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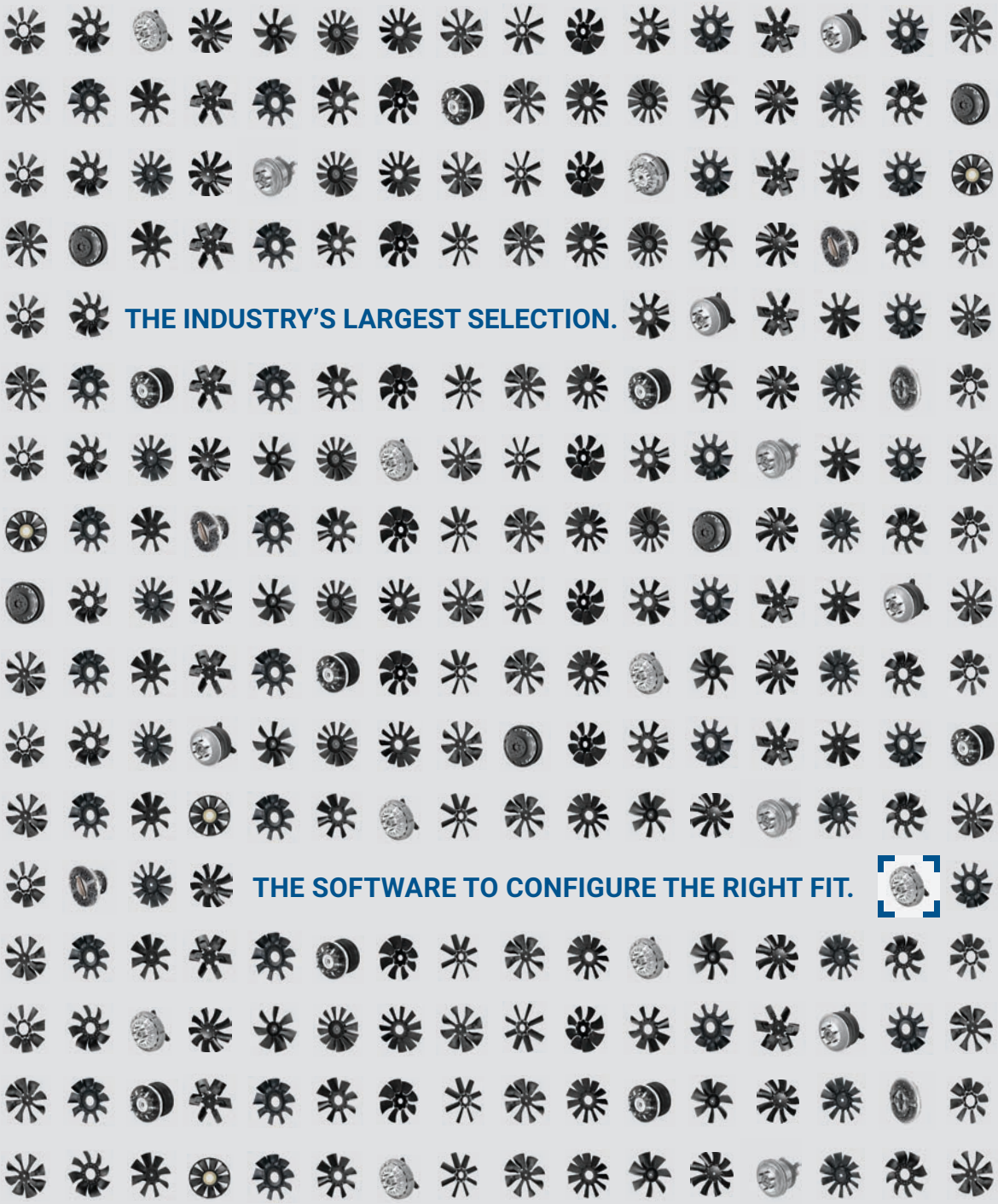

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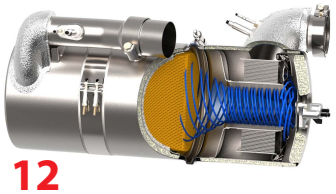

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Volume 35, No. 3, April/May 2017

Why Tradeshows Matter for Engineers

I've been a part of *OEM Off-Highway* for 10 years, and in those 10 years I have attended well over 200 different media events, conferences, trade shows, summits, expos and seminars, both domestically and abroad. All of these events hope to bring together a subset of the larger heavy-duty vehicle space to converse, network, and ultimately learn from one another.

Admittedly, some events do this better than others. Larger trade shows that focus on entire industries lend themselves better to end users and purchasers to walk the show floor and see a large amount of iron on display in one place. The more niche events that focus on a single trend or technology tend to excel at networking opportunities.

But one thing that has been quite apparent for as long as I can remember is the lack of engineer attendance at these industry events. What I hear all the time is that their travel budgets (if they ever had one) get cut first because they don't bring back a direct sale.

From a strict Return on Investment standpoint, it makes more sense for a company to send its sales reps to meet with their customers and bring back revenue than it does to send the engineers that create the products that the sales reps sell (please note the slight sarcasm). And, trust me, I get it. Business is a numbers game. You want to make more than you spend. Simple. But if you keep focusing on short-term gains, it could hurt you in the long-term game of relevancy.

Engineers and the rest of the product development team are the lifeblood of product differentiation. They are a company's longevity and continued relevance in a rapidly evolving and continually advancing technological world. And more obviously, there is no sale without a quality product, and there is no quality product without an inspired engineer that can bring a solution to market that balances the voice of the customer with the latest technologies.

Where do both of those things come together?

At trade shows.

IN THE NEXT ISSUE

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- Drivetrains & Components
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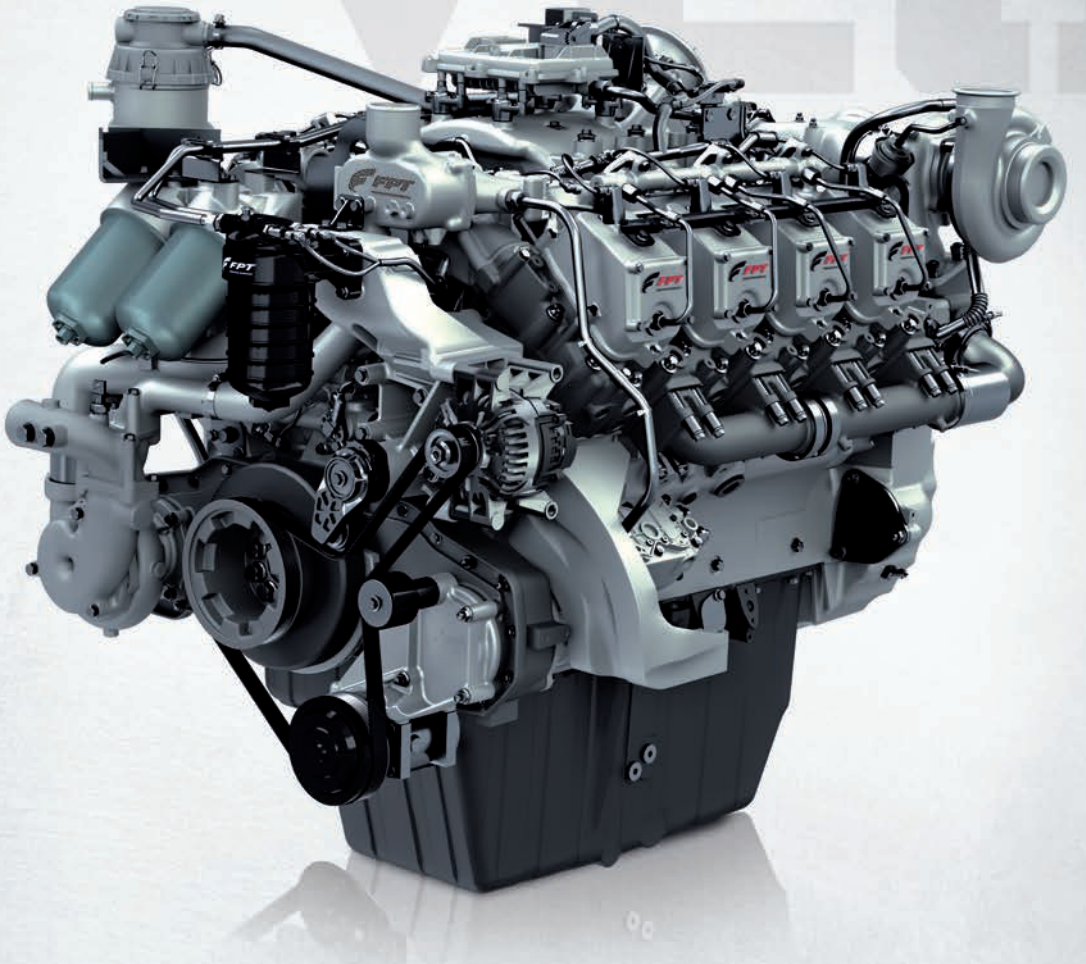

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RECOVERING Industries May Bring Opportunities in Second Half of 2017

Annual average Agriculture Machinery Production in the U.S. and Europe is declining while production in China is trending above the year-ago level, but is stagnating. Construction Machinery Production in the U.S. and Europe is recovering. Cyclical rise signals there may be more opportunities in this sector moving into the second half of 2017.

Europe Construction Machinery and Mining Production Index shows production is recovering. Generally rising commodity prices will support recovery in the Mining component of Production this year. U.S. Mining Machinery Production is recovering and will be virtually even with the 2016 level at the end of 2017.

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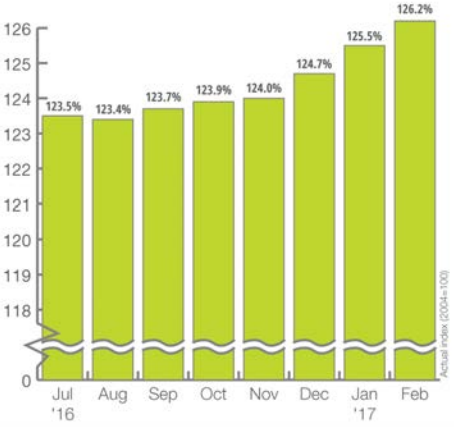
U.S. Leading Indicator:

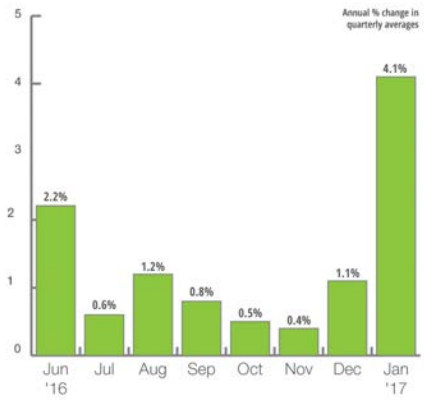
- The U.S. Leading Indicator is generally rising and reached an all-time high in February.
- Rise in the Indicator suggests that overall growth and positive business cycle momentum within the U.S. economy during 2017 is likely.



Editor's Note: Please note that this chart has been modified on the Y-axis to show the trend more easily.

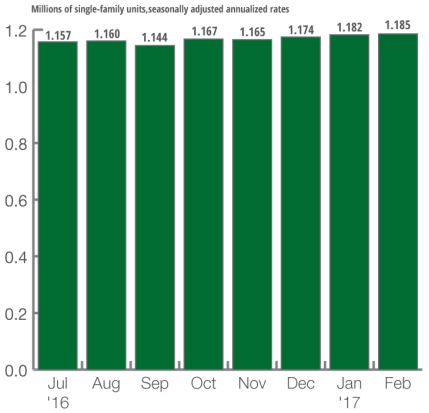
U.S. Total Industrial Production:

- Average U.S. Industrial Production during the 3 months through February was up 0.4% compared to the same 3 months 1 year ago.
- Expect general rise for 2017 as manufacturing activity picks up and headwinds against the mining sector diminish.



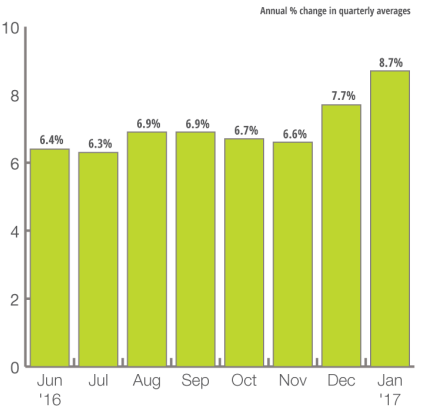
Housing Starts:

- U.S. Housing Starts during the 12 months through February totaled 1.185 million units.
- Starts will transition to an accelerating growth trend during the next quarter and is expected to rise throughout 2017.



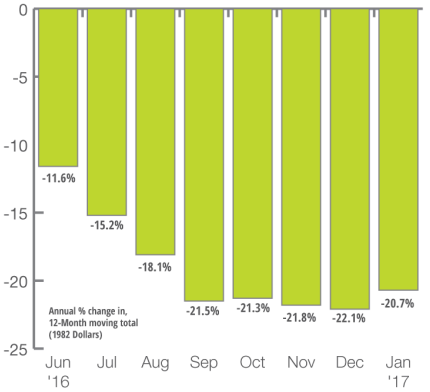
Private Nonresidential New Construction:

- Construction during the 3 months through January was up 8.7% year-over-year.
- Expect Construction to accelerate through the remainder of 2017.



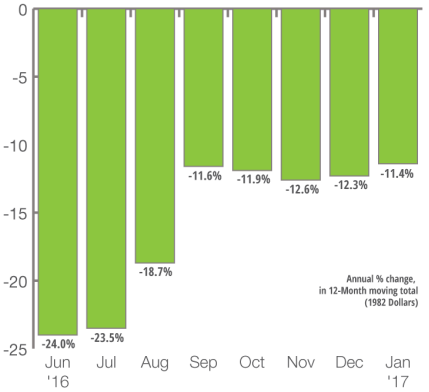
Construction Machinery, New Orders:

- New Orders transitioned to a tentative recovery trend in January.
- Expected growth in U.S. Housing Starts and rising U.S. Nondefense Capital Goods New Orders (excluding aircraft) in 2017 suggest Construction Machinery New Orders will generally recover this year.



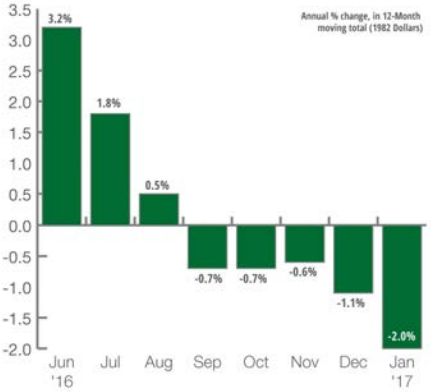
Farm Machinery & Equipment Shipments:

- U.S. Farm Machinery & Equipment Production is down 11.4% year-over-year but is recovering.
- Cyclical rise in John Deere Stock Prices (12-month lead time to Production) signals that further cyclical rise in Production is likely in at least the coming year.



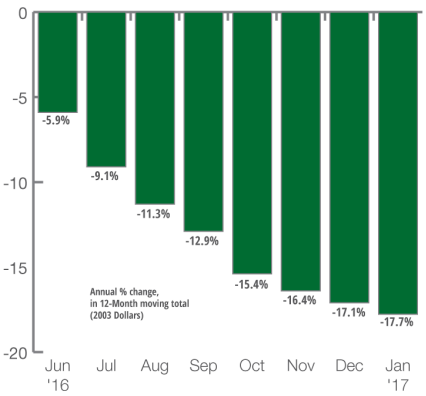
Total Public New Construction:

- U.S. Total Public New Construction during the 12 months through January was down 2.0% compared to the previous year.
- Quarterly Construction is down 2.5%, signaling that further contraction is likely in at least the coming months.



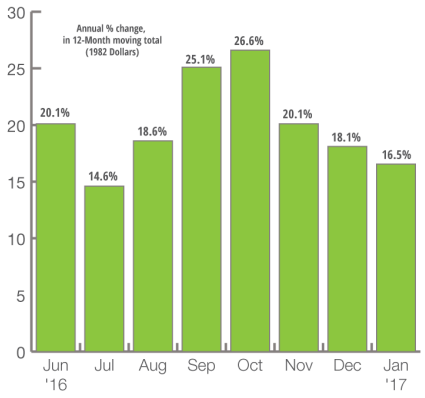
Heavy-Duty Truck Shipments:

- U.S. Heavy Duty Truck Shipments are in recession, down 17.7% year-over-year.
- The quarterly rate-of-change has upward passed the annual rate. This signals that Shipments will likely reach a business cycle low in the near term.



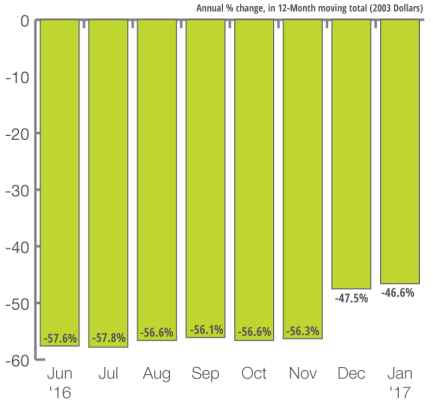
Defense Industry, New Orders:

- U.S. Defense Capital Goods New Orders is decelerating, but is up 16.5% compared to the January 2016 level.
- Expect general growth in this segment during 2017, albeit at a slower pace.



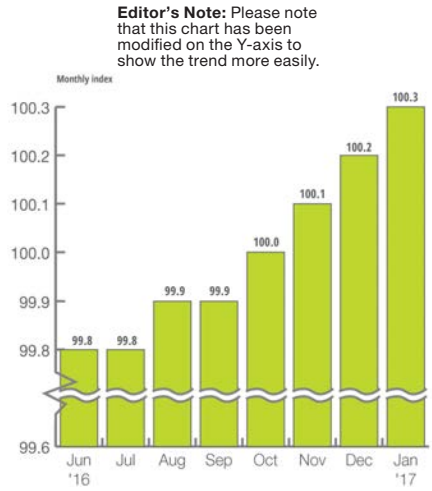
Mining, Oil & Gas Field Machinery New Orders:

- U.S. Mining Machinery New Orders is 46.6% below the year-ago level.
- Expect New Orders to recover as oil and metal prices generally rise.



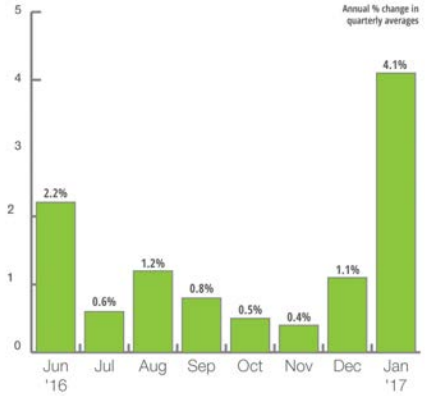
Euro Area Leading Indicator

- The Europe Leading Indicator is in its seventh consecutive month of rise.
- Rise in the Leading Indicator suggests that the European economy will generally expand at a faster pace in 2017 than in 2016.



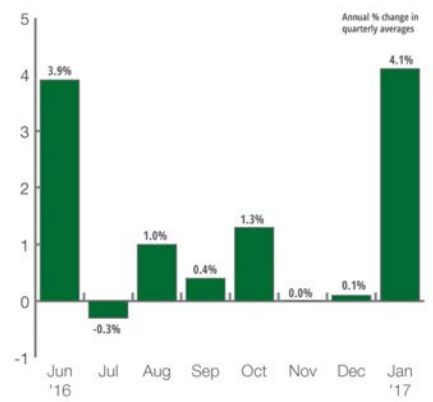
Industrial Production, United Kingdom:

- Average UK Industrial Production during the 3 months through January was 4.1% above the year-ago level. This is the highest quarterly growth rate in nearly 6 years.
- Political actions make the trajectory of this market somewhat uncertain.



Industrial Production, Germany:

- Average Germany Industrial Production in the 3 months ending in January rose 4.1% compared to the same 3 months 1 year earlier.
- Expect Industrial Production to generally accelerate during 2017.



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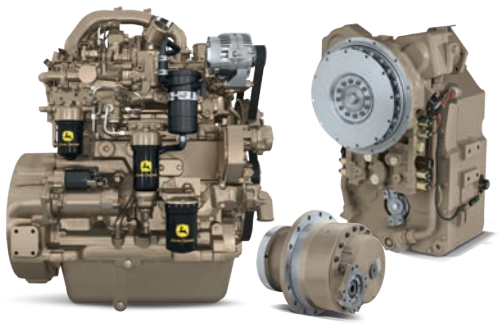

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Technologies Come Together for EMISSIONS REDUCTION

Stricter emissions targets for Stage V may require the use of additional componentry, prompting manufacturers to re-evaluate existing technologies and develop more compact, integrated designs.

by Sara Jensen

In 2019, Stage V emissions regulations will go into effect in Europe for non-road mobile machinery (NRMM) engines in the 19-560 kW (25.5-751 hp) power range. This next step—which will be the strictest in the world—will introduce a limit on particle number (PN) in addition to the previously required particle mass (PM) limits for engine emissions.

By now including PN limits, it is anticipated diesel particulate filters (DPF) will once again be necessary to achieve emissions compliance which many manufacturers were able to eliminate from smaller engines for Stage IV/Tier 4 Final, helping to save space within crowded engine compartments.

Frank Terres, Executive Director, Advanced Technologies – Clean Air, Tenneco Inc., says it will be necessary to have a DPF on engines above 19 kW because, as seen in the light-duty vehicle market, the required PN limits can only be achieved using wall-flow filters which are considered to have the highest filtration efficiency (over 85%).

"Engines that do not utilize DPF technology have particulate levels two times higher than Stage V regulations allow," adds Dr. Xinqun Gui, Manager, Engineering at John Deere Power Systems (JDPS). "Currently, DPF is the only commercially available technology that allows producers to meet Stage V engine requirements."

Integrated package solutions

Packaging constraints will be one of the biggest challenges with reintroducing the DPF to existing aftertreatment systems. Space within engine compartments is already limited, especially in smaller pieces of equipment, making it difficult to include more components. Terres says one way manufacturers are looking to overcome this is to use the SDPF technology being introduced for light-duty vehicles in which the selective catalytic reduction (SCR) catalyst is coated directly onto a DPF substrate. "This DOC + SDPF system requires only a small amount of additional space compared to the Stage IV SCR-only system," he explains.

Also referred to as an SCRF, these SDPF systems are able to warm up faster due to their closer proximity to the vehicle's engine than an SCR located downstream which enables earlier NOx conversion. According to Johnson Matthey, a manufacturer of SCRFs, these systems improve thermal management of the catalyst. They are also demanding systems and therefore may require additional SCR/ammonia slip catalyst to maximize nitrogen oxide (NOx) conversion. Gary Simons, Exhaust/Emissions Engineering Director at Donaldson Company Inc., says these systems can impact packaging, but generally not diesel exhaust fluid (DEF, also referred to as AdBlue) mixing performance.

JDPS will leverage a new advanced filter substrate and high performance catalyst, says Gui, as well as emissions control calibration technologies to downsize the aftertreatment systems for its Stage V engines. The use of these solutions will reduce engine package size 39% and weight 57% *(learn more, 20846507)*. Additionally, Gui says a compact mixer design will also help provide greater package flexibility and easier installation.

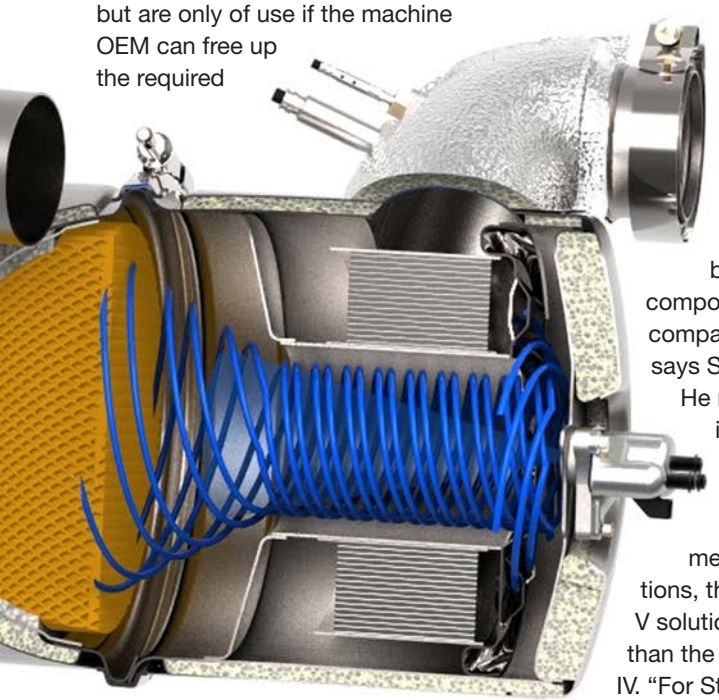
DONALDSON CO. INC.

Korneel De Rudder, Exhaust/Emissions Development Manager, Donaldson Company Inc., says that

when it comes to packaging, it often makes sense to completely redesign a machine to achieve an optimal Stage V aftertreatment layout. "However, the reality of reduced budgets forces many OEMs to update existing machines," he says, which typically leads to the addition of extra componentry, such as a DPF.

To accommodate these redesign constraints, some manufacturers are looking to combine all of the necessary aftertreatment technologies into a single unit. Common in the on-highway truck market, these systems are often arranged in a square box configuration. Volvo Trucks and sister company Mack Trucks both introduced such systems in 2016 which include the DPF, SCR and DEF injector in a single system to reduce installation space and weight *(learn more, 12204717 and 12178177)*.

These one-box solutions can offer many advantages, says De Rudder, but are only of use if the machine OEM can free up the required space. While the systems have the potential to work well in off-highway applications, he says they are not often seen due to the high tooling cost of creating a square box containing round substrates. "These high tooling costs can be justified in an on-road project, but less so with lower volume off-road applications," he says.



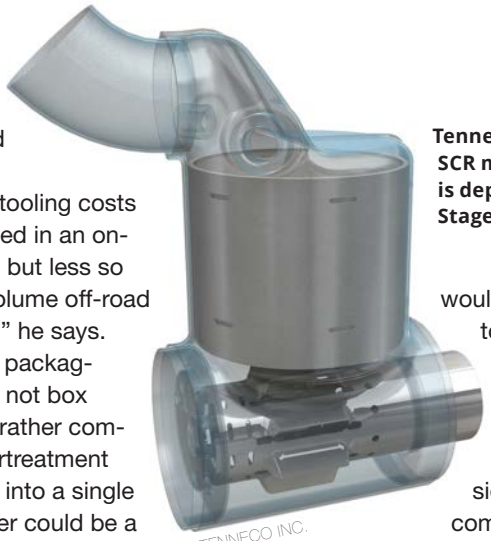
An integrated aftertreatment system for Stage V which includes a DOC, mixer, SDPF and SCR.

Integrated packages which are not box shaped, but rather combine the aftertreatment components into a single round cylinder could be a way to overcome the prohibitive tooling costs. "Such a layout has a much lower tooling cost since it is based on round cross sections," says Simons.

Donaldson will offer customers compact, fully integrated systems when possible. Reducing the size of its mixing technology enables the company to package all of the aftertreatment components in a single unit that is still manageable for vehicle mounting. In addition, improvements to standalone mixers and mixers integrated with the diesel oxidation catalyst (DOC)/DPF have made it possible to package these components in relatively compact modular systems, says Simons.

He notes that in certain instances, such as for manufacturers who already use a DPF and SCR to meet Stage IV regulations, the customer's Stage V solution may be smaller than the one used for Stage IV. "For Stage V, it's possible these customers will focus on optimizing the catalyst sizes and taking advantage of the improved mixing to reduce the overall package size," he says.

OEMs completely redesigning a machine platform to meet Stage V may also benefit from the integrated, single unit option as the volume level would better justify the tooling costs. "However, if the OEM is upgrading the machine platform to the new emission legislation (no complete redesign), one needs to be very creative to find the necessary space to integrate all the aftertreatment components," says De Rudder. In those cases, it may be more advantageous to have multiple, smaller sized aftertreatment components which enable flexible and modular integration, which Donaldson will also offer.



Tenneco's swirl pipe based SCR mixer technology is deposit-resistant and Stage V compliant.

For most customers, though, De Rudder says Stage V will mean extra aftertreatment components being added to their machines.

Besides the packaging challenges, including extra componentry may require global manufacturers to have different designs for different markets. "In several cases there is a desire to use a similar aftertreatment system for Stage III, IV, and V applications with the only changes between them being the catalyst content (downgrading)," says Simons. In addition, the current Stage IV and U.S. Tier 4 Final regulations are relatively harmonized which has made it easier for manufacturers to use similar designs for customers in both markets. For those which use a Donaldson system, he says that if the system is optimized to operate at the higher dosing rate required by Stage V, it will also work for Stage III and IV without further development.

For 56 kW (75.1 hp) and above engines, FPT Industrial intends to meet Stage V regulations with the next generation of its SCR-only technology, HI-eSCR2 *(learn more, 20841622)*. This system adopts SCR on filter (SCRoF) technology—another industry term for SDPF—consisting of a ceramic substrate with

alternatively closed channels and SCR coating. PM filtration is integrated onto the SCR system, enabling it to comply with both the NOx and PM requirements.

The HI-eSCR2 is flexibly designed to aid installation. Its DOC and SCRoF allow for different inlet and outlet pipe orientations. Up to 20 different layout solutions are possible to meet customers' varied packaging needs. FPT says its system is also 10% smaller than others in the market, further aiding installation.

In addition, Federico Gaiazzi, Head of Marketing at FPT Industrial, says there is no cooling system update or vehicle redesign required when going from the Stage IV HI-eSCR system to the new HI-eSCR2.

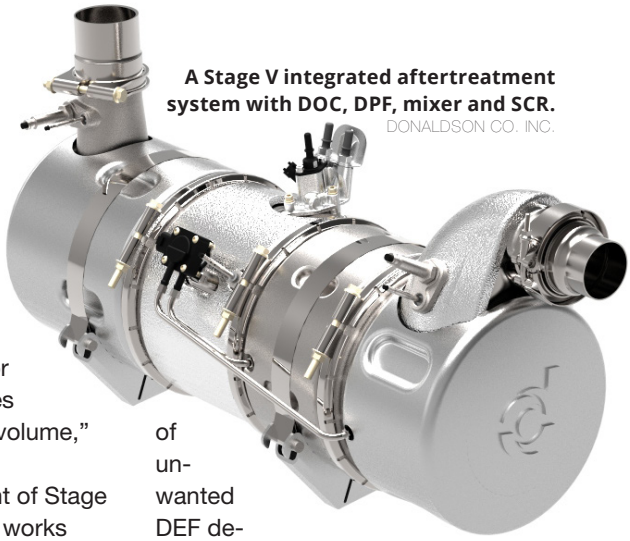
He says continuing to offer an EGR-free technology will maintain the fuel efficiency, performance, reliability and durability benefits its previous aftertreatment offered for engines at lower regulation levels. The lack of exhaust gas recirculation (EGR) means there is no downtime for maintenance or active regeneration. This also eliminates the need for a heat protection device which would otherwise be required to guard against the peak temperatures of active regeneration.

SCR advancements

De Rudder says SCR catalyst technology has improved considerably over the years, and use of state-of-the-art SCR substrates enables very high NOx conversion to be reliably achieved from small catalyst volumes. "For engine OEMs, this translates into reduced SCR catalyst volume," he says.

Donaldson's development of Stage V solutions has been in the works for several years, says Simons, with a primary focus on DEF mixing performance and deposit-free operation within a smaller overall package size.

By maximizing the free spray path length, and reducing or avoiding any droplet impingement on the internal walls of the exhaust system, the build-up of unwanted DEF decomposition by-products (deposits or crystals) can be avoided. For mixing, De Rudder notes that the company has been offering systems using bulk swirl motion to enhance both micro and macro scale mixing in the exhaust. "We are now at a point where we can integrate the SCR mixing in the SCR inlet, and still have a smaller space claim than what was needed for a Stage IV SCR system," he says.

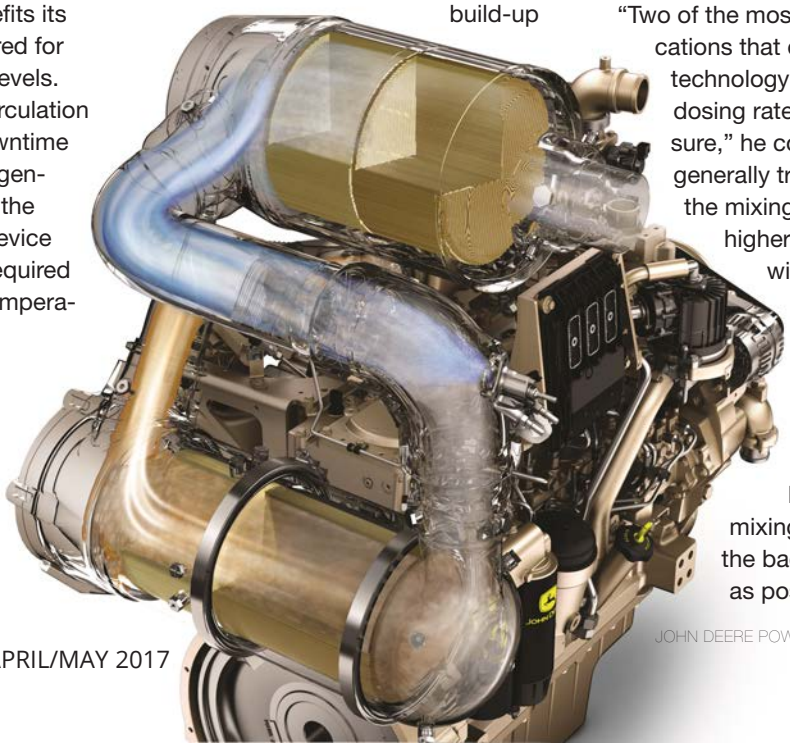


A Stage V integrated aftertreatment system with DOC, DPF, mixer and SCR.
DONALDSON CO. INC.

Simons adds that most of the Stage V solutions represent the next level of mixing technology. "Often the transition from Stage IV to V has been accompanied by an increase in the engine out NOx, caused by the reduction/removal of EGR," he explains. "This has forced the mixing performance to increase, especially when it comes to operating deposit free.

"Two of the most critical specifications that dictate the mixing technology are the AdBlue dosing rate and backpressure," he continues. "It is generally true that the higher the mixing needed, the higher the backpressure will be in order to operate at the best performance [level] and deposit free. With lower dosing rates, it is possible to simplify the mixing system and keep the backpressure as low as possible."

"Currently, DPF is the only commercially available technology that allows producers to meet Stage V engine requirements." *- Dr. Xinqun Gui, Manager, Engineering at John Deere Power Systems*



JDPS will leverage a new advanced filter substrate and high performance catalyst, as well as emissions control calibration technologies to downsize the aftertreatment systems for its Stage V engines.

JOHN DEERE POWER SYSTEMS

Reducing or removing EGR can cause challenges when calibrating the DEF dosing algorithm. “No- or low-EGR engines have high raw NOx emissions which demand a high efficiency SCR system. Often, conversion rates in the range of 96-99% are required,” says De Rudder. “However, at these efficiency levels, any minor local deviations in NOx conversion over the SCR catalyst can lead to a major difference in downstream NOx sensor readings.”

The NOx sensor reads absolute values in the range of 10 parts per million (ppm), and De Rudder says if that reading is off by 1 or 2 ppms, it can cause major issues with the AdBlue dosing algorithm. Because of this, mixers downstream of the SCR catalyst have become more common in system designs to ensure good NOx sensor readings.

Donaldson provides non-impinge-

FPT INDUSTRIAL

The DOC and SCRoF of FPT’s HI-eSCR2 allow for different inlet and outlet pipe orientations to meet individual customer packaging needs.

At CONEXPO-CON/AGG 2017, JDPS introduced its new Integrated Emissions Control System featuring an inline aftertreatment device *(learn more, 20855643)*.

ment swirl mixing systems which are sensitive to DEF crystallization—avoiding plugging the exhaust—and offer high mixing performance. De Rudder says that while the majority of the industry has utilized impact based mixers, today Donaldson sees many embracing swirl-based mixing systems. "There is a directional trend towards more compact aftertreatment systems and less volume being allocated for mixing," he says. "More often than not, these systems use swirling flow to enhance mixing."

"Both swirl type mixing and next generation impingement designs are being proposed," adds Simons. "Time will tell if they are successful."

Terres says active or passive thermal management solutions can be beneficial in overcoming the challenges associated with reducing or removing EGR, as well. Such solutions from Tenneco include low thermal inertia and air gap insulated manifolds, high efficiency insulation technology and Micro Thermal Units, each of which provides active heat to support improved aftertreatment system efficiency. "We've also developed highly efficient compact mixers that allow for urea processing at low temperatures without the formation of undesired urea deposits," he adds.

Though no single, concrete solution for meeting Stage V yet exists, the varied options and advancements made thus far will help ensure OEMs and engine manufacturers are ready to comply with the regulation when it goes into effect in 2 years.

Head to the Web

Read the article "Ready for the Next Stage of Emissions Compliance" to learn about the latest Stage V engine launches from CONEXPO-CON/AGG 2017.

Search: 20857520

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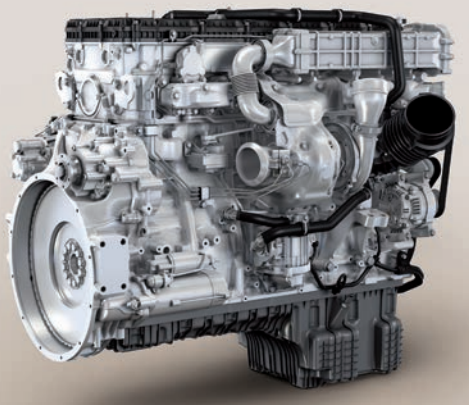

Series 1300

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CAMSO

LEFT: The non-directional tread pattern on Camso's SKS 753 is one of many new design features to come about from the company's scrap tire analysis.

RIGHT: Camso's Conversion Track System is a bolt-on track and undercarriage solution designed to enable easy conversion from tires to tracks.

Variety is Key for OPERATIONAL

As there is no 'one size fits all' solution when it comes to tires, manufacturers are continually looking to expand their product offerings and mix of design features to meet the diverse needs of the construction industry.

by Sara Jensen

Varied applications and working conditions make it necessary for tire manufacturers within the construction industry to offer a wide range of solutions; expanding these product offerings was the theme for many during CONEXPO-CON/AGG 2017 *(event information, 10207294)*.

During the show, Trelleborg Wheel Systems, for instance, announced it is adding to its line of pneumatic tires in the North American market *(learn more, 20854177)*. Doing so enables the company to provide a full line of products for the off-road market, says Marc Margossian, Marketing Director for Trelleborg Wheel Systems in the Americas. "It gives customers more options from a company they already trust."

Part of this pneumatic offering includes the Mitas range of construction tires, which became part of Trelleborg following the acquisition of CGS Holdings in June 2016 *(learn more, 12215310)*. "Mitas has a strong presence in Europe through its agricultural range and has developed a good position within the construction market through some notable OEMs. In North America, Trelleborg has been a strong player in specialist construction niches through its solid OTR (off the road) range and construction tracks; by adding the Mitas range we become a true single source supplier with a full range of proven, quality products," says Margossian.

Camso, formerly known as Camoplast Solideal, also exhibited its expanding line of tire and track products for the construction industry *(learn more, 20852604)*. Over the last 2 years, the company has undertaken an initiative to re-evaluate many of its legacy tires—including those for skid steers, telehandlers and its multi-purpose tire line—through a scrap tire analysis. Camso studied both its own tires and those of competitors to see why and how they fail; it found sidewall and puncture damage to be among the leading causes. It is using this information to develop its "Next Generation" tires, and plans to rebuild two-thirds of its compact construction tire lineup.

"When it comes to tires, you only have so much money to spend," says Mike Dembe, Camso Product Management Director, North America

The Vortech rubber track system improves driver efficiency and workability in compact tracked loader applications through an optimized internal structure and tread pattern to lower the bending resistance.

BRIDGESTONE CORP.

EFFICIENCY

and LATAM for Construction. He explains that a company may have the best tire in the world, but if it's too expensive, no one is going to buy it, so it's important to evaluate where to put the rubber and engineering to address failure points. "[The scrap tire analysis] really helped guide our hands to develop smarter tires, providing added performance and durability," he says.

One of the tires developed based on the scrap tire analysis is the new MPT 753, a multi-purpose tire set to be launched in North America later in 2017. It is being launched in Europe first as it is designed for use on compact telehandlers, compact wheel loaders and mini-dumpers, all of which are more popular equipment types in that market. However, Dembe says Camso does see these smaller pieces of equipment starting to become more popular in North America, as well, which is why the tire will be available in both markets.

A key feature of the MPT 753 is its non-directional tread which has a higher lug to void ratio so that there is more rubber to wear off, making the tire last longer on abrasive surfaces. Dembe says Camso used one of its most premium rubber compounds for the tire to further aid abrasion resistance and durability. Void guards on the tire—little patches measuring just a couple of millimeters—were included to provide tread impact resistance. "We wanted to do something without sacrificing tread depth," explains Dembe. "We have these little void guard protection patches and what we found was a 10% better tread impact resistance, so 10% fewer flats. It's just a tiny bit of rubber, but it's using that rubber smartly."

Another development based on the tire analysis is the impact guard and reverse sidewall concept. Camso's previous sidewall design consisted of a tapered wedge shape; Dembe says this design has been completely reversed so that the thicker part of the tire is farther away from the shoulder and is now closer to the bead area. He says this does two things, one of which is to remove the "shelf" that previously existed and was the weak part of the tire. "Tires don't like hard edges or angles [because] it's something more to rub up against and actually cause structural damage," Dembe says. "We removed that stress point and, in reversing the sidewall, there's a wedge shape at the bottom." This wedge pushes material and objects away from the tire before they can cause any damage. Due to the success of this design, Camso will be including it on all of its next generation tires.

"The most important trend BKT has seen in tires for the construction industry is using multiple design cues to increase operational efficiency on the job site," says Gary Pomp, Manager Field Technical Services, BKT USA Inc. As such, the company integrates various technologies into its tire designs to meet these efficiency needs. Its new Earthmax SR 35 tire, for example, includes steel belts to resist snags and punctures, helping ensure the longevity of the tire's lifespan. The tire also includes a cut-resistant compound to extend tire life *(learn more, 20855072)*.

Radials on the rise

According to Alliance Tires, use of radial tires has been increasing within the construction industry over the past 15 years, with a slight dip seen during the recession says Steve Vandegrift, Product Manager – Construction, OTR at Alliance Tires Americas. In addition, he notes the European construction equipment market has been almost entirely on radials since the early 2000s.

The increased flotation, improved traction and additional stability radial tires can provide relate directly to improved production, explains Pomp, which helps make them an attractive option for fleets. "While there is still demand for bias tires, veterans in the industry are feeling more comfortable with radials now, which is causing

TRELLEBORG WHEEL SYSTEMS

Trelleborg's expanded line of pneumatic tires for the North American market will allow the company to offer a full range of products to meet customers' various application needs.

the increase in demand."

Vandegrift says the move to radials was first driven by OEMs whose engineers appreciated the technology advancements occurring in the tire market. "They realized a more flexible sidewall, significantly larger footprint, and the capacity to increase the load on these radials," he says. "Since then, the replacement market has been picking up as machinery owners see the benefits of radials or just replace the tires that were original to the machine. Either way, it's creating increasing demand for construction radials."

Among the many benefits radials offer is their larger, more evenly distributed footprint. This is due to the body plies being oriented at a 90-degree angle with the bead, creating a strong sidewall that is more flexible, whereas body plies on a traditional tire meet the bead bundle on a bias, or slant. The layers of overlapping fabric create a stiffer sidewall which lifts the edges of the tread so less of the footprint is in contact with the ground.

Vandegrift notes the wide footprint and fact the radial construction distributes torque more uniformly across the tire's circumference produces more even tread wear and a longer tread life. "The larger, more uniform footprint of radials also provides better flotation and less rolling resistance, improving fuel economy," he says.

Research data has shown radials can offer a 16% increase in fuel efficiency, up to 20% less rolling resistance and up to 13% higher machine productivity compared to bias-ply tires.

The flexibility of the sidewalls enable the tire to better conform to the terrain, enhancing ride quality for improved operator comfort. In addition, the sidewall acts as a suspension system which absorbs shock, further improving comfort, as well as reducing machine wear. "Many customers tell us that the time and money they spend maintaining the frames, suspensions and axles of their equipment have gone down after a switch to radials," says Vandegrift.

He says the initial cost of radial construction tires is about 20% higher than an equivalent-sized bias ply tire, however, Alliance Tires has seen radials last twice as long on job sites "so the return on investment, figured by dividing the purchase cost by the service life, is outstanding."

While both Alliance Tires and BKT see increased use of radials, there are applications in which bias-ply tires are still the better option. The thicker sidewall of the bias tires is particularly suited for use in low-speed construction jobs where there is a high potential for sidewall punctures to occur.

"Radials are most appreciated by construction contractors who track the actual cost per hour of running their equipment—the money spent on tires per hour of operation, the amount of fuel consumed per hour on a contract, and the cost of downtime, which of course is less frequent with longer-lasting tires," says Vandegrift.

He says radials are best suited for equipment which runs on the road, especially for long cycles, such as

rock trucks and backhoe/loaders shuttled on the street. The radial's flexible sidewall creates a broad, flat footprint for a comfortable ride on this surface type. Applications in which sidewall stability is paramount—such as machines working across slopes or telehandlers whose center of gravity shift as their load is raised or lowered—would benefit more from the stiffer sidewall of a bias-ply tire.

The transition to tracks

Dembe says Camso is also seeing a greater trend toward the use of tracks on construction equipment. Much like in the agricultural industry, machine operators are looking for improved traction, flotation, stability and durability, all of which he says tracks provide. "You've got a wider footprint, a full-length surface—for a larger footprint contact patch—that [equates] to reduced ground pressure, better pulling power and more torque," he says. "This is where the whole industry is trending."

"Across the construction industry, we're seeing greater adoption and use of rubber tracks on loaders to facilitate projects at a variety of job sites," adds Koji Nakayama, Vice President, Bridgestone Industrial Products Inc. The stability and traction they provide enables equipment to be used in applications it might not otherwise have been able, enhancing its versatility. Nakayama says it's been easy for the industry to transition to rubber tracked equipment since it does not require a significantly different skillset to operate compared to traditional skid-steer loaders.

He adds that rubber tracks have a niche market within the construction industry. "We are seeing tracks used on loaders at one specific job site, rather than on vehicles that are moving between operations since tires provide the versatility and speed needed to move between jobs more easily."

To meet the growing demand for track systems, Camso has developed a Conversion Track System

"We have these little void guard protection patches...It's just a tiny bit of rubber, but it's using that rubber smartly." *- Mike Dembe, Camso Product Management Director, North America and LATAM for Construction*

S. JENSEN

Use of tracks is growing in the construction industry due to the improved stability and flotation they offer, and could be seen on a variety of machines at CONEXPO-CON/AGG 2017.

(CTS) prototype which it exhibited during CONEXPO-CON/AGG. The CTS is a bolt-on track and undercarriage solution currently intended for use on telescopic handlers, compact wheel loaders, smaller full-size wheel loaders and mini dumpers.

The company says the CTS offers customers the benefit of being able to easily switch between tracks and tires as necessary. This enables more flexibility in their operations and eliminates the need to choose between only having a tire or tracked machine. Much like Camso's agricultural version *(learn more, 12136657)*, the CTS is a permanent solution that can be left on a piece of equipment if desired.

Camso is working directly with OEMs to design the CTS precisely to specific machine platforms. A generic aftermarket version will also be available that will be designed as an "all makes" model to fit a variety of machine types. This version will also have an adapter plate that can be added or removed to ease installation on various pieces of equipment.

Bridgestone also introduced its Vortech rubber track system during the show *(learn more, 20854807)*. According to the company, the track was designed to help improve driver efficiency and workability in compact tracked loader applications. It achieves this through an optimized internal struc-

BKT USA INC.

The BKT Earthmax SR 35 tire includes steel belts to resist snags and punctures, helping ensure longevity.

ture and tread pattern to lower the bending resistance which occurs when rubber tracks rotate to enable more fluid vehicle movement.

The H-shaped tread pattern expands the edge of the tracks, providing 60% more biting edge around the tread lug compared to standard tread patterns. "This unique shape results in a consistent grip and improved traction across a variety of job sites," says Nakayama. The tread pattern works in tandem with the track's optimized embed placement, as well, to minimize vibration during machine operation for a smoother, more comfortable ride.

Though there is no one-size-fits-all approach for the construction industry, tire manufacturers' continued efforts to expand and evolve their tire—and track—offerings will ensure there is a solution to meet various customer application needs.

Eliminating downtime

Flat tires can be costly for fleets not only in the downtime they cause but also in regards to repair or replacement and disposal of the tire. The airBOSS segmented tire system, however, aims to offer an alternative to this by enabling just the damaged portions of the tire to be replaced.

airBOSS rubber tire segments.

airBOSS' wheel rims are tailored to each piece of equipment or fleet, and the tire segments are individually bolted onto the rim. If damage occurs to one of the segments, that segment is unbolted from the wheel and replaced with a new one. Operators can also choose to change the damaged segment when it's most convenient for them as the system will continue to work with up to three or four damaged segments at a time.

The tire system is primarily designed for use on slower moving, compact construction vehicles such as skid steers, backhoes and dumpers.

Visit oemoffhighway.com/20857839 to read more about the airBOSS segmented tire system.

AxleTech's new planetary wheel end is designed for electric drivetrain systems to produce extremely low noise, while delivering high strength, high efficiency, and long product life. Learn more about this product online at www.oemoffhighway.com/20858971

GREATER than the Sum of its PARTS

The shift toward full system optimization of drivetrain development continues to gain momentum in off-highway vehicles.

by Michelle Kopier

The general trend over the last several years for drivetrain development in the heavy-duty on-highway vehicle space has been toward optimized system integration. In the more recent years, suppliers have seen this focus on overall system optimization making headway in the off-highway vehicle markets, as well. Several drivetrain manufacturers have recently announced hydraulic or electric component integrations as part of their drivetrain system launches, showcasing the shift toward a more robust and complete system package offering.

OEMs are seeking integrated packages from single suppliers.

Historically, each subsystem manufacturer would focus on internal optimization and deliver an enhanced engine, drivetrain or axle. These efficient pieces, would be assembled in the best way possible. Now subsystem manufacturers are thinking about how they fit into the larger whole of the primary system while at the same time discovering more opportunities for efficiency by better integrating components starting at the design phase.

A lot of the drivetrain system's optimization demands has been driven by the emissions reduction efforts through greenhouse gas (GHG) and fuel economy legislations, but also simply from continued demand from fleet owners for better fuel economy for cost savings. "What we've seen over the last several years is a concerted effort by the OEMs to better integrate the engine, the transmission and the axle to get better fuel economy for the vehicle," says John Bennett, General Manager, Global Product Strategy and Advanced Engineering, Meritor.

"At the same time, while we have been working with these engine manufacturers, we're seeing advancements in the engines to go slower to be more efficient. That has required us as the axle manufacturers to develop axle ratios that are much—what we call faster—but are lower in numerical number. It's having a major impact on our gearing and axle designs," says Bennett.

Another key benefit to a systems-based approach to drivetrain development and optimization is the potential to reduce overall complexity of the system through part reduction and process techniques. "Our customers are looking for complete solutions. They're seeking integrated packages, including motors, gearboxes, axles, and controllers, from a single supplier rather than purchasing individual powertrain components," says Jason Gies, Business Development Manager of Electric Drivetrain Systems, AxleTech International.

Electric motor integration

The Electric Drivetrain Systems product line from AxleTech includes axle systems that are available with patent-pending multiple-speed gearboxes integrated with one or more electric motors. The integrated parallel-axis helical design allows the system to be lighter, more efficient, and run quieter than first generation direct-drive solutions that typically utilize a single, large electric motor driving a conventional axle.

AxleTech teamed up with TM4, a leading provider of electric motor options, controllers, and inverters. TM4's extensive engineering capabilities combined with AxleTech's drivetrain expertise provide a complete drivetrain system.

"Our customers want flexible, custom-engineered axle systems for their applications. By utilizing off-the-shelf motors with our multispeed gearbox and planetary technology, AxleTech is able to offer affordable and efficient solutions without sacrificing vehicle performance," says Gies. Selecting from commercially available electric motors allows packaging options for low-floor or space-constrained applications while simultaneously supplying enough torque through the multispeed gearbox for off-highway applications.

Gies describes AxleTech's electric drivetrain goals for the heavy-duty industry as "achieving the high torque requirements of off-highway equipment in the simplest, most efficient way possible."

As an example, the wheel end for electric drive, released by AxleTech at CONEXPO 2017, was designed with helical planetary gearing to help reduce noise, vibration and harshness (NVH) and boost strength by 38% compared to spur gears of the same tooth size and width (learn more, 20858971). It can be used as an independent module, or integrated as part of AxleTech's electric axle.

Meritor has been integrating electric motors into the drive axle for years, but the volumes were never large enough to be fully realized as a commercial solution. "We see a potential for that to grow in the future," says Bennett. "Everything we've done so far has involved bolting existing motors onto our products. The opportunity is really in fully integrating—and I'm talking about taking the rotor and the stator and literally embedding that around our gearing and differential. That's where we're going."

There are some trucking applications where embedding the electric motor directly into the wheel end makes more sense than the differential carrier, which bulkiness requires a higher vehicle floor. For example, a transit bus or delivery vehicle can benefit from a lower vehicle floor, could benefit from the removal of the differential and embedding the motors into the wheel ends. It comes at a higher cost, but can provide great benefits.

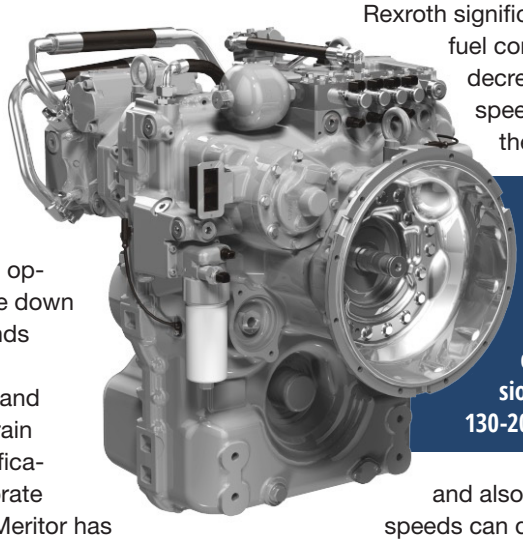
But, if the application doesn't require or benefit from a lower floor, such as school buses which are required to have a higher floor for safety purposes, the electric motor may as well be integrated into the differential carrier in the center of the axle. Conversely, in many off-highway applications, ground clearance

MERITOR

An electric trailing arm independent suspension module with an electric motor integrated at the wheel sized for Class 4 and 5 vehicles with 100 kW peak power at each wheel. The unique trailing arm/air spring configuration also enables a complete low floor with kneeling capability.

is an important feature, and being able to remove the differential and raise the vehicle floor a lot higher is also beneficial.

However, embedding electric motors in each wheel end is inherently more expensive because you need two smaller motors versus one large motor for the differential carrier option. "At this point in time, embedding electric motors in either of the configurations are relatively low volume, so as these opportunities become more popular and drive up volumes, both options will come down in cost," reminds Bennett.



The short-drop version of the HVT R2 features a modular configuration with a redesigned transmission case that reduces input/output distance. This hydromechanical variable transmission supports power outputs from 130-200 kW (174-268 hp).

Developing and leading drivetrain system electrification is a corporate initiative that Meritor has taken some major steps to achieve. One key directive was to build up its internal capabilities, to which Meritor assembled an advanced engineering team focused on electrification. The other part was to seek out and partner with external technology leaders in electric motors, and just recently Meritor announced it would be partnering with UQM Technologies Inc. to develop full electric axle systems for medium- and heavy-duty on- and off-highway vehicles *(read more, 20850955)*.

The alliance calls for Meritor to develop integrated axle components for E-axle technology. The components will be combined with UQM's motor and inverter technology and hardware to create the Meritor and UQM Electric Axle System (MUQM Electric Axles).

The co-developed system will improve the overall package requirements as well as lower cost from integration and offer better vehicle performance. What is helping to drive further development of electric motor technology and integration into heavier duty applications is the strides battery technology has made as well as the significant drop in cost over the past several years.

Hydraulic integration

A product of the joint venture between Dana Incorporated and Bosch Rexroth, hydromechanical variable transmissions (HVTs) from Dana Rexroth significantly reduce fuel consumption by decreasing engine speeds throughout the duty cycle and also at idle, when speeds can drop to as low as 600 rpm.

The HVT systems designed by Dana Rexroth Transmission Systems helps reduce complexity for equipment manufacturers, since the entire system of gears, clutches, and hydrostatic units is managed by an advanced electronic control unit (ECU) and optimized for efficiency by a single supplier.

At CONEXPO -CON/AGG 2017, Dana Rexroth Transmission Systems launched a short-drop version of its R2 HVT *(learn more, 20855417* and *20859183)* featuring a modular configuration with a redesigned transmission case that reduces input/output distance and supports power outputs from 130-200 kW (174-268 hp).

The long-drop version of the R2 HVT, initially launched at 2014's CONEXPO-CON/AGG, is a modular platform that delivers a full suite of configuration options and software controls, such as direct or remote mounting, flexibility in shift control and drive strategy parameters, and the deployment of up to three PTOs *(learn more, 11327063)*.

Dana Rexroth's HVT powersplit systems have demonstrated fuel savings in the drivetrain of up to 25% when compared with the same vehicle outfitted with a conventional torque converter transmission.

"From the beginning, equipment manufacturers have readily recognized the dramatic increases in efficiency that result from combining technologies from Dana and Bosch Rexroth," says Roland Friedl, head of sales and product management for Dana Rexroth Transmission Systems. "…OEMs are seeing firsthand the unique benefits that can result from integrating hydrostatic, mechanical, and control systems through a modular approach."

Dana also used CONEXPO as a launch pad for new Brevini solutions *(read about Dana's recent acquisition of Brevini, 20850964)*. The benefit of the Dana Brevini acquisition is the ability to provide the customer with several alternatives of drivetrain architecture.

One challenge with the drivetrain system is how to manage the engine as a power source and balance the split between auxiliary work functions to the propulsion of the vehicle itself. "Optimizing these dual functions is key to the performance and productivity of the vehicle," says Giulio Ornella, Off-Highway Advanced Engineering Manager, Dana Incorporated.

"The new generation of systems that we will have in 3 to 5 years will show a completely different approach to the drivetrain system with much less distinction between the mechanical side and the hydraulics or electronics side."

Limitations and opportunities

"Power is not the problem with electric motors," says Gies. "The problem comes with the limitations of having enough energy onboard a vehicle to perform its specific duty

cycle. This is why our systems are customized for each application's quiet operation, packaging, and efficiency requirements. And working with pioneering companies such as Wrightspeed gives new capabilities of extending stored energy through their range-extended EV platform."

The range of off-highway applications requires different system solutions. "When you look at a container handler versus a terminal tractor, there are vastly different load, torque and packaging considerations. Our system approach allows for scalable solutions that solve the challenges of each" Gies says.

Another challenge for system optimization is the balance between performance and serviceability. The on-highway experience and knowledge is not a direct transfer for heavier-duty, more rugged and severe environments and applications like the off-road market. "Just by simply merging components together and removing unnecessary parts like bolted joints and fasteners, you can gain advantages in system weight and overall cost. But, it will sometimes come at the expense of serviceability, which is of much more significant value in the higher demands of the off-highway vehicle industry," says Bennett. "You have to be very careful that you don't integrate a system to the point at which it is no longer serviceable."

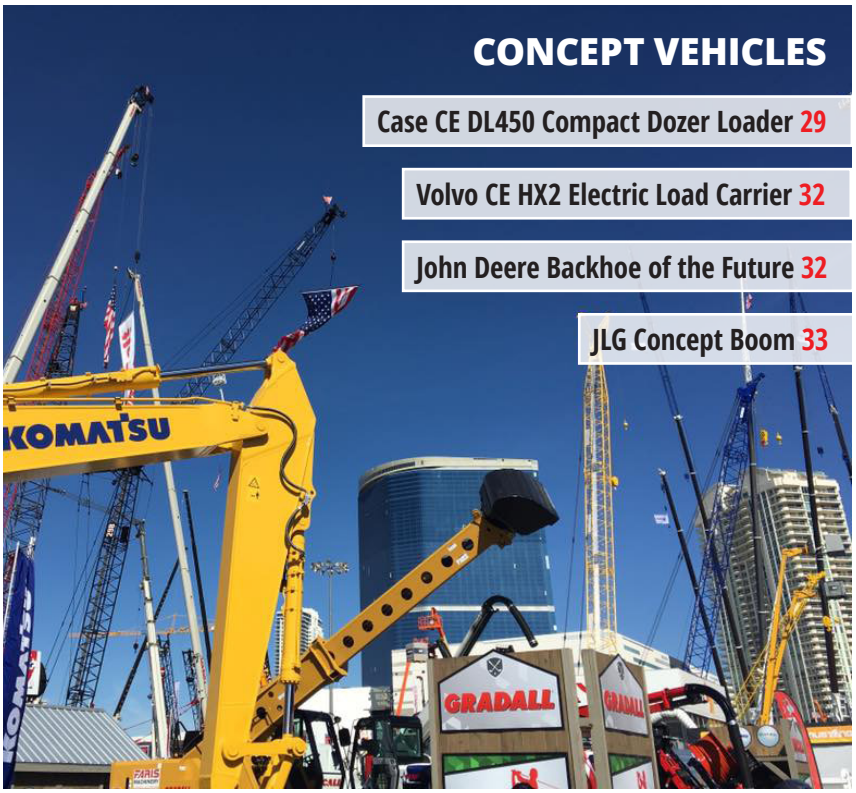
Laser-welding, for example, is a technique Meritor has been using for on-highway trucks for years, which improves the durability of the gear set on top of the weight and cost savings. When the company evaluated using the technique for some off-highway applications, it found that the vehicle fleets were too frequently replacing gear sets and needed to have easy access to be able to repair them.

There are also opportunities that lay between brake systems and suspensions, an area Bennett claims has not been traditionally investigated. "We see a lot of opportunity in improving NVH by taking a bigger systems approach in looking at all of the responses of the suspension system and how they relate to the inputs from the braking system," Bennett continues.

But what is assuredly the most important of opportunities is the continued integration of sensors for system monitoring and data collection. The data can provide notifications prior to system failures, for example, avoiding unforeseen downtime, but also can reduce unnecessary downtime from routine maintenance schedules that may be too frequent based on system performance information gathered by the sensors.

Concepts and Connectivity

CONEXPO & IFPE 2017 featured visions of the future in vehicle design innovations and advanced technologies.



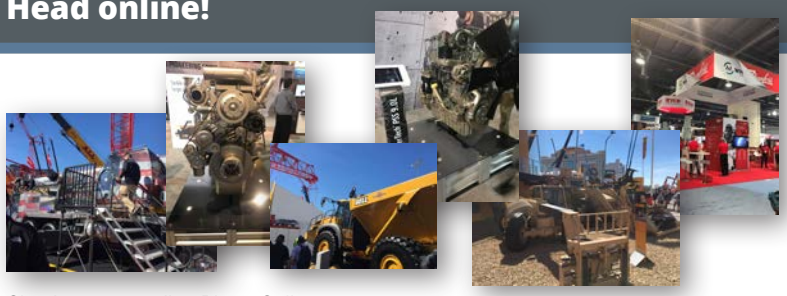
The construction industry was filled with positivity at CONEXPO-CON/AGG and IFPE 2017 in Las Vegas this past March. Most equipment manufacturers used the show to launch new vehicle models with enhanced performance features and advanced on-board technologies, but some brought more than just new iron to the show—they brought the future of equipment with concept vehicle displays.

From a unique two-in-one vehicle combining a compact track loader and a bulldozer; to a battery-electric, fully autonomous load carrier; to a lightweight hybrid backhoe, OEMs did not disappoint with their forward thinking ideas at this year's show.

But beyond the visions of vehicle designs, were the concrete principles of vehicle and system connectivity. The terms Big Data, the Industrial Internet of Things, and Industry 4.0 were exemplified with smart technologies, telematics and sensor integration, and an understanding as to how those terms will continue to shape and guide the direction of the mobile construction industry.

See a few of the hundreds of new products and technologies launched at CONEXPO-CON/AGG and IFPE 2017 starting on page 34.

Want to experience more from the show? Head online!



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And find more vehicle and technology announcements on our CONEXPO & IFPE website channel at *www.oemoffhighway.com/ifpe-conexpo*

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COMBINED MACHINE PLATFORMS Improve Equipment Utilization

An OEM brings elements of two equipment platforms together into a single design to increase the amount of work customers can get out of their machine.

by Sara Jensen

At CONEXPO-CON/AGG 2017, CASE Construction Equipment unveiled its new DL450 Compact Dozer Loader Concept Vehicle. The machine is a combination of a large-frame compact track loader and a bulldozer.

John Dotto, Brand Marketing Manager at CASE Construction Equipment, says the compact dozer loader (CDL) concept came about because contractors are continually looking for ways to get more out their equipment. The three elements which he says contributed to the machine's development are:

- A growing compact track loader market which is moving toward larger machines.
- Contractors involved with earth-moving processes want to own a dozer, but it often doesn't make sense to own a full-sized dozer from both a jobsite capacity and transportation perspective.
- Two-in-one functionality allows contractors to invest in equipment from which they will ultimately get higher utilization.

"The CASE DL450 concept is a first-of-its-kind machine that fits in well with the current CASE lineup and, while being innovative, also provides a very practical and real solution to our customers," says Dotto.

Technologies come together for improved performance

Termed "Project Minotaur," Dotto says the DL450 provides the power and performance of a small dozer in a platform which also serves as a loader, and is capable of running all the attachments contractors own for their skid steers and compact track loaders. "Contractors can now have one machine on site that handles all of these items," he says.

The core feature of the DL450, says Dotto, is a C-frame dozer interface that pins directly into the chassis of the machine. Doing so ensures all operating power and stresses are channeled through the chassis and

CONCEPT VEHICLES: COMPACT DOZER LOADER

www.oemoffhighway.com/20853922

Machine controls within the DL450 will be familiar to both operators of CTLs/skid steers and of dozers, helping to minimize the learning curve for customers.

Watch John Dotto explain the various features and benefits of the DL450 at *oemoffhighway.com/20857036*.

not the arms of the machine because the chassis to blade connection through the C-frame assembly never changes the way a load is transferred to the chassis.

Though modestly effective, he says dozer attachments on compact track loaders (CTL) and skid steers channel operating stress through the coupler and loader arms, which adversely affects performance and adds wear and stress to those components. "You also lose some of the multifunctional control capable with a true dozer blade," he says, "and as soon as you raise or lower the loader arms, performance is affected."

In addition, the C-frame interface

can be unpinned to free the loader arms for use with a bucket or other attachment typically used with a CTL or skid steer.

Machine controls within the DL450 will be familiar to both operators of CTLs/skid steers and of dozers, helping to minimize the learning curve for customers. Similar to ISO controls, the forward and reverse travel and steering is controlled with the left hand while the boom and bucket are controlled with the right. The right hand controls the lift, angle and tilt of the six-way dozer blade, as well.

When designing the dozer loader, CASE engineers wanted to include the pushing power and frame strength of a radial lift machine, so they combined the frame of the company's current TV380 CTL with a radial-lift loader arm design similar to that of CASE's legacy 465 skid steer. Dotto says the TV380 has a robust structure built for heavy stress; combining that machine platform with the strength of the radial arm design ensures the DL450 will be capable of providing maximum pushing performance.

Steel tracks and grousers are included on the DL450 to aid its use as a dozer. Using steel instead of rubber for the tracks creates a heavier undercarriage to put more pressure on the ground while the grousers "bite" into it for improved traction. "More ground pressure and better bite are a formula for better tractive force or pushing performance," says Dotto.

Dozer performance is further aided by the inclusion of additional steel and support built into the machine, while also ensuring it meets required ROPS standards.

"There is nothing on the market today that provides this dual functionality and purpose-built design," says Dotto. "There are crawler loaders. You can put a dozer blade on a CTL or a skid steer. But neither of those solutions can provide the all-in-one engineered strength, control, versatility and functionality of this purpose-built dozer loader. It is truly a unique offering to the market."

At CONEXPO, the dozer loader was outfitted with a 3D Leica Geosystems grade control system which Dotto says is ideal for working with the DL450 due to its true dozer-like performance.

Residential contractors, commercial construction contractors and landscapers—basically those looking to add more strength to their fleet, as well as the refined dozing/finishing controls of a bulldozer—are among the key customers CASE sees for the DL450, though it anticipates receiv-

A Nod to Company History

John Dotto, Brand Marketing Manager at CASE Construction Equipment, says elements of the DL450 Compact Dozer Loader Concept Vehicle recall popular legacy machines in the CASE lineup, which is appropriate considering the company will celebrate its 175th anniversary in 2017.

In addition, the machine's "450" nomenclature is reminiscent of the former 450 dozer and 455 crawler loader, two small frame tractors which were popular in their time and can still be seen operated by contractors today.

The dozer loader is shown outfitted with a 3D Leica Geosystems grade control system which is ideal for working with the DL450 due to its true dozer-like performance.

ing interest from customers in a broad range of markets.

The company is currently conducting voice-of-customer input and feedback on the machine, some of which took place at CONEXPO. Though the machine is not yet on the market, Dotto says CASE sees it having a practical place within its product lineup. "Our current belief is that contractors will see the true two-in-one value of the machine, and that the purpose-built performance of the machine in terms of both dozer and loader/attachment functionality will ultimately allow contractors to be more competitive and expansive in the types of jobs they bid on."

PROJECT MINOTAUR

A The main body was born from the base frame of a TV380 CTL – the largest and most powerful CTL in the CASE family – and further increased in size to handle the greater load.

B While the frame is based off of a vertical lift machine, CASE engineers built the pushing power and frame strength of a radial lift machine into the design. The DL450 marries that TV380 frame with a radial-lift loader arm design similar to the CASE legacy 465 skid steer.

C Dozer control features such as blade shake and pitch adjustment will be incorporated.

D Counterweight has been added to the machine, while the undercarriage features steel tracks and grousers, as well as a fifth roller for better traction and greater ground clearance to reduce the likelihood of drag.

E The design includes a rear, integrated ripper. This is achieved without impeding full access to daily service points.

CONCEPT VEHICLES

www.oemoffhighway.com/ifpe-conexpo

John Deere Backhoe of the Future

John Deere and Designworks, a BMW Group subsidiary, gave CONEXPO-CON/AGG 2017 attendees a first-hand look into the backhoe vision of the future, the result of a unique research and design process introduced to John Deere by Designworks called "Fixstern." The concept leverages emerging materials and technology innovations, such as a lightweight metal matrix exoskeleton and a hybrid powertrain, to dramatically reconfigure the traditional backhoe machine form. The futuristic design was presented through unique augmented and virtual reality experiences at the John Deere booth and outside in the Tech Experience.

John Deere and Designworks established four goals on the project to highlight the key areas of advancement. This included designing a highly capable and robust future machine; reducing weight by a minimum of 20% and the machine's environmental impact by a minimum of 10%, and lowering the cost to manufacture; elevating the user experience through user interaction and improved interior spaciousness; and addressing changing market demands through flexibility and versatility.

As a result, the visionary backhoe incorporates several compelling features and innovations. A hybrid powertrain delivers the right amount of machine power, efficiency and lightweighting without compromising productivity. It also enables a lower center of gravity and improves forward visibility. The machine form incorporates forward stabilizers, enabling an extended wheelbase with airless radial tires, which, in turn, improves transport stability and expands the operator station.

To elevate the user experience, John Deere and Designworks expanded the operator station with larger openings and fewer obstructions to improve ingress/egress, visibility and storage space. The isolation of seat and controls from a now-structural rollover protective structure (ROPS) greatly improves comfort and control while reducing vibration and noise. Electric four-wheel steering improves maneuverability in tight areas.

The backhoe itself is manufactured with intelligent, emerging, lightweight materials that help reduce dig component weight, which translates directly into increased payload. A combination of center-mount and side-shift capability delivers versatility, no matter what the application. The implementation of a "tuck" feature minimizes overall length for better on-road driving experience and a smaller parking footprint.

To learn more about the John Deere Backhoe of the Future, go to oemoffhighway.com/20855949.

Volvo CE HX2 Next-Generation Electric Load Carrier Concept

The prototype autonomous, battery-electric, load carrier is one element of an electric site research project that predicts up to a 95% reduction in carbon emissions and up to a 25% reduction in total cost of ownership (TCO).

Watch an interview with Joakim Unneback from CONEXPO-CON/AGG 2017 about the HX2 concept at oemoffhighway.com/20858077.

In addition to battery-electric operation, the load carrier is fully autonomous. It follows an adjustable, pre-programmed GPS path to maneuver around the job site. The HX2 is part of a complete job site solution; it works in tandem with an LX1 prototype hybrid wheel loader and grid connected excavator to complete daily tasks. The company says the project's aim is to electrify a transport step in a quarry—from excavation to primary crushing and transport to secondary crushing. A fleet management system is used to track the vehicles and ensure efficient equipment flow.

To learn more about the HX2, read *Testing Technologies of the Future, Today*, by Sara Jensen at oemoffhighway.com/20849703.

JLG Concept Boom

A static demonstration of a JLG concept boom positioned on uneven terrain demonstrated the machine's self-leveling chassis automatically leveling itself in a longitudinal and/or horizontal direction depending on the demands of the terrain.

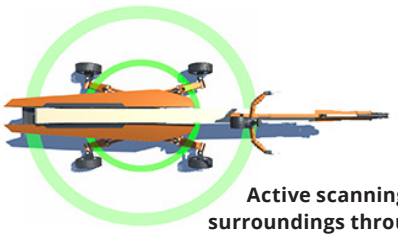
It reduces three-wheeling, allowing the machine to maintain traction on sloped or uneven ground. Machines equipped with a self-leveling chassis can traverse slopes up to 10 degrees with the boom elevated, which means greater uptime and less repositioning.

This feature enables easier loading, unloading, and transport, as the chassis can be lowered to reduce the total height of the machine.

To learn more about JLG's Concept Boom, go online to oemoff-highway.com/20859082.

Fully automatic, real time leveling

Intelligent attachment recognition



Active scanning of surroundings through enhanced detection system

PRODUCT LAUNCHES

www.oemoffhighway.com/directory

Thrust Washers

Freudenberg Sealing Technologies showcases the Levitorque low-friction transmission thrust washer designed to save fuel, lower emissions and extend the operating life of industrial powertrains.

- Relies on the principles of hydrodynamic oil film technology, designed to create a surface on which a bearing can roll, or a load can be applied
- Traditional thrust washers are made from metals, but Levitorque uses proprietary thermoplastic or thermoset alternatives that allow engineers to replace heavy, torque robbing, metal thrust washers
- Material helps reduce weight, decrease friction, improve thickness/flatness control, and often provides a cost benefit to the customer
- Company's proprietary DTRA (Design Tool for Rotary Application) software can simulate how thrust washer designs will behave in unique applications, decreasing development time and cost
- Company has developed thrust washer validation test rigs that can be outfitted for dry and lubricated testing

oemoffhighway.com/20856614

Hydraulically-Actuated PTO

Twin Disc introduces the HP800, a middle horsepower-range option, to its industrial lineup of heavy-duty, hydraulically-actuated PTOs.

- Maximum power rating of 800 hp at 1,800 rpm
- Features modular design allowing for either side-load "P" or in-line "I" applications with simple change of bearing carriers
- Advanced control system allows for smooth engagement of driven equipment
- Rotatable by 0, 45 and 90 degrees, either clockwise or counter-clockwise, to allow for clearance in any installation
- Optional speed increase ratios of 0.77:1 and 0.83:1 are available
- Pads and splines are easily interchangeable to accommodate varying pump sizes
- Sizes SAE A through SAE E are available
- Integrated reservoir can be built in, saving space and reducing installation cost
- Includes spring applied, hydraulically released brake (SAHR) as standard
- Mechanical brake release allows output shaft to easily be rotated

oemoffhighway.com/20854017

Directly Operated Pressure Control Valve

Thomas has developed the PPCD08 (Proportional Pressure Control Direct-Operated) valve to achieve gentle, yet quick hydraulic engagement within powershift transmissions.

- Uses directly operated pressure control
- Suited to clutch control tasks in powershift transmissions for tractors, earthmovers, and crawlers in particular
- Flow rate between 18 and 25 L/min. (4.76 and 6.60 gpm)

- Offers high flow capacity in compact installation space, ensuring clutch is filled quickly and pressure levels are kept stable regardless of flow rate
- Fits into spaces measuring less than 30 mm (1.18 in.) in outer diameter of housing
- Delivers faster switching times (< 45 ms) than predecessors
- Electromagnetic force is transmitted directly to valve spool in directly operated valves and does not need to pass through pressure stage, a technically complex process required in previous models
- Direct mechanical contact with valve spool means better dynamics, fewer pressure overshoots during regulation, and low susceptibility to fluctuations within system
- Vehicle operator does not lose any traction or experience any juddering when changing gear
- Features high proportion of tried-and-tested carry-over parts and simple valve design with few individual components

oemoffhighway.com/20857700

Read Online

Don't forget to...

SEARCH for more product information online using the unique **URL** under each product!

5-Liter Engine

For the first time, Kubota is expanding its diesel lineup to include engines up to the 200 hp class. The first model in the Kubota 09 Series is the 5-liter V5009.

- Meets Tier 4 Final and impending Stage V emissions regulations
- Compact, 4-cylinder design
- Output of 157.3 kW (210.9 hp)
- Aftertreatment devices include DPF and SCR
- Features variety of power take off options for different accessories such as hydraulic pumps

oemoffhighway.com/20856660

12-Cylinder Engine

MAN Engines' 12-cylinder D2862 LE13x engine is based on the most up-to-date engine technology which demonstrates significantly improved performance characteristics.

- Power output range from 588-816 kW (800-1,110 hp)
- Available in variants 588, 650, 750 and 816 kW (800, 884, 1,020 and 1,110 hp)
- Displacement of 24.24 L capable due to 28 mm (1.1 in.) cylinder bore with 157 mm (6.2 in.) stroke
- Waste gate charging allows maximum torque of 3,700-5,000 Nm (2,729-3,688 ft.-lbs.) at low speeds (1,300-1,400 rpm)
- Omission of exhaust gas recirculation results in lower heat dissipation from engine, enabling smaller radiator to be used
- Provides space-saving installation by measuring 1,660 mm long x 1,333 mm wide x 1,391 mm high (65.4 in. x 52.5 in. x 54.8 in.)
- Additional modular exhaust gas aftertreatment system with variable setup options for individual components enables use in wide range of applications
- Meets Tier 4 Final and EU Stage V emissions standards without exhaust gas recirculation, purely via selective catalytic reduction (SCR-only)

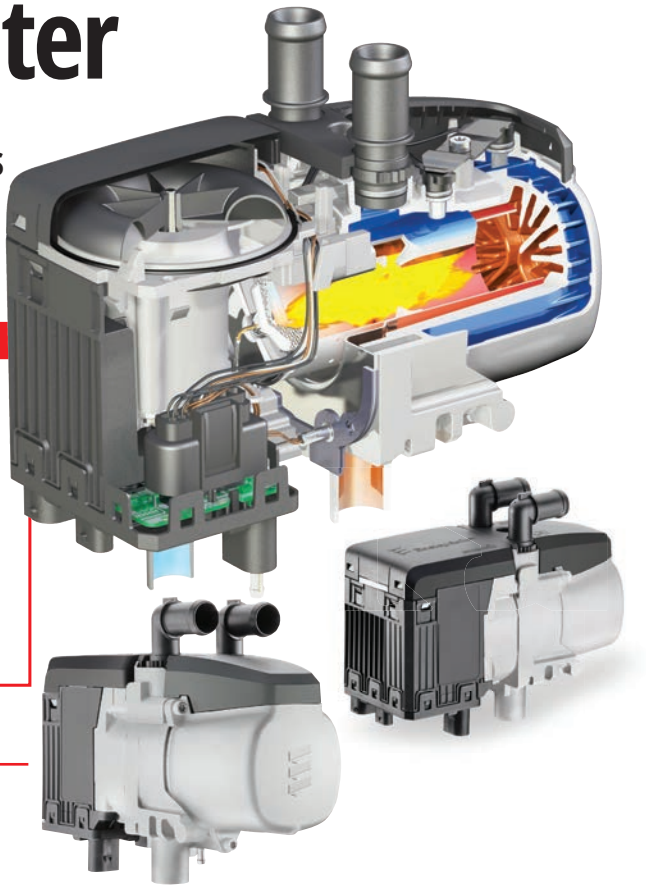
oemoffhighway.com/20855963

FEATURED PRODUCT

www.oemoffhighway.com/12248617

Eberspaecher Hydronic S3 Economy Pre-Heater

The compact water heater features CAN/LIN Bus technology, multiple flow options, installation flexibility, and a quieter performance.



BACKGROUND

Eberspaecher, the leading system developer and supplier of vehicle heaters, is expanding its product portfolio with the new Hydronic S3 Economy pre-heater. The water heater's compact dimensions and flexible installation options make it simple to retrofit in a large number of vehicle models.

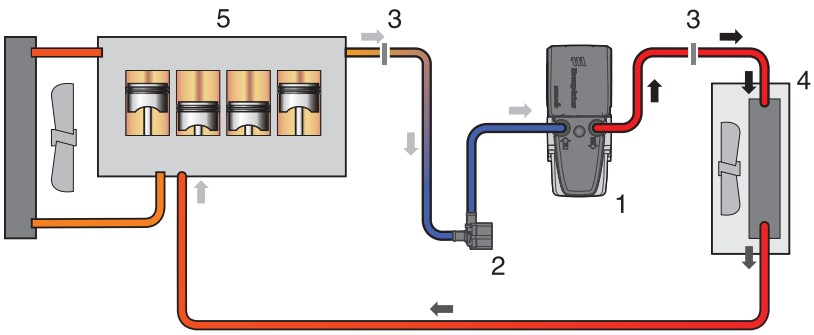
As a groundbreaking all-in-one solution with comprehensive peripheral devices, it offers many practical advantages, such as engine-off cabin pre-heating with advanced defrost, warm reliable engine starts, and the pre-heating of critical fluids like hydraulics.

BENEFITS

- Compact, efficient water heater with CAN/LIN Bus technology interfaces
- Innovative peripheral devices and new diagnostic device
- Simplified installation
- CARB approved

PRODUCT SPECS

- 5 kW | 17,500 BTu/hr output
- Reliable warm engine starts
- Preheat of critical fluids
- Lower fuel costs and emissions
- Increased productivity
- Engine off, instant heat and defrost
- Measures (in inches) 8.4 L x 3.6 W x 4.9 H



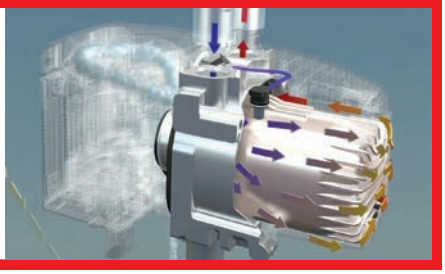
Standard circuit: "inline integration" of coolant circuit

FOR MORE INFORMATION
800-387-4800
www.eberspaecher-na.com

Watch the Hydronic S3 Work

Take an inside look at the features and functionalities — as well as the engineering accomplishments — achieved in the the Hydronic S3 Economy pre-heater from Eberspaecher.

Go online and watch the video at:
www.oemoffhighway.com/20857570

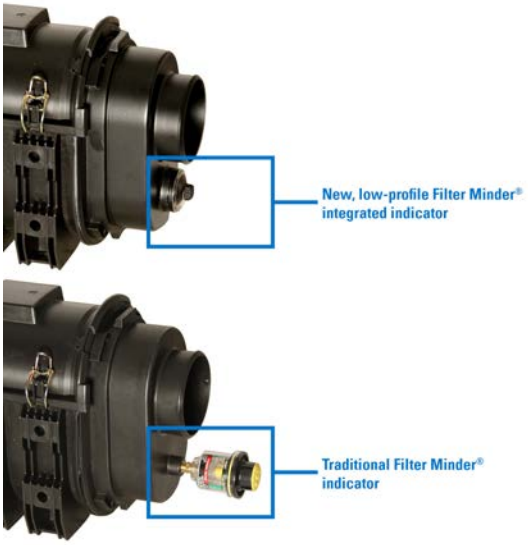


Air Cleaner Indicator

Donaldson Company, Inc. introduces an advancement to its Filter Minder air cleaner indicator technology with a low-profile visual indicator.

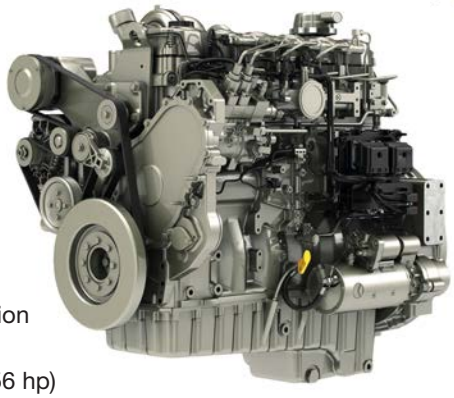
- Low-profile visual indicator line allows for streamlined packaging into an engine air intake system
- Large, visible dial makes the indicator easy to read
- Low-profile design is less susceptible to accidental damage during routine engine maintenance
- Profile is only one-third the height of previous offerings
- OE engineers have more flexibility to position the fully integrated indicator in a variety of locations on the air cleaner housing
- New design results in fewer system components
- Future product enhancements include providing more real-time data

oemoffhighway.com/20856597



9 L Engine

Perkins has expanded its industrial engine range with the launch of the 9 L 1700 Series.



- 6-cylinder turbocharged and aftercooled design
- Direct injection and fully electronic control system that will meet EU Stage V, U.S. EPA Tier 4 Final emission standards
- Power range of 250-340 kW (335-456 hp)
- Offers good power density, allowing construction machine manufacturers to downsize
- Compactly designed
- Low heat rejection allows for small cooling pack, thereby simplifying installation
- On-engine aftertreatment mounting contributes to reduced installation costs

oemoffhighway.com/20856553

Compact Fan

Horton announces an expansion of its High-Efficiency, Hybrid-Flow (HEHF) fan product line.

- Combines features of axial-, mixed- and radial-flow technology
- Compact fans address customer demand for more efficient cooling packages and reduced noise
- Specifically designed to engage more of the radiator core through direct and focused airflow
- Design maximizes cooling capacity by reducing the size of an engine's overall cooling package
- Hybrid-flow design and integrated shroud improve airflow by more than 20% while reducing fan noise by up to 5 dB in vehicle testing
- Applications for both on- and off-highway vehicles and equipment
- Available in 550 and 750 mm (21.7 and 29.5 in.) diameter range, with plans for further expansion

oemoffhighway.com/20856639

Variable Displacement Piston Pumps

The C Series Variable Displacement Piston Pumps from the Hydraulic Pump and Power Systems Division of Parker Hannifin Corporation are designed for use in closed-circuit hydrostatic applications.

- Features rugged swash plate and bearing design
- Offers full range of controls, such as manual lever with feedback, hydraulic proportional and electric proportional
- Available with variety of accessories including hydraulic pressure override, electric cut-off valve and cross-port relief valves to protect from pressure overloads
- Rated to 420 bar (6,090 psi) continuous pressure and 3,800 input rpm
- C055 model is a 55cc/rev (3.35 CIR) unit that also features compact and robust design

oemoffhighway.com/20856386

FEATURED PRODUCT
www.oemoffhighway.com/12167680

SIKO Position Sensor Makes Hydraulic Cylinders Smart

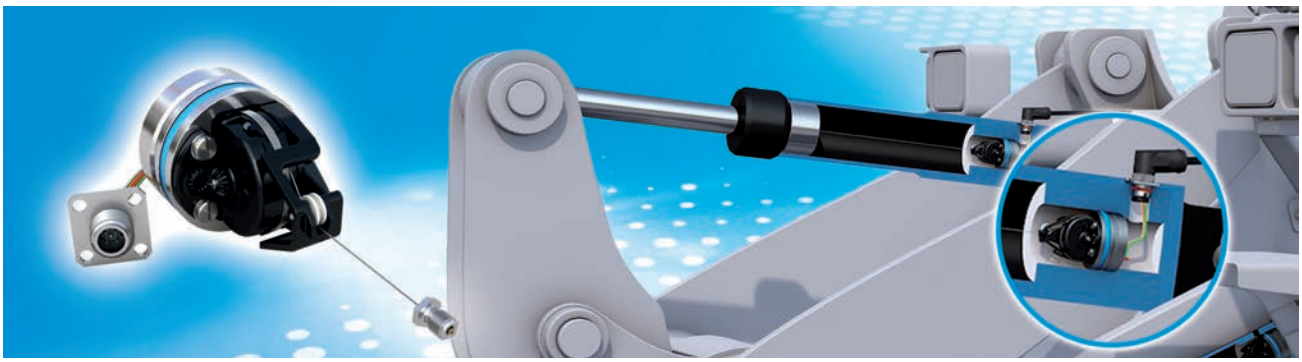
The wire-actuated encoder from SIKO GmbH measures the absolute, direct cylinder stroke in a hydraulic or telescopic cylinder.

COMING SOON

Later this year, the SGH Sensor range from SIKO GmbH will be complete with two additional measuring lengths:

- **The SGH25 at 2.5 meters**
- **The SGH50 at 5.0 meters**

All three sensors in the SGH Sensor family (SGH10/25/50) will be available with analog, CANopen and SAE J1939 outputs.



BENEFITS

- Intelligent functions improve the convenience and safety of mobile machines, increases performance and efficiency, and allows repetitive work processes to be automated
- No drilling of the piston necessary
- Can be used in telescopic cylinders

PRODUCT SPECS

- Measuring range 0...1000 mm (36 in.)
- Absolute measuring system
- Operating voltage 9-32V DC
- CANopen interface, analog: current and voltage
- Pressure-resistant up to 300 bar, pressure peaks up to 500 bar
- High degree of flexibility, adjustable to all measuring lengths
- Electro-magnetic compatibility
- Shock and vibration resistance

FOR MORE INFORMATION
Cary Mulvany
Branch Manager - Mobile Automation
SIKO GmbH
734-426-3476 ext. 217
cary@sikoproducts.com

Watch the SGH10 in Action!

The SGH10 is a specialized, integrated and innovative measurement solution for direct stroke measurement in hydraulic cylinders.

Go online and watch the video at:
www.oemoffhighway.com/20848221

Steering Valve

Power management company Eaton introduces the ASV60 Steering Valve, a compact, modular valve that helps reduce cab noise and improve machine flexibility and intelligence.

- Designed for mobile off-highway equipment in the construction, agriculture and material handling industries
- Allows tailoring of steering performance to operator's driving habits or operating conditions
- Mountable on orbitrol controller or remote mounted wherever space exists on machine
- Prototype allowed machine designers to remove front- and rear-mounted steering wheels, instead using a joystick and steer-by-wire system
- Enables all hydraulics to be moved out of cab, significantly reducing operator noise
- Meets safety level PLD

oemoffhighway.com/20856025

Modular Lights

HELLA's modular light series Shapeline allows manufacturers to arrange their own individual vehicle light signatures in a modular system.

- Enables manufacturers and designers to compile their own design with the click of a mouse using HELLA Shapeline configurator
- Automatically integrates either current American SAE regulation or European ECE R48 regulation
- Available in two design alternatives: classically straight "Shapeline Tech" and dynamically curved "Shapeline Style"

oemoffhighway.com/20853976

Heavy-Haul Planetary Axle

Meritor Inc. introduces its P600 Series Tridem Heavy-Haul Planetary Axle for heavy-duty, long-haul, oil field, mining and logging applications. Full production begins in June.

- Developed for global markets
- Built to operate in extreme conditions
- Compatible with industry-leading suspension options
- Offers gross axle weight rating (GAWR) of 126,000 lbs. and gross combination weight of 560,000 lbs.
- Proportioning inter-axle differential delivers even torque split between the three axles for improved traction, maximum load capacity and increased longevity of drivetrain
- Wide ratio coverage and standard anti-lock brakes deliver optimum safety and performance in extreme conditions
- Can be equipped with optional driver-controlled differential lock and hardware for central tire inflation systems (CTIS)

oemoffhighway.com/20854235

Inline Aftertreatment System

John Deere Power Systems has debuted its latest Integrated Emissions Control system configured with an inline aftertreatment device.

- Offers greater packaging and integration flexibility to both internal John Deere and OEM customer applications
- Contains diesel particulate filter (DPF), diesel oxidation catalyst (DOC) and selective catalytic reduction (SCR) system, achieving Tier 4 Final and Stage V emission levels
- Can be mounted horizontally or vertically
- Diesel exhaust fluid (DEF) management system provides efficiency and performance
- Enhanced interface points ease application integration and reduce leak paths, connection points and heat loss
- Available in two sizes for 13.6L engine

oemoffhighway.com/20855643

Electrohydraulic Inline Steering Valve

Danfoss Power Solutions' EHi electrohydraulic inline steering valve is compact, making it beneficial when working in limited engine compartment spaces.

- Can be used to remove steering column and steer with joystick or other steer-by-wire inputs for four-wheel, or even full autonomous, steering
- Flow capacity from 12-70 lpm (3.17-18.5 gpm)
- Works with most applications in small- to mid-size vehicles
- Ten available hydraulic configurations
- Flexible mounting options
- Allows OEM to receive complete Category 3 safety architecture
- Steering system is SIL2 certified when used with PVED CLS

oemoffhighway.com/20853965

WHERE SHOULD YOU BE GOING NEXT?

Use OEMOffHighway.com's new Event Filters to sift through hundreds of relevant industry events, seminars and expositions around the world. Search by a particular industry, system, topic or event type and get traveling!

FLUID POWER TECHNOLOGY CONFERENCE
Milwaukee School of Engineering (MSOE) Kern Center
May 16-17, 2017 | Milwaukee, WI
www.fluidpowertechconference.com

INTEGER EMISSIONS SUMMIT & ADBLUE FORUM CHINA
Renaissance Beijing Capital Hotel
May 16-18, 2017 | Beijing, China
www.integer-research.com/conferences/ies-china-2017

AMCON DESIGN & CONTRACT MANUFACTURING EXPO
Overland Park Convention Center
May 17-18, 2017 | Kansas City, KS
www.amconshows.com/spring-shows/kansas-city-ks

NIWEEK 2017
Austin Convention Center
May 22-25, 2017 | Austin, TX
www.ni.com/niweek

PROFESSIONAL EDUCATION SEMINAR: ELECTRICAL MOTORS
GS Global Resources
May 31-June 2, 2017 | Mukwonago, WI
www.msoe.edu

INTERMAT ASEAN
Impact Exhibition & Convention Center
June 8-10, 2017 | Bangkok, Thailand
asean.intermatconstruction.com

NAFEMS WORLD CONGRESS
Stockholm Waterfront Congress Center
June 11-14, 2017 | Stockholm, Sweden
www.nafems.org/congress

SAE NOISE AND VIBRATION CONFERENCE AND EXHIBITION
DeVos Place Convention Center
June 12-15, 2017 | Grand Rapids, MI
www.sae.org/events/nvc

FOREST PRODUCTS MACHINERY & EQUIPMENT EXPO
Georgia World Congress Center
June 14-16, 2017 | Atlanta, GA
sfpaexpo.com

HYDRAULIC SPECIALIST CERTIFICATION REVIEW
GS Global Resources
Jun. 19-21, 2017 | Mukwonago, WI
www.msoe.edu

INTERNATONAL FUEL ETHANOL WORKSHOP & EXPO
Minneapolis Convention Center
June 19-21, 2017 | Minneapolis, MN
www.fuelethanolworkshop.com

VALVE WORLD AMERICAS EXPO & CONFERENCE
George R. Brown Convention Center
June 20-21, 2017 | Houston, TX
www.valveworldexpoamericas.com

ENGINE EXPO
Messe Stuttgart
June 20-22, 2017 | Stuttgart, Germany
www.engine-expo.com

ITEC 2017
Navy Pier
June 22-24, 2017 | Chicago, IL
itec-conf.com

SENSORS EXPO & CONFERENCE
McEnery Convention Center
June 27-29, 2017 | San Jose, CA
www.sensorsexpo.com

INTERNATIONAL SYMPOSIUM ON AUTOMATION AND ROBOTICS IN CONSTRUCTION
National Taiwan University of Science and Technology
June 28-July 1, 2017 | Taipei, Taiwan
www.isarc2017.org

INTL. CTI CONFERENCE SCR SYSTEMS/OFF-HIGHWAY APPLICATIONS
Dormero Hotel Stuttgart
July 5-7, 2017 | Stuttgart, Germany
cti.euroforum.de/en/events/scr_systems_2017

WISCONSIN FARM TECHNOLOGY DAYS
Ebert Enterprises
July 11-13, 2017 | Algoma, WI
www.wifarmtechnologydays.com

ASABE ANNUAL INTERNATIONAL MEETING
Spokane Convention Center
July 16-19, 2017 | Spokane, WA
www.asabemeetings.org

NFPA INDUSTRY & ECONOMIC OUTLOOK CONFERENCE
Westin Chicago North Shore
August 14-16, 2017 | Wheeling, IL
nfpaevents.com/ieoc

AUTONOMOUS VEHICLES 2017
TBD
August 22-24, 2017 | Detroit, MI
autonomousvehiclesevent.iqpc.com

AIMEX
Sydney Showground
Aug. 29-31, 2017 | Sydney, Australia
www.aimex.com.au

FARM PROGRESS SHOW
Farm Progress Show Grounds
Aug. 29-31, 2017 | Decatur, IL
farmprogressshow.com

GREAT LAKES LOGGING & HEAVY EQUIPMENT EXPO
UP State Fairgrounds
Sept. 7-9, 2017 | Escanaba, MI
gltpa.org

FTR TRANSPORTATION CONFERENCE
Crowne Plaza Hotel Downtown at Union Station
Sept. 12-14, 2017 | Indianapolis, IN
www.ftrconference.com/wp

THE BATTERY SHOW
Suburban Collection Showplace
September 12-14, 2017 | Novi, MI
www.thebatteryshow.com

ELECTRIC & HYBRID VEHICLE TECHNOLOGY CONFERENCE
Suburban Collection Showplace
September 12-14, 2017 | Novi, MI
www.evtechexpo.com

SAE COMMERCIAL VEHICLE ENGINEERING CONGRESS
Crowne Plaza Chicago O'Hare Hotel and Convention Center
Sept. 18-20, 2017 | Rosemont, IL
www.sae.org/events/cve

BICES 2017
New Beijing International Exhibition Center
Sept. 20-23, 2017 | Beijing, China
www.e-bices.org

NORTH AMERICAN COMMERCIAL VEHICLE SHOW
Georgia World Congress Center
Sept. 25-29, 2017 | Atlanta, GA
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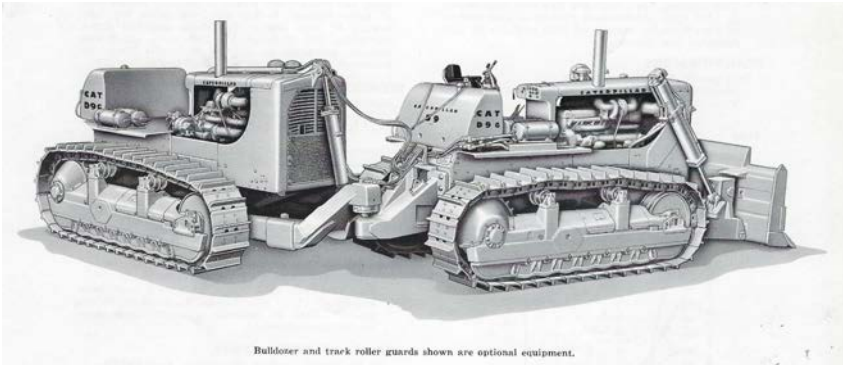

CATERPILLAR, INC. SPEC SHEET 1823-412-A, NOVEMBER 1964. HCEA ARCHIVES

Caterpillar D9G crawler tractors with the Quad-Track Arrangement, shortly after the arrangement was introduced.

The Dual D9

Instead of multiple tractors coordinating efforts behind a single scraper, a lead tractor was coupled with a second via a ball joint and operated by synchronized controls.

by Thomas Berry, Archivist, Historical Construction Equipment Assn.

Efficient pushloading of an open bowl scraper often required more power than could be provided by one tractor *(read last issue's Off-Highway Heroes column,* Pushloading*, to learn more, 20852079)*. A more powerful tractor was an option, but when power requirements exceeded what was commercially available, most contractors did not have the means to customize. Besides, more powerful tractors tended to be larger, leading to logistical problems, such as being too wide to move behind the scraper without pushing dirt from the sides of the cut, and being too large and heavy for transport without disassembly.

Instead, two or more tractors (five is the most known to have been used) could be lined up behind the scraper. But while the scraper would be loaded more quickly, there were drawbacks. A lot of coordination between operators was required, and the scraper and the lead tractor could end up waiting for the second. Congestion in the pit increased markedly as multiple tractors, instead of just one, required maneuvering back into position for another push. Also, each tractor had its own costs, including the operator; so the cost of pushloading one scraper multiplied more or less by the number of tractors pushing it.

R. A. "Buster" Peterson had the answer. He had established an outstanding record for California Caterpillar dealer Peterson Tractor & Equipment Company, designing attachments and modifications for Cat equipment, as well as shop equipment and tooling. One of his modifications was to combine two Cat D8s into one tractor in the late 1940s by putting two engines and drivetrains on one set of crawlers. It had plenty of power, but ran afoul of the dimensional issues by being doubly wide.

In the early 1960s, he came up with a different approach to the problem. His idea was eminently logical—instead of building one big tractor, put two smaller (relatively speaking) tractors together to make a big one. He coupled two Cat D9Gs together end-to-end by means of a ball joint with a down-pressure hydraulic cylinder on the front of the second tractor to increase traction from one tractor to the other, or float the rear tractor to smooth the ride of the first. Both were operated from the lead tractor through synchronized controls.

The concept provided some 760 hp (566.3 kW) under control of one operator, all available at once instead of waiting for a second pusher. It solved the problem of multiple pushers in the cut, as the Dual D9 could return across rough ground for another push faster than two separate machines because of the weight transfer. Finally, the single operator would be less fatigued because of less stress and a smoother ride.

The idea caught on, and a number of earthmoving contractors ordered new sets of Dual D9s for heavy pushloading applications, or the components to assemble their own. In the late 1960s, Anaconda Copper amassed no less than 13 Dual D9s—which were also known as Quad D9s or Quad-Tracks—to pushload 52 Cat scrapers during overburden removal at its Twin Buttes Mine near Green Valley, AZ. Cat itself bought the rights to the design in 1968 and continued production into the D9H era. They were finally discontinued when the D10 was introduced.

The Historical Construction Equipment Assn. (HCEA) is a 501(c)3 non-profit organization dedicated to preserving the history of the construction, dredging and surface mining equipment industries. With over 4,000 members in 25 countries, its activities include publication of a quarterly educational magazine, Equipment Echoes*; operation of National Construction Equipment Museum and archives in Bowling Green, OH; and hosting an annual working exhibition of restored construction equipment. The 2017 show will be November 3-5 in North Carolina. Individual memberships are $35.00 within the USA and Canada, and $45.00 U.S. elsewhere. HCEA seeks to develop relationships in the equipment manufacturing industry, and offers a college scholarship for engineering and construction management students. Information is available at www.hcea.net, by calling 419-352-5616 or e-mailing info@hcea.net.*

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