ZF-Drive Systems for Lift-Trucks
ZF Gotha – active throughout the world ................. 4
Dependable system partner ........................................ 6
Specialist for lift-truck drive systems ....................... 8
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ZF Gotha is part of the division Off-Road Driveline Technology and Axle Systems at ZF Friedrichshafen AG. ZF Gotha is therefore not just part of the development resources of the ZF Group, but also integrated into the international sales and service organisation.

As a result, our customers have 26 sales and more than 500 service locations available – and most certainly near to you. Our capable logistics enables us to supply you with complete drive systems or single components throughout the world. The sun never sets in ZF’s close-mesh service and logistics network!
Located in the heart of Germany

In our highly modern plant at the Gotha site, we have realised a “short-path” factory. All functional units from development through purchasing, production and sales to after-sales service are combined here.

We develop, produce, assemble and supply drive systems for industrial trucks according to customer requirements – all just in time. In this respect we have defined a quality standard which is regarded as pioneering in our field.

ZF Gotha is one of the most modern sites within the ZF Group.

The highest qualified staff and the latest technology set benchmarks within a whole industrial field.
Computer-aided procedures help to shorten development times.

Qualified staff and the latest development tools ensure our innovative lead – for the future too.

ZF Gotha – this is where expertise and capability for drives and running gear for industrial trucks come together within the ZF Group. This has enabled ZF to set new benchmarks in the development of drive systems for lift-trucks.

As a systems supplier and with our development capability we offer complete systems, including wheel, brakes, electric motor, frame plate and steering motor.

Unbeatable ease-of-use, quiet running and economy are here the primary development objectives.

With ZF as a dependable system partner, numerous potential savings open up for the vehicle manufacturer, such as reduced costs for development, logistics, assembly and handling. The more extensive is the co-operation, the greater the resulting synergies.

Strong on detail for more system value

Highly specialised, perfectly matched individual components are representative of the outstanding quality of ZF drive systems.

ZF Gotha – dependable system partner
State-of-the-art gear-mesh technology ensures constant quiet running

Very quiet running, a long service life and constantly high production quality are the principle requirements made on a modern drive. To combat the difficulty of surface deformity due to heat treatment, which is encountered with the conventional production of gearwheels, we grind our gear teeth after hardening. This means that we can produce gears with an especially high level of quiet running and with a constant quality. The bevel gear grinding machines are directly linked to the design programs used by the design calculation specialists.

Comprehensive system integration and optimised gear-mesh technology demonstrate the high standards of ZF drive systems.
Online evaluation of an acoustic measurement.

Examining efficiency on one of our test rigs.

Our systems are precisely tuned to the customer’s concept and requirements and are developed in simultaneous engineering with the vehicle manufacturers.

The most modern development tools, strength calculations following each stage of design and close communication throughout the project shorten the development times whilst increasing efficiency and versatility. This means that process optimisation is possible with regard to costs, time and quality.

To simulate the levels of noise and efficiency during the design phase, we use special software tools in order to be able to assess and optimise the influence and effects of modified parameters at an early stage. Also, we have access to the wealth of experience from colleagues in other parts of the ZF Group and in the Central Research and Development Department.
Tested through and through
Our systems are thoroughly tested before they are released for series production. We compress testing time, for example realistic continuous stresses in accelerated tests on fatigue test rigs. To do this, the demands of the daily operating routine are simulated. The advantage of this testing procedure is that it avoids protracted, expensive practical vehicle tests.

In the test laboratory the drive components are tested under simulated real conditions for noise emission, loading capacity and quiet running.
The quality of the lift-truck is determined by the components used. Anyone watching lift-trucks at work soon realises that the drive units must be subjected to enormous stresses in daily operation. The functional capability of the systems under these extreme requirements demands innovative and optimised solutions with regard to mounting, economy, reliability and service-friendliness. The ZF Ergomat range of transmissions and drives was developed to meet these challenges. ZF-Ergomat is a complete range of models offering solutions for all classes of lift-trucks. As a systems supplier and with our development capability we offer complete systems, including wheel, brakes, electric motor, frame plate and steering unit. Along with the system responsibility, we then relieve the customer of the effort needed for the whole logistics for additional components. In a lift-truck there can never be too much of ZF!
Comprehensive system integration and consistent process optimisation are the prerequisites for high customer benefits.
The challenge for drive systems lies in the compact construction in three or four-wheel counterbalance lift trucks. This is because handling heavy loads demands soft, stepless manoeuvring with precise, accurately controlled actions. In this respect, the ZF-Ergomat range offers rugged and compact solutions.

With frontwheel-drive vehicles the GP planetary-spur gear is installed in pairs. We can produce customised transmission variants using spur gears. The wet-running multi-disc brake ensures increased braking power and operates almost without wear. An optimised gear-mesh geometry produces a noticeable reduction in noise.

As an alternative to the electrical single-wheel drive, ZF offers the GK range as rearwheel servodrive. The finely graded range enables the gear unit to be closely matched in size and performance to suit the vehicle parameters. For AC technology high transmission ratios can also be provided. With a vertical arrangement in the vehicle, the small operating radius enables the available installation space to be used effectively, giving particularly high manoeuvrability.
**GK 15**

The Gleason hypoid gear drive on the crown wheel provides high strength under shock loads and higher power transfer due to a greater transmission ratio.

**GP 20**

The combination of spur-gear and planetary drive fulfils the fundamental requirement for an installation width of less than 1,000 mm. The planetary gear with wheel bearings is fully integrated into the wheel. In contrast the spur gear which is very narrow in terms of space requirement is positioned directly adjacent to the wheel.

**GK 25 LD**

The fully integrated helical gear stage enables the gradual loading and relieving of the teeth, giving the effects of low noise, extremely high load-bearing capability and smooth running at high circumferential speeds.
Just-in-time production and supply, customised production from a batch size of one up to mass production along with the networking of suppliers and customers cannot be mastered these days without highly modern materials handling technology and logistics. When lift-trucks are on the move, components from ZF-Ergomat very often come into play.

The GK range represents the core of the classical drive with bogie wheel, brake and vertically mounted electric motor. Consequently, the spur-bevel gear drive enables the design of very compact units. Easy fitting to the vehicle is taken as a matter of course, as is the unbeatable, small operating circle and the service-friendly concept.

For transporting extremely heavy loads, we offer the rugged planetary wheel-hub gear in the HFP range. Its coaxial in-line design facilitates high lifting loads and the use of motors with large control ranges and power reserves.

Our traction drive HFD 80 is predestined for the requirements of hand-guided pallet-trucks and lift-trucks. The concept is designed such that the standard version can be employed almost without modification.

**Technical Specifications: from p. 20**
**HFP 40**
The basic unit consists of a planetary gear with high power reserves, quiet running and high operational reliability. Customised designs are possible through varied transmission variants. Four types for wheel loads up to 3,200 kg can be supplied.

**GK 5**
The drive system for light pallet-trucks up to 700 kg wheel load consists of a gear unit with electric motor, wheel and brake. With a drawbar connection, the system can be easily expanded.

**HFD 80**
The complete system unit consists of a two-stage gear unit with belt and spur-gear stages, stored-spring brake, tillerbar interface, swivel bearing and wheel.
CLEANING EQUIPMENT
The greatest manoeuvrability in tight spaces is essential for sweepers. The GK range offers ideal features in this respect. With the vertical mounting orientation for the electric motors they achieve the smallest possible operating circle, giving extreme mobility.

ELECTRIC TRACTOR UNITS
High performance capabilities with the lowest width and greatest manoeuvrability enables towing tractors to efficiently transport people and goods in almost all industrial and commercial areas, public amenities and in municipal applications. The driveline solutions in the GP range are ideally suited to these tasks.

AGVs
The technology of automatically guided vehicles is suited to the most varied tasks: It is employed for horizontal transport, with lifting devices for warehouse duties or also as a working platform for installation. To meet these demands you can make use of the well-proven HFP range with its very low installation height.
HFP 40
The basic unit consists of a planetary gear with high power reserves, quiet running and high operational reliability. Customised designs are possible through varied transmission variants. Four types for wheel loads up to 3,200 kg can be supplied.

GP 20
The combination of spur-gear and planetary drive fulfils the fundamental requirement for an installation width of less than 1,000 mm.

The planetary gear with wheel bearings is fully integrated into the wheel. In contrast the spur gear which is very narrow in terms of space requirement is positioned directly adjacent to the wheel.

GK 25 LD
The fully integrated helical gear stage enables the gradual loading and relieving of the teeth, giving the effects of low noise, extremely high load-bearing capability and smooth running at high circumferential speeds.
Proven a thousand times over in everyday use...
**FEATURES:**

- Very small gear set width due to the innovative gear drive concept
- Customer specific gear ratios are realized within the helical gear set step
- Further noise level reduction thanks to optimised gear geometry
- Increasing braking power through wet-running multiple disk brake
- Maintenance-free operation with rugged gearbox components

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**ZF spur gear planetary drive GP 20**

<table>
<thead>
<tr>
<th>LIFT CAPACITY (max.)</th>
<th>kg</th>
<th>2,000</th>
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</thead>
<tbody>
<tr>
<td>WHEEL LOAD (max.)</td>
<td>kg</td>
<td>2,500</td>
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<tr>
<td>DRIVING POWER**</td>
<td>kW</td>
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<td>WHEEL TORQUE ACCELERATION</td>
<td>Nm</td>
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<td>GEAR RATIO (max.)</td>
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<td>WEIGHT without oil</td>
<td>kg</td>
<td>31</td>
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</tbody>
</table>

* depending on configuration of vehicle
** depending on configuration of motor and controller
GK-Series

Steerable Drive Systems for Lift-Trucks and AGVs

<table>
<thead>
<tr>
<th>ZF-ERGOMAT GK-Series</th>
<th>GK 5</th>
<th>GK 10</th>
<th>GK 15</th>
<th>GK 20</th>
<th>GK 25</th>
<th>GK 30</th>
<th>GK 25LD</th>
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<tbody>
<tr>
<td>LIFT CAPACITY* (max.)</td>
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<tr>
<td>WHEEL LOAD (max.)</td>
<td>kg</td>
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</tr>
<tr>
<td>DRIVING POWER**</td>
<td>kW</td>
<td></td>
<td></td>
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<tr>
<td>WHEEL TORQUE ACCELERATION</td>
<td>Nm</td>
<td></td>
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<td></td>
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<tr>
<td>GEAR RATIO (max.)</td>
<td>i</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>ENVELOPE CIRCLE</td>
<td>mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WEIGHT without oil</td>
<td>kg</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* depending on configuration of vehicle
** depending on configuration of motor and controller

** FEATURES:**
- smallest envelope possible due to vertical mounting position of the electric motor
- customised gear ratio reduction and layout for the drive system by flexible modular GK gearbox series
- minimum noise emission of the gearbox by using ground gears
- serviceable turntable bearing for longer life
- alternative chain or gear steering
- no additional components are required due to integrated chain flange with adjustable chain anchor
- the conception of the motor placement is easy to service
- very low maintenance

** Installation dimensions in mm:**

<table>
<thead>
<tr>
<th></th>
<th>GK 5</th>
<th>GK 10</th>
<th>GK 15</th>
<th>GK 20</th>
<th>GK 25</th>
<th>GK 30</th>
<th>GK 25LD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reifendurchmesser (max.)</td>
<td>A</td>
<td>200</td>
<td>230</td>
<td>254</td>
<td>310</td>
<td>350</td>
<td>400</td>
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<tr>
<td>Reifenbreite</td>
<td>B</td>
<td>65</td>
<td>75</td>
<td>125</td>
<td>140</td>
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<td>160</td>
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<tr>
<td>Mitte Radwelle bis zur Schnittstelle zum Fahrzeug</td>
<td>C</td>
<td>148</td>
<td>197</td>
<td>208</td>
<td>249</td>
<td>275.5</td>
<td>305.5</td>
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<tr>
<td>Lochkreisdurchmesser Drehkranzlager</td>
<td>D</td>
<td>169</td>
<td>220</td>
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<td>270</td>
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<td>270</td>
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<tr>
<td>Durchmesser Drehkranzlager</td>
<td>E</td>
<td>183</td>
<td>240</td>
<td>240</td>
<td>289.5</td>
<td>289.5</td>
<td>289.5</td>
</tr>
</tbody>
</table>

Subject to technical modifications. For installation investigation purposes and in order to ascertain final version, please request relevant installation drawings.
FEATURES:

- compact arrangement for gear drive components featuring small envelope circle and overall size
- low stress for the pivot bearing with the design position directly over the drive wheel
- integrated brake dispenses with the need for additional braking
- minimum noise emission due to belt drive reduction in 1st step
- almost maintenance-free due to lifetime lubrication in gearbox and pivot bearing

Subject to technical modifications. For installation investigation purposes and in order to ascertain final version, please request relevant installation drawings.
## Planetary Wheel-hub Drive Systems for Warehouse Lift-Trucks and AGVs

### ZF planetary wheel-hub drive

<table>
<thead>
<tr>
<th></th>
<th>HFP 10</th>
<th>HFP 10A/S</th>
<th>HFP 20</th>
<th>HFP 40</th>
<th>HFP 50</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DRIVING POWER</strong></td>
<td>0.8</td>
<td>0.8</td>
<td>1.1</td>
<td>3</td>
<td>4.5</td>
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<tr>
<td><strong>WHEEL TORQUE ACCELERATION</strong></td>
<td>210</td>
<td>210</td>
<td>540</td>
<td>1,210</td>
<td>2,040</td>
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<tr>
<td><strong>GEAR RATIO (max.)</strong></td>
<td>1</td>
<td>22.9</td>
<td>34</td>
<td>36.8</td>
<td>34.8</td>
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<tr>
<td><strong>ENVELOPE CIRCLE</strong></td>
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<td>195</td>
<td>256</td>
<td>209-285</td>
<td>292.5</td>
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<tr>
<td><strong>WEIGHT without oil</strong></td>
<td>11.5</td>
<td>21</td>
<td>44</td>
<td>65</td>
<td></td>
</tr>
</tbody>
</table>

** depending on configuration of motor and controller

### FEATURES:

- extremely low installation high by housing electric motor and brake into the wheel hub
- high efficiency of the drive unit
- minimum noise emission of the gearbox
- simple installation of the drive unit in the vehicle using a standardized joints
- adjustable braking torque
- customized design to customer’s data
- accessory range includes tachometer, angle encoder, line-driver, adjustable chain anchor and several kinds of brake

### Installation dimensions in mm:

<table>
<thead>
<tr>
<th></th>
<th>HFP 10</th>
<th>HFP 10A/S</th>
<th>HFP 20</th>
<th>HFP 40</th>
<th>HFP 50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reifendurchmesser (max.)</td>
<td>A</td>
<td>225</td>
<td>225</td>
<td>260</td>
<td>381</td>
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<tr>
<td>Reifenbreite</td>
<td>B</td>
<td>70</td>
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<td>100</td>
<td>127</td>
</tr>
<tr>
<td>Mitte Radwelle bis zur Schnittstelle zum Fahrzeug</td>
<td>C</td>
<td>150</td>
<td>192</td>
<td>189.5</td>
<td>245</td>
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<td>Lochkreisdurchmesser Drehkranzlager</td>
<td>D</td>
<td>-</td>
<td>-</td>
<td>270</td>
<td>270</td>
</tr>
<tr>
<td>Durchmesser Drehkranzlager</td>
<td>E</td>
<td>-</td>
<td>-</td>
<td>289.5</td>
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