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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.

Four basic versions are currently available:

- The RailPack 400DM – engine power up to 390 kW
- The RailPack 400DH – engine power up to 390 kW
- The RailPack 600DH – engine power up to 588 kW
- The RailPack 800DH – engine power up to 735 kW

The basic versions can, upon customer request, add options such as a winter package for low-temperature use.

<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>T 211 re.4 + KB190</td>
</tr>
<tr>
<td>Engine</td>
<td>Voith R2876T MAN D2876LUE</td>
<td>Voith R2876T MAN D2876LUE</td>
</tr>
<tr>
<td>Engine power</td>
<td>294 kW to 390 kW</td>
<td>353 kW to 390 kW</td>
</tr>
<tr>
<td>Speed</td>
<td>80 to 120 km/h</td>
<td>100 to 140 km/h</td>
</tr>
</tbody>
</table>

Other engines available on request.
Advantages:

+ All necessary components are combined in one system in a space-saving manner.
+ Excellent riding comfort is provided by low-vibration, elastic bearings. The flexible design of the RailPack allows individual adaptation.
+ The construction follows customer specifications in accordance with UIC requirements and/or European standards.
+ Design, coordination and reliable operation of the components are checked and verified during type testing.
+ The RailPacks are checked before delivery for function, communication, adjustment of the hydrostatic system and leaks by way of a series-test run following assembly.

<table>
<thead>
<tr>
<th>RailPack 600DH</th>
<th>RailPack 800DH</th>
<th>RailPack 400 / 600 / 800DE</th>
</tr>
</thead>
<tbody>
<tr>
<td>T 212 bre</td>
<td>T 312 bre</td>
<td>Generator</td>
</tr>
<tr>
<td>MAN D2862LE</td>
<td>MAN D2862LE</td>
<td>All types possible</td>
</tr>
<tr>
<td>Voith V2862T</td>
<td>Voith V2862T</td>
<td></td>
</tr>
<tr>
<td>MAN D2842LE</td>
<td>Cummins QSK19</td>
<td></td>
</tr>
<tr>
<td>500 kW to 588 kW</td>
<td>560 kW to 735 kW</td>
<td>294 kW to 735 kW</td>
</tr>
<tr>
<td>120 to 160 km/h</td>
<td>140 to 200 km/h</td>
<td>80 to 200 km/h</td>
</tr>
</tbody>
</table>
The proven Voith DIWARail transmission was reworked and the transmission input power increased for the RailPack 400DM. The RailPack 400DM 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 390 kW.

RailPack 400DH / 600DH

The RailPack 400DH is available in this version with the T 211 turbo transmission and a maximum engine power reaching 390 kW. The RailPack 600DH is equipped with the T 212 turbo transmission for a maximum engine power of 588 kW.
RailPack 800DH

The maximum performance RailPack 800DH is the RailPack with the T 312 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.

RailPack 600DH

The RailPack 600DH is primarily suited for use in railcars having a maximum speed of 100 to 140 km/h or 120 to 160 km/h since very high efficiency is available over a wide range of speeds because two hydrodynamic couplings are used.
The RailPack X00DE is available with engine powers ranging from 294 kW to 735 kW and is ideally suited for railcars. The drive generators integrated into the system form an essential component of a RailPack 400DE. Together with other Voith components, they form an entire electrical drive chain.
System Supplier with Engine Expertise

Besides engines from third-party manufacturers, two engines that Voith supplies in one system are integrated into the RailPacks. Two Voith engine versions are available for this: the R6 and the V12 diesel engines. Both were jointly developed in a cooperative effort with MAN Truck & Bus AG especially for railroad use. With these engines, Voith offers an ideal system architecture for your rail vehicles.

The R6 diesel engine (R2876T3) is a horizontal engine that displays its class in a variety of applications. It is available in three different versions providing 390 kW / 353 kW / 294 kW. With a power of 390 kW and a maximum torque of 2 300 Nm, it achieves the emission values prescribed since 2012 (EU Stage IIIB) thanks to an SCR system (selective catalytic reduction). The 6-cylinder engine is used in railcars and special vehicles.
The V12 diesel engine (V2862T3) is available with output ratings of 588 kW / 622 kW / 735 kW for railcar applications and also uses an SCR system for exhaust gas treatment. With very low fuel consumption and high reliability, it shines with the highest grades in comparison to the market environment.

**R6-R2876T3 external dimensions**

---

**Technical Data**

<table>
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<tr>
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<th>R2876T3</th>
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<tr>
<td>Nominal power</td>
<td>390 / 353 / 294 kW</td>
</tr>
<tr>
<td>Nominal speed</td>
<td>1800 rpm</td>
</tr>
<tr>
<td>Max. torque</td>
<td>2300 / 2200 / 1900 Nm</td>
</tr>
<tr>
<td>At speed</td>
<td>1100 – 1400 rpm</td>
</tr>
<tr>
<td>Max. effective medium pressure</td>
<td>22.6 / 21.6 / 18.6 bar</td>
</tr>
<tr>
<td>Displacement</td>
<td>12.82 dm³</td>
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<tr>
<td>Exhaust standard</td>
<td>Stage IIIB</td>
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<tr>
<td></td>
<td>(EU 97 / 68 / EG-2011 / 88 / EG)</td>
</tr>
</tbody>
</table>
V12-V2862T3 external dimensions

V2862T3/L3

735 / 662 / 588 kW
1800 rpm
4000 / 3750 / 3350 Nm
1300 – 1500 rpm
20.7 / 19.4 / 17.4 bar
24.24 dm³
Stage III B
(EU 97/68/EG-2012/46/EG)
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

**T 312 bre turbo transmission**

Turbo transmission for diesel railcars  

- **T** Railcar transmission  
- **3** Circuit size index  
- **1** Number of torque converters  
- **2** Number of couplings  
- **b** Hydrodynamic brake  
- **r** Mechanical reversing transmission  
- **e** Electronic control unit
Type Designation

L 620 reU2 turbo transmission

Turbo transmission for locomotives in mainline service

L 620 rzU2

L  Locomotive transmission
6  Circuit size index
2  Number of torque converters
0  Number of couplings
r  Mechanical reversing transmission
e  Electronic control unit
U2  Drive design
L 3r4 zse turbo reversing transmission

Turbo reversing transmissions for shunting and multi-purpose locomotives.

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 Transmission for Diesel Railcars

Performance characteristics

<table>
<thead>
<tr>
<th>Type</th>
<th>T 211 r.3 + KB 190 pneumatic*</th>
<th>T 211 re.4</th>
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</thead>
<tbody>
<tr>
<td>Input power $P$</td>
<td>[kW]</td>
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<tr>
<td>Input speed $n_1$</td>
<td>[rpm]</td>
<td>1 800 – 2 400</td>
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<td>Mass separate</td>
<td>[kg]</td>
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<tr>
<td>Mass flange-mounted</td>
<td>[kg]</td>
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</tr>
<tr>
<td>Oil capacity</td>
<td>[l]</td>
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<td>Power takeoff $M_{max}$</td>
<td>[Nm]</td>
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</tr>
<tr>
<td>$n_{power takeoff}/n_1$</td>
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<td>approx. 1.0</td>
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<tr>
<td>Dimensions</td>
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<td>–</td>
<td>900</td>
</tr>
<tr>
<td>$A_2$</td>
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<tr>
<td>$L_1$</td>
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<td>–</td>
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<td>$L_2$</td>
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<td>$H_1$</td>
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<td>335</td>
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<td>$H_2$</td>
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<tr>
<td>$H_3$</td>
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<td>675</td>
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<tr>
<td>$B_1$</td>
<td>514</td>
<td>595</td>
</tr>
<tr>
<td>$B_2$</td>
<td>24.5</td>
<td>24.5</td>
</tr>
<tr>
<td>$B_3$</td>
<td>920</td>
<td>1 095</td>
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</table>

( ) - values for the version with power takeoff

* Upon request

Special versions available upon request
Separately supported version

Flange-mounted version

<table>
<thead>
<tr>
<th></th>
<th>T 211 re.4 + KB 190</th>
<th>T 212 bre</th>
<th>T 312 bre</th>
</tr>
</thead>
<tbody>
<tr>
<td>T 211 re.4</td>
<td>350</td>
<td>450</td>
<td>650</td>
</tr>
<tr>
<td></td>
<td>1 800–2 400</td>
<td>1 800–2 400</td>
<td>1 800–2 400</td>
</tr>
<tr>
<td></td>
<td>–</td>
<td>–</td>
<td>1 510 (1 521)</td>
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<td></td>
<td>900</td>
<td>1 200</td>
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<td>100</td>
</tr>
<tr>
<td></td>
<td>800</td>
<td>800</td>
<td>230</td>
</tr>
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<td>approx. 1.0</td>
<td>1.0</td>
<td>approx. 1.35</td>
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<td>–</td>
<td>–</td>
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<td>990</td>
<td>994</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>–</td>
<td>–</td>
<td>1 258</td>
</tr>
<tr>
<td></td>
<td>1 130</td>
<td>1 070</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>335</td>
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<td></td>
<td>0</td>
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</tr>
<tr>
<td></td>
<td>675</td>
<td>756</td>
<td>765</td>
</tr>
<tr>
<td></td>
<td>595</td>
<td>510 (514)</td>
<td>557</td>
</tr>
<tr>
<td></td>
<td>24.5</td>
<td>21</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>1 095</td>
<td>1 055 (1 061)</td>
<td>1 106</td>
</tr>
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</table>
# Turbo Transmission for Power Cars and Locomotives

## Performance characteristics

![Graph showing performance characteristics](image)

**Special versions available upon request**

**Type** | **L 530 breU2** | **L 620 rzU2**
---|---|---
Input power [kW] | 1 700 | 2 700
Input speed [rpm] | 1 500–2 100 | 1 500–2 100
Mass (excluding oil filling) [kg] | 4 680* | 4 700
Oil capacity [l] | 200 | 300
Dimensions [mm] | | |
A₁ | 684 | 656
A₂ | 925 | 925
A₃ | 1 103 | 1 132
A₄ | 125 | 96
B₁ | 565 | 565
B₂ | 565 | 565
H₁ | 1 390 | 1 563
H₂ | 1 065 | 1 150
H₃ | 310 | 395
H₄ | 240 | 320

* with hydrodynamic brake
## Dimensions

<table>
<thead>
<tr>
<th></th>
<th>L 620 reU2 +KB 385</th>
<th>LS 640 reU2</th>
<th>LS 640 reU2 +KBD 385</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B1</strong></td>
<td>2 700</td>
<td>4 200</td>
<td>4 200</td>
</tr>
<tr>
<td><strong>B2</strong></td>
<td>1 500 – 2 100</td>
<td>1 000 – 1 800</td>
<td>1 000 – 1 800</td>
</tr>
<tr>
<td><strong>B3</strong></td>
<td>5 500</td>
<td>8 000</td>
<td>9 000</td>
</tr>
<tr>
<td><strong>H1</strong></td>
<td>300</td>
<td>400</td>
<td></td>
</tr>
<tr>
<td><strong>H2</strong></td>
<td>656</td>
<td>826</td>
<td></td>
</tr>
<tr>
<td><strong>H3</strong></td>
<td>925</td>
<td>1 192</td>
<td>1 192</td>
</tr>
<tr>
<td><strong>B4</strong></td>
<td>1 472</td>
<td>1 526</td>
<td>1 526</td>
</tr>
<tr>
<td><strong>H4</strong></td>
<td>96</td>
<td>106</td>
<td>106</td>
</tr>
<tr>
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<td>565</td>
<td>745</td>
<td>745</td>
</tr>
<tr>
<td><strong>H5</strong></td>
<td>565</td>
<td>745</td>
<td>745</td>
</tr>
<tr>
<td><strong>A1</strong></td>
<td>656</td>
<td>826</td>
<td></td>
</tr>
<tr>
<td><strong>A2</strong></td>
<td>925</td>
<td>1 192</td>
<td></td>
</tr>
<tr>
<td><strong>A3</strong></td>
<td>1 472</td>
<td>1 526</td>
<td></td>
</tr>
<tr>
<td><strong>A4</strong></td>
<td>96</td>
<td>106</td>
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</tr>
<tr>
<td><strong>A5</strong></td>
<td>1 150</td>
<td>1 150</td>
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</tr>
<tr>
<td><strong>A6</strong></td>
<td>395</td>
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<td><strong>A7</strong></td>
<td>355</td>
<td>355</td>
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## Turbo Transmission for Special Vehicles

### Performance characteristics

![Graph showing performance characteristics]

<table>
<thead>
<tr>
<th>Performance Parameter</th>
<th>Type L 520 rzU2*</th>
<th>L 520 rzU2 + KB 360</th>
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<tbody>
<tr>
<td>Max. input power [kW]</td>
<td>1 400</td>
<td>1 400</td>
</tr>
<tr>
<td>Input speed [rpm]</td>
<td>1 400 – 2 400</td>
<td>1 400 – 2 400</td>
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<tr>
<td>Mass (excluding oil filling) [kg]</td>
<td>3 000</td>
<td>3 400</td>
</tr>
<tr>
<td>Oil capacity [l]</td>
<td>220/240</td>
<td>220/240</td>
</tr>
<tr>
<td>Dimensions [mm]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A1</td>
<td>620</td>
<td>620</td>
</tr>
<tr>
<td>A2</td>
<td>574</td>
<td>574</td>
</tr>
<tr>
<td>A3</td>
<td>995</td>
<td>1 173</td>
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<td>A4</td>
<td>129</td>
<td>129</td>
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<tr>
<td>B1</td>
<td>520</td>
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</tr>
<tr>
<td>B2</td>
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<tr>
<td>B3</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>H1</td>
<td>1 423</td>
<td>1 423</td>
</tr>
<tr>
<td>H2</td>
<td>1 059</td>
<td>1 059</td>
</tr>
<tr>
<td>H3</td>
<td>359</td>
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<tr>
<td>H4</td>
<td>429</td>
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</tr>
<tr>
<td>L2</td>
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</table>

* Upon request
L 220 dimensions

L 311 with power takeoff dimensions

S 111 re.1 dimensions

<table>
<thead>
<tr>
<th>L 220 reV2</th>
<th>L 311 reV2HA + KB 260</th>
<th>L 311 reV2 + KB 260</th>
<th>S 111 re.1</th>
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<tbody>
<tr>
<td>350</td>
<td>600</td>
<td>650</td>
<td>250</td>
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<tr>
<td>1 310</td>
<td>1 950</td>
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<td>760</td>
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<td>80</td>
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<td>550</td>
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<td>787.5</td>
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<td>1 130</td>
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Turbo Reversing Transmissions for Shunting and Multi-Purpose Locomotives

Performance characteristics

<table>
<thead>
<tr>
<th>Type</th>
<th>L 3r2 V2</th>
<th>L 3r4 zseU2</th>
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</thead>
<tbody>
<tr>
<td>Input power [kW]</td>
<td>530</td>
<td>660</td>
</tr>
<tr>
<td>Input speed [rpm]</td>
<td>1 750–2 400</td>
<td>1 400–2 500</td>
</tr>
<tr>
<td>Mass (excluding oil filling) [kg]</td>
<td>1 500</td>
<td>2 650</td>
</tr>
<tr>
<td>Oil capacity [l]</td>
<td>140</td>
<td>80</td>
</tr>
<tr>
<td>Dimensions [mm]</td>
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<td></td>
</tr>
<tr>
<td>A₁</td>
<td>805</td>
<td>600</td>
</tr>
<tr>
<td>A₂</td>
<td>488</td>
<td>760</td>
</tr>
<tr>
<td>A₃</td>
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<tr>
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<tr>
<td>H₃</td>
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<td>300</td>
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<tr>
<td>H₄</td>
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<td>240</td>
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* Upon request

Special versions available upon request
### Dimensions

<table>
<thead>
<tr>
<th></th>
<th>L 4r4 zseU2 (a)</th>
<th>L 5r4 zU2*</th>
<th>L 5r4 zseU2*</th>
</tr>
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<tbody>
<tr>
<td><strong>B1</strong></td>
<td>1 050</td>
<td>1 400</td>
<td>1 400</td>
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<tr>
<td><strong>B2</strong></td>
<td>1 200–2 500</td>
<td>1 400–2 400</td>
<td>1 400–2 400</td>
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<tr>
<td><strong>H1</strong></td>
<td>3 900</td>
<td>4 400</td>
<td>4 650</td>
</tr>
<tr>
<td><strong>H2</strong></td>
<td></td>
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<tr>
<td><strong>H3</strong></td>
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<tr>
<td><strong>H4</strong></td>
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<tr>
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</tr>
<tr>
<td><strong>L 5r4</strong></td>
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<td><strong>L 5r4</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td><strong>A2</strong></td>
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<tr>
<td><strong>A3</strong></td>
<td>565</td>
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<tr>
<td><strong>A4</strong></td>
<td>565</td>
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<tr>
<td><strong>H4</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>L 4r4 (1 418)</strong></td>
<td>1 308</td>
<td>1 430</td>
<td>1 401</td>
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<td><strong>L 5r4 (1 075)</strong></td>
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<td><strong>L 5r4 (491)</strong></td>
<td>381</td>
<td>395</td>
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</tbody>
</table>

Diesel Drive Systems | Hydrodynamic Transmissions
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.

<table>
<thead>
<tr>
<th>Type</th>
<th>DIWARail D 884.5</th>
<th>DIWARail D 884.5</th>
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</thead>
<tbody>
<tr>
<td>Max. transmission input power $P_{1\text{max}}$ [kW]</td>
<td>320</td>
<td>320</td>
</tr>
<tr>
<td>Transmission input speed $M_{1\text{max}}$ [Nm]</td>
<td>1 900</td>
<td>1 900</td>
</tr>
<tr>
<td>Transmission input speed $n_{1\text{max}}$ [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

DIWARail with parallel shaft reversing transmission
Voith production of complete wheelsets provides vehicle manufacturers with many benefits. We offer complete wheelsets from a single source as the only transmission manufacturer for rail vehicles. We match the wheelsets, consisting of the wheelset transmission, wheelset shaft, wheels, brake discs and wheelset bearings, individually to the requirements. Whether for light rail and streetcars, metros, regional railcars, high-speed trains, locomotives or special vehicles — the individual components of the complete wheelset are perfectly matched to one another.
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

Helical gear, completely sprung
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
Wheelset Transmissions

Voith wheelset 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 – light rail and streetcars, metros, regional railcars, high-speed trains, locomotives or special vehicles – we offer the individually and optimally matched transmission for the axle load, speed and tractive force.

High-performance components for every drive
Our wheelset transmissions for transverse or longitudinal drives are distinguished by their quality, reliability, high power density and proven design. Voith offers both single-stage and two-stage helical-gear and bevel-gear transmissions. These are available in an axle-riding version and, particularly gentle for the vehicle and the track bed, in a fully sprung version.

Wheelset transmission with aluminum housing for modern high-speed trains
Special Applications

SE-530

SZH-695

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.
Engine-Transmission 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.

EmDrive engine-transmission unit
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 $M_T$ [kNm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST</td>
<td>0.25 to 275</td>
</tr>
<tr>
<td>MT</td>
<td>32 to 143</td>
</tr>
<tr>
<td>MTR</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>
</table>
| 58 to 435              | + Basic version of the Voith universal joint shaft
|                        | + Non-split bearing eyes thanks to one-piece forged flange yoke
|                        | + Length compensation with involute profile |
| 225 to 350             | + Optimized torsion and bending rigidity in a low-weight design
|                        | + Particularly well-suited for use with high-speed drives
|                        | + Low-maintenance length compensation through use of plastic-coated (Rilsan) involute profile |
| 225 to 435             | + Length compensation using rolling elements
|                        | + Axial displacement forces virtually constant over the entire torque range
|                        | + Optimized torsion and bending rigidity in a low-weight design
|                        | + Particularly well-suited for use with high-speed drives |
SafeSet Safety Couplings

Torqued-limiting SafeSet couplings have been installed for decades in the drives of rail vehicles.

In the event of an impermissible increase in torque, SafeSet safety couplings protect the components of the drive chain against serious damage. SafeSet couplings are used both in electrical railcars / multi-unit railcars (EMUs) as well as electric locomotives.
Features of SafeSet safety couplings:
- Precise, adjustable cut-out torque
- Cut-out torque that remains constant over time
- Construction adaptable for every application in the torque range from 5 to 100 kNm
- Quick reactivation following tripping
- Backlash-free power transmission
- Compact, lightweight design
- Minimal maintenance required

Chief customer benefits when using a SafeSet safety coupling in the drive chain:
- 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
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

\[ P_{\text{Mot}} \text{ Diesel engine power} \]
\[ P \text{ Drive power} \]
\[ t \text{ Outdoor temperature} \]
Cooling Systems

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
For Diesel Electric and Diesel Hydraulic Locomotives, Railcars and Special 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)
For Electric Locomotives, Railcars and Special 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 RailPacks, 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
The Coupler Head – The Heart of the Coupler

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.
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
SA3 coupler

Properties

- Automatic coupling and uncoupling possible
- Mechanism for automatically coupling the air pipes
- Integrated mixed coupler device
- Very robust with high load capacity
- In wide use in the former Soviet countries and for ore transport
AAR coupler

Properties

- Automatic coupling
- Automatic connection of air pipes and electric heads possible using separate carriers
- Transmits large forces
- Available as an integrated system with Crash Energy Management (CEM)
- Primarily used in the American 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 air pipe connections, electric head, energy absorbing components and gangway support
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
Buffers – Safety for People and Freight

The VSSM-110-170 and VSSM-105-400 buffers, developed jointly with SMW Spezialmaschinen, provide additional safety for passenger and freight service. They are TSI-compliant and meet all safety standards. In addition, they are compact and ready for use without additional modifications. Standardized interfaces permit quick replacement and retrofitting.

VSSM-105-400 for freight cars

VSSM-110-170 for passenger cars
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.

In its new developments, Voith Turbo Scharfenberg 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.
CFRP Adapter: The Lightweight Towing Coupler

Adapter couplers are chiefly used for towing trains. They must be mounted manually by the operating personnel of the train. For this purpose, they must be as light as possible but must still withstand large forces. This is possible with the CFRP adapter coupler. The weight of the coupler was cut in half so that the coupler can be attached to the vehicle by one person.
Galea: GFRP Vehicle Head with Crash Components

Proven engineering and innovative GFRP technology for structural elements and energy absorbing components: The complete Galea GFRP vehicle head has integrated crash components. Safe, lightweight and flexible in use, the modular concept provides a standard frame which can hold the various designs. This allows an individual appearance with optimal energy absorption.

The Galea crash head consists completely of glass fibre reinforced plastic (GFRP)

* Vehicle parts made of GFRP
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.
Rail Service

As a specialist in core components and systems of rail vehicles we offer high safety, increased service life and higher availability.
Our service offer

- Servicing
- Overhaul
- Maintenance
- 24h service hotline
- On-site Service
- Technical consulting
Specialist for the Entire System.

Engineering

- System engineering, design, approval of the overall system through to the single component
- Production of software solutions using our own vehicle control system TracSys

Applications:
- Subsequent integration of subsystems
- Modernization i. a. with OptiSys™, of the retrofittable intelligence of stock vehicles
- Vibration analyses
- Structural mechanical calculations
- Emission management (noise, exhaust gas)
- Ergonomics, work safety, air conditioning
- Risk analyses, safety management

New construction

- Production of parts and systems as specified by the customer
- Coverage of the complete supply chain

Applications:
- Production planning
- Production equipment design / construction
- Steel construction / welded assemblies
- Surface coating
- Assembly work
- External consulting
General overhaul

- Planning and performance of general overhauls according to legal requirements
- Documentation of the work carried out
- Infrastructure for handling vehicles up to a length of 120 m and the respective weights
- Industrial process control and logistics for minimizing the lead times

Applications:
- Diesel vehicles regardless of the manufacturer
- Bogies of all types
- RailPacks
- Wheel sets
- Axle gearboxes, turbo transmission

Mobile service

Fulfilling the maintenance functions according to ECM in all possible combinations of the following performances:

- Managing function:
  responsible maintenance authority towards official authorities and for auditing
- Development function:
  Definition and permanent optimisation of maintenance tasks using permanent operation data analysis by means of OPRA software support
- Maintenance management:
  Optimised planning on the basis of online condition monitoring and operation data analysis
- Performance of maintenance, i. a.:
  – Mobile service with 24 / 7 hotline in case of malfunctions
  – Customer-specific full service
- Other performances, for example:
  – Customer-specific spare parts management
  – Vehicle-specific and railway operative training