

# VOITH

## Rail Business Division Product Overview



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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:**

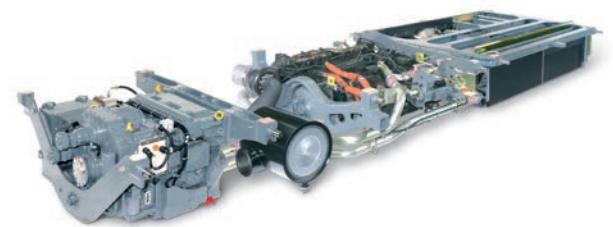
- The RailPack 400DM – engine power up to 390 kW
- The RailPack 400DH – engine power up to 390 kW
- The RailPack 600DH – engine power up to 588 kW
- The RailPack 800DH – engine power up to 735 kW

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

Basic data	RailPack 400DM	RailPack 400DH
Transmission	DIWARail	T 211 re.4 + KB190
Engine	Voith R2876T MAN D2876LUE	Voith R2876T MAN D2876LUE
Engine power	294 kW to 390 kW	353 kW to 390 kW
Speed	80 to 120 km/h	100 to 140 km/h

Other engines available on request.





**RailPack 800DH**

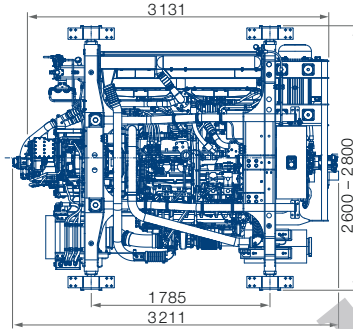
**Advantages:**

- + 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.

RailPack 600DH	RailPack 800DH	RailPack 400/600
T 212 bre	T 312 bre	Generator
MAN D2862LE Voith V2862T MAN D2842LE	MAN D2862LE Voith V2862T Cummins QSK19	All types possible
500 kW to 588 kW	560 kW to 735 kW	294 kW to 588 kW
120 to 160 km/h	140 to 200 km/h	80 to 200 km/h

## RailPack 400DM

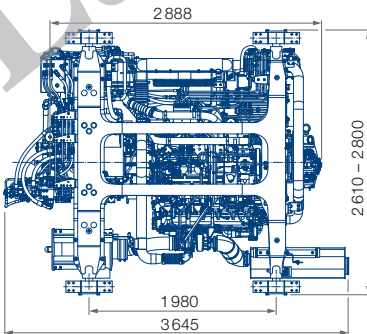
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The proven Voith DIWARail transmission was reworked and the transmission input power increased for the RailPack 400DM. The RailPack 400DM is ideally suited for all single-segment or multi-segment light rail cars because of the broad traction range and the maximum engine power of up to 390 kW.

## RailPack 400DH / 600DH

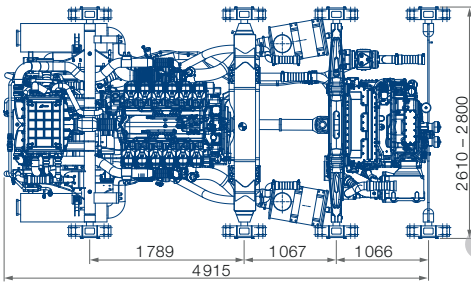
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The RailPack 400DH is available in this version with the T 211 turbo transmission and a maximum engine power reaching 390 kW. The RailPack 600DH is equipped with the T 212 turbo transmission for a maximum engine power of 588 kW.

## RailPack 800DH

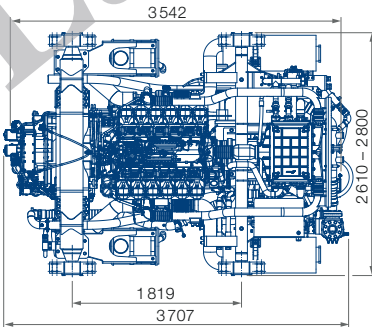
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The maximum performance RailPack 800DH is the RailPack with the T 312 turbo transmission. The RailPack 800DH is designed for a power output of up to 735 kW. It is perfectly suited for railcars with maximum speeds between 140 and 200 km/h.

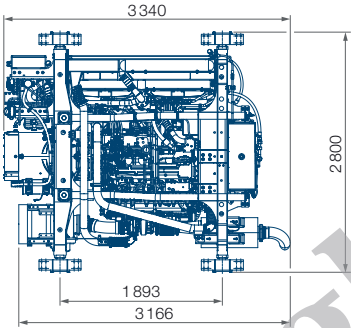
## RailPack 600DH

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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.

RailPack 400 / 600



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.

## 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.

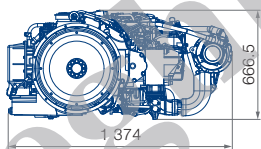
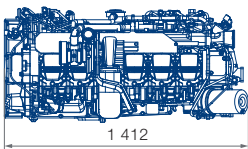


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**R6 diesel engine – R2876T3**

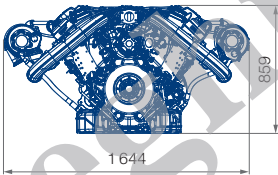
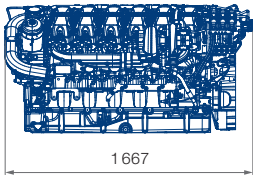
The V12 diesel engine (V2862T3) is available with output ratings of 588kW/622kW/735 kW for railcar applications and also uses an SCR system for exhaust gas treatment. With very low fuel consumption and high reliability, it shines with the highest grades in comparison to the market environment.

R6-R2876T3 external dimensions



Technical Data	R2876T3
Nominal power	390/353/294 kW
Nominal speed	1 800 rpm
Max. torque	2 300/2 200/1 900 Nm
At speed	1 100 – 1 400 rpm
Max. effective medium pressure	22.6/21.6/18.6 bar
Displacement	12.82 dm <sup>3</sup>
Exhaust standard	Stage IIIB (EU 97/68/EG-2011/88/EG)

V12-V2862T3 external dimensions



V2862T3

735/662/588 kW
1800 rpm
4 000/3 750/3 350 Nm
1300 – 1500 rpm
20.7/19.4/17.4 bar
24.24 dm <sup>3</sup>
Stage IIIB
(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.

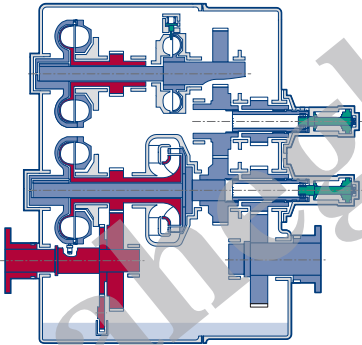
The gears are shifted by filling and emptying the circuits. In the case of turbo reversing transmissions, the converter can be used in the opposite direction for hydrodynamic braking.

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



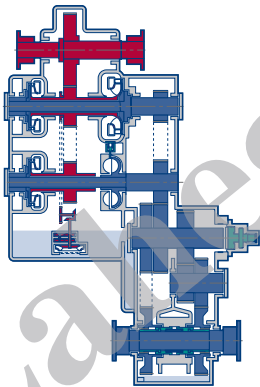
**Turbo transmission for diesel railcars**

**T 312 bre**

- 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 530 breU2 turbo transmission



**Turbo transmission for locomotives  
in mainline service**

**L 530 breU2**

**L** Locomotive transmission

**5** Circuit size index

**3** Number of torque converters

**0** Number of couplings

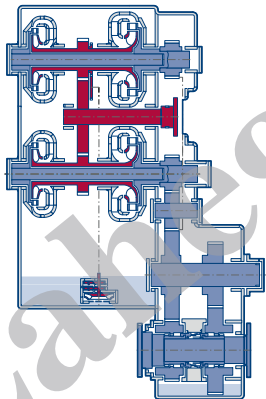
**b** Hydrodynamic brake

**r** Mechanical reversing transmission

**e** Electronic control unit

**U2** Drive design

L 3r4 zse turbo reversing transmission



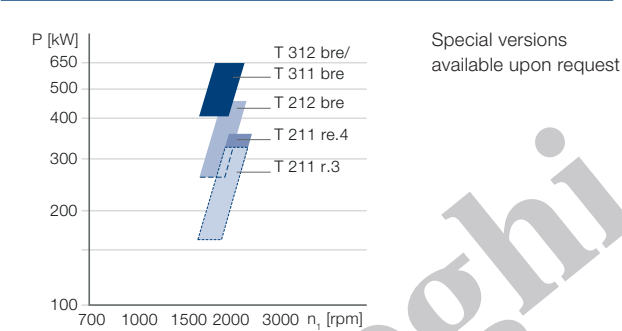
Turbo reversing transmissions for shunting and multi-purpose locomotives.

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 Transmission for Diesel Railcars

## Performance characteristics

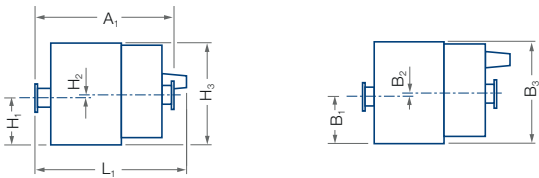


Type		T 211 r.3 + KB 190 pneumatic*	T 211 re.4
Input power	P [kW]	320	350
Input speed	$n_1$ [rpm]	1 800–2 400	1 800–2 400
Mass	separate [kg]	–	760
	flange-mounted [kg]	900	840
Oil capacity	[l]	75	75
Power takeoff	$M_{max}$ [Nm]	800	800
	$n_{Power\ takeoff}/n_1$	approx. 1.0	approx. 1.0
Dimensions	[mm] $A_1$	–	900
	$A_2$	990	890
	$L_1$	–	–
	$L_2$	1 170	1 030
	$H_1$	335	335
	$H_2$	0	0
	$H_3$	675	675
	$B_1$	514	595
	$B_2$	24.5	24.5
	$B_3$	920	1 095

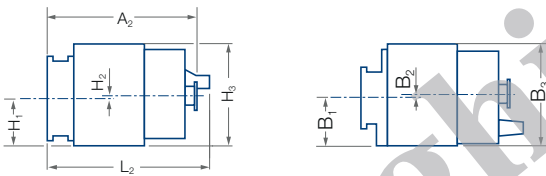
( ) - values for the version with power takeoff

\* Upon request

Separately supported version



Flange-mounted version



T 211 re.4  
+ KB 190

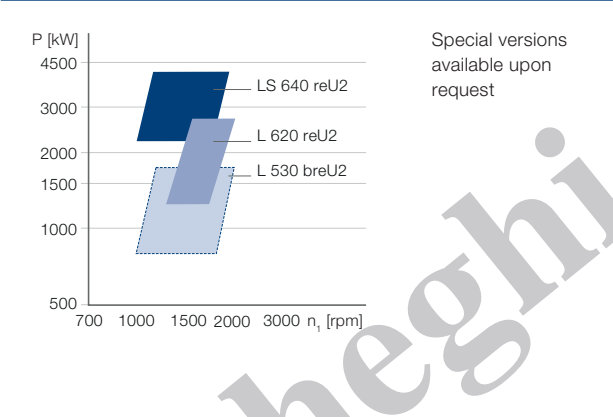
T 212 bre

T 312 bre

350	450	650
1 800–2 400	1 800–2 400	1 800–2 400
–	–	1 510 (1 521)
900	1 200	–
75	95	100
800	800	230
approx. 1.0	1.0	approx. 1.35
–	–	1 115
990	994	–
–	–	1 258
1 130	1 070	–
335	325	327
0	58	63
675	756	765
595	510 (514)	557
24.5	21	25
1 095	1 055 (1 061)	1 106

# Turbo Transmission for Power Cars and Locomotives

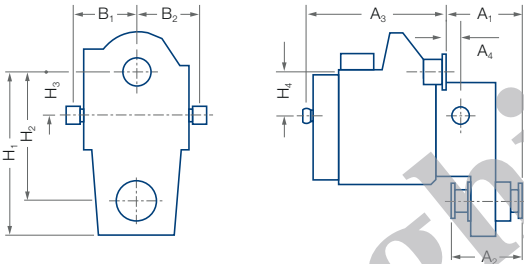
## Performance characteristics



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] A <sub>1</sub>	684	656
	A <sub>2</sub>	925	925
	A <sub>3</sub>	1 103	1 132
	A <sub>4</sub>	125	96
	B <sub>1</sub>	565	565
	B <sub>2</sub>	565	565
	H <sub>1</sub>	1 390	1 563
	H <sub>2</sub>	1 065	1 150
	H <sub>3</sub>	310	395
	H <sub>4</sub>	240	320

\* with hydrodynamic brake

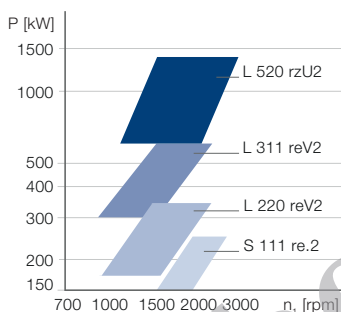
Dimensions



L 620 reU2 +KB 385	LS 640 reU2	LS 640 reU2 +KBD 385
2 700	4 200	4 200
1 500–2 100	1 000–1 800	1 000–1 800
5 500	8 000	9 000
300	400	400
656	826	826
925	1 192	1 192
1 472	1 526	1 526
96	106	106
565	745	745
565	745	745
1 563	1 538	1 538
1 150	1 150	1 150
395	355	355
355	355	355

# Turbo Transmission for Special Vehicles

## Performance characteristics

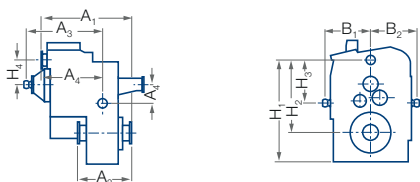


Type		L 520 rzU2*	L 520 rzU2 + KB 360
Max. input power	[kW]	1 400	1 400
Input speed	[rpm]	1 400–2 400	1 400–2 400
Mass (excluding oil filling)	[kg]	3 000	3 400
Oil capacity	[l]	220/240	220/240
Dimensions	[mm] A <sub>1</sub>	620	620
	A <sub>2</sub>	574	574
	A <sub>3</sub>	995	1 173
	A <sub>4</sub>	129	129
	B <sub>1</sub>	520	520
	B <sub>2</sub>	520	520
	B <sub>3</sub>	–	–
	H <sub>1</sub>	1 423	1 423
	H <sub>2</sub>	1 059	1 059
	H <sub>3</sub>	359	359
	H <sub>4</sub>	429	359
	L <sub>2</sub>	–	–

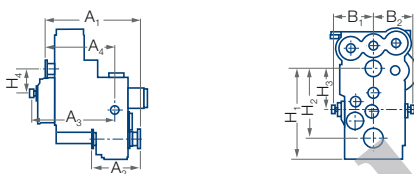
\* Upon request



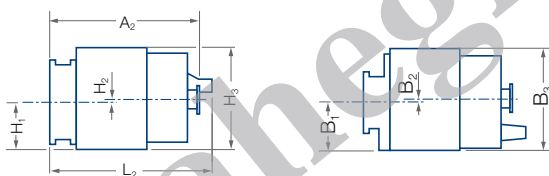
## L 220 dimensions



## L 311 with power takeoff dimensions



## S 111 re.2 dimensions



### L 220 reV2

### L 311 reV2HA + KB 260

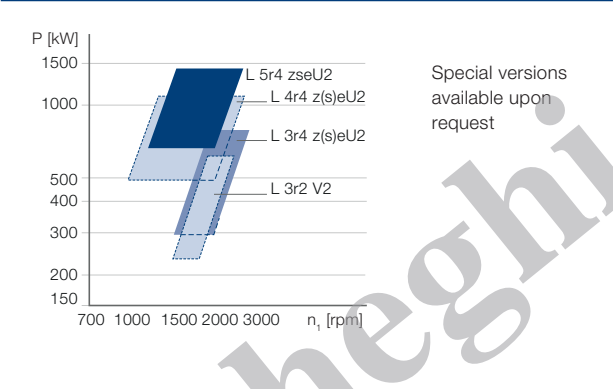
### L 311 reV2 + KB 260

### S 111 re.2

350	600	650	250
1800-2400	1800-2300	1800-2300	600
1310	1950	1725	672
80	125	125	38
931.5	1095	1095	-
565	550	550	890
787.5	979	979	-
632.5	812	812	-
465	455	455	365
465	465	465	0
-	-	-	684
1075	1083	1083	338.5
750	820	820	22
444	480	480	681
250	286	286	-
-	-	-	1006

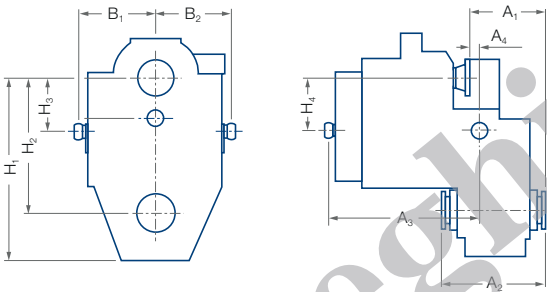
# Turbo Reversing Transmissions for Shunting and Multi-Purpose Locomotives

## Performance characteristics



Type		L 3r2 V2
Input power	[kW]	530
Input speed	[rpm]	1 750 – 2 400
Mass (excluding oil filling)	[kg]	1 500
Oil capacity	[l]	140
Dimensions	[mm] A <sub>1</sub>	805
	A <sub>2</sub>	488
	A <sub>3</sub>	810
	A <sub>4</sub>	637
	B <sub>1</sub>	415
	B <sub>2</sub>	415
	H <sub>1</sub>	1 093
	H <sub>2</sub>	705
	H <sub>3</sub>	262
	H <sub>4</sub>	222

Dimensions



L 3r4 zseU2	L 4r4 zseU2 (a)	L 5r4 zseU2
660	1 050	1 400
1 400–2 500	1 200–2 500	1 400–2 400
2 650	3 900	4 650
80	190	250
600	599	625
760	922	922
924	1 110	1 268
124	53	95
500	565	533
500	565	533
1 175	1 308 (1 418)	1 401
840	965 (1 075)	1 060
300	381 (491)	395
240	381 (491)	395

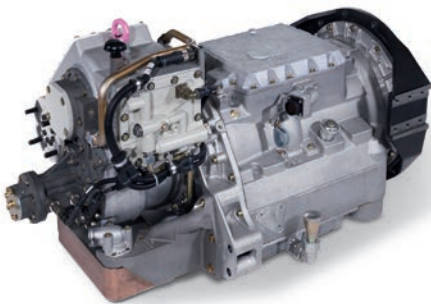
# Hydromechanical Transmission – DIWARail

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.

Type		DIWARail D 884.5	DIWARail D 884.5
Max. transmission input power $P_{1max}$	[kW]	320	320
Transmission input speed $M_{1max}$	[Nm]	1 900	1 900
Transmission input speed $n_{1max}$	[rpm]	2 200	2 200
Retarder braking torque $M_{BR}$	[Nm]	1 000	1 000
Number of gears		4	4
Transmission mass (dry) including retarder	[kg]	approx. 415	approx. 540

\* with parallel shaft reversing transmission

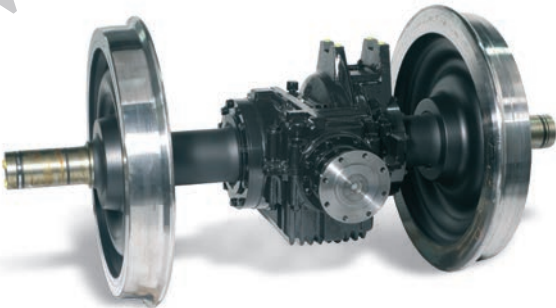


DIWARail with parallel shaft reversing transmission

# Mechanical Drives

## Complete Wheelsets

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.



**Voith complete wheelset for a heavy-duty freight locomotive**

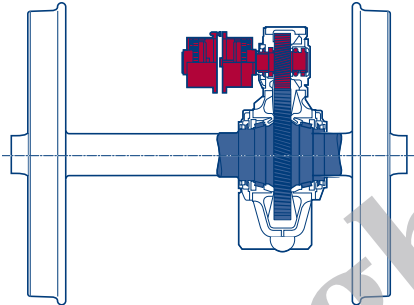
**Axle-riding helical gears**

Driven wheel rigidly connected to the wheelset shaft

**SE – Helical-gear drives**

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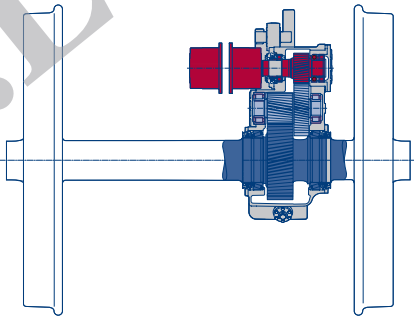
single-stage



**SZ – Helical-gear drives**

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two-stage



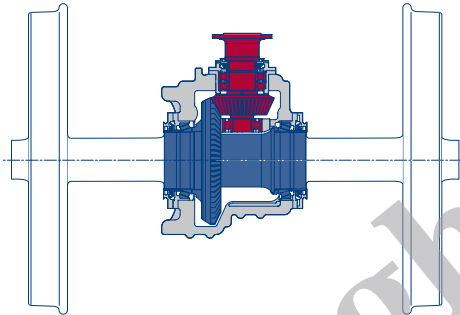
**Axle-riding bevel gears**

Driven wheel rigidly connected to the wheelset shaft

**KE – Bevel-gear drives**

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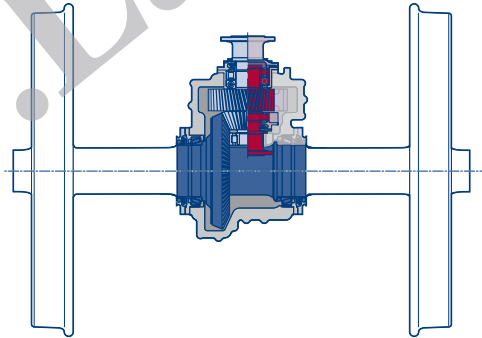
single-stage



**SK – Helical-gear/bevel-gear drives**

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two-stage



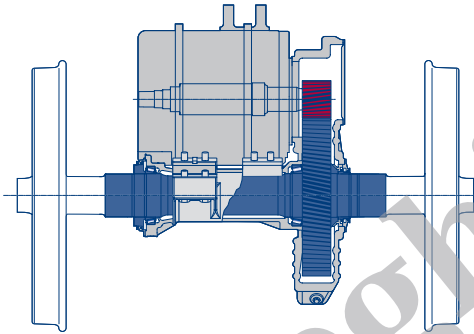
## Nose-suspended drive

not sprung

## SET – Helical-gear drives

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Single-stage nose bearing



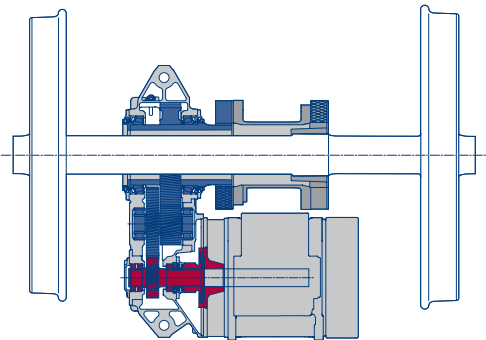
## Helical gear, completely sprung

Driven wheel rigidly connected to the quill shaft

## SZH – Helical-gear drive

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Two-stage quill shaft



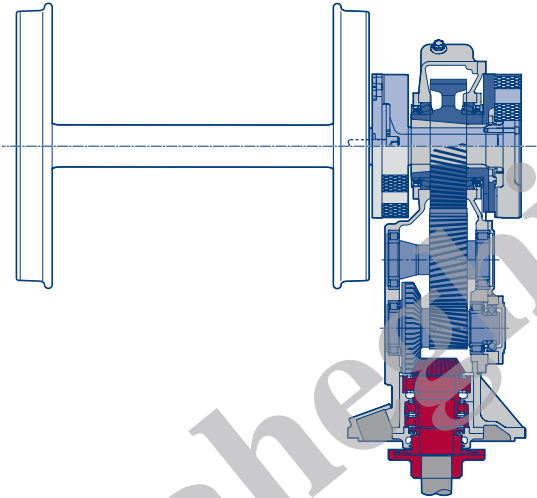


**Bevel gear, completely sprung**

Driven wheel rigidly connected to the quill shaft

**KSH – Bevel-gear / helical-gear drive, quill shaft**

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## 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.

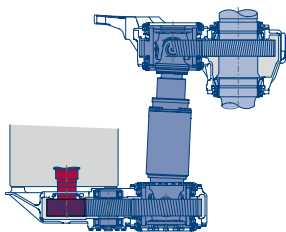


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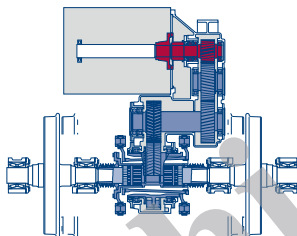
**Wheelset transmission with aluminum housing for modern high-speed trains**

## 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.



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**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:**

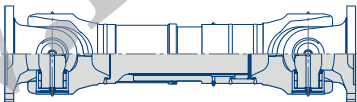
- Robust, long-lived drive components
- High reliability
- Long maintenance intervals

Series

Torque capacity  $M_z$  [kNm]

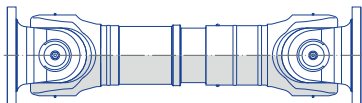
ST

0.25 to 275



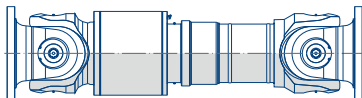
RT

32 to 143



RTR

Values available upon request



**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**

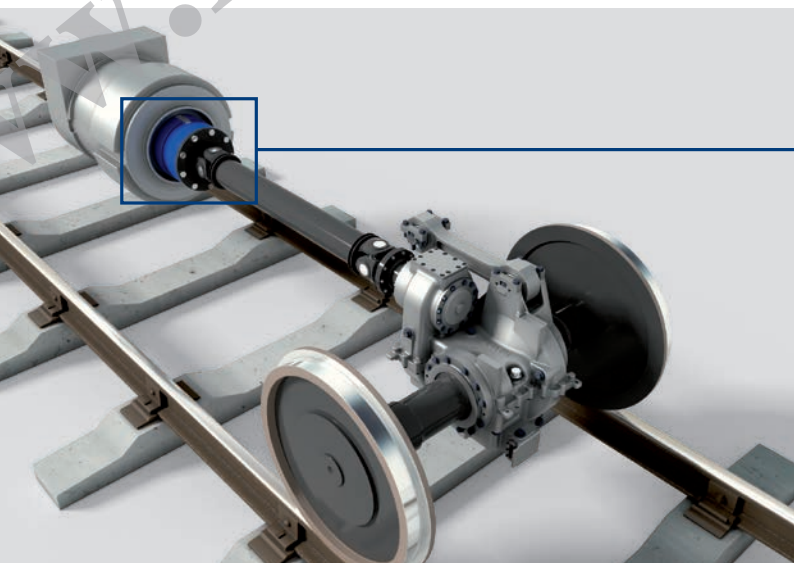
- + Proven concept of the non-split bearing eye
- + Large profile and tube diameters for high torsion and bending rigidity
- + Low-maintenance length compensation upon request

Flange diameter a [mm]	Features and benefits
58 to 435	<ul style="list-style-type: none"><li>+ Basic version of the Voith universal joint shaft</li><li>+ Non-split bearing eyes thanks to one-piece forged flange yoke</li><li>+ Length compensation with involute profile</li></ul>
225 to 350	<ul style="list-style-type: none"><li>+ Optimized torsion and bending rigidity in a low-weight design</li><li>+ Particularly well-suited for use with high-speed drives</li><li>+ Low-maintenance length compensation through use of plastic-coated (Rilsan) involute profile</li></ul>
225 to 435	<ul style="list-style-type: none"><li>+ Length compensation using rolling elements</li><li>+ Axial displacement forces virtually constant over the entire torque range</li><li>+ Optimized torsion and bending rigidity in a low-weight design</li><li>+ Particularly well-suited for use with high-speed drives</li></ul>

## 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:**

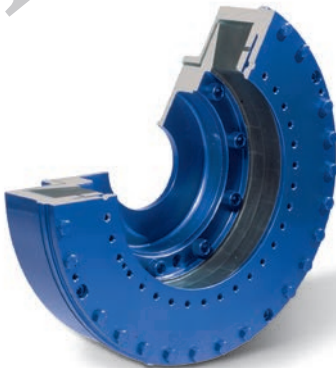
- Greater availability of all drive components thanks to damping of torsional vibrations and torque peaks in the drive chain
- Reduced lifetime costs resulting from the increased service life of all the components in the drive
- Increased comfort as the result of less vibration and noise

## **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



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**Voith BR 152 Series highly flexible coupling**

# Cooling Systems

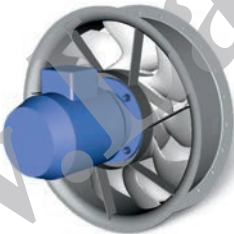
## For Locomotives and Railcars

### 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

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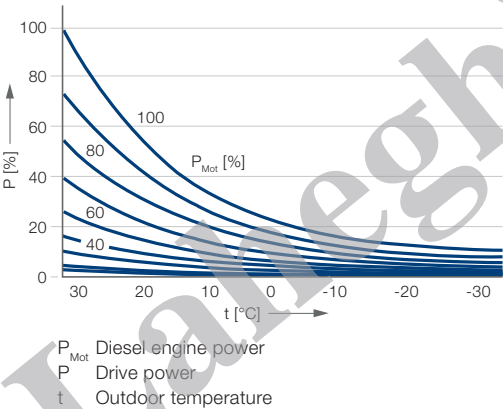


Electrical



Hydrostatic

Fan drive power requirement



# For Monorails and High-Speed Trains

## Equipment to be cooled

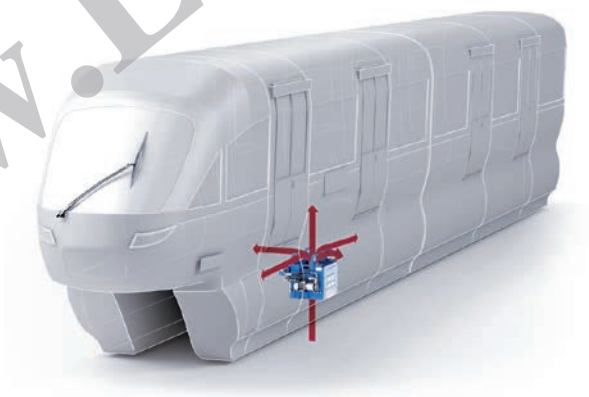
- Transformers
- Traction motors
- Rectifiers
- Chokes, electrical resistors

## 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 Vehicles

## For all performance levels of

- Diesel electric and diesel hydraulic locomotives
- Diesel electric and diesel hydraulic railcars

## Equipment to be cooled

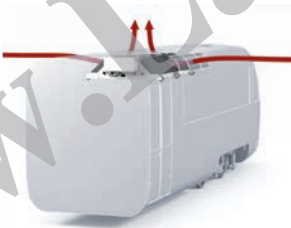
- Diesel engine (cooling water and charge air)
- Transmission (hydrodynamic, mechanical)
- Hydrostatic drives

## Coolants

- Water-glycol mixtures
- Oils
- Air

## Installation variants

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In or on the rooftop

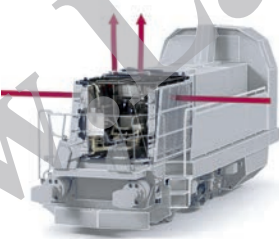


Under the floor



## 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 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



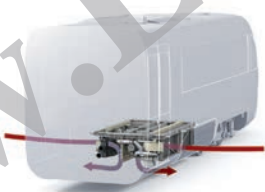
In or on the rooftop

### 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

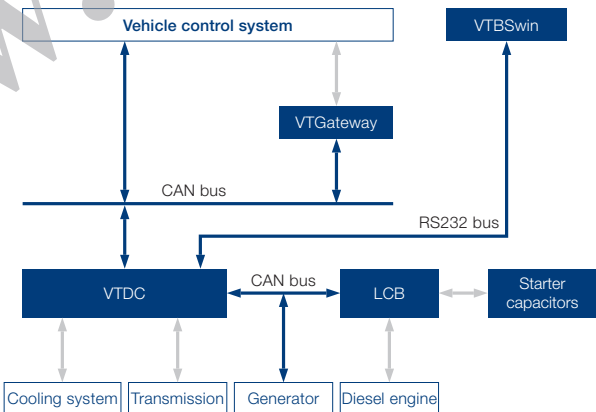
## For RailPacks, Turbo Transmissions and Cooling Systems

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.



# Voith Turbo Scharfenberg

## Automatic couplers

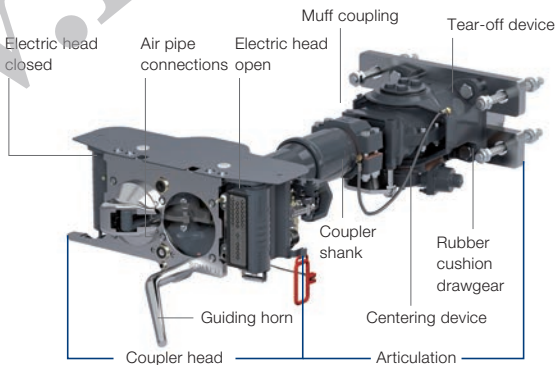
### Schaku basics - the modular design

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

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



### Coupler design

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# 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.

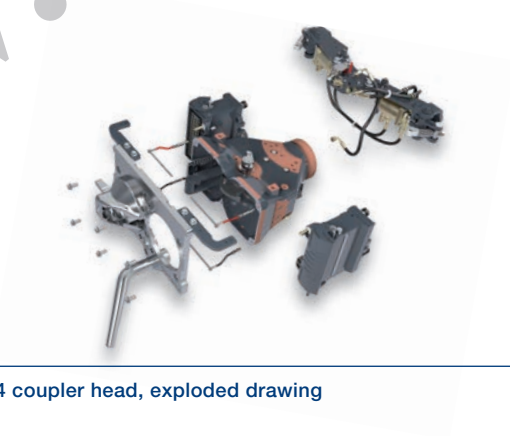
## **The One4 concept – everything compatible and modular**

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**

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- + 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

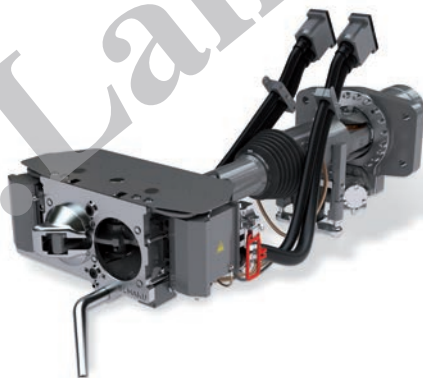
Depending on the application and the forces required, various coupler types are available. For example:

### Type 10 – mainline trains to high speed

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#### 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



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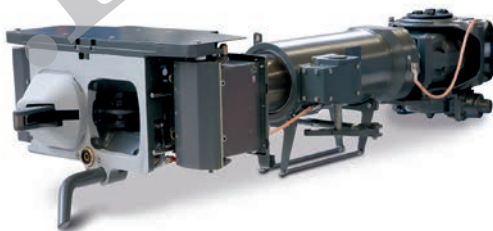
#### Type 10

## Type 35 – metros

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### Properties

- Primarily found in metro vehicles
- Suitable for all-electric vehicles
- High strength



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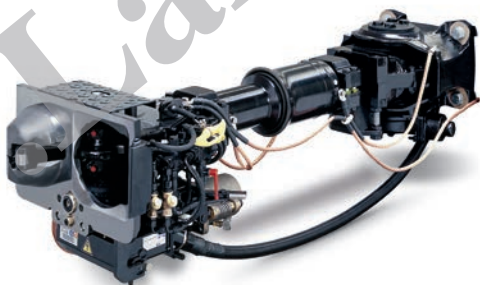
### Type 35

## Type 330 – light rail and streetcars

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### 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



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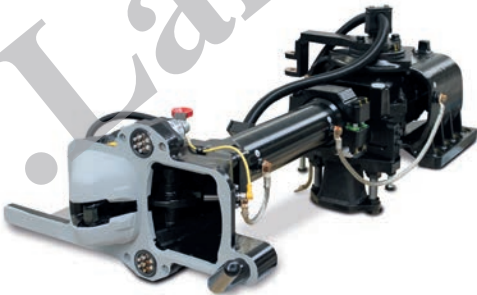
### Type 330

## Type 430/530 – light rail applications

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### Properties

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



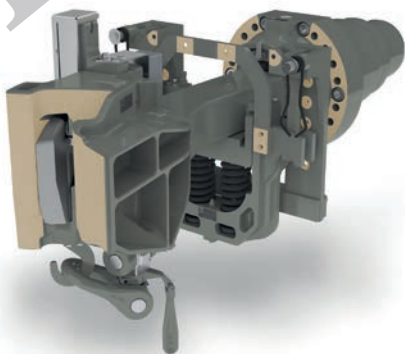
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### Type 430/530

## Voith SA3 coupler

SA3 couplers are semi-automatic centre buffer couplers. They are widely used in the widely used in Russia, Scandinavia, as well as in the Baltic and Eastern European States.

Apart from AAR couplers, SA3 couplers can be seen as the mother of all freight couplers. SA3 coupler heads are extremely robust and designed for heavy load applications, like those in coals or iron ore transportation. Voith has developed an advanced, modular type of SA3 coupler head.



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**SA3 coupler head (long version) featuring mixed coupler device, support and draft gear.**

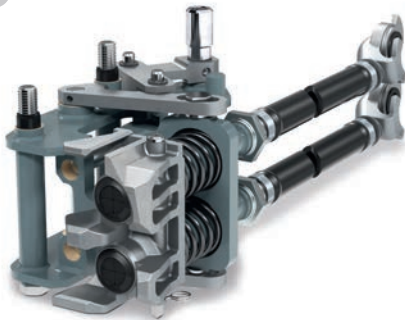
SA3 coupler heads are extremely robust and designed for heavy load applications, like those in coal or iron ore transportation. As semi-automatic center buffer couplers they are widely used in the former Soviet states. In a modular approach, Voith combines an advanced SA3 coupler head with different types of energy absorption in the draft gear.

### SA3 coupler

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#### 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



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#### Automatic Air Pipe Connection

## 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 CEM (Crash Energy Management) system is available, complying with the latest FRA and PRIIA 305 safety regulations.



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**AAR Coupler with Standard Energy Absorption**



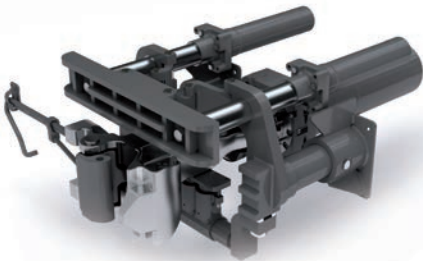
## Crash-Energy-Management-System

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

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- “Push back” AAR coupler including support
  - Anti-climber
  - Lateral energy absorbers
- 



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Crash Energy Management System (SMART Project)

# Semipermanent Couplers

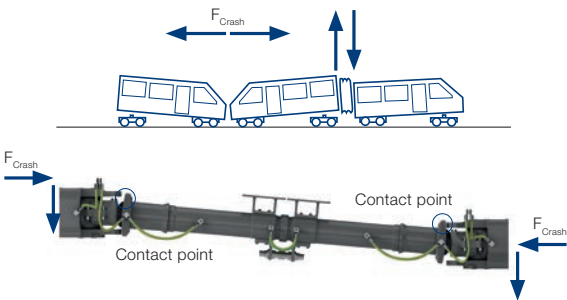
Semipermanent couplers connect intermediate cars in a train set. They represent a permanent connection but, connected by muffs, may easily be disconnected if needed.

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

## Semipermanent coupler with anti-climber

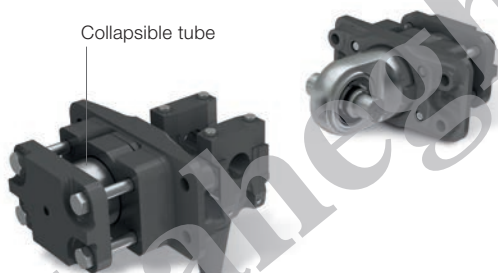
In case of this semipermanent coupler for the metro sector, an anti-climber was integrated for the first time. This protection is active before climbing is even started. This is achieved by a special geometry at the rear end of the semipermanent coupler. Once the reversible stroke of the coupler has 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.



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**Joint yoke and joint eye**



Front noses made of GRP

## 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.



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ICx front nose

## 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.



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CFRP adapter coupler

## 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.



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**Energy absorber made of GFRP**

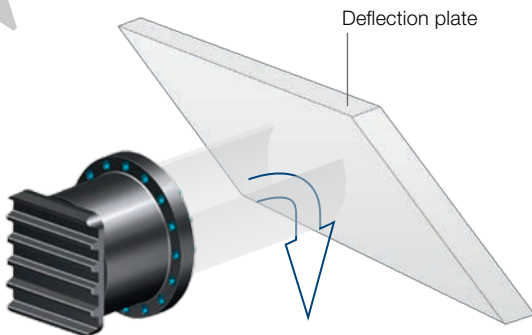
## Benefits

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- + low total weight
  - + constant energy absorption behaviour
  - + above average weight-specific energy absorption capacity
  - + variable design and force layout
  - + multi-level force layout possible
  - + minimum corrosion through the use of aluminium and glasfibre reinforced plastics
- 

## Deflection of laminate after an impact

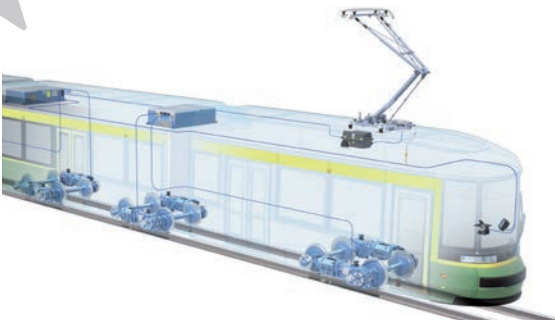
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# System Competence for the Highest Demands

Perfectly adapted systems make everyday rail vehicle operations more reliable, efficient and safer. Voith has the system competence for entire electromechanical traction systems: from high-voltage equipment, transformers, synchronous generators, traction converters, control technology and motor-gear units to complete wheelsets including bearings.

Voith Turbo offers electromechanical drive systems for DC and AC vehicles and for diesel-electric vehicles. Besides equipping new vehicles, we also offer customized solutions for modernization and repowering projects.



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**It simply performs better: EmTrac Electromechanical Drive Systems**

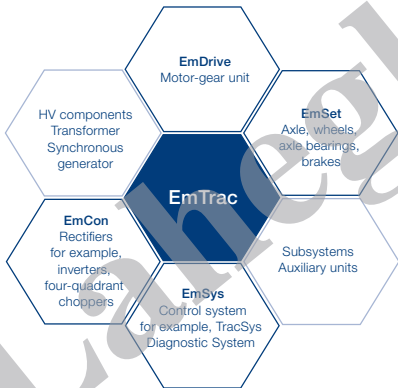


### EmTrac: Efficient drive systems

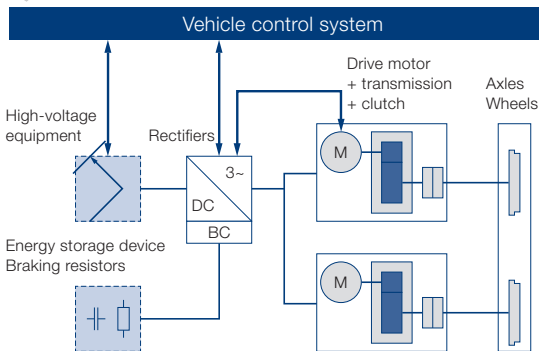
The heart of EmTrac are the EmCon Traction Converters with a power range of 185 – 1200 kW. The electromechanical drive system is formed together with additional Voith components such as the motor-gear unit (EmDrive), the wheelset (EmSet), the vehicle control system (EmSys) and the high-voltage equipment, the transformer and synchronous generator.

### EmTrac combines all the relevant components

for electromechanical drive systems



### Drive components for LRVs



# High-Performance – The New EmCon Traction Converters

## **Power and efficiency for your benefit**

Very advanced power electronics and highly dynamic motor control methods guarantee optimum tractive force under the most varied conditions. During braking, the maximum amount of braking energy is automatically fed into the electrical power system. This is assured in an engineering sense not just by careful design and simulation but also by the comprehensive testing of all relevant drive components in a system configuration from the transformer and traction converter to the motor and transmission.



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Optimum integration of hardware and software

### **A long service life thanks to quality and service**

Regardless of whether it is  $-40^{\circ}\text{C}$  and snowing or over  $+40^{\circ}\text{C}$  in a sandstorm: EmCon Traction Converters are operationally reliable and have a long service life under any conditions. Starting from the device concept and through all development steps, we pay great attention to the use of suitable development methods and tools as well as the qualification of the components used. Comprehensive simulations and tests up to device type testing in accordance with the standard are an integral part of our product development and consequently satisfy the highest demands on quality.

EmCon Traction Converters are very low-maintenance, have a long service life and are extremely reliable. A mature 3-level service concept, coordinated with the other drive components on the vehicle, ensures high availability and low maintenance costs. Global Voith service with short response times and original equipment manufacturer parts is another aspect of trouble-free operation.



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**For trouble-free operation: The new EmCon Traction Converters**

### **Key technologies and innovations with customer benefits**

- The newest generation of IGBT modules with improved power cycling and thermal cycling
- Compact power components with low commutation inductance and improved switching response
- High-power heat sinks and cooling circuits for increased power density
- Powerful traction control with a digital signal processor (DSP) and MATLAB/Simulink programming
- Energy-efficient drive control compatible with the electric power system
- Highly dynamic wheel spin / slip protection for optimal utilization of friction
- Understandable PC tool for setting parameters, configuring software and analyzing the fault memory
- Rugged housing in lightweight design with a high IP protection level



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**Compact power module solutions for LRV and metro**

### **Modularity using proven core components**

- EmCon Traction Converters based on tested and proven power components
- Power components can be used for inverters and four-quadrant choppers
- The Voith drive control unit is standardized and used for all EmCon products.
- Control software can be configured individually to the customer requirements.
- The electric power system filter is designed in accordance with customer requirements.
- The housing and interfaces can be adapted to meet customer requirements.

### **The best quality from a competent source**

Product development and testing as per EN 61287-1 and EN 50155. Comprehensive type tests including:

- Load test, thermal response, losses, cooling, climate tests
- Short-circuit, overvoltage and insulation tests, dust test
- EMC, noise, shock and vibration tests
- Verification of protection and safety functions
- Verification of the IP protection level

All traction converters are unit tested in accordance with EN 61287-1.



# Modularity and Flexibility – The EmCon Product Family.

## EmCon Traction Converters for LRV

### LRV



Type		Power <sup>1)</sup>	Voltage
DI1000-5AR	Double inverter	2 x 220 kVA	DC 600 / 750 V
I1000-6AR	Inverter	250 kVA	DC 600 / 750 V
I1000-9AR	Inverter	370 kVA	DC 600 / 750 V

## EmCon Traction Converters for DEMU, Metro and EMU

### DEMU



Type		Power <sup>1)</sup>	Voltage
I1000-9AU	Inverter	370 kVA	DC 750 V
I1000-9LU	Inverter	460 kVA	DC 750 V
I2000-6LU	Inverter	700 kVA	DC 1500 V
I2000-9LU	Inverter	1100 kVA	DC 1500 V

## EmCon Traction Converters for EMU and Locomotives

### EMU



Type		Power <sup>1)</sup>	Voltage
C2000-6LC(U)	4QS + Inverter	900 kVA	AC 15 / 25 kV
C2000-9LC(U)	4QS + Inverter	1350 kVA	AC 15 / 25 kV
C2000-12LC(U)	4QS + Inverter	1800 kVA	AC 15 / 25 kV

<sup>1)</sup> Continuous apparent power

## LRV



### Cooling

### Mounting

### Application

Air

Roof

LRV

Air

Roof

LRV

Air

Roof

LRV

## Metro



### Cooling

### Mounting

### Application

Air

Underfloor

Metro / EMU / DEMU

Liquid

Underfloor

Metro / EMU / DEMU

Liquid

Underfloor

Metro / EMU / DEMU

Liquid

Underfloor

Metro / EMU / DEMU

## Locomotives



### Cooling

### Mounting

### Application

Liquid

Cabinet / Underfloor

EMU / Locomotives

Liquid

Cabinet / Underfloor

EMU / Locomotives

Liquid

Cabinet / Underfloor

EMU / Locomotives



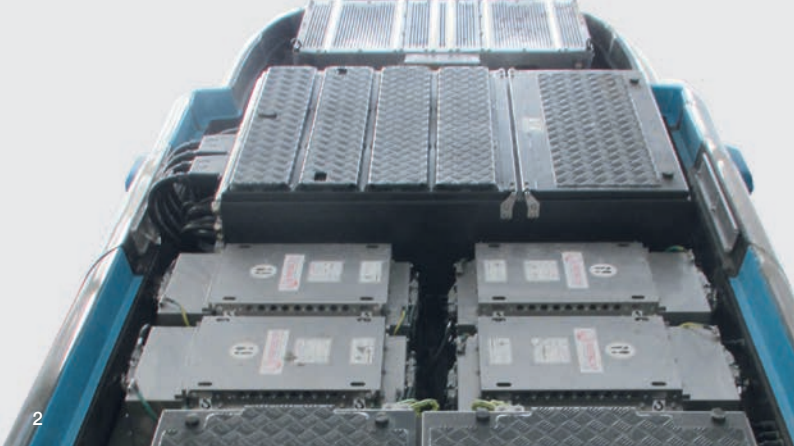
## Energy Storage

The Voith Energy Storage Unit integrates SuperCap modules of well known manufacturers to appropriate units for typical LRV applications



FreeMo 500 V Unit





- 1 SYLRV100 low-floor streetcars using Voith traction equipment and energy storage device for Shenyang.
- 2 Energy storage devices in the roof configuration

#### Significant data:

- In addition to the SuperCap modules, each unit includes its filter choke and cooling
- No other equipment is necessary because choppers and control equipment are integrated to the traction inverters
- The capacity per unit is 0.5 kWh which is multiple applied per vehicle (2 to 8).

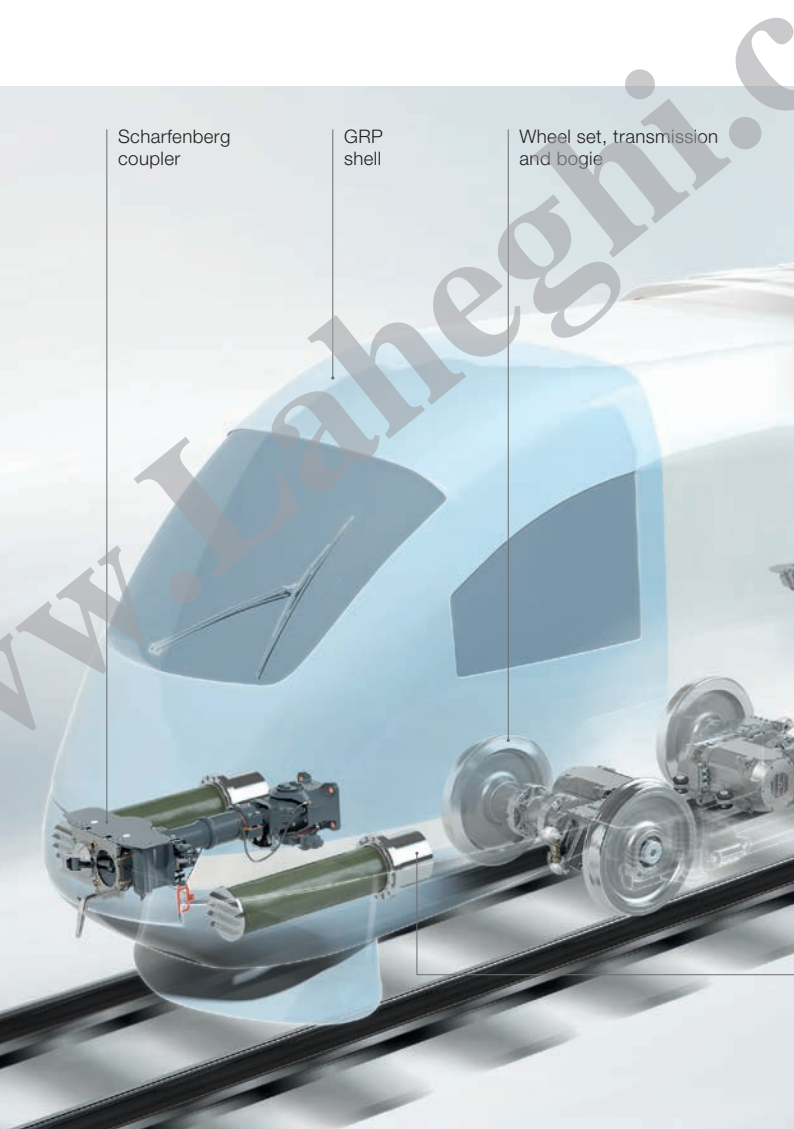
Alternatively, battery systems of well known suppliers can be integrated to the Voith traction system.



FreeMo 125 V Module

# Rail Service

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



Scharfenberg  
coupler

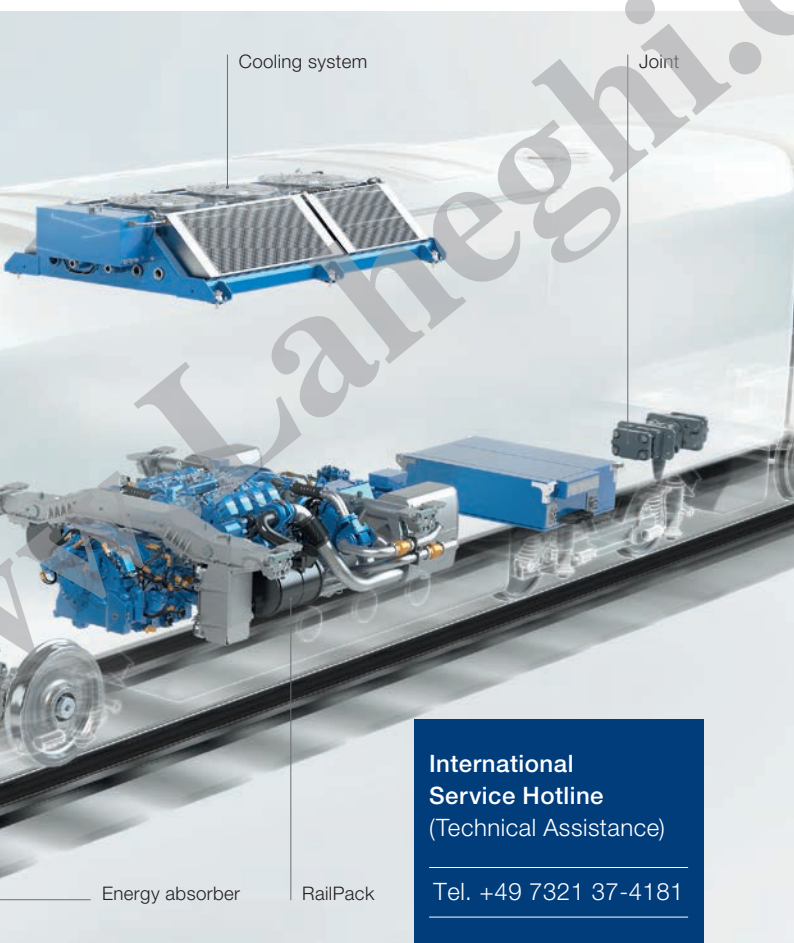
GRP  
shell

Wheel set, transmission  
and bogie

## Our service offer

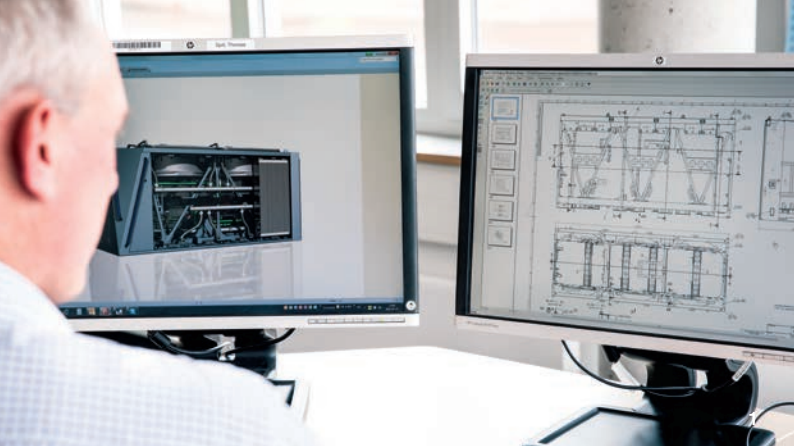
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- Servicing
- Overhaul
- Maintenance
- 24h service hotline
- On-site Service
- Technical consulting



**International  
Service Hotline**  
(Technical Assistance)

Tel. +49 7321 37-4181



## Specialist in Complex Systems.

### Engineering

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.



1 Engineering

2 Bogie overhaul

### 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.



### **Servicing of rolling stock**

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.





1 Servicing of rolling stock

2 Mobile Service

### Mobile Service

With its 3 main locations and 7 service sites, plus around 40 service technicians, Voith's service network covers all of Germany. Short distances, fast response times and servicing done directly on the vehicle – truly mobile service to your specifications and at your own site. 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.

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**VOITH**  
Engineered Reliability