Drive New Ways
Products and service for the rail industry
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Diesel drive systems

RailPacks

RailPacks are drive systems for use in single-segment and multi-segment diesel railcars for commuter, regional, national and Intercity service.

Special features
• Engines from other manufacturers can be integrated
• Broad output spectrum from 400 kW to 735 kW
• Complete customer service from consultation on vehicle construction and inspection up to full service
• Worldwide sales and service network for rail applications
• Low calculable life cycle costs
• Hybridization possible
• Consumption-optimized VTDC Eco control
• Meets all current emission standards

Technical data

<table>
<thead>
<tr>
<th>Basic data</th>
<th>RailPack 400DM</th>
<th>RailPack 400DH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission</td>
<td>DIWARail</td>
<td>S 1 11 re.1 or T 211 re.4 + KB190</td>
</tr>
<tr>
<td>Engine</td>
<td>Voith I6H135-R3/5-400</td>
<td>Voith I6H135-R3/5-400/450</td>
</tr>
<tr>
<td>Energie power</td>
<td>400 kW</td>
<td>400–450 kW</td>
</tr>
<tr>
<td>Speed</td>
<td>80–120 km/h</td>
<td>80–140 km/h</td>
</tr>
</tbody>
</table>
Basic versions

- RailPack 400 DH/DM/DE engine power up to 400 kW
- RailPack 500 DH/DM/DE engine power up to 480 kW
- RailPack 600 DH/DE engine power up to 588 kW
- RailPack 800 DH/DE engine power up to 735 kW

<table>
<thead>
<tr>
<th>RailPack 500DH</th>
<th>RailPack 600DH</th>
<th>RailPack 800DH</th>
<th>RailPack 400 / 500 &amp; 600 / 800DE</th>
</tr>
</thead>
<tbody>
<tr>
<td>T212 bre</td>
<td>T212 bre</td>
<td>T312 bre</td>
<td>Generator</td>
</tr>
<tr>
<td>Voith I6H135-R3/5-480</td>
<td>12 cylinder</td>
<td>12 cylinder</td>
<td>Voith I6H135-R3/5 or 12 cylinder*</td>
</tr>
<tr>
<td>480 kW</td>
<td>588–662 kW</td>
<td>735 kW</td>
<td>400–735 kW</td>
</tr>
<tr>
<td>100–160 km/h</td>
<td>120–160 km/h</td>
<td>140–200 km/h</td>
<td>80–200 km/h</td>
</tr>
</tbody>
</table>

*or other engines >500 kW.
The proven Voith DIWARail transmission was reworked and the transmission input power increased for the RailPack 400/500DM. The RailPack 400/500DM is ideally suited for all single-segment or multi-segment light rail cars because of the broad traction range and the maximum engine power of up to 480 kW.

The RailPack 400/500DH is available in this version with the T 211 turbo transmission and a maximum engine power reaching 480 kW. The RailPack 500DH is equipped with the T 212 turbo transmission for a maximum engine power of 480 kW.
The maximum performance RailPack 800DH is the RailPack with the T312 turbo transmission. The RailPack 800DH is designed for a power output of up to 735 kW. It is perfectly suited for railcars with maximum speeds between 140 and 200 km/h.

The RailPack 600DH is primarily suited for use in railcars having a maximum speed of 120 to 160 km/h since very high efficiency is available over a wide range of speeds because two hydrodynamic couplings are used.
Diesel-electric RailPacks are available with engine powers ranging from 294 kW to 588 kW and are ideally suited for railcars. The drive generators integrated into the system form an essential component of the RailPacks. Together with other Voith components, they form an entire diesel-electrical drive chain.
Voith Rail Engine

Future emission standards and the demand for higher efficiency require rail engine development. The efficient and powerful Voith diesel engines are specifically developed to meet the newest requirements and are optimally suited for rail vehicles.

The Voith Rail Engine is the most advanced and efficient diesel engine of its class. Compared to other rail engines, it is characterized by reduced fuel consumption and a high power density. The emission treatment system developed by Voith ensures the engine meets the upcoming European emission regulations including the Stage V (valid in Europe as from 2021) regulation. Voith offers a horizontal and a vertical engine for diesel multiple units as well as locomotives in the output categories 400 / 450 / 480 kW.

Voith Rail Engine I6H135 – horizontal
Voith Rail Engine I6H135
for railcars and special vehicles

Powerful and efficient in the smallest installation space: The I6H diesel engine is a horizontal inline six-cylinder engine that shows its class in a wide range of applications. Together with Voith’s exhaust aftertreatment system, the aggregates comply with the emission standards 2016-1628 (stage V) and 97/68 EC (stage IIIB) for rail applications. The emission after-treatment systems, the motor architecture, the injection system and the engine control are perfectly harmonized. This results in optimum efficiency and lower fuel consumption.

Voith Rail Engine I6H135 – horizontal

Technical data

<table>
<thead>
<tr>
<th>Engine</th>
<th>Horizontal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cylinder</td>
<td>6</td>
</tr>
<tr>
<td>Displacement [l]</td>
<td>13.5</td>
</tr>
<tr>
<td>Emission standard acc. 2016-1628 &amp; 97/68 EC</td>
<td>Stage V &amp; stage IIIB</td>
</tr>
<tr>
<td>Rated power [kW]</td>
<td>400 / 450 / 480</td>
</tr>
<tr>
<td>Rated speed [rpm]</td>
<td>2 100</td>
</tr>
<tr>
<td>Max. torque [Nm]</td>
<td>2 400 / 2 600 / 2 800</td>
</tr>
<tr>
<td>Broke / stroke [mm]</td>
<td>135 / 157</td>
</tr>
<tr>
<td>Compression ratio</td>
<td>17:1</td>
</tr>
<tr>
<td>Dry weight [kg]</td>
<td>1 200</td>
</tr>
</tbody>
</table>

All data preliminary
Voith Rail Engine I6V135
for locomotives, railcars, and special vehicles
Robust design for rail applications: based on the robust design of construction machinery engines the vertical version I6V and horizontal version are ideally suited to rail vehicles. Other designs for example with flat oil pan and auxiliary drives are realized upon customer request.

Voith Rail Engine I6V135 – vertical

<table>
<thead>
<tr>
<th>Vertical</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>13.5</td>
</tr>
<tr>
<td></td>
<td>Stage V &amp; stage IIIb</td>
</tr>
<tr>
<td></td>
<td>400 / 450 / 480</td>
</tr>
<tr>
<td></td>
<td>2 100</td>
</tr>
<tr>
<td></td>
<td>2 400 / 2 600 / 2 800</td>
</tr>
<tr>
<td></td>
<td>135 / 157</td>
</tr>
<tr>
<td></td>
<td>17:1</td>
</tr>
<tr>
<td></td>
<td>1 150</td>
</tr>
</tbody>
</table>
Hydrodynamic transmissions

Voith turbo transmissions are automatic multi-circuit transmissions. They are constructed using basic hydrodynamic components such as a torque converter, hydrodynamic coupler and retarder that are optimally matched to the current application.

The gears are shifted by filling and emptying the circuits. In the case of turbo reversing transmissions, the converter can be used in the opposite direction for hydrodynamic braking.

Voith turbo transmissions are robust, less sensitive and have a long service life. Diesel rail cars with turbo transmissions are in use by many national railroads in Europe, Asia, Australia, and both North and South America. Voith turbo transmissions and Voith turbo reversing transmissions achieve particularly high mileage up to the first major overhaul in industrial locomotives with mixed shunting and mainline use. Up to now, more than 38,000 turbo transmissions have been delivered to more than 80 countries of the world.
**Type designation**

**Turbo transmission T 312 bre**

![Diagram of a turbo transmission for diesel railcars]

**Turbo transmission for diesel railcars T 312 bre**

<table>
<thead>
<tr>
<th>T</th>
<th>Railcar transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Circuit size index</td>
</tr>
<tr>
<td>1</td>
<td>Number of torque converters</td>
</tr>
<tr>
<td>2</td>
<td>Number of couplings</td>
</tr>
<tr>
<td>b</td>
<td>Hydrodynamic brake</td>
</tr>
<tr>
<td>r</td>
<td>Mechanical reversing transmission</td>
</tr>
<tr>
<td>e</td>
<td>Electronic control unit</td>
</tr>
</tbody>
</table>
Type designation

Turbo transmission L 530 breU2

Turbo transmission for locomotives in mainline service

L  Locomotive transmission
5  Circuit size index
3  Number of torque converters
0  Number of couplings
b  Hydrodynamic brake
r  Mechanical reversing transmission
e  Electronic control unit
U2  Drive design
Turbo reversing transmission L 3r4 zse

Turbo reversing transmission for shunting and multi-purpose locomotives

L 3r4 zse

L  Locomotive transmission
3  Circuit size index
r  Hydraulic reversing
4  Number of circuits
z  Heavy-duty design
s  Mechanical multi-step transmission
e  Electronic control unit
Turbo transmissions for diesel railcars

Performance characteristics

![Graph showing performance characteristics](image)

**Input power**

<table>
<thead>
<tr>
<th>Type</th>
<th>T 211 r.3</th>
<th>T 211 re.4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>P [kW]</strong></td>
<td>320</td>
<td>350</td>
</tr>
<tr>
<td><strong>n₁ [rpm]</strong></td>
<td>1 800 – 2 400</td>
<td>1 800 – 2 400</td>
</tr>
<tr>
<td><strong>Mass [kg]</strong></td>
<td>separate</td>
<td>760</td>
</tr>
<tr>
<td></td>
<td>flange-mounted</td>
<td>900</td>
</tr>
<tr>
<td><strong>Oil capacity [l]</strong></td>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td><strong>Power takeoff M_max [Nm]</strong></td>
<td>800</td>
<td>800</td>
</tr>
</tbody>
</table>

\[n_{\text{power takeoff}}/n₁\] approx. 1.0

**Dimensions [mm]**

<table>
<thead>
<tr>
<th>A₁</th>
<th>A₂</th>
<th>L₁</th>
<th>L₂</th>
<th>H₁</th>
<th>H₂</th>
<th>H₃</th>
<th>B₁</th>
<th>B₂</th>
<th>B₃</th>
</tr>
</thead>
<tbody>
<tr>
<td>–</td>
<td>990</td>
<td>–</td>
<td>1 170</td>
<td>335</td>
<td>0</td>
<td>0</td>
<td>514</td>
<td>24.5</td>
<td>920</td>
</tr>
</tbody>
</table>

( ) - values for the version with power takeoff

*Upon request
## Separately supported version

![Separately supported version diagram]

## Flange-mounted version

![Flange-mounted version diagram]

<table>
<thead>
<tr>
<th>Type</th>
<th>Input power [kW]</th>
<th>Input speed [rpm]</th>
<th>Mass separate [kg]</th>
<th>Mass flange-mounted [kg]</th>
<th>Oil capacity [l]</th>
<th>Power takeoff $M_{\text{max}}$ [Nm]</th>
<th>$M_{\text{max}}/n_1$ approx. 1.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>T 211 re.4 + KB 190</td>
<td>350</td>
<td>1 800–2 400</td>
<td>–</td>
<td>760</td>
<td>75</td>
<td>800</td>
<td>1 130</td>
</tr>
<tr>
<td>T 212 bre</td>
<td>450</td>
<td>1 800–2 400</td>
<td>900</td>
<td>840</td>
<td>95</td>
<td>800</td>
<td>990</td>
</tr>
<tr>
<td>T 312 bre</td>
<td>650</td>
<td>1 800–2 400</td>
<td>1 510 (1 521)</td>
<td>900</td>
<td>100</td>
<td>230</td>
<td>1 115</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Dimensions [mm]

- **A**: 900, 890, 990, 994
- **L**: 1 170, 1 030, 1 130, 1 070
- **H**: 335, 335, 335, 325
- **B**: 514, 595, 595, 510 (514)
# Diesel drive systems

## Turbo transmissions for mainline locomotives and special purpose vehicles

### Performance characteristics

![Graph showing performance characteristics of different types of turbo transmissions.]

**Special versions available upon request**

### Type

<table>
<thead>
<tr>
<th>Input power [kW]</th>
<th>L 530 breU2</th>
<th>L 220 reV2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 700</td>
<td>350</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Input speed [min⁻¹]</th>
<th>L 530 breU2</th>
<th>L 220 reV2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 500 – 2 100</td>
<td>1 800 – 2 400</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mass [kg] (excluding oil filling)</th>
<th>L 530 breU2</th>
<th>L 220 reV2</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 680*</td>
<td>1 310</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Oil capacity [l]</th>
<th>L 530 breU2</th>
<th>L 220 reV2</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>80</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dimensions [mm]</th>
<th>L 530 breU2</th>
<th>L 220 reV2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A₁</td>
<td>684</td>
<td>931,5</td>
</tr>
<tr>
<td>A₂</td>
<td>925</td>
<td>565</td>
</tr>
<tr>
<td>A₃</td>
<td>1 103</td>
<td>787,5</td>
</tr>
<tr>
<td>A₄</td>
<td>125</td>
<td>632,5</td>
</tr>
<tr>
<td>B₁</td>
<td>565</td>
<td>465</td>
</tr>
<tr>
<td>B₂</td>
<td>565</td>
<td>465</td>
</tr>
<tr>
<td>B₃</td>
<td>1 390</td>
<td>–</td>
</tr>
<tr>
<td>H₁</td>
<td>1 065</td>
<td>1 075</td>
</tr>
<tr>
<td>H₂</td>
<td>310</td>
<td>750</td>
</tr>
<tr>
<td>H₃</td>
<td>240</td>
<td>444</td>
</tr>
<tr>
<td>H₄</td>
<td>429</td>
<td>250</td>
</tr>
<tr>
<td>L₂</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

*with hydrodynamic brake
### Dimensions L 220

- A
- B1
- H1
- H2
- H3

### Maße L 311 with power takeoff dimensions

- A
- B1
- H1
- H2
- H3

### Dimensions S 111 re.2

- A
- B1
- H1
- H2
- H3

<table>
<thead>
<tr>
<th></th>
<th>L 311 reV2HA + KB 260</th>
<th>L 311 reV2 + KB 260</th>
<th>S 111 re.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>650</td>
<td>250</td>
<td></td>
</tr>
<tr>
<td>1800–2300</td>
<td>1800–2300</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>1950</td>
<td>1725</td>
<td>672</td>
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<td>125</td>
<td>125</td>
<td>38</td>
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<tr>
<td>1095</td>
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<tr>
<td>550</td>
<td>550</td>
<td>890</td>
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</tr>
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</tr>
<tr>
<td>812</td>
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<td>455</td>
<td>455</td>
<td>365</td>
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<td>465</td>
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<td>684</td>
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<td>1083</td>
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<td>338,5</td>
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<td>820</td>
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<td>22</td>
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<td>480</td>
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<td>681</td>
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<td>286</td>
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<td>–</td>
<td>1006</td>
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</tbody>
</table>
Turbo reversing transmissions for shunting- and multi-purpose locomotives

Performance characteristics

![Graph showing performance characteristics](image)

### Type

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>L 3r4 zseU2</strong></td>
<td></td>
</tr>
<tr>
<td>Input power [kW]</td>
<td>660</td>
</tr>
<tr>
<td>Input speed [min⁻¹]</td>
<td>1 400 – 2 500</td>
</tr>
<tr>
<td>Mass (excluding oil filling) [kg]</td>
<td>2 650</td>
</tr>
<tr>
<td>Oil capacity [l]</td>
<td>80</td>
</tr>
<tr>
<td>Dimensions [mm]</td>
<td></td>
</tr>
<tr>
<td>A₁</td>
<td>600</td>
</tr>
<tr>
<td>A₂</td>
<td>760</td>
</tr>
<tr>
<td>A₃</td>
<td>924</td>
</tr>
<tr>
<td>A₄</td>
<td>124</td>
</tr>
<tr>
<td>B₁</td>
<td>500</td>
</tr>
<tr>
<td>B₂</td>
<td>500</td>
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<tr>
<td>H₁</td>
<td>1 175</td>
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<td>H₃</td>
<td>300</td>
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<tr>
<td>H₄</td>
<td>240</td>
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</tbody>
</table>

Special versions available upon request.
Dimensions

<table>
<thead>
<tr>
<th></th>
<th>L 4r4 zseU2 (a)</th>
<th>L 5r4 zseU2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input power [kW]</td>
<td>660</td>
<td>1 050</td>
</tr>
<tr>
<td>Input speed [min⁻¹]</td>
<td>1 400 – 2 500</td>
<td>1 200 – 2 500</td>
</tr>
<tr>
<td>Mass [kg]</td>
<td>2 650</td>
<td>3 900</td>
</tr>
<tr>
<td>Oil capacity [l]</td>
<td>80</td>
<td>190</td>
</tr>
<tr>
<td>Dimensions [mm]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A₁</td>
<td>600</td>
<td>599</td>
</tr>
<tr>
<td>A₂</td>
<td>760</td>
<td>922</td>
</tr>
<tr>
<td>A₃</td>
<td>924</td>
<td>1 110</td>
</tr>
<tr>
<td>A₄</td>
<td>124</td>
<td>53</td>
</tr>
<tr>
<td>B₁</td>
<td>500</td>
<td>599</td>
</tr>
<tr>
<td>B₂</td>
<td>500</td>
<td>922</td>
</tr>
<tr>
<td>H₁</td>
<td>1 175</td>
<td>1 308 (1 418)</td>
</tr>
<tr>
<td>H₂</td>
<td>840</td>
<td>965 (1 075)</td>
</tr>
<tr>
<td>H₃</td>
<td>300</td>
<td>381 (491)</td>
</tr>
<tr>
<td>H₄</td>
<td>240</td>
<td>381 (491)</td>
</tr>
</tbody>
</table>
Voith DIWA transmissions are automatic hydromechanical transmissions predominately used in public transit buses.

The driven-side bearings were reinforced for use in rail vehicles. In addition, a lubrication pump driven by the secondary side was integrated for towed operation.

**Diesel drive systems**

### Hydromechanical transmission

**DIWARail with parallel shaft reversing transmission**

<table>
<thead>
<tr>
<th>Type</th>
<th>DIWARail D 884.5</th>
<th>DIWARail D 884.5*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. transmission input power $P_{\text{max}}$ [kW]</td>
<td>320</td>
<td>320</td>
</tr>
<tr>
<td>Transmission input speed $M_{\text{max}}$ [Nm]</td>
<td>1 900</td>
<td>1 900</td>
</tr>
<tr>
<td>Transmission input speed $n_{\text{max}}$ [rpm]</td>
<td>2 200</td>
<td>2 200</td>
</tr>
<tr>
<td>Retarder braking torque $M_{\text{BR}}$ [Nm]</td>
<td>1 000</td>
<td>1 000</td>
</tr>
<tr>
<td>Number of gears</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Transmission mass (dry) including retarder [kg]</td>
<td>approx. 415</td>
<td>approx. 540</td>
</tr>
</tbody>
</table>

*with parallel shaft reversing transmission*
Voith gear unit transmissions are working reliably worldwide. They are optimized for weight and noise and allow speeds of up to 400 km/h. For all rail vehicles we offer the individually and optimally matched transmission for the axle load, speed and tractive force.

**Benefits**

+ Customized solutions for all rail vehicles  
+ Reliable operation  
+ Low life cycle costs  
+ Proven and tested design  
+ Safety and standard conform  
+ Noise optimized  
+ Optimized installation space  
+ Weight optimized  
+ Optimum lubrication  
+ Labyrinth seals ensure eco-friendly operation

**SZ-440 gear unit**
Axle-riding helical gears
Driven wheel rigidly connected to the wheelset shaft

SE – Helical-gear drives
Single-stage

SZ – Helical-gear drives
Two-stage
Axle-riding bevel gears
Driven wheel rigidly connected to the wheelset shaft

KE – Bevel-gear drives
Single-stage

SK – Helical-gear/bevel-gear drives
Two-stage
**Nose-suspended drive**
Not sprung

**SET – Helical-gear drives**
Single-stage nose bearing

**Stirnrad voll abgefedert**
Driven wheel rigidly connected to the quill shaft

**SZH – Helical-gear drive**
Two-stage quill shaft
Bevel gear, completely sprung
Driven wheel rigidly connected to the quill shaft

KSH – Bevel-gear/helical-gear drive, quill shaft
Special applications

Transmissions for high-speed applications and gauge-change transmissions
Technically demanding, customer-oriented solutions are a tradition at Voith. High demands are placed on transmissions for high-speed trains in regard to power density, weight, safety and noise emissions. These demands are verifiably satisfied in Voith wheelset transmissions, for example, the KTX, and intensive development continues in this area.

Wheelset transmissions that allow an automated gauge change of the power trucks are also tailored for customer benefit. In addition, Voith has also developed fully sprung bevel-gear and helical-gear transmissions with driven quill shafts containing the gauge-change mechanism. With this, powers of up to 900 kW are transmitted permitting vehicle speeds of 380 km/h and beyond.
Motor-gear units

Voith’s comprehensive system experience provides the operators of electromechanical drive systems with more efficiency and safety in every respect – continuously from development up to current operation.

We offer the complete electrical drive chain as an engine-transmission unit for all streetcars, light rail and mainline trains. From the motor to the wheelsets to the transmission, everything matched – we supply the entire system from a single source. We implement individual solutions and, in this process, we bring to bear our comprehensive experience with transmissions and wheelsets together with our electrical knowledge.

The transmission-engine interface is perfectly matched allowing dynamic riding characteristics under all operating conditions. The engine-transmission units are exceptionally reliable and extraordinarily easy to maintain. Installation and removal are very easy thanks to their compact design.
Service for the entire product life cycle
Voith performs complete engineering for the engine-transmission unit: from system design and calculating the operating cycle to system specification and construction, verification, testing and integration into the vehicle truck. In addition, we take care of the maintenance of the units for which Voith, instead of any number of vendors, is your only point of contact.
Universal joint shafts

Voith universal joint shafts reliably transmit the torque from input to output in all types of rail vehicles.

When needed, our universal joint shafts can be combined with torque-limiting and vibration-damping drive components.

Chief customer benefits in railroad drives:
• Robust, long-lived drive components
• High reliability
• Long maintenance intervals

<table>
<thead>
<tr>
<th>Series</th>
<th>Torque capacity MZ [kNm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST</td>
<td>0.25 to 275</td>
</tr>
<tr>
<td>RT</td>
<td>32 to 143</td>
</tr>
<tr>
<td>RTR</td>
<td>Values available upon request</td>
</tr>
</tbody>
</table>
Our offer includes a series of engineering services such as:

- Construction of special universal joint shafts matched to your drive and your operating conditions
- Design and sizing of universal joint shafts and connecting components
- Torsional and bending vibration calculations

---

**Features and benefits**

+ Proven concept of the non-split bearing eye
+ Large profile and tube diameters for high torsion and bending rigidity
+ Low-maintenance length compensation upon request

---

<table>
<thead>
<tr>
<th>Flange diameter $a$ [mm]</th>
<th>Features and benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>58 to 435</td>
<td></td>
</tr>
<tr>
<td>+ Basic version of the Voith universal joint shaft</td>
<td></td>
</tr>
<tr>
<td>+ Non-split bearing eyes thanks to one-piece forged flange yoke</td>
<td></td>
</tr>
<tr>
<td>+ Length compensation with involute profile</td>
<td></td>
</tr>
<tr>
<td>225 to 350</td>
<td></td>
</tr>
<tr>
<td>+ Optimized torsion and bending rigidity in a low-weight design</td>
<td></td>
</tr>
<tr>
<td>+ Particularly well-suited for use with high-speed drives</td>
<td></td>
</tr>
<tr>
<td>+ Low-maintenance length compensation through use of plastic-coated (Rilsan) involute profile</td>
<td></td>
</tr>
<tr>
<td>225 to 435</td>
<td></td>
</tr>
<tr>
<td>+ Length compensation using rolling elements</td>
<td></td>
</tr>
<tr>
<td>+ Axial displacement forces virtually constant over the entire torque range</td>
<td></td>
</tr>
<tr>
<td>+ Optimized torsion and bending rigidity in a low-weight design</td>
<td></td>
</tr>
<tr>
<td>+ Particularly well-suited for use with high-speed drives</td>
<td></td>
</tr>
</tbody>
</table>
SafeSet torque limiting couplings

SafeSet torque limiting couplings have been installed for decades in the drive chain of rail vehicles.

In the event of excessive torque overload, SafeSet couplings protect the components of the drive chain against serious damage. The couplings are used both in electrical railcars/multi-unit railcars (EMUs) as well as electric locomotives.
Features of SafeSet torque limiting couplings:

- Precise and adjustable release torque
- Cut-out torque that remains constant over time
- Construction adaptable for every application in the torque range from 5 to 100 kNm
- Long roll-out time
- Quick reactivation in depot
- Backlash-free power transmission
- Compact and lightweight design
- Minimal maintenance required

Customer benefits when using a SafeSet coupling:

- Protection of all drive components against the introduction of excessive torque
- Minimization of secondary damage if a drive component fails
- Increased availability of the rail vehicle
Highly flexible couplings

Highly flexible couplings from Voith have been used for over 35 years by renowned manufacturers and users in very many different branches.

On all international markets, Voith HighFlex GmbH & Co. KG is the reliable partner of engine manufacturers and has been equipping rail vehicles, construction machinery, ships, test rigs and other drives.

Highly flexible couplings have essentially two tasks:
1. Shifting resonance frequencies
2. Damping critical torsional vibration amplitudes

The chief customer benefits when using a Voith highly flexible coupling in the drive chain are:
• Greater availability of all drive components thanks to damping of torsional vibrations and torque peaks in the drive chain
• Reduced lifetime costs resulting from the increased service life of all the components in the drive
• Increased comfort as the result of less vibration and noise
Highly flexible couplings are used in the following, among other applications:

- Railcars
- Locomotives
- Railroad construction machinery and other special vehicles with diesel-hydraulic and/or diesel-electric main and auxiliary drives. At this time, torques up to 150,000 Nm can be transmitted.

Services such as:

- Torque vibration calculations (TVC)
- Torque vibration measurements (TVM)
- Failure analyses (FA) on complete drivelines
- Special designs complete our range of products on offer

Voith BR 152 series highly flexible coupling
Cooling systems

For locomotives and railcars

Power requirements of a fan with stepless speed control

- About 10% energy savings using intelligent speed control – an economic necessity
- Control using the electronic Voith Turbo Digital Temperature Control

Drive options for a cooler fan

Electrical  Hydrostatic
Fan drive power requirement

$P_{\text{Mot}}$ Diesel engine power
$P$ Drive power
$t$ Outdoor temperature
For Monorails and High-Speed trains

Equipment to be cooled
- Transformers
- Traction motors
- Rectifiers
- Chokes, electrical resistors

Coolants
- Water-glycol mixtures
- Mineral oils
- Silicone oils
- Ester oils

Installation variants

As a cooling container under the floor
Components

- Cooling elements made from aluminum
- Electric drives for fans
- Fans made from aluminum, steel or plastic
- Recirculating pumps for the coolant
- Air filters
- Expansion tanks with fill level monitoring

Under the floor
For diesel electric and diesel hydraulic locomotives, railcars and special purpose vehicles

For all performance levels of
• Diesel electric and diesel hydraulic locomotives
• Diesel electric and diesel hydraulic railcars

Equipment to be cooled
• Diesel engine (cooling water and charge air)
• Transmission (hydrodynamic, mechanical)
• Hydrostatic drives

Coolants
• Water-glycol mixtures
• Oils
• Air

Installation variants

In or on the rooftop

Under the floor
Components

- Whole-block or partial-block cooling elements made from nonferrous metals or aluminum
- Fans made from aluminum or plastic
- Digital temperature controller
- Expansion tanks with fill level monitoring equipment
- Heat exchangers in tube-and-shell or plate-and-frame designs
- Hydrostatic drives for fans and other auxiliary equipment (e.g., compressors or generators with high frequency accuracy)

At the front

In the equipment compartment
For electric locomotives, railcars and special purpose vehicles

For all performance levels of

- Locomotives
- Power cars

Installation

- As a cooling tower in the equipment compartment
- As a cooling container in the vehicle roof or under the floor

Equipment to be cooled

- Transformer
- Traction motors
- Rectifiers
- Chokes, electrical resistors

Installation variants

In the equipment compartment       In or on the rooftop
Coolants
- Water-glycol mixtures
- Mineral oils
- Silicone oils
- Ester oils
- Air

Components
- Whole-block or partial-block cooling elements made from aluminum
- Electric drives for fans
- Fans made from aluminum or plastic
- Recirculating pumps for the coolant
- Air filters
- Expansion tanks with fill level monitoring

Under the floor
Electronic control systems

For Rail Packs, turbo transmissions and cooling systems

The electronic control systems of rail vehicles must be capable of quickly relaying and processing commands from the vehicle control system and signals from the drive components using modern data networks in the vehicle. For this, as a result of the increased system integration, the interaction of the control systems responsible for the drive and brake functions is very important. For this purpose, Voith integrates essential functions of the drive components into a drive control system.
VTDC
The Voith Turbo Drive Control (VTDC) was specially developed for controlling turbo transmissions and cooling systems. The VTDC permits integration, in a controls sense, and the optimal matching of the diesel engine, transmission, cooling system and generator. The control device is directly attached to the hydrodynamic transmission. Comprehensive diagnostic and operating data recording functions are available for the drive system. Ideally, it is connected to the vehicle control system using a CAN bus system.

Interfaces of the VTDC control system
**Engine integration**
The Local Control Box (LCB) is available for optimally linking engine control devices and different engine auxiliary components. This includes direct communication with the engine control devices using the SAE J1939 CAN protocol and the integration of preheating systems or additional engine monitoring components.

**Starter double layer capacitors**
Double layer capacitors are available as an option in place of the conventional starter battery for starting the diesel engine. The system consists of stacks of double layer capacitors and a charger adapted and matched to the diesel engines.
VTGateway
Ideally, Voith control systems are linked using a CAN bus system. If this data bus is not available in the vehicle, various gateways can also be used. Gateways for converting CAN signals to digital and analog signals are available as is a converter from CAN to MVB (Multi Vehicle Bus).

VTBSwin
VTBSwin is a diagnostic tool installed on a laptop. VTBSwin allows access to the diagnostic results and to recorded operating data from the drive system. In addition, it provides functions for service and commissioning and has several access levels available using passwords. The diagnostic and operating data recording allows quick troubleshooting and provides information regarding the operating conditions of the drive system and its components.
Automatic couplers

Schaku basics – the modular design
Flexibility, adaptability, reliability and safety are the major demands on couplers for rail vehicles. The modular design of the Scharfenberg couplers and different coupler types allow us to provide the optimum coupler for each and every application and condition.

Advantages

+ Automatic coupling and uncoupling – safe and reliable
+ Simultaneous coupling of mechanical, pneumatic and electrical components
+ Low wear and minimal maintenance
+ Smooth operation

Coupler design
One4 – the newest generation of coupler head

With the new One4 coupler head, the previous modular concept has undergone systematic further development. Radically simplified and standardised, this coupler head brings enormous benefits, most notably in the field of maintenance and repair.

The One4 concept – everything compatible and modular

In this new approach, the coupler face is separated from the coupler body and connected to it by means of only a few screws.

Advantages

+ The coupler body becomes a standard component
+ The coupler face can be added on a coupler-type-specific basis and compatible with existing systems

One4 coupler head, exploded drawing
Coupler types

Depending on the application and the forces required, various coupler types are available. For example:

Type 10 – mainline trains to high speed

Properties

• Especially high strength
• Large gathering range both horizontally and vertically
• Complies with the UIC standards for mainline multi-unit railcars
• Part of TSI since 2002 and a standard for high-speed trains
Type 35 – metros

Properties

• Primarily found in metro vehicles
• Suitable for all-electric vehicles
• High strength
Type 330 – light rail and streetcars

Properties
- Versatile, primarily in metros and light rail vehicles
- Compact design with relatively high strength
- Designed without guiding horn, it allows a bottom-mounted electric head
- Designed for a large gathering range, even without guiding horn
Type 430/530 – light rail applications

Properties

• Especially lightweight design
• Ideal for low-floor streetcars or monorails
• Very compact design without guiding horn
• Type 530 for the East German market
Semipermanent couplers

Semipermanent couplers connect intermediate cars in a train set. They represent a permanent connection but, connected by muffs, may easily be disconnected if needed.

Depending on the requirements, semipermanent couplers may be equipped with pneumatic and electric connections and energy absorbing components.

**Semipermanent coupler with anti-climber**

In case of this semipermanent coupler for the metro sector, an anti-climber was integrated for the first time. This protection is active before climbing is even started. This is achieved by a special geometry at the rear end of the semipermanent coupler. Once the reversible stroke of the coupler has been reached, the coupler makes positive lock with the bearing bracket and thus counteracts climbing – without requiring additional space.

**Principle of operation of the anti-climber**
Joints

Trains equipped with Jacobs bogie require joints as intermediate-car connections in place of semipermanent couplers that are otherwise customary. The two-piece joints are connected to the Jacobs bogie and pull it along while travelling. They can – if needed – also be equipped with an additional energy absorber.

Joint yoke and joint eye
Crash energy management for Voith AAR coupler

AAR type couplers are in common use on railcars on the American market and suited for heavy loads. The mechanical connection between the couplers is established automatically, whereas the large coupler head play usually does not allow any pneumatic or electric connection.

Voith has developed technologies which optimally complement the high strength of the AAR coupler head with energy absorbing components. Today, a complete crash energy management system is available, complying with the latest FRA and PRIIA 305 safety regulations.
Crash energy management system
A crash energy management system is composed of several matched energy absorbing components which are integrated in both the coupler and the carbody. The energy absorption works in a cascading way, compensating a high amount of energy in case of a crash and preventing an overriding of the cars.

Constituent parts of the system
- “Push back” AAR coupler including support
- Anti-climber
- Lateral energy absorbers

Crash energy management system (SMART project)
Freight couplers
Voith CargoFlex

Safe, automatic coupling for freight trains. Freight applications are characterised by high strength requirements and rough conditions. What is needed here is a simple and robust coupler, one that requires hardly any maintenance even in rough environment. Furthermore, Voith’s coupler design meets the latest and upcoming crash worthiness requirements (DIN EN 15227), even for locomotives.

Voith CargoFlex is a modular system that allows coupler heads, such as an advanced SA3 head to be combined with Voith energy absorption systems. Depending on the region and the requirements, different types of freight couplers are available. Our couplers offer maintenance-friendly design. Along with that, we provide technical support, including strength calculations and energy absorption certificates.

For European freight applications, Voith CargoFlex Type Scharfenberg and Hybrid offer fast, automatic coupling based on the type 10 coupler head. The couplers are suited for UIC 530 installation space and for vehicles according to TSI standard. Due to energy absorption components and a stabilising linkage safety can be increased and wear can be reduced. Additional components allow for further automation of operation.
Voith CargoFlex Type SA3 featuring mixed coupler device, automatic uncoupling device and energy absorption solution

CargoFlex Type Scharfenberg for wagons:
Safe, automatic coupling in freight applications

CargoFlex Hybrid for locomotives:
For coupling with drawhooks, the coupler head can be swiveled upwards
Lightweight design

Until now, mostly metals such as steel and aluminium were used in the construction of rail vehicles to achieve the required high strength values. However, in the current age of economy and ecology, operating costs and energy consumption are moving more and more into the foreground.

CFRP frontend systems

In its new developments, Voith is using more and more fibre reinforced plastics, from the adapter coupler made of CFRP and front noses made of GFRP to a complete vehicle head with energy absorbing components. This results in lower weight, greater economy, better environmental compatibility and lower wear.
GFRP energy absorber: lightweight and effective

In the event of a crash, energy absorbers are to convert the resulting energy and to provide the best possible protection for people and material. GFRP energy absorbers provide a low overall weight and a uniform energy absorption capacity. This results in a high weight-specific energy absorption.

The absorbers are equipped with anti-climber plates. Depending on the requirements, the GFRP absorber can have different designs and force layouts.

In case of a collision, the fibre composite tube is pressed through the nozzle. This induces a controlled collapse of the laminate. The laminate defibrates on its way, which makes it easy to deflect downwards. This reduces the space required behind the absorber.

Energy absorber made of GFRP
Voith supplies complete traction systems for mainline and urban rail vehicles. In addition to equipping new vehicles with efficient drive systems, we also offer customized solutions for repowering of vehicles that are currently in service.

Our traction systems are available for a broad spectrum of power supplies including AC, DC (up to 1500 Vdc), diesel-electric, on-board energy storage as well as hybrid solutions and cover the entire range of power requirements.

At the heart of each electric drive system is the traction converter. Voith EmCon traction converters provide the essential benefits.
High-performance – the new EmCon traction converters

Double traction inverter EmCon DI1000-5AR
750 V LRV application

The EmCon DI1000-5AR is a high performance double traction inverter for roof installation in 600 Vdc and 750 Vdc power supply applications such as trams and low-floor Light Rail Vehicles (LRV) in particular.

Power range

- 2 x 225 kVA rated
- 2 x 450 kVA maximum

Key benefits

+ High performance
+ Highest redundancy
+ Well-structured arrangement
+ Minimized maintenance
+ Suitable for energy storage application
+ Optimized integration with separated IO-Control Unit

Product variant EmCon Di1000-5AR

A variant with significant more powerful energy storage choppers is available. It allows a continuous, cyclic catenary free operation with full performance similarly to catenary operation.
Traction inverter EmCon I1000-9AR
750 LRV application

The EmCon I1000-9AR is a compact traction inverter for roof installation in 600 Vdc and 750 Vdc power supply applications such as trams and low floor Light Rail Vehicles (LRV) in particular.

Power range

• 360 kVA rated
• 720 kVA maximum

Key benefits

+ Compact
+ Economic single inverter
+ Well-structured arrangement
+ Minimized maintenance
+ Suitable for energy storage application
+ Optimized integration with separated IO-Control Unit
Product variant EmCon Ie1000-9AR
A variant with significant more powerful energy storage choppers is available. It allows a continuous, cyclic catenary free operation with full performance similarly to catenary operation.

Product variant EmCon I1000-9AU
A variant for underfloor installation in high-floor LRVs is available.
Double traction inverter
EmCon DI2000-5AU & EmCon DI1000-10AU
1500 V & 750 V metro application

The EmCon DI2000-5AU & EmCon DI1000-10AU are high performance double traction inverters for underfloor installation in 1500 Vdc respectively 750 Vdc power supply applications such as metros in particular.

Power range
- 2 x 450 kVA rated
- 2 x 900 kVA maximum

Key benefits
+ High performance
+ Highest redundancy
+ Separated control of each motor bogie
+ Outstanding completeness
+ Well-structured arrangement
+ Minimized maintenance
Double traction inverter
EmCon DI1000-9AU
750 V metro application

The EmCon DI1000-9AU is a double traction inverter for underfloor installation in 750 Vdc power supply applications such as metros in particular.

Power range

• 2 x 400 kVA rated
• 2 x 725 kVA maximum

Key benefits

+ Optimized performance
+ Highest redundancy
+ Separated control of each motor bogie
+ Outstanding completeness
+ Well-structured arrangement
+ Minimized maintenance

Product variant EmCon DCH1000-9AU

For application with dc-traction motors in repowering projects especially, a double traction chopper EmCon DCH1000-9AU is available.
Traction inverter power stack core
PSC 33-600L
EMU/DEMU or locomotive application

The Power Stack Core (PSC) unit represents 2 half bridges. By use of two PSCs AC motor inverters or 4-quadrant converters can be easily arranged. Typical applications are traction converters for EMU’s, DEMU’s or locomotives with 1 500–2 000 Vdc intermediate voltage. For heavy duty applications the two half bridges can be switched in parallel to double the output current.

Rated power range

- 1 500 Vdc supply: 900 kVA
- DE application: 900 kVA
- AC supply: 1 100 kVA

Key benefits

+ High performance
+ High power density by liquid cooling
+ Compact design
+ Modular, well-structured arrangement
+ Minimized maintenance
+ Suitable for cabinet-, underfloor-, roof applications
Traction inverter power stack core
PSC 33-900L
EMU/DEMU or locomotive application

The Power Stack Core (PSC) unit represents 2 half bridges. By use of two PSCs AC motor inverters or 4-quadrant converters can be easily arranged. Typical applications are traction converters for EMU’s, DEMU’s or locomotives with 1 500–2 000 Vdc intermediate voltage. For heavy duty applications the two half bridges can be switched in parallel to double the output current.

Rated power range

- 1 500 Vdc supply: 1 350 kVA
- DE application: 1 350 kVA
- AC supply: 1 650 kVA

Key benefits

+ High performance
+ High power density by liquid cooling
+ Compact design
+ Modular, well-structured arrangement
+ Minimized maintenance
+ Suitable for cabinet-, underfloor-, roof applications
As specialists in components and systems for rail vehicles, we ensure safe operation, highest availability and long service life.
International service hotline
(Technical assistance)

Phone +49 7321 37-4181

Non-Voith units

Technical support

Exchange program
As a component and subsystem manufacturer, Voith has a particular affinity with rail vehicles. Outstanding system competence as well as the expertise of its qualified staff are today utilized in the manufacturer-independent and high-quality servicing of rail vehicles and cooling systems. Maintenance, repair, major inspections or modernizations – our services are customized to suit your vehicles.

Our infrastructure includes all necessary equipment to process locomotives and multiple units of a length of up to 120 m comprehensively. Servicing of cooling systems is done by Voith with the required system and integration know-how. Thanks to its high vertical integration and replacement part availability, including the option of putting in replacement components, Voith acts with great flexibility. With fast repairs Voith contributes to minimized downtimes and an efficient operation.
Bogie overhaul

Whether an entire train in our one-stop shop or a single component is delivered, with Voith you can have your whole bogie overhauled. Voith offers work on wheelsets, wheelset gear units, brake systems and all further components from one source – the complete range for the undercarriage of your rail vehicle.

With its optimized, holistic approach to bogie overhauls, Voith can offer reliable process procedures at the shortest possible throughput times and the highest quality standards you have come to expect. The final verification on the modern pressure rig is of course included.
As a former developer and manufacturer of rail vehicles, Voith has the system and expert competence necessary for developing railway-specific systems and associated software solutions. Voith covers the entire development process from concept creation through system engineering, diverse simulation techniques and design to approval of components, systems or complex overall systems. We can therefore supply even prototypes or series production from one source.

Customer benefit is at the core of everything we do, whether for new developments, modernizations, retrofitting of subsystems for increasing efficiency and improvements in eco-friendliness or occupational safety.
Worldwide at your side
Workshop and mobile service

Our service specialists are available to you anytime, anywhere. Voith’s worldwide service network includes workshops, technicians, service engineers and technical account consultants. Together they provide fast reaction times, competent service and personal customer support. As a result, we offer individual, customized solutions and on-site service worldwide.

The mobile service organized to ECM structures offers a broad range of services, from immediate corrective actions 24/7 to full-service packages.

Do you want to optimize your servicing? We also gladly take on higher-level ECM functions for you and develop an optimized service program.
Real time safety
Smart Schaku

The new Smart Schaku system enables coupler monitoring in real time, giving operators the information they need to improve availability, reduce costs and optimize maintenance procedures.

Real time monitoring and problem detection
Force and coupling frequency are key parameters that give valuable insight into the coupler’s overall condition and usage. Sensors collect these data in real-time and combine it with the vehicle operation data. The result is transmitted as digital log to the Voith Cloud where it is analyzed. The information is visualized on the customer’s individualized interface and it notifies the operator of any potential trouble areas, such as a broken deformation tube or a malfunctioning damper.

Countdown to the next overhaul
Smart Schaku is the first milestone for predictive maintenance where the operator will have the ability to predict breakdowns before they occur, announcing potential damage to key coupler components.
Customer benefits

+ Immediate notification of incidents
+ Optimized maintenance frequency
+ Reduction of unexpected or planned downtimes
+ Plannable downtimes and calculable costs