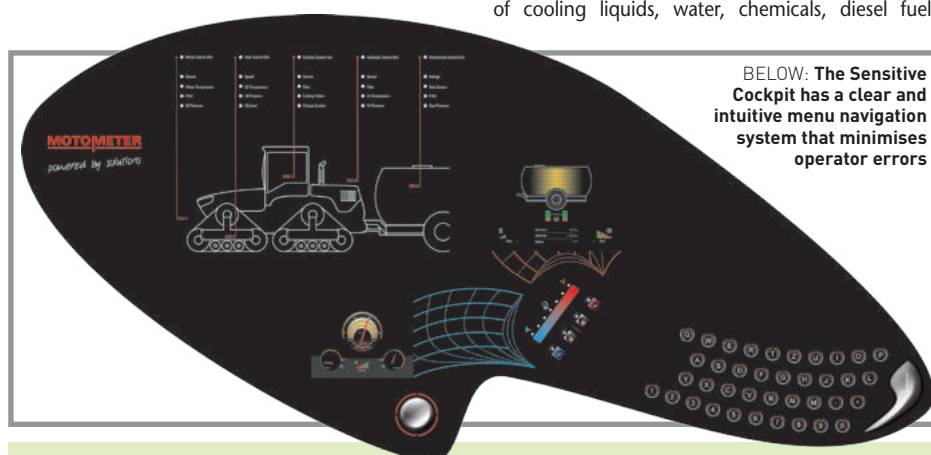
ABOVE: Motoguard can be used as an immobiliser for all kinds of vehicles

our agricultural and construction machines,” explains Thomas Fuhr, manager of aftersales marketing for CNH Germany and Austria. “With the Motosonic, we get a product that covers all of our requirements. One of the reasons for this is that measurement of the liquid level in the tank occurs without contact. The ultrasonic technology and the focus tube give incomparably precise measurement results, even on extreme slopes. And compared with mechanical measurements, it avoids abrasions, which shorten the life of the sensor.”

A further advantage is the flexibility within the geometric tank shapes and the variety of liquids, which enable Motosonic to simply measure the level of cooling liquids, water, chemicals, diesel fuels,

biodiesels, and vegetable and hydraulic oils, in ambient temperatures of -40° to +85°C. Motometer’s extensive array of accessories enables it to react to any conditions. Furthermore, it aids detection of fuel theft due to its lower power requirement and therefore does not limit the performance of the machine.

Another product, Motoguard, can be used as an immobiliser for all kinds of vehicles. This offers an effective, low-cost way of protecting them against access without permission, as the device recognises the vehicle key of the authorised driver over the transponder. Automatically user-defined settings can be made on the vehicle by this driver identification, such as the seat or mirror position. Beyond that, Motoguard is a storage medium for data such as mileage, service intervals and vehicle equipment.



BELOW: The Sensitive Cockpit has a clear and intuitive menu navigation system that minimises operator errors

Sensitive Cockpit

Motometer achieves clear and intuitive menu navigation with its Sensitive Cockpit. “Highly complex machine cycles can be simply demonstrated, and elements that are necessary, but not always in use, will be reduced or clustered,” says Bulla. “That minimises sources of error, error rates and operator limitations. This simplified and clear machine control will unburden the driver, help the security aspect during daily use, and help avoid cost-intensive operating errors.” **IVT**

Ute Dambacher is Motometer’s marketing & PR manager



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United we stand

IN THE FACE OF EXTREME VIBRATION, MOISTURE AND TEMPERATURE CYCLES, ONLY THE STRONGEST, MOST ROBUST CONNECTORS WILL CONTINUE TO MEET THE DEMANDS OF OFF-HIGHWAY MACHINERY

▶ Reliable electrical connector systems are indispensable for the use of various devices, ranging from simple electrical functions to complex electronic or mechatronic operations, such as driver-assistance systems or engine management solutions. Often positioned in exposed areas, these applications are susceptible to extreme stress by vibration, moisture and temperature cycles. The design and the materials of the connector systems must therefore be tailored to meet this challenge.

As a result, TE Connectivity specifically developed LeavySeal connectors to meet the tough engine and gearbox compartment requirements of the truck industry. This fully sealed series therefore combines the advantages of proven AMP MCP terminals with a robust design and easy mating of multiposition connectors (Figure 2). The series is protected against the ingress of water, dust and other contaminations to maintain the integrity of the mated connector pairs, by using single-wire seals and a combination of radial and axial sealing technology to meet IP69 standards. Selective silver-plated contact surfaces meet the temperature and vibration requirements.

While the lever-slide mechanism system gives a package advantage, the operator also receives a visual and tactile feedback that the connector is safely locked and supports quick and easy connection with reduced installation and service time. Due to their high vibration resistance, perfect temperature behaviour and overall size, LeavySeal connectors are the product of choice for many major commercial and industrial vehicle ECU manufacturers.

The programme currently consists of seven groups, each with a strong polarisation feature and up to four mechanical key codes. Circuits from 15 to 120 ways are available with combinations of up to three different terminal sizes. AWG, JASO and ISO wire types are qualified for the AMP MCP terminal family for the LeavySeal series. Depending on the group size, the series offers solutions for line to line, as well as certain accessories such as protection covers (Figure 2).

An important functional size for contact systems is the current-carrying capacity,^[2,3] which, like contact resistance, is one of the essential electrical values. To protect harnesses from overheating, and to avoid damage of contact systems, restriction of the current-carrying capacity is necessary^[1]. For stationary loads



FIGURE 1: TE Connectivity 62-way LeavySeal connectors and suitable header used for wire-to-board solutions

this capacity, which is dependent on the environmental temperature, is shown in derating curves. These are always made with the correction-factor $[\alpha = 0.8]$ according to DIN-IEC 512 part 3; analogously, the restriction is applied also to the wire according to DIN-VDE 0298 part 4. Derating curves with a lower correction factor as recommended according to DIN-IEC 512 part 3, should be judged as critical.

Beside stationary electrical loads, increasingly dynamic load cases arise. With short and transient loads, e.g. high starting currents of applications or trip times of fuses, the permissible temperature within the contact area must not be exceeded. To avoid the overheating and failure of any contact system, so-called current time-limit curves should be provided, e.g. according to the AK test guideline 'thermal time constant'. All current values below the limit curves are allowed for the contact system.

The competency chain

For a component manufacturer with a huge range of applications for terminals and connectors, plus the associated importance of the security function for

electrical and electronic applications, it is vital to develop and produce high-quality products. TE Connectivity, a specialist in passive electrical and electronic components, completely covers the competency chain. The company's long-standing development and manufacturing excellence, and its close working relationship with its clients led to the successful production of the LeavySeal series. **ivt**

Christian Eberwein is manager of product engineering, EMEA, Industrial & Commercial Transportation, TE Connectivity, Bensheim

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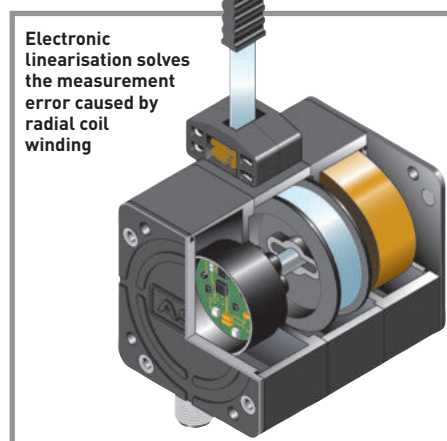
Tale of the tape

CABLE EXTENSION SENSORS ARE COMMONLY USED IN MOBILE CRANES AND FORKLIFTS. BUT TAPE EXTENSION SENSORS OFFER A STURDIER ALTERNATIVE THAT ABLY SATISFIES THE HIGH SAFETY REQUIREMENTS

Crane accidents are alarming – but it is often found that safety standards were not properly followed, with operator error and improper maintenance being contributing factors. Therefore, the crane design should incorporate components that will ensure high safety standards, such as DIN EN 12999, are attained. Sensors are the best example of this – in mobile cranes, for example, they are used to monitor the position of the outriggers, which is variable and must be known to calculate how much load can be lifted. Responsible for the absolute position of the outriggers, they must be failsafe as well as compact due to the limited mounting space inside the vehicle. Sensors are also found in the lifting mechanisms of cranes and forklifts, where maximum acceleration needs to be closely monitored.

For these applications, cable extension sensors have commonly been used. Measurement cables can have reliability problems, particularly under extreme temperature changes or when multiple cable pulleys are used. Cable durability has been increased by using a cable strand construction that increases the number of bending cycles, but as the individual strands are very thin, they are sensitive and can be easily damaged. Sometimes a polyamide PA12 covering is added to these cables for protection, but this does not completely solve the low-temperature problem. PA12 can absorb 6% water so cable jackets will freeze during the time the sensor is in -30°C refrigerated warehouses. With constant bending cycles during these temperature swings, the covering splinters off and soon causes the cable extension sensor to fail.

Although cranes are not always subjected to daily extreme temperature changes, cable sensors often use cable pulleys due to the limited installation space. ASM has therefore developed tape extension position



sensors that replace the cable with durable 0.08mm-thick stainless steel tape, giving several advantages:

- Higher safety, because the tape cannot jump off the internal coil drum if the maximum allowable acceleration of the tape is exceeded;
- The risk of icing is reduced by its flat, smooth surface, which may be cleaned with external tape brushes;
- The tape is designed for a higher number of bending cycles, which reduces maintenance costs compared with cable sensors.

A measurement tape enables distances to be measured by various methods, such as using a coil drum with an integral counter. This implementation uses a tape comprising markings and evenly spaced holes. However, this method is not reliable over the long term due to possible miscounting of holes and higher wear and tear, which reduces the service life.

The measuring tape inside ASM tape extension sensors does not contain any markings – the position

is determined with either an analogue or digital angle-sensing element such as an encoder. To meet high safety requirements, a magnetic absolute, multi-turn encoder is used that is resistant to dirt, oil and water as well as shock, vibration and extreme temperature changes. A completely potted housing ensures resistance against condensation.

The encoder is directly coupled to the tape coil drum and measures the angular movement. The tape is wiped to remove dirt buildup and does not have weak spots that can lead to a break. Provided that the tape is not damaged by external factors, it has a much longer life than a cable when multiple cable pulleys are used. Tests have shown that the measurement tape can survive with pulleys that twice redirect the tape in opposite directions, a condition that would be impossible with a cable.

A position sensor often needs to be as small as possible, which is only possible with a thin tape instead of cable laid side by side on the cable drum. The tape is wound – layer upon layer without any gap – onto the coil drum in a single radial plain. A flat spiral spring that is either coaxial to, or internal to, the coil drum sets the tape under tension. The drum circumference increases with every 360° rotation, which could lead to a measurement error, but as this is easily eliminated electronically, the angular sensing element is not fixed on a specific angular distance.

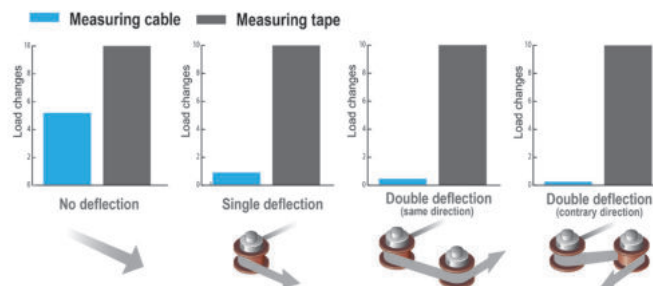
Another important point is the number of turns – the sensor output has been electronically linearised. Generally a linearity of 0.25% FS is sufficient, but some applications require up to 0.01%, which can optionally be supported by ASM tape extension sensors.

Frequent pulley use is common in cranes, but cold-store trucks have the added adverse effect of extreme temperature cycles. Cable extension sensors with plastic-coated cables therefore show more premature wear and tear with a lower breaking point than tape extension position sensors. The smooth, flat surface of the stainless-steel tape reduces icing.

Cable extension sensors are undoubtedly a price-competitive and reliable solution in many applications. However, whenever pulleys are used or temperature differences are involved, tape extension position sensors are a much better choice! **ivt**

Klaus Manfred Steinich is CEO of ASM GmbH

RIGHT: Low temperatures and multiple cable pulleys will eventually lead to cable breakage in the cable sensor



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THE LAUNCH OF TWO NEW PAPER-BASED FRICTION GRADES WILL BE A HUGE HELP TO OFF-HIGHWAY ENGINEERS UNDER IMMENSE PRESSURE TO DEVELOP THE MOST COMPACT AND EFFICIENT TRANSMISSION DESIGNS DEMANDED BY TODAY'S OPERATORS

As a leading worldwide supplier of highly engineered friction solutions to severe-duty markets, Carlisle Brake & Friction's paper-based wet friction products are noted for providing the optimal compromise of friction coefficient, energy and thermal capacity, as well as wear resistance for each application. Its two new grades of paper friction material, N701 and N822, will give OEMs the ability to push the limits of their design packages, and will also offer greater overall value.

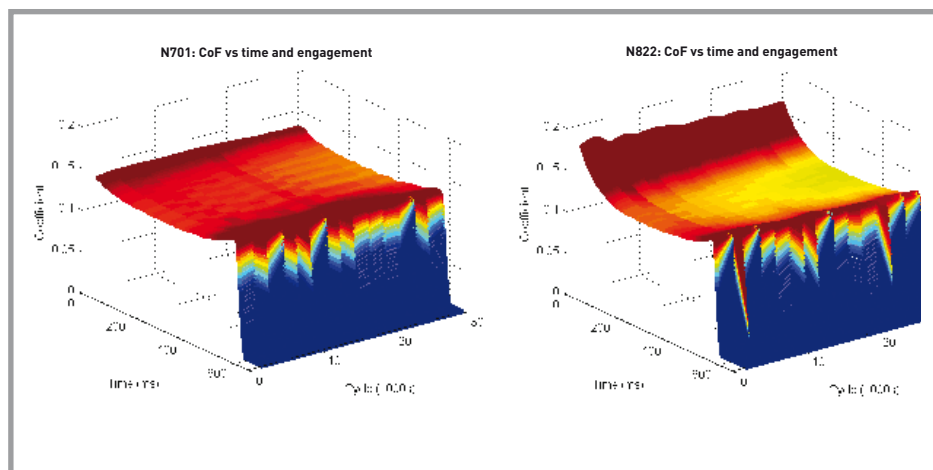
The heavy-duty off-highway industry has always been focused on using materials that are abuse-resistant. However, Tier 4 emissions regulations and the demand for improved fuel efficiencies are challenging off-highway equipment engineers to seek out compact and efficient designs of brakes and transmissions with minimal cost impact.

"At Carlisle, we prove every day that we are up to the challenge of developing next-generation materials whose quality, efficiency and cost-effectiveness meet and exceed all expectations," notes Dave Anderson, vice president of research and development at Carlisle Brake & Friction.

Friction material performance can influence the final design of a transmission, the final size of which is typically determined by torque output and energy capacity or abuse tolerance. Torque output is the product of a material's friction coefficient, clamping force, diameter and number of plates. Materials that provide higher coefficient and greater pressure capability enable designers to either reduce diameters or plates needed.

The other constraint is the thermal management of abusive events. Materials that are more abuse-tolerant provide designers with the ability to reduce plate thicknesses and oil flow without fear of distortion or thermal decomposition. Materials also play a large role in determining the overall value package of the transmission – their properties in typical operating conditions determine the part's life.

Carlisle understands the impact that lost time, repair and replacement costs have on its customers, and therefore places a great emphasis on providing the longest-lasting materials that can consistently survive the toughest conditions. In addition, off-highway OEMs, like their automotive counterparts, are demanding improved engagement quality to



ABOVE: Specifications of Carlisle's new N701 and N822 friction materials (compare with the benchmark standards available on ivtinternational.com)

ensure smooth shifts. Although shift quality is a system issue, the material choice can often solve problems without requiring costly system redesigns, software upgrades and other countermeasures.

New offerings

Carlisle has completed its multiyear development programme to further improve upon on its existing premium transmission materials with two new offerings. N701 has been developed for heavy-duty transmission applications that require improved coefficient, energy capacity and engagement quality, and N822 was optimised to increase wear resistance and provide the highest pressure capability. Depending on the individual application, one of these two materials will provide many OEMs with greater design flexibility and better overall value than previous offerings on the market.

"We strive to bring the latest in friction technology to the marketplace and work closely with our customers' design teams to help garner overall success in these transmission systems," explains the company's president, Matt Dietrich. By intimately understanding a friction material's properties, while fully utilising a premium material's capabilities, transmission designers are given greater flexibility to optimise performance and space, lower product costs

and provide greater overall value to the end user. "We are very excited about these new offerings, and we are confident that our customers around the globe will benefit from these new innovations."

Carlisle Brake & Friction is a solutions provider of high-performance and severe-duty brake, clutch and transmission applications to OEM and aftermarket customers in the mining, construction, military, agricultural, motorsports, industrial and aerospace markets. The strength of Carlisle's brands, including Wellman Products Group, Carlisle Industrial Brake & Friction, Hawk Performance, Cragar, Black Rock, Japan Power Brake, VelveTouch and Field Pro, gives its customers access to a diverse range of some of the most highly engineered braking, friction, clutch and transmission products available to the market today.

With 11 manufacturing facilities globally located in the USA, the UK, Italy, China, India and Japan, and with more than 2,000 employees, the company serves more than 100 leading OE manufacturers in 50 countries, making Carlisle the right choice for your new brake or friction design. **ivt**

Brian Baddorf is NVH engineer; Vinod Vemparala is market segment director; and Megan Astman is marketing communications specialist at Carlisle Brake and Friction



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- Comatrol's 260 bar (3770 psi) valve offers repeatable proportional control while reducing vehicle cost and weight - an excellent alternative to higher priced directional control valves.

**PSV12-34—A Lighter Alternative for
Proportional Directional Control**

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RESPONSIVENESS IN MOTION

MEMBER OF THE SAUER-DANFOSS GROUP



CETOP D05 (NG10)



NEW! PSV12-34

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Proportional valves with slip-on coil

It is the high power density, the customer-friendly operation, the robustness as well as the ease of maintenance, which characterise the mobile hydraulics. These characteristics are also demanded of the hydraulic components, which are utilised in the applications in the mobile sector.

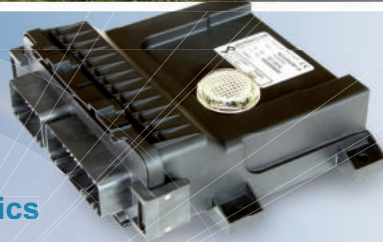
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Requirements

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- ◆ Compactness
- ◆ High reliability
- ◆ Long service life

**Valves
with integrated
electronics**



Wandfluh AG, Helkenstrasse 13, 3714 Frutigen, Switzerland, www.wandfluh.com

Flow-motion replay

ADVANCED HYDRAULIC SYSTEMS EASILY COPE WITH CHANGING CONDITIONS – BUT ARE EXPENSIVE. SO ONE COMPANY WENT BACK TO BASICS, DEVELOPING A LOW-COST RANGE OF FLOW CONTROL VALVES FOR HIGHER PERFORMANCE

▶ When industrial vehicles are designed today, the focus is not only on optimising operator safety and minimising the carbon footprint, but to do so while optimising machine performance and output reliability. This has led to more focus on the efficiency of the hydraulic components used when designing machines. Not only should a machine perform at its designed level when new, but also over its expected lifetime – while still being an affordable purchase.

Output per machine unit is measured in tonnes of material moved from one point to another over a period of time. Equipment buyers will certainly hold their machine suppliers responsible for any output promises made at the point of sale, regardless of whether the conditions of use, such as variances in material composition or weight, change. This is why it is necessary to use components that will compensate for these variations and still remain economical.

In applications where cost is not as relevant and a machine requires advanced performance using load-sensing valves, CPUs and pumps, the Nimco CV 2000 system with the EasyProg electronic control system can be used. However, in less sophisticated systems, this has to be solved in a simpler and more affordable way, with components that are able to offer high performance at lower cost while operating in simple, less advanced systems.

A simple solution

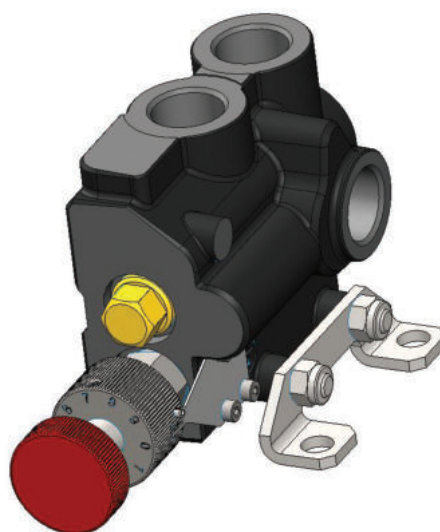
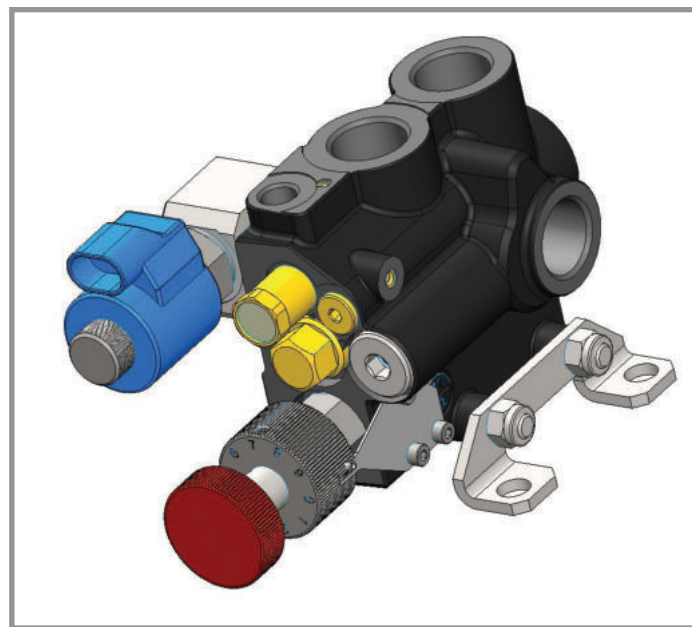
This is why Nimco AB of Malmö, Sweden, has designed the PFCV series, a new range of robust pressure-compensated flow-control valves. The PFCV series models can be used either as a single valve or in multiple units that are assembled together as one block for multiple function usage.

The PFCV will, in its most basic version, regulate the pump flow to a motor or cylinder at a preset speed, regardless of the weight of the load, and divert the remaining oil flow back to the tank. If a number of PFCVs are stacked together as one block or in series, they will divert both the regulated and bypassed flow into a second or third valve circuit. This flow can be reused to run subsequent functions. The pressure-compensated feature allows set speeds to be maintained at all times.

Another useful feature integrated in the PFCV body as standard is a check valve incorporated between the

RIGHT: PFCV with electrical unloading pressure control and anti-cavitation check valve

BELOW: PFCV basic valve



regulated priority flow line and the bypass line. This check valve will protect a motor against cavitation, when the flow is suddenly reduced or cut off.

A further option is an integrated relief valve to set the maximum pressure available to the motor or motors when the PFCV is connected in series. This will function as a torque limiter on the regulated circuit functions. With its linear pressure curve, the specially designed PPRV relief valve allows for optimal usage of the motors up to its set levels.

When the PFCVs are connected in parallel, there is also the option to integrate a pressure limiter valve in each section. This will allow each motor to operate at its preset pressure level regardless of the other motors' pressure settings.

When the requirement is to activate or deactivate the regulated flow, it is possible to equip the PFCVs with either a 12V DC or 24V DC solenoid valve, which can be integrated in any electrical control system or used as a safety feature. **IVT**

Sofia Inestam is marketing co-ordinator at Nimco AB

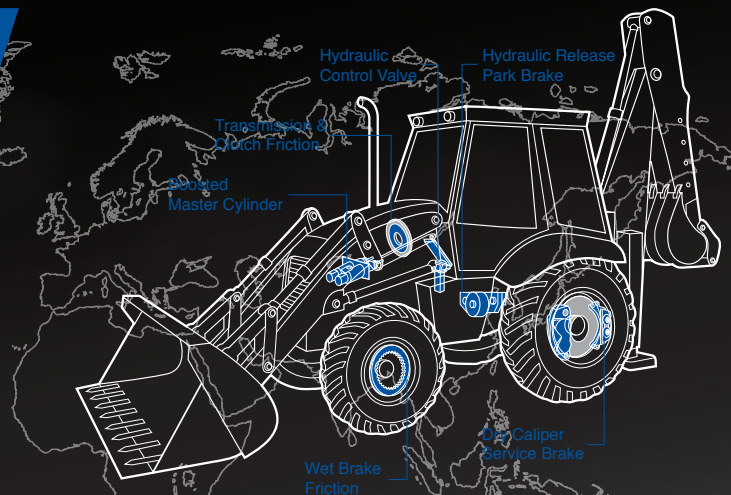


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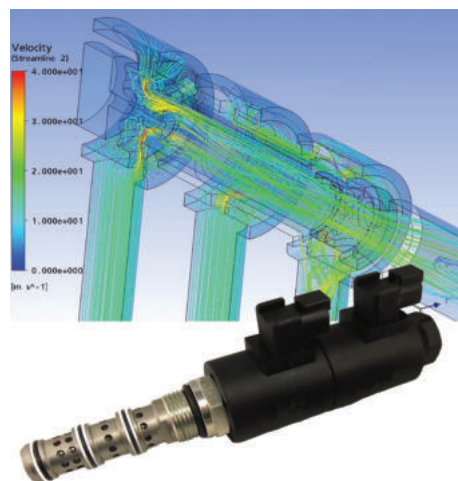
CONTINUING IMPROVEMENTS IN THE USE OF COMPUTATIONAL FLUID DYNAMICS ARE OPTIMISING THE PERFORMANCE OF CARTRIDGE VALVES, GREATLY SPEEDING UP THE TIME TO MARKET OF NEW DESIGNS

Having released one product family per month since April 2012, Comatrol is rapidly positioning itself as a leader in the cartridge valve and hydraulic integrated circuit (HIC) industry. A key driver behind the company's new cartridge development is the use of computational fluid dynamic (CFD) software, used to optimise performance by maximising valve power density while increasing the speed to market.

"The latest in CFD technologies, coupled with the experience of our engineering team, means that we can simulate and optimise the product performance before hardware is made," says Enzo Soncini, product development leader (Italy). "These advances let us do more with less, giving much better flow capability than from a cartridge valve designed 15 years ago. For example, we've launched 25 new proportional flow controls with 46 flow options, and optimised the PSV12-34, a size 12 proportional directional valve with market-leading flow capability of 60 l/min."

Going with the flow

Comatrol's latest product offerings demonstrate an ongoing commitment to proportional flow control technology by addressing the industry trend towards more precise and repeatable control of cylinder and motor speed. Using CFD, the company recently expanded its proportional flow control line to provide the largest and most complete product family in the industry. This vast product range includes size 08, 10,



12 and 16 cavities, poppet-style for low leakage, restrictive or priority design, and compensated or non-compensated. These options enable customers to select the optimum valve to match their vehicle performance expectations for cylinder and motor speed control, with flows up to 110 l/min and pressures up to 260 bar.

"Comatrol sees tremendous opportunities for the off-highway vehicle market segment to benefit from the cost- and space-saving benefits of our proportional valve portfolio," says Kristian Lernmark, regional account manager (EU). "Customers are no longer required to over-design their systems with more sophisticated control; instead finding that balance with proportional cartridge valves that meet their requirements. By using proportional flow control cartridge valves, each function can have exactly the characteristics it needs."

Recognising the latest market need for precision hydraulic controls with a focus on customisation and flexibility, Comatrol has now shifted its focus to proportional directional valves for flow control of cylinders and motors in both directions, using a single valve. Building on the popular PSV10-34 cartridge design, the new PSV12-34 offers higher flow capabilities for controlling the speed and direction of larger cylinders and motors. This family of proportional

ABOVE: One of the largest product families of proportional flow controls in the market

LEFT: The new PSV12-34 was optimised using CFD to provide market-leading flow capacity of 60 l/min for a size 12 cartridge

directional valves now includes size 10 and 12 cavities in both closed-centre and float-centre schematics, with flows ranging from 3 l/min to a market-leading 60 l/min, and pressures up to 260 bar.

"We developed the new valves as a cost-effective option between on/off solenoid valves and higher-end proportional sectional valves and CETOP valves," says Dave Duvall, general manager. "This offers customers a good alternative to the higher-priced directional valves on the market. Comatrol's cartridge products give a machine designer more flexibility, a smaller space claim, lighter weight and reduced power consumption than is offered by other proportional directional technologies."

The company plans to continue its rhythm of innovation with a steady flow of product releases in 2012 and beyond, enabling customers to benefit from its commitment to product development. **IVT**

Darren Magner is director of marketing and product development at Comatrol



CONTACT

www.comatrol.com
marketing@comatrol.com

Lighten the overload

OBSTACLES IN THE DEVELOPMENT OF POWER SYSTEMS FOR INDUSTRIAL VEHICLE PLATFORMS CAN BE OVERCOME WITH A NEW SOLID-STATE POWER CONTROLLER THAT CAN BE USED IN CONJUNCTION WITH EXISTING DEVICES

▶ The design and distribution of power systems for many modern industrial vehicle platforms encounters a number of challenges. Some of these involve reducing the equipment downtime, wiring complexity, the operator's workload and overall vehicle weight. Other important challenges include power system prognostics, diagnostics, power management and load status awareness.

Now, Carling Technologies has addressed these challenges head-on with the development of the CAN communication SAE J1939 Solid-State Power Controller (SSPC). In addition to the basic on/off power-switching function, the Carling SSPC provides accurate current measurement for each load, low-loss solid-state switching, fast response, short-circuit protected outputs, and implementation of the I²t overload protection technique.

Relative to electromechanical breakers and relays, SSPCs can increase thermal efficiency by providing lower power dissipation and better fuel efficiency by providing higher power-to-weight densities.

By means of bus or network connectivity, SSPCs provide real-time feedback to vehicle systems. Reported data from these controllers can be used for system-level diagnostics and prognostics, enabling predictive or condition-based maintenance, thereby reducing operating cost through reduced equipment downtime and advanced determinations of pending failures of various loads.



ABOVE: The Solid-State Power Controller improves efficiency of distributed power systems

RIGHT: The Multiplex Rocker module (VOCM) provides the look and feel of traditional electromechanical switches with the connection benefits of a multiplexed module



The benefits

The Carling SSPC provides a number of functional and performance advantages over traditional types of electromechanical circuit breakers and relays. Relays and breakers are subject to arcing, oxidation, erosion, welding and mechanical failure. So in relation to electromechanical switching, SSPCs provide an order of magnitude improvement in reliability, thereby greatly reducing vehicle downtime.

SSPCs are processor-based, providing advantages in flexibility, measurement and bus connectivity (such as CAN) to external systems. Other features include the ability to both program different values for the SSPC channels' rated currents to accommodate varying loads, and parallel SSPC output channels to

enable higher current capacities. To better support prognostics, diagnostics, health monitoring and fault detection, various parameters for each output channel are accessible on the network. These include on/off, overload and output voltage and current.

Each SSPC channel includes two MOSFETs, current and voltage measurement, and protection circuits. SSPCs use PWM to control their output voltage rise and fall times, thereby minimising electromagnetic interference (EMI) emissions and reducing inrush current into inductive loads. **ivt**

Simon Cordner is vice president of Electronic Technology at Carling Technologies



Customer-specific keypads are available with multiple functions, utilising a single connector to the CANbus



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- Protection class IP67 / IP69K

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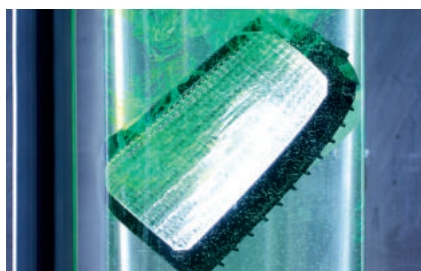
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BULLETIN BOARD

COMPACT WORKLAMP MAKES LIGHT OF TOUGH CONDITIONS

With the Power Beam 3000 LED, Hella presents a worklamp capable of exceeding the light output values of Xenon models. While the latter achieve about 2,700 lumen measured light output, the Power Beam 3000 offers 3,000 lumen with a power consumption of just 43W. The 5,700°K colour temperature of the high-power LEDs will give a visual impression of a 20% increase in improved light output (Xenon's is approximately 4,200°K). The Power Beam 3000 also boasts a much more compact size than Xenon worklamps.

All Hella lights are tested during development and manufacturing to meet the highest quality demands. In temperature cycle tests, they are exposed to fluctuations from -40° to +90°C in climatic exposure test cabinets; in vibration tests, this varies between -30° and 80°C, while the lights are shaken for several hours at forces of 9.6g.



The worklights are also fully tested under real environmental conditions in universal spray booths equipped with devices for rain, flood water, water jets and spray mist. They are tested for leaks at a pressure of up to 5 bar in the dripping and spray water test and at a pressure of up to 10 bar in the water jet test. They are also tested at up to 100 bar and a water temperature of 80°C, reproducing

the conditions of a carwash or a pressure washer. All LED worklights must pass an immersion and pressure leak test, where they are submerged in water for 30 minutes in an immersion pipe at a depth of 1m. There must be no ingress of water.

The dust protection test measures the degree to which a headlight is protected against the ingress of solid foreign particles. The tough environmental conditions of the road are simulated with a salt spray mist that swirls around the worklight for up to 700 hours to test resistance to corrosion.

More information can be downloaded from: www.ivtinternational.com

ENQUIRY No. 501

Hella
www.hella.com/agro
hfasales@hfa.at
 +43 1606 8920



Hall 20 Stand D/54

A LEADING LIGHT IN LED



LED lights are now beginning to replace both halogen and Xenon lights due to their superb light quality, long burn-life and robust design. The TYRI Group is one of the pioneers in this field and supplies more than 200,000 LED lights each year to major OEMs of equipment used in mining, forestry, construction and materials handling.

Up until now, most LED lights have been designed to look like conventional lights and perform the same way – but LED offers so many new opportunities.

Most LED lights will give a colour temperature somewhere between 5,000K and 6,000K, but TYRI also offers models with 3,000K and 4000K when that offers a more suitable option for the work environment.

As the individual LED is tiny, lights can be offered in many shapes and sizes – even down to 30mm wide. LED lights will be increasingly integrated in the cab designs of the future, using parts of the cab structure to dissipate heat.

TYRI also offers lights with a dimmer to adjust the intensity (and power consumption) in snowy/dusty conditions, or when people are close to the machine, for example. This can be built in to the machine's operating system and make the light intensity follow the operating pattern of the vehicle.

ENQUIRY No. 502

TYRI
www.tyri.se
martin.karlberg@kle.se
 +46 31 659330

MODULAR CONTAINER CAN BE MADE TO MEASURE

Customer-specific container solutions are now increasingly demanded for individual needs. The latest innovation from KML Miller is the contiflex container system, a multifunction container with a complete modular construction, for which the customer determines the required dimensions and equipment.

To achieve this variety cheaply and economically, KML Miller has stipulated a grid that is the basis for the construction. This is the only restriction on the external dimensions. Besides the simple wall modules – without any further functions – special modules have been developed according to the requirements for doors, windows, other glass parts, emergency exit, and connections for HVAC units.

The external construction (roof, ground, side surfaces, framework) is subdivided into interchangeable segments that are equal in shape. The basic dimension is made by newly developed multifunctional transverse frames and longitudinal bars/struts; necessary because the common welded skeleton construction is not compatible with the modular principle of



the containers. For the modular construction it is necessary that the framework and struts are constructed in this way so that the complete segments can be connected and be replaced.

The company now offers a web-based configurator for the contiflex to enable customers to individually configure products, whether an operator cabin, control station, or container.

The contiflex configurator includes all measurements, as well as equipment components, construction siding/exterior trim (glass, closed 100%, 50% glass + 50% closed), roof construction, interior trim, air-conditioning unit and control stations.

ENQUIRY No. 503

KML Miller
www.kml-contiflex.de
info@kml-miller.de
 +49 7821 94760

SUPERIOR SCREEN NAVIGATION

The CAN-Communicator (C-Com) 2G from Ametek VIS is a rugged, versatile 2in graphic display gauge with a multitude of possibilities for applications. C-Com 2G features a 106x56 pixel graphic display and a three-button interface with tactile feedback to navigate the set of standard screens provided by Ametek or the custom screens created for a particular application, including proprietary applications.

The CAN J1939 databus and analogue input provide maximum flexibility to display any vehicle data, as well as the switch-to-ground 500mA output to control an external annunciator, relay or other device. The gauge also features a dual-colour (amber or red) dead-fronted warning indicator positioned above the display.

Current applications include DEF level, DPF gauge, general engine and transmission data monitor, battery charge monitor, fuel economy display, and hourmeter. The gauge can also be used to interact with other vehicle systems and can broadcast data out on J1939 CAN, such as odometer and hourmeter information it has stored. The low-power mode allows users to have the ignition off and wake the gauge with the press of a button to view data without risking draining the battery.

One of Ametek's customers, Forster Instruments, based in Mississauga, Canada, uses C-Com 2G in



various transit bus manufacturing applications. The gauge is used as a diagnostic tool in the engine compartment for mechanics, a vehicle testing tool as an alternative to expensive test equipment, and to display vehicle parameters. Forster Instruments prefers C-Com 2G due to its versatile design and capabilities.

ENQUIRY No. 504

Ametek VIS
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Bauser's wide range of instrument clusters is available in many casing sizes and custom front fascias, guaranteeing a custom design of standard units tailored to the OEM's requirements. Designed to withstand tough environmental requirements and undergoing special hardware treatments and production procedures, the instruments are resistant to severe shocks and vibrations, extreme variations in temperature and extreme applications.

The IP67 front protection provides resistance to high-pressure cleaning and salt spray and, on request, the rear can be resistant up to IP65 via a super-seal-connector. Extensive certifications, endurance test approvals and environment tests have been successfully passed.

ENQUIRY No. 505

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

AVOIDING THE AIR-CONDITIONING SNOWBALL EFFECT

From the outside, an air-conditioning system may look simple, each one built with similar components. But on closer inspection, every single component plays its own role in the refrigerant circuit: even a minor change to one parameter will create a snowball effect, influencing the overall cooling performance and, last but not least, reliability and longevity.

Installing an oversized evaporator that means the compressor cannot deliver the refrigerant flow is rather like a truck with a car engine pulling a heavy load uphill – a condenser not capable of coping with the heat rejection absorbed in the refrigerant circuit (compressor and evaporation) will reduce the efficiency. Even hoses being different between one vehicle and the next will influence the final system performance.

To enhance compressor lifetime, it is important to watch the running conditions, especially in extreme environments. The system AC performance – the answer to the customers' expectation in lowering the cab temperature in a given timescale – can be evaluated with the assistance of HVAC Standards (ISO 14269, ISO 10263). One

thing to ensure is that the cab heat being transferred into the evaporator by airflow can be handled by the refrigerant flow.

SNDC is able to predict the compressor cooling performance through the use of its sophisticated software. In combination with the heat-load and coil determination, it can produce a graph that indicates whether the system will meet or exceed the expectation and warnings about excessive pressures or temperature.

The ultimate aim is a smooth-running compressor for trouble-free operation and reduced costs. With great confidence, it can then go to the final check-up in the climate chamber where the software outcome is compared with real figures.

Before signing off, more tests are then performed, covering charge determination, oil level, air distribution, cab pressurisation, ATC behaviour, condenser water issues and noise levels.

ENQUIRY No. 506

SNDC
www.sndc.net
sales@sndc.net
+33 534 480480



From the publishers of Industrial Vehicle Technology International magazine

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WM-580 JOYSTICK OFFERS CLEAN-SHEET SOLUTION

Williams Controls has applied the same design expertise to heavy-duty joysticks that has made it a leader in accelerator pedal and vehicle controls for more than 75 years. Designed from the base up as a clean-sheet solution to today's mobile vehicle demands, the WM-580 joystick is the end result of countless hours of operator use analysis, endurance testing and ergonomic studies.

In developing this joystick family, Williams worked directly with equipment operators on product designs under the supervision of a kinesiologist. The resulting mechanical

kinematics became the foundation for a grip designed to minimise both user fatigue and repetitive stress risk and to maximise comfort.

With more than 50 variations of the WM-580 currently on the shelf, there is sure to be an intuitive grip and control button configuration to meet any user's needs. Current options include Hall-effect thumbwheels; right- or left-hand grip orientations; up to six control buttons in multiple-button panel layouts; and separate trigger switches.

A fully potted circuit board provides trouble-free performance in high-moisture environments, as well as superior resistance to shock, vibration and chemical exposure. Water-tight electronics encapsulated to IP67 and best-in-class lifecycle ratings mean less equipment downtime when machines are working in isolated locations and every minute of run-time counts.

The WM-580 is just one of a full range of joystick solutions Williams Controls can offer.

ENQUIRY No. 507
Williams Controls
www.wmco.com
info@wmco.com
+1 503 684 8600



MULTI-USE JHT JOYSTICK PACKED WITH FEATURES



Boasting numerous applications, the Z-Axis version of Otto's JHT joystick is ideal for construction equipment, hydraulic controls, industrial vehicle controls, medical and surgery equipment, remote controlled applications and surveillance video cameras.

The Z-Axis version allows for a 60° rotational movement of the knob at the top of the joystick, and also accommodates push-button switch(es) along the top. Options include detent, friction hold, or spring return to centre.

The JHT joystick has been tested to five million cycles in all directions with no degradation of performance. Various gating

options are also available. The JHT Z-Axis electronics are sealed to IP68S and are able to withstand EMI/RFI per SAE J1113 specifications, with the exception of the push-button feature, which is watertight per IP65.

Its compact design is the ideal solution where space is limited and precision control is highly desired. The robust construction is particularly suited for use in demanding applications.

Features include:

- Contactless analogue output Hall-effect technology;
- 5 million operational cycles in all directions;
- Electronics sealed per IP68S;
- Optional push-button switch(es) available (watertight per IP65);
- Operating temperature range of -40° to +85°C;
- Travel angle 20° typical, 18° minimum to 22° maximum;
- Overtravel angle 1° typical, 0.5° minimum to 1.5° maximum;
- RoHS/WEEE/REACH-compliant.

ENQUIRY No. 508
Otto
www.ottoexcellence.com
info@ottoexcellence.com
+1 847 428 7171

COLOUR DISPLAY UNIT OFFERS USER-FRIENDLY SYSTEM

To program any system, a graphical user interface (GUI) with 'drag and drop' of both a multitude of standard modules and any custom-made macros is used, making the software design very user-friendly. Modules are also easier to manage as they can be updated without needing to change the lower-level firmware, thereby enabling rapid system build.

A new colour display unit from David Brown Hydraulics, and a completely reworked and extended Display Designer complement each other through higher resolution, improved colour schemes, and customisable graphical objects. It also has multi-language support.

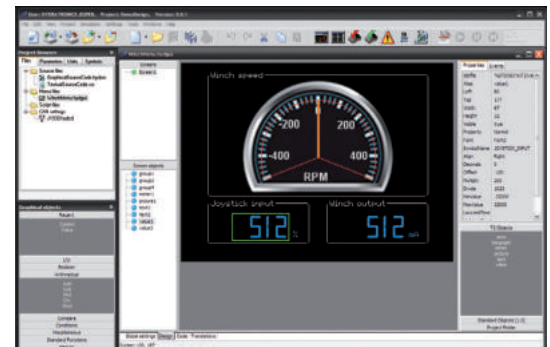
Aluminium protection shells cater for maximum durability, with the use of a Gore-Tex membrane providing the highest humidity protection.

Generous overload margin power transistors handle any application current spike extremes. A dedicated error-logging memory records system events, simplifying system diagnosis, fault-finding and even potential machine enhancements.

The display's in-built 'watchdog' timer secures the processor functionality and overall machine safety.

Dual-return springs in the company's new electronic pedal controls provide both driving comfort and a redundant, failsafe system to reset the pedal position. The interface includes alternatively:

- One or two analogue signals or PWM signals;
- One analogue voltage signal plus switch;
- One analogue voltage signal plus two switch signals: 'idle' and 'run';
- Kick-down function.



ENQUIRY No. 509
David Brown Hydraulic Systems
www.davidbrownhydraulics.com
info@dbhsL.com
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international
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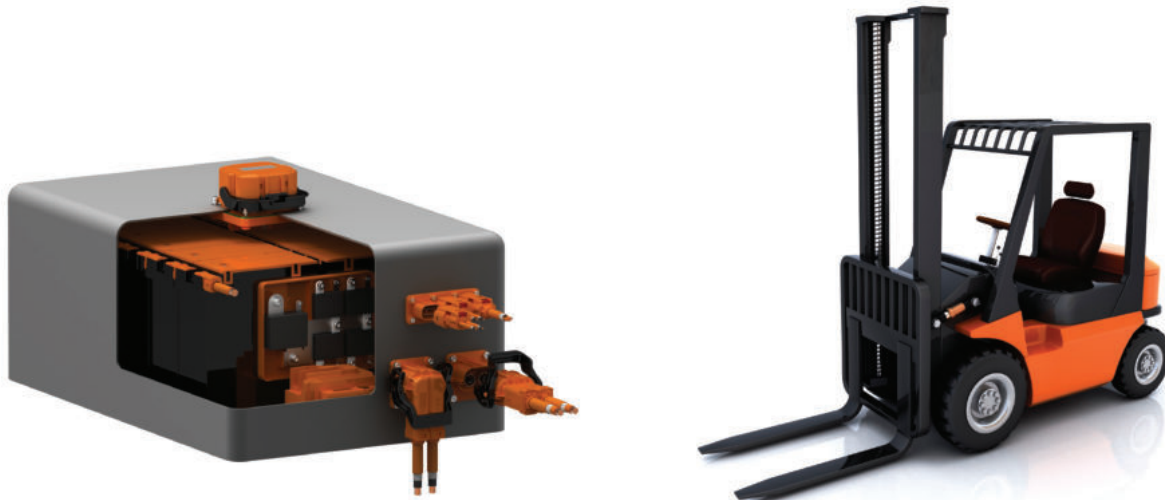


Image courtesy of TE Connectivity

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BIG IN BOLOGNA

OEMs from 40 countries, visitors from 140 nations, and a 137,000m² exhibition area are impressive credentials for EIMA (International Exposition of Agricultural Mechanisation), held from 7-11 November in Italy.

The show is preparing for a record edition. The great biennial of mechanisation for agriculture, gardening, greenskeeping and components will require 117,000m² indoors and 20,000m² outdoors for trials of equipment. Overall, the exhibition's 137,000m² will be the world's largest in the sector to mark the highest achievement in the history of the event.

This expansion was required in part due to the return to the fold of the greenskeeping and gardening sector, with the specialised EIMA Green Salon flanking three other themed salons: EIMA Components, EIMA Energy and EIMA M.i.A (multifunctional agriculture).

► **ENQUIRY No. 510**

EIMA
www.eima.it
eima@unacoma.it
+39 06 432981

CORN HEADER TRANSMISSION ON A ROLL

For more than 20 years, Comer Industries has been a partner of the leading manufacturers of corn headers in the global agriculture market. The transmission for corn headers consists of modular elements that are repeated according to the number of rows in the machines, with eight or 10 rows being typical of the European market, up to a maximum of 18 rows for the emerging South American markets.

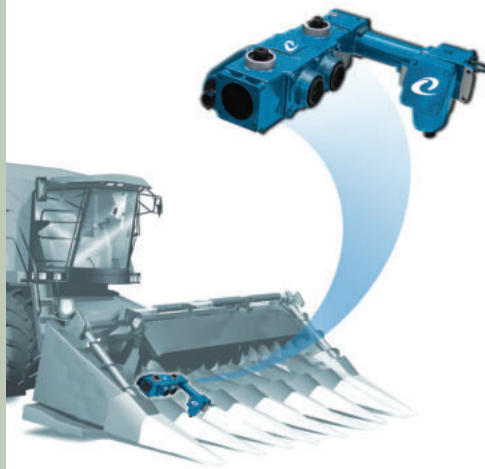
Over the years, the gradual evolution of this kind of transmission has enabled continuous improvements in the efficiency of cutting and harvesting of the corn header. The transmission module enables the rotation

of all the machine parts: the stalk rolls that have the function to remove the cob from the stem, the chains that convey the material towards the auger, and the cutting blade that cuts off the stem to the base.

Comer Industries offers different solutions with features targeted to specific requests from the final manufacturer of the corn header, from a robust and simple solution in ductile cast iron, to a compact and lightweight aluminium version for folding machines. The alloy version is verified both by finite element calculations and crash tests performed in Comer Industries' Mechatronics Research Center.

Several solutions are based on the needs and philosophies of the corn header manufacturers, from the monolithic solution with cutter device integrated, to the transmission box or separate cutter system. The cutter system can also be equipped with an on/off manual switching device.

All Comer Industries modules have an internal device to protect the transmission from accidental impacts. Technical and manufacturing know-how, production capacity for innovation, and service to the customer are Comer Industries' areas of expertise for this type of application.



► **ENQUIRY No. 511**

Comer Industries
www.comerindustries.com
sales@comerindustries.com
+39 0522 974111



Hall 20 Stand B/9

JOINT EFFORT ACHIEVES POWER THROUGH EFFICIENCY

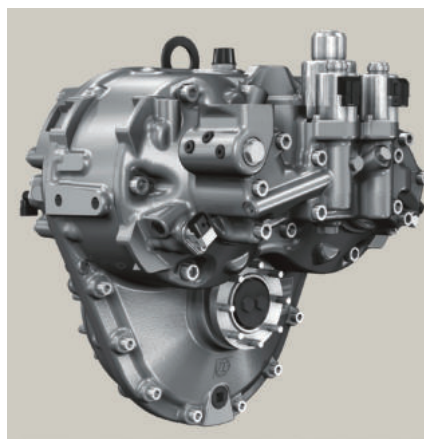
Power through efficiency is SAI's motto – and it is one that has not been chosen lightly. The phrase sums up perfectly the fruitful relationship that has been forged between SAI and ZF Passau, the German specialist for off-highway driveline technology and axle systems.

Their first transmission was displayed in 2007 during the Bauma exhibition in Munich, following years of joint development work. The individuals involved in this prestigious collaboration, from both companies, have worked very hard over the intervening period to validate the project to its current position.

After a comprehensive development period for this highly sophisticated and new driveline, the transmission has successfully been in production since 2010.

The new 2 HC 85 ZF transmission system is powered by two integrated variable-displacement radial piston hydraulic motors from SAI. The resultant package is perfectly matched to the requirements of today's market, in that it achieves higher efficiency and improved noise characteristics.

The advanced design features of the SAI motors used in this project help achieve the



highest levels of energy efficiency. ZF has accepted the challenge of changing the thinking of the transmission market, usually dominated by axial piston motors, by investing in the radial piston crankshaft design of the SAI motors.

The continuously variable transmission of ZF, which employs two completely integrated motors, offers high speed, high volumetric and mechanical efficiencies, reduced power losses, better fuel

consumption, reduced vibration and lower noise emissions. Moreover, the compact shape of the hydrostatic drive transmission means that it is extremely adaptable to almost any vehicle design.

Because it can achieve speeds in excess of 42km/h, the ZF system is claimed to be the fastest compact loader transmission manufactured today, and is capable of supporting a load of about 10 tonnes. In addition to the superb high-speed characteristics, the utilisation of the SAI radial piston design gives remarkably efficient and accurate controllability, even when running down to creep speeds.

It is this feature of the SAI radial piston design hydraulic motor that makes the ZF transmission the most versatile hydraulic motor available in today's off-highway market.

All of this means that the project has achieved its primary goal by supplying cleaner, faster, cheaper energy efficiency – otherwise known as 'green energy'.

► **ENQUIRY No. 512**

SAI
www.saispa.com
saispa@saispa.com
+39 059 420111



Hall 18 Stand B/36



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BALL-AND-RAMP BRAKES THAT WON'T LET YOU DOWN

Modern farmers have to be sharp business managers too. One thing that they simply can't afford to happen is a machine breakdown. When it comes to brakes, major OEMs such as Fendt have long since learned to place their trust in Knott's proven ball-and-ramp wet-disc brakes.

"This wet-running, multidisc brake integrates many of the features indispensable in agricultural machinery," explains Stephan Raab, sales and application manager at Knott. This is why the ball-and-ramp brake is configured as a sealed, closed system, which means it is insensitive to dirt. And where no spanners are thrown into the works in the guise of grit and dirt, maintenance will not be an issue. "To put it bluntly, unless a brake is deliberately overloaded, it will last at least as long as the machine in which it is mounted," Raab continues.

Whether hydraulic, mechanical, pneumatic or a combination, the ball-and-ramp brake lends

itself with ease to any application. At the same time, it achieves something that ring piston brakes never can due to their design: a unique multiservo effect that provides a braking force greater than that attained using any other system. All featuring optimum, reliable and repeatable deceleration in the shape of a combined service and parking brake.

But how do you overcome the issue of overheating in ever-faster agricultural machines? Raab has a confident answer: "We not only have a range of premium dry disc fixed caliper brakes to offer, but also a slogan you can take literally: 'We make your brake'."

ENQUIRY No. 513

Knott
www.knott.de
info@knott.de
+49 8056 9060



Hall 20 Stand C65



SPACE-SAVING SOLUTION

Marzocchi Pompe has introduced a new family of short-stack multiple pumps. Divided into two groups (ALPC group with aluminium flanges and covers, and the GHPC group with cast-iron flanges and covers), this new family of pumps fits any application with a requirement for many pumps to be driven by just one motor, or where the space constraints do not allow the use of standard multiple modular pumps.

Short-stack multiple pumps are available in both groups with displacement from 1.4 to 35.2cc/rev.

Marzocchi short pumps can be supplied with two and three stages; they can also be supplied with different configuration of flanges, shafts, inlet and outlet ports. A common inlet version is also available with only one port feeding two or three elements. All the connections are made with internal splined joints which guarantee excellent torsional strength alongside outstanding compactness.

A careful design and the definition of optimal clearance between each element enables precise compensation of small misalignments between shafts

of different pumps, assuring the transmission of high torque.

Maximum operating pressure depends on pump displacement and type: this varies on average between 230 bar on aluminium models and 280 bar for the cast-iron versions.

For more information about combinations of size, possible configurations and relative working conditions, contact the technical and sales department using the details below.



Hall 20 Stand B/4

ENQUIRY No. 514

Marzocchi Pompe
www.marzochigroup.com
pompe@marzochigroup.com
+39 051 6137511



EFFICIENT AIR CON WILL CUT FUEL AND WEIGHT



New solutions from ContiTech Fluid Technology enhance the efficiency of air-con systems – while reducing refrigerant consumption and the weight of the unit. This goes easy not only on the environment but also on the driver's pocket: "Because ultimately, air-con systems play a significant role in overall fuel consumption," states Robert Wurm, head of ContiTech Fluid Technology's Industrial Hose Assembly segment.

The new Eco AC refrigerant circulation system obtains higher efficiency by optimising internal diameters of the air-con lines and minimising pressure losses. This offers enormous optimisation potential for vehicle air-con systems: from a performance upgrade and lower consumption, through to reduced pressure losses and enhanced design.

As a result, ContiTech has greatly reduced the volume of the overall system. Accordingly, less coolant has to flow through the narrower lines; in addition, the weight of the lines is cut by up to 30% or 500g per vehicle.

Merely using the inner heat exchanger recently developed by ContiTech boosts efficiency by roughly 5%. It uses a simple thermodynamic effect to cool down the refrigerant further without increasing the energy consumption. Alongside this in-line solution, the Conti Eco Compact XR also sports a tightly sized, low-cost heat exchanger alternative developed in-house at ContiTech.

ENQUIRY No. 515

ContiTech
www.contitech.de
achim.liecker@fluid.contitech.de
+49 3342 4257 026

MH AGRI SENSOR FOR IN-CYLINDER MEASUREMENT

MTS Sensor Technology is announcing the new Temposonics MH Agri sensor for in-cylinder measurement of the cylinder position. The MH Agri (identified by its green lid) targets large projects in the agricultural machine market and features the same technology as the standard MH, but has limited specification fitting right into the target market.

The main features are:

- 12V power supply;
- .25V-4.75V output;
- 10mm sensor rod;
- 50-1,000mm measuring range;
- 300 bar operating pressure, with 400 bar pressure spikes;
- 50g shock, 15g vibration rating;
- EMC tested to ISO 14982;
- MTS proprietary M12 connector system for IP69k when installed in-cylinder.



The MH Agri is designed to provide customers with a cost-effective solution for their position-sensing requirements. MTS Sensors accomplished this by optimising the electronics to the specific

features and requirements of the agricultural machine market. Using new production processes and automation enables it to manufacture this sensor in large quantities and, with that, reduce the cost even further.

Manufacturers of agricultural machines will now be able to replace rotary, potentiometric and angle sensors, as well as proximity sensors, with this highly reliable absolute, non-contact magnetostrictive technology that is protected inside the cylinder for a long lifecycle. It will considerably reduce warranty and service cost, as well as improving the overall reliability of an agricultural machine.

ENQUIRY No. 516
MTS Sensor Technologie
www.mtssensor.de
info@mtssensor.de
 +49 2351 95870

POWER PLAYER

With 80 years of experience, Perkins is expert at designing custom power solutions. Its latest flagship engine is the top of the range, twin-turbo, 1206F-E70TTA – a 7-litre, six-cylinder unit capable of producing 225kW (300hp).

With improved power density, it now gives off-highway OEMs who may previously have chosen a larger engine the choice of the same power from a smaller engine package.

The 1206F-E70TTA features twin turbochargers – one small, one large – mounted in series. The smaller, first-stage turbo accelerates quickly, giving excellent low-speed response and 1,280Nm of torque at 1,400rpm, while the larger second-stage provides the high airflow required to provide class-leading power density.

In developing its new range, Perkins minimised the space impact of the aftertreatment required to meet Tier 4 Final requirements, packaging the SCR system and DOC/DPF canister into one integrated module, which can be positioned remotely in a machine chassis or directly on top of the engine.



The lightweight yet compact dimensioned aftertreatment incorporates many features to ease installation. These include flexible inlet and outlet options, pre-installed electronics and diesel exhaust fluid (DEF) line hook-ups.

The DPF now uses passive regeneration, which is totally transparent to the operator, and is service-free, thereby reducing maintenance costs over the life of the machine.

ENQUIRY No. 517
Perkins
www.tier4air.com
 +44 1733 583000

RVD50-20P CARTRIDGE VALVE IS UP TO STANDARD

HydraForce has released a new hydraulic pressure-relief cartridge valve that meets the highest level of safety of the European Pressure Equipment Directive (PED) 97/23/EC – Category IV, Group 2.

The new RVD50-20P cartridge valve is CE-marked and intended for applications that must comply with PED 97/23/EC, such as hydraulic accumulator charging circuits for hydrostatic brakes or off-highway suspensions. It can handle operating pressures up to 385 bar (5,575psi) and flow rates up to 113 l/min (30 gal/min).

The direct-acting, poppet-type valve functions as a pressure-limiting device for hydraulic circuit protection. The poppet design was developed using computational fluid dynamics (CFD) to ensure fast response to pressure surges with minimal friction and low hysteresis.

The RVD50-20P has six spring ranges – 08, 15, 24, 32, 42 and 50 – to handle pressures ranging from 13.7 bar (200psi) up to 350 bar (5,075psi). The variety of springs enables the valve to effortlessly handle a wide range of application flows and pressures.



The RVD50-20P hydraulic cartridge valve comes with a tamperproof sealed housing that prevents field adjustments. Its proprietary plating is salt-spray-tested to 1,000 hours to guard against corrosion. This valve also carries the five-year HydraForce warranty.

HydraForce is a leading independent designer and manufacturer of hydraulic cartridge valves, manifolds and hydraulic integrated circuits for heavy-duty mobile and industrial equipment. Founded in 1985, the company is headquartered near Chicago, Illinois, USA, and has plants in Birmingham, UK, and near Shanghai, China.

For further information on the PED-certified valve, please visit www.tinyurl.com/9uleloz

ENQUIRY No. 518
HydraForce
www.hydraforce.com
HFMarketing@hydraforce.com
 +1 847 793 2300

JUST 17, YOU KNOW WHAT I MEAN



The recently released Spicer TZL16 powershift transmission is engineered to supply 17-tonne front-end loaders with higher-horsepower capability, reduced maintenance, and smoother, quieter operation.

With an expected rating of 150-180kW (200-245hp) and a 555mm drop, the Spicer TZL Series is a new four-speed transmission platform that uses proven internal components from the extensive line of Spicer powershift transmissions already available for the

off-highway market. It incorporates high-energy-capacity forward and reverse clutches, adaptive clutch modulation, and helical gears to deliver a robust transmission with improved shift quality.

This transmission also features two 400Nm (295 lb-ft) SAE 'C' pump drives with a variable pump ratio and wider, 240mm pump spacing, which enables OEMs to take advantage of optimum displacement system pumps and hydraulic plumbing.



ENQUIRY No. 519
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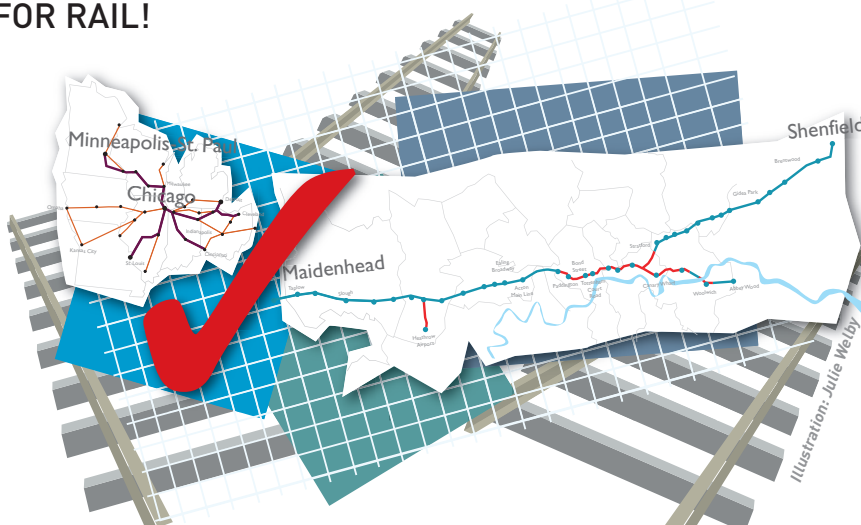
▷ As UK prime ministers go, Gordon Brown will probably not go down in history as one of the country's finest statesmen. Not just for his sartorial shortcomings and regular gaffes, but in no small part for his apparent naivety to the economic sharp practice of recent years that must surely have appeared scarcely creditable to someone who held the purse strings so tightly during the Blair premiership.

It is in some ways surprising, though, that his government shared the optimism of the current White House incumbent that infrastructure investment is one of the tools to breathe life back in to the flagging economies of the west. Perversely, their projects hark back to earlier days in the development of industry as both have opted for projects of railway expansion.

Mr Obama staked his reputation on not only reviving the concept of rail travel, but in building the first real high-speed links to places such as Minneapolis and Chicago (there is the possibility of linking all down the east coast and on to Houston). Unfortunately, the route will share track with current systems, so the average speed will be way down on world standards but, even so, any modernisation of the ostensibly neglected US rail system should be welcomed with open arms.

What will actually be a fairly modest project in US terms is huge by most standards and, although the UK project seems slightly more modest at a mere 78 miles of track, Gordon's friends thought it would be a jolly spiffing idea to lay the said 78-mile line from the town of Reading, which is way out west of London, through to a terminus in the far east of London in a small suburb called Shenfield. That nice Mr Cameron and his sidekick (what is his name again?), have done nothing to 'derail' this idea since taking office.

But while Barack's dream will cut a swath through open and mainly virgin territory, the British lads will be tunnelling under a 2,000-year-old



city that houses some of the world's most expensive real estate, passing under the River Thames twice.

Both projects seem to score on the achievement front, however, and even as the USA is still working out the routes to develop, the Brits have already started tunnelling.

Now, you may point out that the Brits have been doing this for over 100 years as their first underground railway system ran on steam trains, but even so, the Crossrail project will be demanding both in terms of logistics and expertise. Last month, according to one of the managing engineers of the project, one of the moles was already in position a mile below the surface.

Despite the differences in these projects, they both have a sound base as an economic tool, and the ensuing works will call for a huge number of man hours, copious amounts of materials and, of course, tunnelling or construction equipment.

Both countries are well endowed with all three of these necessary elements (or at least they should be): with unemployment running at more than 8% on either side of the Atlantic there must be plenty of labour around; the USA is sitting on a stagnating pile of construction materials, so that should not be too much of a problem either; and the UK's links with its European partners means it has easy access to any of the missing requisites.

I am not quite sure exactly how much tunnelling and construction equipment will be needed but – trust

me – it will be a lot. Most of it may well already have been ordered.

Commitments like this are long term; the UK project alone will not reach completion until 2020, and then only at the commissioning stage. So it will continue to generate demand for machinery far into the second decade of this century, like the high-speed rail projects in the USA – and, almost inevitably, will go over budget, encounter problems, and be criticised by successive governments, etc.

But no doubt it will also continue to generate enormous development opportunities for the construction equipment industry and is a tangible goal that visionaries can use to stimulate growth in technological advancement and engineering. Whether our universities recognise it or not, projects like this are so much more stimulating to our job markets and our up-and-coming generations than the 'soft options' which are frequently peddled to undergraduates. It is also a whole lot better than having governments pouring money into the pockets of foreign investors who strip the assets before moving the work abroad.

Few things tickle me more than knocking politicians, but both Barack and Gordon got it right when they signed off on these projects. Put our money where it can do the most for our countries and industry – their legacy will be there long after their names have faded into historical insignificance. **ivt**

Comments: theinsider@ukipme.com

THESE RAIL PROJECTS WILL CONTINUE TO GENERATE ENORMOUS DEVELOPMENT OPPORTUNITIES FOR THE CONSTRUCTION EQUIPMENT INDUSTRY