

Underground mining

John Deere Power Systems offers two diesel engines suitable for the tough environments of the underground mining market. PowerTech 2.4 (shown) and 3.0 L low-profile diesel engines are suitable for low-



clearance equipment such as personnel carriers, lube centers, utility vehicles, pumps, and compressors. The 2.4-L engine features four cylinders and a power range of 37 to 47 kW (50 to 63 hp), while the 3.0-L engine has five cylinders and a range of 56 to 62 kW (75 to 83 hp). Both models feature an improved fuel system for clean design and minimized leaks, reduced noise and vibration, integrated multifunction components, and a 500-h oil change and filter interval.

Drive axle

Dana's Spicer Model 114 (33R092) Hercules drive axle was designed for vehicles with an operating mass up to 15 ton (13.6 t) in front-axle applications and 18 ton (16.3 t) in rear-axle applications. Model 114 features 425 mm (16.7 in) wheel mounting, self-ad-



justing internal wet brakes, a trunion mounting option, and torque-biasing differential options. Engineered for the mining and forestry industries, the drive axle's

clutch-actuated, limited-slip differential lock provides a 45% locking capacity that delivers tractive force and vehicle steering for front-end wheeled loader applications. Hydraulic-locking differential options, including a park brake, improve reliability, while liquid-cooled brakes offer fail-safe stopping performance.

Marine engine

Caterpillar Marine Power Systems offers C32 marine propulsion and generator-set engines with ACERT technology for the commercial workboat market, including lobster and fishing boats, patrol craft, commercial utility vessels, and



tugs. The 32.1-L engine features high levels of torque, improved acceleration, a small footprint, side-access block for service, optional deep-sump oilpan, and a commercial cooling system. The compact V12 C32 features a twin turbocharger and aftercooler. Dual electronic control units improve monitoring and I/O capabilities, and a 70-pin connector offers remote operation and display. A two-piece forged steel piston handles high engine-firing pressures, and engine liners improve oil retention.

Power-shift transmission

ZF offers the WG 90/94 power-shift transmission for small, self-propelled construction machinery and off-highway vehicles such as loaders, telehandlers, and forklifts with empty vehicle mass of up to 8.5 ton (7.7 t) and engine power ratings of up to 75 kW (100 hp). Features include quick reversing, high road speed, improved noise emissions and serviceability, an



optional front axle disconnect feature, and a lightweight, flexible design. The WG 90/94 is a power-shift forward-reverse shuttle group with an integrated torque converter and a reduced number of internal parts, increased helical gear contact, and shorter shafts.

Compact engine

The 400 series of 10 compact engines from **Perkins** offers 11 to 66.5 hp (8.2 to 49.6 kW) and meets all major emissions requirements up to 2012 for North America and Europe. Features include ease of changeover, broad choice with



model instructions to meet key power nodes, and various product refinements to improve installation and user experience. Noise is improved up to 3 dB(A) with the option to lower it an additional 2 dB(A) with a low-noise fan. Redesigned coolant flows improve cooling performance and reduce radiator size, while standard power takeoff increases torque availability and improves sourcing of hydraulic pumps.

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Filter indicator

Donaldson filter service indicators maximize filter use and signal when filters should be changed. The restriction measurement tools offer a reliable assessment of filter service life not possible by visual inspection alone. Indicators may



be attached to an air cleaner, in the ducting, or remotely. Benefits, according to the company, include reduced maintenance costs, assurance of the longest possible filter life, and improved engine protection. The line of indicators includes models designed for light-, medium-, and heavy-duty vehicles; all are resistant to vibration, breakage, weather, corrosion, dust, and dirt to ensure reliable filter restriction readings.

Side-PTO engine

The **Kubota** 07 series features the V3007-DI-T and V3307-DI-T offering 65 and 74.3 hp (50 and 55 kW), respectively. The company's cylinder block design allows



for a larger displacement within the 2.4-L engine package. Kubota 07 series engines feature up to 100% power take-off (PTO) from a geartrain located on the flywheel side and designed for compact positioning of PTO hydraulic devices. Up to three hydraulic pumps with various capacities can be installed.

Closed-crankcase ventilation

The CCV12000 series closed-crankcase filtration systems from **Parker Hannifin/Racor Division** slow oil consumption by returning the captured oil back to the crankcase. They are suited for applications in which extra capacity is desired and immediate engine accessibility is not available. The robust, compact systems provide improved coalescence and



crankcase pressure control. The units feature environmentally friendly design, reduced oil consumption, extended service life of turbo and aftercooler, and easy installation.

Turbocharged four-cylinders

The 2010 series of turbocharged four-cylinder compact engines from **Deutz** offers power outputs up to 75 kW (100 hp) with a displacement of 3.5 L. Offered with or without charge air cooling depending on requirements, the engines were designed for harsh operating conditions and are suitable for construction and agricultural equipment. Features include a bore of 96 mm (4.0 in) and a stroke of 120 mm (5.0 in). Power output ranges from 64 to 75 kW (85 to 100 hp), and maximum torque is 350 N·m (260 lb·ft). Engines operate with direct



fuel injection; mechanical governors are standard with an optional electronic engine governor.

Driveline system

In its backhoe driveline system, **Carraro** couples a 26.22 front axle, 28.48 rear axle, and TLB1 servo synchro transmission




that combines the features of synchronized and automatic gearboxes. The company says that the servo synchro scheme offers "significant advantages" vs. the power-shift version, including equal or better shifting performance, reduced power loss, a simplified architecture with fewer components and complex parts, and easier installation. A monolithic structure adds to the durability of the axle, which Carraro says offers optimal heat exchange, less power loss, and easier serviceability due to outboard service brakes.

Flywheel couplings

HEX-FLX flywheel couplings from **Hayes Manufacturing** offer a two-piece design for users to operate hydraulic pumps above critical speeds and to maximize torsional vibration. The temperature-resistant composite construction extends life, while improved ventilation creates a more stable environment.



The light and compact couplings were designed to handle high shock loads. Other features include a large driving surface and multiple hub lengths for improved installation, a secure locking system to minimize spline fretting, and an operating temperature range of -40 to +300°F (-40 to +150°C). Suitable applications include low- to mid-range off-highway construction equipment such as aerial lifts, excavators, and bucket, skid steer, and wheeled loaders.



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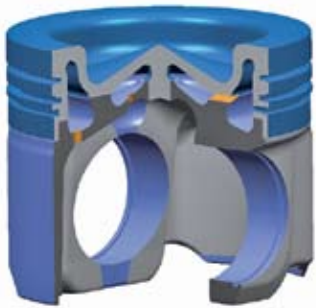
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Aluminum pistons

A cooled aluminum ring carrier piston from **Mahle** is recommended for medium heavy-duty commercial vehicle diesel engines with high loads and peak cylinder pressures of more than 220 bar



(3190 psi). Constructed from high-temperature-resistant aluminum alloy, the pistons' cooled ring carrier enables a reduction in bowl edge temperature by as much as 30°C (54°F) and extends service life. Other benefits include improved oil consumption and blow-by as well as combustion optimization while maintaining production-level dimensions.

Rugged diesel

MTU's series 4000 diesel engines for high-speed construction machinery, rail, and marine applications compress charge air up to 5.0-bar (72.5-psi) and adjust to onsite pressures through an electronic engine-control system. Benefits include a reduced risk of fire for mining vehicles,



improved economy, and performance up to an altitude of 3700 m (12,100 ft). The engine control also adjusts the injection system to optimum combustion values, lowering fuel consumption and exhaust emissions. Engines are available in 12-, 16-, and 20-cylinder versions, and a constant pressure of 1800 bar (26,000 psi) is achieved across the operating range of 1200 to 2800 kW (1600 to 3750 hp).

Bypass oil filters

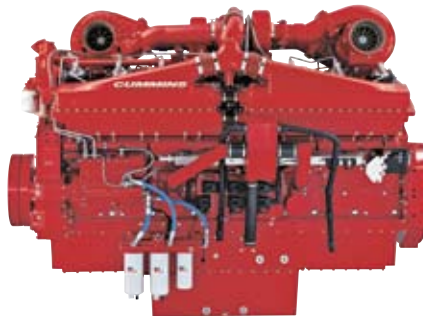
The Racor Off-Highway Bypass Oil Filter series from **Parker Hannifin/Racor Division** removes dirt, varnish, ash, tar,



soot, and other contaminants that full-flow filters cannot remove from an engine's oil and hydraulic systems. The system also removes condensed water, which forms component-damaging acids if left in the oil. It removes 99.5% of damaging contaminants to minimize wear and extend engine component life. The series comes in various sizes and capacities to fit any application. Benefits include significantly reduced maintenance costs, increased engine life, and quick installation.

Mining engine

The Tier 2 QSK60 single-stage turbocharged mining engine from **Cummins** is rated from 1389 up to 2014 kW (1860 to 2700 hp) and is available for applica-



tions down to 3000 m (10,000 ft). Benefits include a compact, lower-weight installation, reduced maintenance, and improved fuel economy, according to the company. The QSK60 provides up to 10,628 N·m (7840 lb·ft) torque at 1500 rpm, making it suitable for the durability and power-density requirements of high-hour and hard duty-cycle applications such as front-end loaders, mining excavators, and haul trucks. The company's modular common-rail fuel system increases power while maintaining standard low-pressure turbocharging and aftercooling systems.

Electronic transmission control

Poclair Hydraulics' SmartDrive Easy electronic transmission control system contributes to meeting Tier 3 standards. Tier 3 imposes a CAN bus system to col-

lect the engine's data. The data are readily available with the system, which controls the engine and the pump's displacement using CAN bus. Along with a competitive price and simple setup process, system features include automotive-style driving, speed regulation, and braking assistance. Additional functions



contributing to reduced fuel consumption and limited noise include acceleration and deceleration control, power limitation, and anti-stall.

Low-emissions engines

Tier 3/Interim Tier 4, and European Union Stage III A ready engines under 75 kW (100 hp) are available from **John Deere Power Systems (JDPS)**. Four ratings of the naturally aspirated or turbocharged PowerTech M 2.4 L engine are planned, while four ratings of the turbocharged and air-to-air aspirated PowerTech E 2.4 L engine and one turbocharged PowerTech 3.0 L (shown) are ready. The E series engines are designed



as a simple emissions solution that uses a fixed-geometry turbocharger and full-authority electronic controls, while the M series is a simpler mechanical engine best suited for lower-horsepower applications. In addition, six PowerTech E Tier 3/Stage III A ratings will be offered above 56 kW (75 hp).

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Overhead-valve engine

The **Subaru** Robin EH035 and EH035V mini four-cycle overhead valve engines feature a lightweight design, improved performance and starts, smooth operation, and low emissions, making them a



suitable power source for various types of handheld equipment. The EH035 horizontally mounts, while the EH035V vertically mounts, diversifying the application range. Offering two-cycle engine capabilities in a four-cycle configuration, the air-cooled, single-cylinder engines produce a maximum 1.6 hp (1.2 kW). Other features include a compact oil tank and crankcase-base design, heavy-duty components, automatic decompression system for one-pull starts, low-vibration design, resin-constructed cam gear blower housing and rocker covers, and a mass of 8 lb (3.5 kg).

Natural-gas power

Due to the success of its 913 series diesel engines, **Deutz** has developed a natural-gas-powered version for continuous-duty operation in the 20 to 89 kW (27 to 120 hp) range. The robust inline engines feature turnkey power units with three, four, and six cylinders. All components except the cylinder heads and pistons are



identical to those used in the diesel versions. The engines can be operated with natural gas or propane. Features include a bore of 102 mm (4 in), stroke of 125 mm (5 in), corresponding cylinder displacement of 1.02 L, and an improved ignition

system with established components and water-resistant connectors. A turbo-charged six-cylinder unit with charge air cooler is available.

Air cleaners

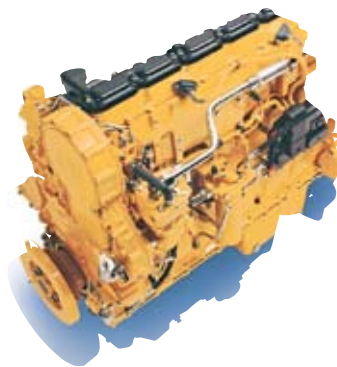
Four additional products have been added to **Mann+Hummel's** PicoFlex air cleaner series. The PicoFlex V two-stage and S single-stage cleaners have been developed for flow rates up to 7 m³/min (250 ft³/min), while sizes 10 and 14 m³/min (350 and 500 ft³/min) have been added to the line for high flow rates. The easy-to-service V and S feature an oval design, making them suitable where installation space is limited. The V has a



cyclone precleaner and dust-discharge valve and is designed for dusty operating conditions, while the S variation is suitable for low-dust applications requiring a low initial pressure drop. The complete PicoFlex line now covers a flow rate range of 4.5 to 14 m³/min (160 to 500 ft³/min).

Emissions-compliant diesels

Caterpillar has grown its family of Tier 2/Stage III A and Tier 3/Stage III A compliant diesel engines—with ACERT technology—to include 12 models that



cover a range from 62 kW to 2700 kW (83 to 3600 hp). The C15 engine, a Tier 3/Stage III A compliant diesel, is just one example. Intended for off-highway applications, the C15 is rated from 328 to 444 kW (440 to 595 hp) at 1800 to 2100 rpm and outfitted with ACERT. ACERT technology enables the engine to focus on the precise control of the combustion cycle by taking a systems approach to air management, electronics, fuel systems, and combustion systems.

Commercial generators

Briggs & Stratton introduces a range of Vanguard powered generators and welders including single- and three-phase versions for off-highway applications.



Single-phase generator sets between 2.2 and 9.0 kVA deliver 220 V at 50 Hz. Sets are supplied with two single-phase sockets and thermal protection; selected models also feature a voltmeter and electric start. The three-phase range provides 400/230 V at 50 Hz and includes two standard single-phase sockets, one three-phase socket, and thermal protection. The line uses commercial-grade components, including engines and alternators, to withstand harsh environments onsite.

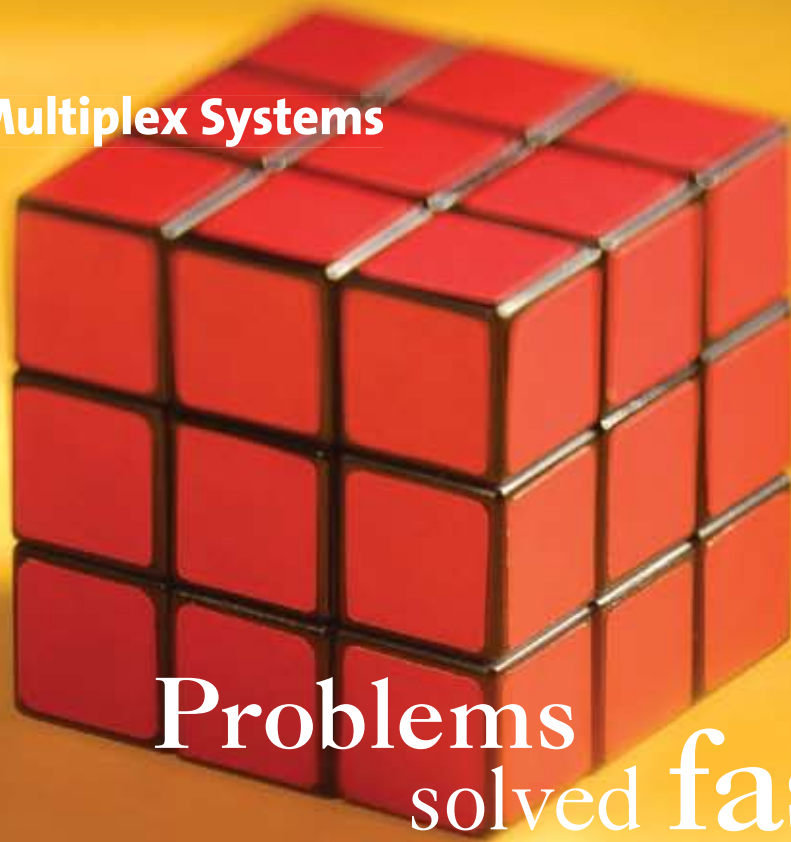
Efficiency upgrades

The Ergopower efficiency packages from **ZF** were designed to improve driver comfort and decrease operating costs by



improving fuel efficiency and shift comfort and by reducing wear. The ZF-Ergolockup ensures the converter lockup is modulated and applied by the software at low speeds to reduce wheel-loader fuel consumption by up to 15% and to decrease noise. ZF-Ergotraction automates engagement and disengagement of power-shiftable differentials and enables an automated axle-disconnect function to improve fuel consumption and driving performance at high speeds.

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Common-rail technology

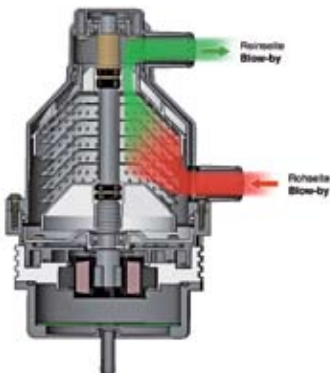
A family of Tier 3/Stage III A certified PowerTech E off-highway diesel engines from **John Deere Power Systems** offers improved performance and four displacement options. The 6.8 L features a



power range of 104 to 149 kW (140 to 200 hp); the 4.5 L 63 to 104 kW (85 to 140 hp); the 3.0 L 48 to 75 kW (65 to 100 hp); and the 2.4 L 45 to 60 kW (60 to 80 hp). Full-authority electronic controls improve cold-start performance, engine-speed control, and torque-curve shaping. The engines feature a two-valve cylinder head; are turbocharged or air-to-air intercooled; and incorporate a high-pressure common-rail or an electronic unit pump fuel system, multiple injection strategy, and a fixed-geometry turbocharger.

Disk separator

Mahle's electrically driven disk separator was designed as a service-life component and requires no additional maintenance up to 1.2 million km (750,000 mi). The separator can extract more than 98.5% of pollutants, lowers oil consumption, and requires no additional replacement parts such as filters, according to the company. Designed with non-wear



components and offered as a module ready for installation, the disk separator features various installation position options and is driven by a brushless direct current motor.

Multiple-disc brake

A wheel-end brake from **Mico** is designed for installation on purpose-built or converted light-duty vehicles. The wet multiple-disc brake provides a durable and dependable alternative to standard OEM brake systems that require maintenance due to harsh or corrosive environments. The brakes are enclosed and intended to replace standard caliper disc and drum brakes on light-duty vehicles such as personnel carriers and maintenance trucks. The unit decreases brake



maintenance costs over the vehicle's life while increasing brake performance and driver safety. Currently deployed in several underground mines in North America, the existing brake design can be modified for various vehicles and industries, depending on requirements.

Rugged gasoline engines

Kohler adds six models to the Command PRO engine line for construction and industrial applications, including turf mowers, generators, and pumps. The 34-, 36-, and 38-hp (25-, 27-, and 28-kW) gasoline engines offer increased power and an improved design to extend maintenance intervals. A 90° twin-cylinder overhead-valve design features an electronic ignition system, two-barrel carburetor, and mechanical governor. Air-cooled Command PRO models are available in horizontal- and vertical-shaft configurations and meet EPA Tier 3 emissions requirements. Features include a bore and stroke of 90 x 78.5 mm (3.5 x 3 in), dry mass of 130 lb (60 kg), top-



mounted oil and air filters, front-mounted choke and throttle controls, hydraulic valve lifters, aluminized muffler, and full power capability.

Data collector

Cummins releases the QuickCheck 5100 handheld engine information tool to monitor electronic diesel engines.

Designed for extreme environmental conditions, the rugged, weather-resistant device features a 97-mm (4-in) backlit LCD screen and connects using standard data links with supplied 6- or 9-pin cables.



QuickCheck reads and captures fault codes, parameter values, and lifetime trip data and allows users to monitor various information from any engine with electronic controls, transmission, braking, and vehicle systems. A supplied USB cable enables the device to be linked to a desktop PC to download created job summary reports for analysis.

Diesel generators

The RGD3300H and RGD5000H lines of diesel generators from **Subaru** are powered by **Hatz** four-cycle, single-cylinder diesel engines and are suitable for the oil, mining, and marine industries. The RGD3300H features a 6.8-hp (5-kW) Hatz 1B30 engine with an output of 3000 W, while the RGD5000H offers a 9.9-hp (7-kW) Hatz 1B40 rated at 5000 W. Both single-phase capacitor-type generators have electric starters with recoil backup, fuseless circuit breakers, and ground-fault circuit interrupter receptacles to



protect the current level, full-power switches, spark arrestors to decrease noise, voltmeters, 4.4-gal (16-L) fuel tanks, a low-oil shutdown system, and 12-V dc charging.



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Six-cylinder power

Perkins' flagship 1106D-E66TA six-cylinder engine delivers up to 186 kW (250 hp) and more than 1000 N·m (740 lb-ft), providing improved power density over the Tier 2/Stage II product. Increased displacement to 6.6 L, high-pressure common-rail fuel system, reworked turbocharger geometry, and re-



finements to the manifold and combustion areas further improve power and torque. The 1106D-E66TA uses Caterpillar ACERT technology to better fuel economy and lower heat rejection, while engine noise levels have been reduced up to 5 dB(A) for a smooth noise signature across the speed range. Various options are available, and the range is also compatible with B-20 biodiesel.

Small-package power

Cummins' 82 kW (110 hp) rated 3.3-L QSB3.3 diesel engine offers performance equivalent to a 4.0- or 4.5-L engine but



with a 30% smaller and lighter installation package, according to the company. The QSB3.3 incorporates full-authority electronic controls and a high-pressure common-rail fuel system. The small, economical engine meets EPA Tier 3/EU Stage III A emissions requirements and is suitable for powering compact construction equipment. Features include improved power and reduced noise.

Single-cylinder engine

A series of 5.5 to 9.0 hp (4.0 to 6.7 kW) Vanguard single-cylinder engines from Briggs & Stratton features heavy-duty internal-design components for improved durability. The cylinder and crankcase cover feature dual industrial ball bearings to extend engine life, while a valvetrain system with steel pushrod guides, large rocker arms, and heavy valve springs allows higher loads with a



wide engine speed range. An industrial dual-element air-cleaner system is standard, and a heavy-duty cast-iron inertia flywheel maintains engine performance when intermittent loads are applied. Optimized piston skirt profiles improve oil control, reduce emissions, and reduce engine noise, according to the company.

Pressure sensors

PCB Piezotronics offers the series 105 family of ICP miniature dynamic pressure sensors suitable for monitoring dynamic combustion pressure in diesel and natural-gas-powered engines. Features include extended maintenance intervals, improved fuel efficiency, lower NOx emissions, lack of moving parts, and solid-state construction. Mountable internal to the engine, series 105 offers a



range of 3600 psi (250 bar) with maximum pressure up to 4000 psi (300 bar), and is suitable for temperatures up to 570°F (300°C). Piezoelectric sensing elements offer continuous monitoring or walk-around cylinder balancing; frequency response may be tailored for use on low- or high-speed engines.

Hub reduction axles

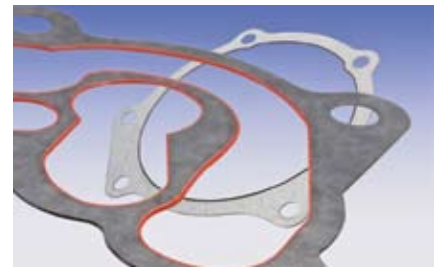
A global hub reduction axle family of single and tandem rear axles from ArvinMeritor is suited for the heavy-haul, construction, refuse, logging, con-



crete, and mining industries. Features include a fabricated housing for high capacity that can support a variety of suspension requirements; up to a 600-lb (270-kg) mass savings; streamlined carrier design for improved ground clearance and mobility; needle-bearing design for spinout protection; driver-controlled differential locks; and four-planet wheel-end hub-reduction gearing for higher-capacity ratings. The single axle is rated 26,000 to 35,000 lb (12,000 to 16,000 kg) gross axle mass rating, and the tandem is 52,000 to 70,000 lb (23,500 to 32,000 kg).

Gasketing system

The Interface Sealing Solutions Select-a-Seal Generation II gasketing system features stable bolt-load retention (BLR) and improved heat resistance. Rubber-edged composite uses a compressible, non-rigid carrier and polymer sealing edge. Gen II provides a corrosion-proof, durable joint by combining both compression and adhesion in the sealing



process. The carrier's high density and low organic content deliver stable BLR in a range of joint designs and at temperatures up to 175°C (350°F). Suitable applications include sealing joints with non-uniform loading or high shear stresses in various off-highway powertrain uses such as diesel and gas engines, axles, and transmissions.



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Mixer transmission

The Ecomix II next-generation mixer transmission for concrete mixer trucks from ZF is 20% lighter and 50% shorter than its predecessor. Ecomix II—CML 10 (concrete mixer low-speed) is suitable for mixers with a drum capacity up to 10 m³ (350 ft³) and an output torque of 62,000 N·m (45,730 lb·ft). A bearing concept increases the output bearing strength to improve rigidity during off-highway applications, while use of elastomer units

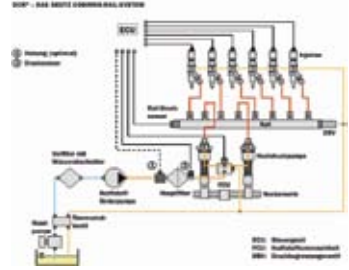
increases the axial run-out at drum bottom and permits up to a 20° installation angle. Acoustical and mechanical decoupling of the drum and vehicle frame reduces noise, and a low-speed hydro motor with separate oil for the transmission and the hydro-



static improves serviceability. Compact size facilitates design freedom and assembly.

Variable emissions

DVERT variable emissions-reduction technology from Deutz offers a modular system to reduce exhaust emissions and noise in compact diesel engines with power ranges up to 500 kW (670 hp). Using the DCR common-rail system or the MVS system for higher power



classes allows integration into the electronic machine management system. Features include two feed pump elements incorporated into the crankcase and driven by the camshaft to avoid a design change and ensure compatibility with level 2 mechanical-injection engines. An integrated engine diagnostic and safety control system can reduce the engine's power output during a disturbance.

Medium-duty engine

Perkins' medium-duty 800D range of engines is suited for the 47 to 62 kW (63 to 83 hp) off-highway equipment sector. The 800 series of naturally aspirated and turbocharged 4-cylinder engines offers a capacity of 3.3 L and noise refinements over 2 dB(A) through quiet combustion and a redesigned gear train and stiffer



timing case. A top tank temperature increase of 110 to 112°C (230 to 234°F) minimizes the impact on heat rejection and provides ease of installation. Other features include improved fuel consumption, strengthened cast-iron cylinder block for rigidity, mechanical rotary fuel-injector pump and cross-flow cylinder heads for combustion efficiency, and 500-h service intervals.

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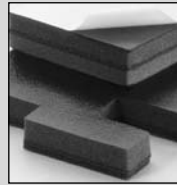
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