ZF in Wheel Loaders

- **Up to 20% less fuel**
- **Up to 40% more productivity**

ZF Converter Lock-Up clutch and other components of the ZF-Efficiency Package increase fuel savings, reduce emissions and extend lifetime.

The easy handling of ZF fully automatic transmissions and high tech axle systems support the driver in all working situations, which means a significant increase of productivity and that is what pays off at the end.

In Loaders the ZF-Powertrain management provides the efficiency which is required under any working condition. Wheel loaders are amongst the most purchased and technically most demanding off-road vehicles. The efficiency of a wheel loader is shown in the working cycle: An intelligent driveline system always makes the power available where it is needed.

There is a great value in ZF innovations! They produce advantages in equal measures for the driver, operator and manufacturer. Topics such as consumption savings, comfort or ecological compatibility are of increasing importance with construction machines and construction site vehicles. ZF is decisive in pushing development forward in driveline and chassis technology

ZF is a renowned specialist for driveline technology and recognized worldwide as innovative systems supplier for off-road machinery. The demands on these vehicle types are high: fast work with millimeter accuracy and highest productivity combined with reduced operating costs. ZF underlines its systems competence with the EFFICIENCY PACKAGE which includes many benefits due to perfectly matched components. The field of application mainly comprises the important wheel loader, dump truck, diesel and gas lift truck market. The options of the

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EFFICIENCY PACKAGE provide increased productivity and enhanced operating and driving comfort for the operator associated with a reduction of the operating and maintenance costs for the vehicle owner. Full utilization of the EFFICIENCY PACKAGE allows fuel savings of up to **20%**.

For many years already, ZF driveline and chassis systems have proven themselves in meeting the challenges of the market. With the EFFICIENCY PACKAGE ZF consolidates its competence in the transmission, axle and software development, thus offering more than the sum of individual advantages. This approach makes it possible to reconcile the frequently conflicting demands for:

- enhanced comfort
- increased productivity
- less consumption
- reduced component wear

Following are the modules of the EFFICIENCY PACKAGE in detail:

- The **MULTITRAC** and **MULTISTEER** axles featuring lightness, stability and high transmission power
- The **ERGOPOWER** transmission with 5 instead of previously 4 gears
- The **ERGOLOCKUP** which engages the torque converter lock-up clutch by modulation in low gears already
- The **ERGOTRACTION** which optimizes the engagement and disengagement of the powershift differentials in the axle
- The **ICCO** dynamically adjusts the clutch cut-off point depending on transmission output torque

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Over the last years ZF was able to develop basic optimization in axle technology. Especially according to efficiency and power dissipation our engineers could achieve major improvements.

The EFFICIENCY PACKAGE for axle features:

- **Low speed wheel brake:**
  - less heat generation
  - less power losses
  - less fuel consumption
  - higher brake capacity
  - low energy level

- **Cylindrical roller bearing in final drive:**
  - less heat generation
  - less power losses
  - less fuel consumption

- **Open differential w/HASR multi-disc DiffLock**
  - reduced power losses
  - improved efficiency
  - less tire wear

ZF ERGOPOWER

This proven and tested fully automatic powershift transmission system has been optimized for different construction machinery types and offers the innovative feature of 5 instead of 4 gears. Therefore, the noise-optimized transmission allows even more comfortable and easier handling, high shifting quality and flexibility. Moreover, the operating costs can be further reduced. The ZF ERGOPOWER provides additional possibilities for connecting an electronic driveline management, thus enabling vehicle-specific controls.

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ZF ERGOLOCKUP

The ERGOLOCKUP ensures that at low speeds already the ERGOPOWER converter lock-up clutch is applied by modulation via the software. The optimum effect of this function is of particular benefit to transmissions with 5 gears, since in this case the converter lock-up clutch can be kept closed when shifting gears.
Advantage: Depending on the application conditions, the fuel consumption can be reduced by 10% to 15%. This corresponds depending on operation conditions with a saving of approx. **2.5 liters/hour**. Considering an average annual performance of 2,000 operating hours and a fleet of 10 vehicles, this means 50,000 liters of fuel saving per year. In addition, a lower engine speed further reduces the noise emission and improves the lifetime.

Because of the lock up we increase the tractive effort in the different gears and additionally the maximum speed of the machine. For this reason the productivity is improved considerably.

ZF ERGOTRACTION

This feature for axle control offers a differential lock management which governs the interwheel differential locks in wheel loaders and the interaxle differential locks in articulated dump trucks. The ERGOPOWER transmission control provides automatic engagement and disengagement of the powershift differentials. Previously, the differential locks were only engaged depending on the operator. Today, they are always engaged unless they would disturb the operation. No manual actuation is required.
Advantages: This innovation protects the drive system components and the tires whilst offering 100% tractive effort. It also contributes to a significant fuel saving. Moreover, ERGOTRACTION improves the cross-country mobility and increases the performance. Vehicle handling is more comfortable and easy. Protection against maloperation is also guaranteed.

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ZF ICCO – Intelligent Clutch Cut-Off Function

The ICCO dynamically adjusts the clutch cut-off point depending on transmission output torque and brake pressure. It enables the vehicle drawbar pull via the brake pedal, independent of engine speed. The ICCO is an advanced driveline management feature to improve loader application such as truck loading and tight corner operation by limiting vehicle tractive effort in hydraulic stall conditions to the minimum required to hold the vehicle and not to the maximum available.

Reduced fuel consumption

- Reduced power loss in the torque converter
- Reduced energy dissipation in the axle service brake

Improved productivity:

- Provides more power to the vehicle hydraulics
- Ensures smooth control at high engine rpm and low vehicle speed
- Allows better handling of the vehicle

Fig. 1, 2, 3, 4, 5

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ZF is one of the world's leading automotive industry suppliers specializing in driveline and chassis technologies. With a workforce of 63,000 employees, the company operates 125 plants in 26 countries. To sustain its success with innovative products, ZF invests 5 percent of its annual revenues (over € 625 million from an annual total of € 12.5 billion in 2008) in research and development.

The ZF division Off-Road Driveline Technology and Axle Systems with headquarters in Passau specializes in the development and production of transmissions and axles for agricultural and construction machines as well as axle systems for buses and trucks. With approximately 7,500 employees, the division recorded a turnover of € 1.9 billion in 2008.

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