Maximum Performance in Every Terrain

Drive Systems for Mobile Cranes and Special Vehicles
Contents

04  TraXon
06  CeTrax
07  PowerLine
08  EcoLife Offroad
10  Transfer Cases
12  Technical Data
13  Service
14  Digitalization
Moving the Big Things!

Our enthusiasm for innovative products and processes and our uncompromising pursuit of quality have made us a leading global technology company. We are contributing towards a sustainable future by producing advanced technology solutions with the goal of improving mobility, increasing the efficiency of our products and systems, and conserving resources.

ZF offers system-based solutions from a single source, ranging from mechanical basic transmissions, intelligent automatically shifting transmission systems to electric all-in-one solutions. True to our claim, “See. Think. Act.”, we offer innovative solution approaches and ideas for the market of special vehicles.
TraXon – Individuality Through Diversity

ZF designed TraXon as a modular system. Customers can flexibly and economically combine the automatic transmission with various modules for the respective application.

The optimum solution for every application

The compact, robust design and the highest transmission efficiency in its category make the transmission the new standard in terms of efficiency. The intelligent software ensures an optimized shifting strategy and permits groundbreaking technology for special applications. The modular system opens up new dimensions in terms of performance, economy, environmental compatibility and comfort – exactly where it is demanded.

The single/twin plate clutch Perform

Effective transmission of power and a long service life make this starting module the perfect choice for both long-distance traffic as well as construction site transportation.

The heavy-duty module Torque

The torque converter clutch module enables heavy load vehicles or construction site vehicles to start powerful and, at the same time, is gentle on the transmission and driveline.

The multidisk clutch DynamicPerform

ZF offers manufacturers and service providers of mobile cranes and special vehicles the ideal product for challenging applications – the DynamicPerform starting module. Designed as a wet starting clutch, the module transfers the engine output. The clutch disks are cooled by circulating oil, which protects the clutch system from overheating and enables nearly wear-free and long-term maneuvering even with high friction energy. This prevents downtime and helps to considerably extend the service life of the driveline. Customers therefore benefit from greater efficiency and lower maintenance costs; while drivers experience a clutch which is now easier to engage.

The power-take off PowerDivide

Irrespective of the clutch actuation status, this module ensures quick readiness for use for the most diverse applications. In doing so, this module is characterized by superior load capacity – even in continuous use. It could be combined with all AMT and manual transmissions (SAE1).
Best-in-class transmission efficiency of

99.7%

TraXon transmission and modules
Perform, PowerDivide, Torque and DynamicPerform

PreVision GPS

The intelligent networking between transmission and GPS system enables an anticipatory driving strategy that ideally adapts shifting points to the gradient and length of uphill and downhill slopes.

Software-based additional functions

A variety of software functions can be integrated into the automatic transmission control that are tailored to the specific applications and increase the added value for the user.

Your advantages at a glance

- Robust and tested components for utmost reliability
- Best power-to-weight ratio for maximum efficiency
- Statistics memory for recording operating data
- High noise quality
- Maximum transmission ratio for less fuel consumption
- Less customization effort thanks to platform design
- Tailor-made and comprehensive system solutions for all applications
- New software functions for enhanced comfort
- Reduced mechanics concept and modular design facilitate service and repair
CeTrax – System Expertise for Electric Vehicles

Modern vehicles need to be fast and effective as well as clean and quiet; both of the latter are particularly important in the current climate. ZF offers its CeTrax electric central drive especially for conventional drive-line arrangements.

Compact and powerful

The new CeTrax system is a purely electric central drive that can be used in a variety of vehicles. When installed in battery-driven vehicles, the system operates with zero local emissions. The target group for CeTrax are manufacturers who want to be able to offer existing conventional vehicles with electric drive systems. It is suitable for replacing internal combustion engines in the truck chassis in conventional arrangements. CeTrax saves on costs and reduces the time and expense involved in technical integration as well as in service. With a maximum power output of up to 300 kW and a maximum torque of 4,500 Nm, CeTrax is second to none in terms of performance when compared with a classic drive system and also enables vehicles to overcome the biggest challenges. As with all commercial vehicle electric drive systems from ZF, the CeTrax system is supplied complete with an inverter and an electronic control unit.

Technical data

<table>
<thead>
<tr>
<th>Performance peak / 30 min [kW]</th>
<th>300 / 200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output torque peak / 30 min [Nm]</td>
<td>4,500 / 2,170</td>
</tr>
<tr>
<td>E-motor speed / Output speed [rpm]</td>
<td>8,500 / 2,530</td>
</tr>
<tr>
<td>Technology</td>
<td>Asynchronous motor</td>
</tr>
<tr>
<td>Voltage [V]</td>
<td>DC 650</td>
</tr>
<tr>
<td>Current AC (peak / continuous)</td>
<td>500 / 375 A_{max}</td>
</tr>
<tr>
<td>Weight with Inverter [kg]</td>
<td>approx. 285</td>
</tr>
</tbody>
</table>
PowerLine – The New Driving Experience

Acceleration. Deceleration. Acceleration. Every bit of assistance helps in these situations. Speed, punctuality and accuracy are vital in the transport industry.

PowerLine, up to

-10% fuel savings

Lightweight, powerful and economical

To meet these demands, ZF is launching a completely new transmission: PowerLine, the automatic powershift transmission, reduces the driver’s workload by safely engaging the gear with the greatest traction, providing intelligent driving assistance, skipping gears, offering powerful sprinting and scoring points with fuel savings in the double-digit range.

PowerLine has been specially designed for the medium-duty vehicle category and delivers consistently excellent results in modern special vehicles and in trucks alike.

PowerLine is based on our tried-and-trusted transmission concept with millions of units sold, a benchmark in the passenger car sector. The torque converter is non-wear-ing, is bypassed early by a lock-up clutch and reduces consumption when the vehicle is at a standstill (neutral idle control). The integrated dual torsional damper allows the transmission to run at reduced speeds and significantly increases driving comfort.

The revolutionary, ZF-patented planetary gearset featuring eight gears offers a higher spread than any other transmission on the market for this vehicle segment. Gear steps over several gears at once are also possible. The intelligent on-board transmission control comes with a large number of driving functions. These range from the extremely sensitive maneuvering function to the hill start aid to automatic engine stop support. A shift control unit customized for off-road vehicles is also available.

In addition, engine-dependent PTOs on both sides are available. A parking lock completes the outstanding service portfolio of this transmission. Servicing is also inexpensive thanks to extended oil change intervals. The oil filter is designed to last throughout the entire service life of the transmission.
EcoLife Offroad – The Robust Lightweight

Reliable special-purpose vehicles require robust, customized transmission technology. The new 7-speed ZF-EcoLife Offroad automatic transmission has been further developed and optimized for off-road applications in medium to heavy-duty special vehicles.
Efficient basic transmission

ZF-EcoLife Offroad measurably improves the dynamics and handles engine torques with more than 2,600 Nm, which is transmitted without interruption in tractive force. This transmission is thus perfectly compatible with current as well as future engine generations.

When it comes to other important criteria, the new ZF transmission also offers clear advantages over comparable competitor products. In conjunction with the new torque converter with integrated torque converter lock-up clutch, a smooth launch and quiet operation are ensured even at low engine speeds. The torque converter lock-up clutch can already close near idle speeds. Thus the transmission is highly efficient and reduces fuel consumption. The integrated torsional damper filters and dampens unwanted engine vibrations already before the transmission. Its helical toothed planetary gearsets make this automatic transmission very quiet.

Viable for the future

Thanks to Smart Driveline Torque Control, the EcoLife transmission works together with engines which would otherwise require a much larger transmission. This saves costs, weight and valuable installation space. EcoLife Offroad features a dual cooling system which integrates a transmission oil cooler as well as another oil cooler for retarder and converter operation. This configuration makes the ZF automatic transmission viable for the future for another important reason: It has been designed from the ground up to accommodate the higher cooling water temperatures required by new engines in order to meet increasingly stringent emission standards such as Tier 4 final or Euro 6. Last but not least, the EcoLife Offroad transmission system helps make heavy trucks and special vehicles more cost-efficient and environmentally friendly.
Transfer Cases –
Maximal Traction
and Mobility

For off-road applications and construction sites: ZF’s all-wheel drive technology guarantees perfect traction and is thus ideally suited for demanding tasks in difficult terrain.

<table>
<thead>
<tr>
<th>Transfer cases</th>
<th>VG 750</th>
<th>VG 7501400</th>
<th>VG 1600 / VG 2000</th>
<th>TC 27</th>
<th>VG 2700</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-speed</td>
<td>2-speed</td>
<td>2-speed</td>
<td>2-speed</td>
<td>2-speed</td>
<td>2-speed</td>
</tr>
<tr>
<td>Max. input torque [Nm]</td>
<td>10,000</td>
<td>12,500</td>
<td>18,000 / 27,000</td>
<td>27,000</td>
<td>35,000</td>
</tr>
<tr>
<td>Max. input speed [rpm]</td>
<td>3,500</td>
<td>4,500</td>
<td>2,800</td>
<td>3,200</td>
<td>2,800</td>
</tr>
<tr>
<td>Gear ratio high gear / low gear option</td>
<td>1.00 / 2.00</td>
<td>1.09 / 2.10</td>
<td>0.89 / 1.54</td>
<td>0.87 / 1.54</td>
<td>0.91 / 1.41</td>
</tr>
<tr>
<td></td>
<td>(1 / 2.39)</td>
<td>(1 / 2.52)</td>
<td>(0.72 / 1.54)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spreading</td>
<td>2.00</td>
<td>1.93</td>
<td>1.73</td>
<td>1.76</td>
<td>1.55</td>
</tr>
<tr>
<td>Differential torque distribution option</td>
<td>1:2</td>
<td>1:2</td>
<td>1:2.696</td>
<td>1:2.636</td>
<td>1:2.60</td>
</tr>
<tr>
<td></td>
<td>(1:1)</td>
<td>(1:1)</td>
<td>(1:1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shaft distance [mm]</td>
<td>270</td>
<td>400</td>
<td>300 or 396</td>
<td>300 or 396</td>
<td>400</td>
</tr>
<tr>
<td>Weight from, dry [kg]</td>
<td>from 115</td>
<td>from 155</td>
<td>from 290</td>
<td>from 246</td>
<td>from 450</td>
</tr>
</tbody>
</table>
Designed for tough use

The transfer case is the most important driveline component in any all-wheel drive vehicle. It distributes the propulsive power which comes from the engine and the main gearbox to the front and rear axles. ZF is world market leader of transfer cases for all-wheel drive vehicles starting at 9 tons total weight, and is supplier of all major, renowned commercial vehicle manufacturers worldwide, apart from some very few exceptions. ZF provides for a highly comprehensive program of transfer cases which are available for input torques of 10,000 to 35,000 Nm and are designed for the medium-duty and heavy all-wheel drive commercial vehicle sector. The underlying modular system enables ZF to offer a multitude of customized transfer case versions and solutions. The compact design of the VG model range makes vehicle installation easier and more cost-effective, while the 2-speed system of the transfer cases allows for high off-road capability and mobility.

All ZF transfer cases can be equipped with the ZF-ADM 2 (Automatic Drive-Train Management) function; thus, this is an essential element of overall driveline performance enhancement for all-wheel drive commercial vehicles.

An All-Rounder for All-Wheel Drives: New transfer case TC 27

Once again ZF proves its reputation as being a true specialist for all-wheel drive applications. In comparison to its predecessor, the TC 27 can process a maximum input speed of 3,200 rpm. This enables shorter axle-drive ratios at a constant maximum speed. At a permitted input torque of 27,000 Nm, the transmission is perfectly prepared for demanding all-wheel drive applications. In addition, the power take-off now is now rated to 8,500 Nm. Equally, efficiency has been optimized to such an extent that an external oil cooler is no longer required for many applications. This further simplifies installation saving cost and space. During development of the product, ZF was able to realize further weight optimization – the TC 27 weighs around 100 kilograms less than its predecessor thanks to its sleeker housing and the use of aluminum. This weight advantage can reduce fuel consumption or increase the load capacity.

Your advantages at a glance

- Weight-optimized thanks to aluminum housing
- Higher payload or reduced fuel consumption due to lower weight
- New suspension method reduces installation cost
- Oil sensors help to prevent overload
- Compact design
- Improved efficiency
## Technical Data

### Engine-dependent PTO PowerDivide

<table>
<thead>
<tr>
<th></th>
<th>NMV 2000 L1</th>
<th>NMV 2003 L1</th>
<th>NMV 1600 L1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max power [kW]</td>
<td>421</td>
<td>421</td>
<td>336</td>
</tr>
<tr>
<td>Output torque [Nm]</td>
<td>2,000</td>
<td>2,000</td>
<td>1,600</td>
</tr>
<tr>
<td>PTO position</td>
<td>12 o’clock</td>
<td>3 o’clock</td>
<td>12 o’clock</td>
</tr>
<tr>
<td>Length [mm]</td>
<td>210</td>
<td>210</td>
<td>210</td>
</tr>
<tr>
<td>Weight [kg]</td>
<td>165</td>
<td>165</td>
<td>165</td>
</tr>
<tr>
<td>Speed factor [f]</td>
<td>1.21</td>
<td>1.21</td>
<td>1.54</td>
</tr>
</tbody>
</table>

### Automatic transmission

<table>
<thead>
<tr>
<th></th>
<th>TraXon</th>
<th>TraXon</th>
<th>TraXon</th>
<th>Powershift transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Torque</td>
<td>Dynamic</td>
<td>Perform</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12 TX 2610 SO</td>
<td>12 TX 3420 SO</td>
<td>16 TX 3440 SO</td>
<td>12 TT 3021 SO</td>
</tr>
<tr>
<td>Number of gears</td>
<td>12</td>
<td>12</td>
<td>16</td>
<td>12 + WSK</td>
</tr>
<tr>
<td>Max. input torque [Nm]</td>
<td>2,600</td>
<td>3,400</td>
<td>3,400</td>
<td>3,000</td>
</tr>
<tr>
<td>Length [mm]</td>
<td>from 866</td>
<td>from 898</td>
<td>from 953</td>
<td>from 1.272</td>
</tr>
<tr>
<td>Weight approx. [kg]</td>
<td>254</td>
<td>268</td>
<td>292</td>
<td>580</td>
</tr>
<tr>
<td>Transmission ratio</td>
<td>12.92-0.77</td>
<td>12.92-0.77</td>
<td>14.68-0.82</td>
<td>12.92-0.77</td>
</tr>
<tr>
<td>Max. power [kW]</td>
<td>645</td>
<td>712</td>
<td>712</td>
<td>628</td>
</tr>
</tbody>
</table>

### Powershift transmission

<table>
<thead>
<tr>
<th></th>
<th>PowerLine</th>
<th>EcoLife</th>
<th>Offroad</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8 AP 1200 S</td>
<td>6/7 AP 2600 S</td>
<td></td>
</tr>
</tbody>
</table>

1) Indicative value only (engine auxiliaries are not covered)
Worldwide Mobile Power

ZF offers you a comprehensive and attractive range of products and services to ensure mobility anywhere, anytime. Being close to the customer is an essential element.

Globally present, locally anchored

The quality of innovative transmission systems is also a question of experience. For many decades, ZF transmissions have been a major impetus for on and off-road driving and technological progress. ZF provides comprehensive system solutions all from a single source. The transmission components are perfectly harmonized with one another. The available power range is, in each case, tailored to the specific demands of the market and manufacturers. The result: every ZF transmission system is a brand name product known for its reliability around the world. And if necessary, our ZF service specialists are always available for our customers, anytime, anywhere.

Highest customer satisfaction is one of the top targets ZF wants to achieve with its products and services. This claim determines the quality of all services linked to our products, starting with development and consultancy up to after sales service.
Intelligent Assistance

ZF develops products for all applications that make driving and working with mobile cranes and special vehicles easier. The next generation of our intelligent sensors, central control units and actuators forms the basis for Advanced Driver Assistance Systems.

As a technology company, ZF dedicates considerable effort to innovative approaches in all its product fields. The megatrend “digitalization” is a high blow to developments in the areas of assistance systems and autonomous driving.

As such, ZF accepts this challenge and – true to its motto “See. Think. Act” – combines mechanics, electronics and digital technologies for the mobility of tomorrow. High performance mechanical systems are turned into smart systems by using ZF’s digital know-how and electronics competence. Through their connectivity features these “Intelligent Mechanics” will enable performance optimization of the overall system.

Advanced Driver Assistance Systems play a major role here. They support drivers in certain situations to increase convenience, safety and cost-efficiency. This reduces both operating costs and emissions and additionally lowers the risk of accidents.

ZF is one of the few manufacturers in the world that can draw on an extensive product range in the commercial and special vehicle sector. These include sensors, processors and controllers as well as actuators.

More safety in road traffic

Increasing bicycle traffic heightens the risk for truck drivers of serious accidents with cyclists. This is not only a blind spot problem but is also often due to poor visibility. With the aid of Short Range Corner Radar, the Turn Assist developed by ZF is able to detect cyclists in the danger zone of a truck and warn them if necessary. This makes it superior to today’s common retrofit solutions, which are often deactivated due to false alarms.
See.

Sensors are the “eyes” of the vehicle. They capture the environment and send their data to the central control unit for processing. Multiple sensors such as cameras, Radar and Lidar sensors are used in order to meet different requirements for resolution and contour accuracy, range and scope of operation. Detecting objects with several different sensors increases the performance, availability and safety of the functions.

Think.

The central control unit is the “brain” that controls automated driving. It collects and analyzes the data that has been captured by the sensors and determines the instructions/functions that are required for accelerating, braking and steering the vehicle and assisting the driver. Among other functions, these include adaptive cruise control, collision avoidance systems, automatic light control as well as more complex functions such as turn assist.

Combining or „fusing” data from the signals of different sensors, which have to be processed simultaneously in real time, is a major challenge. This is achieved by processor-supported central control units using defined algorithms or artificial intelligence. The latter enables the control units to learn and expand their capabilities.

Act.

The central control unit analyzes the sensor data and then uses functions that control the vehicle’s actuators for longitudinal and lateral guidance. These include steering and safety functions, damping, and braking and transmission control.
ZF Friedrichshafen AG
Industrial Technology
Marine & Special Driveline Technology
Ehlersstr. 50
88046 Friedrichshafen / Germany
Phone +49 7541 77-3246
Fax +49 7541 77-961797
special-transmission@zf.com

Get to know more about our drive systems for special applications:

www.zf.com/special-vehicles