



Together on Track

ZF solutions for rail vehicles



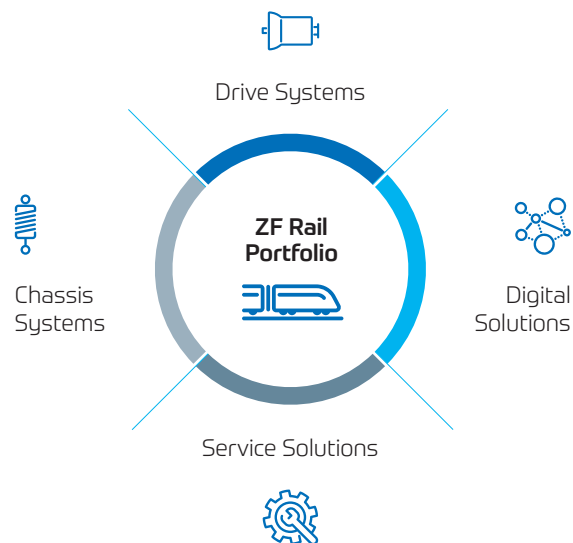
Content

- 04** **Driving Progress on Rail**
- 06** Drive Systems EMU, Metro & LRV
Powering Everyday Mobility
- 08** Drive Systems High-speed Trains
Engineered for Maximum Speed
- 10** Drive Systems DMU
Efficiency Meets Proven Performance
- 12** Drive Systems Locomotive
Built to Move Heavy Loads
- 13** Drive Systems Multiple Purpose Vehicle & Skytrain
Precision for Special Applications
- 14** Drive Systems
Redefining Coupling Technology
- 16** Chassis Systems
Advanced Dampers and Chassis Components
- 20** Digital Solutions
Turning Data Into Motion
- 22** Service Solutions
**ZF Aftermarket: Your One-Stop-Shop
in Rail Fleet Maintenance**
- 26** **Think Globally, Act Locally**



**Reliability that
keeps rail moving**

ZF Rail reflects our commitment to reliable technology, uncompromising quality and long-term partnerships in passenger and freight mobility worldwide. Built on a century of experience and as one of the world's leading technology suppliers for rail systems, the portfolio spans driveline technologies, chassis components, smart condition monitoring systems and a service network, all designed to safeguard availability, reduce downtime and optimize lifecycle costs. With global reach and a customer-first mindset, we act as a long-term partner – reliable, responsive and future-ready.



Driving Progress on Rail

The train has always been a driver of progress. It has connected cities and countries, enabled mobility and shaped everyday life for generations. From early railway systems to today's high-speed networks, rail has played a central role in economic and social development and continues to shape the future of passenger and freight mobility.



ZF has been part of this journey for more than a century. Railway technology became an integral part of the company as early as 1924, when a specially adapted transmission marked the starting point of ZF's rail activities. Since then, ZF has continuously advanced its technologies – driven by a clear ambition: to make mobility more reliable and efficient.

Today, mobility demands are changing faster than ever before. Urbanization is increasing worldwide, passenger numbers are growing, and the global flow of goods is accelerating. At the same time, rail operators and manufacturers face the challenge of combining speed, safety, comfort and sustainability, while remaining cost-efficient.



In this evolving landscape, rail vehicles compete with other modes of transport across short, medium and long distances. Whether in high-speed travel, regional transport or urban mobility, the expectations are rising: higher performance, lower emissions, reduced noise levels and optimized lifecycle costs are becoming standard requirements.

ZF is a reliable partner in meeting these challenges. As one of the world's leading technology companies in driveline, chassis and digital solutions, ZF develops innovative components and systems that make rail transport more powerful, efficient and future-ready.

By combining decades of rail expertise with cross-industry know-how, ZF creates intelligent, modular solutions tailored to specific vehicle and application requirements. The result: technologies intended to reduce energy consumption, minimize wear, increase availability and enhance passenger comfort – even under demanding operating conditions.

With a global presence, a strong customer focus and a relentless spirit of innovation, ZF continues to shape the future of rail mobility. Because sustainable mobility needs rail, and rail needs technologies that keep it moving.



Powering Everyday Mobility

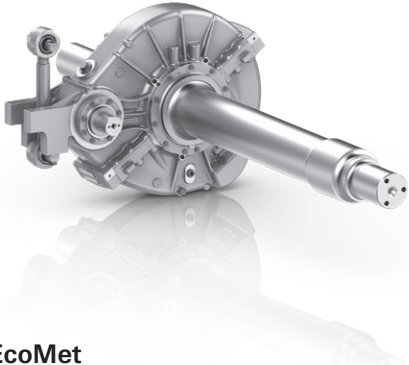
Electric multiple units (EMU), metros and light rail vehicles (LRV) are the backbone of modern urban mobility. They connect people and regions with high frequency, reliability and sustainability. Their diverse operating environments require flexible, efficient and space-optimized driveline solutions.

ZF delivers tailored driveline technologies designed to meet the diverse and demanding requirements of urban rail applications. With a strong focus on flexibility, scalability and integration, ZF solutions can be adapted to a wide range of vehicle platforms, from high-capacity metro systems to compact, low-floor trams.

By combining modular gearbox designs with advanced noise optimization and lightweight engineering, ZF enables efficient,

quiet and space-saving operation, even in the most densely populated urban environments. At the same time, optimized power transmission and reduced wear contribute to lower maintenance requirements and improved lifecycle costs. The result is a comprehensive portfolio that supports operators and manufacturers alike in delivering reliable, efficient and passenger-friendly electric mobility – setting new standards for urban rail transport.

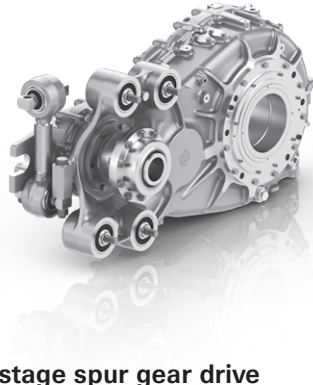
Metro

**EcoMet**

Modular gearbox family for metros and semi-high-speed trains

Benefits

- Flexible design: Different axle distances and gear ratios within the same envelope space
- Fast delivery: Proven components enable quick delivery
- Low LCC costs: Optimized lubrication and design increase oil change interval

**Two-stage spur gear drive**

Compact and lightweight metro gearbox

Benefits

- Compact: Weight-optimized and space-saving design
- Powerful: Extremely low power-to-weight ratio
- Customer-oriented: Local and cost-optimized maintenance

**Two-stage spur gear drive**

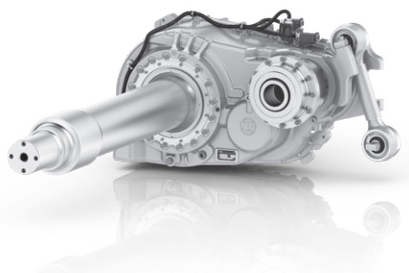
Noise- and weight-optimized gearbox for subways

Benefits

- Noise-optimized: Quiet operation through optimized gearing and housing
- Lightweight: Aluminum housing reduces weight and improves efficiency
- Maintenance-friendly: Less oil and easy handling reduce service effort and downtime

EMU

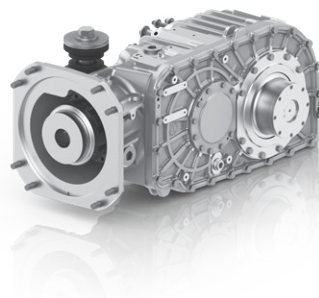
LRV

**Helical gear, axle drive**

Optimal transmission for local passenger trains

Benefits

- Quiet drive: Low noise emissions
- Compact design: Usable for very compact envelope space
- Heavyweight: Robust and reliable design for 20-ton axle load

**Hypoid spur gear**

Compact and lightweight gearbox for low-floor trams

Benefits

- High integration: Highly integrated gearbox in a fully suspended bogie
- High passenger comfort: Reduced vibration transmission into vehicle structure
- Digitalization: Prepared for additional sensoric and ZF's digital solutions

**Hypoid bevel gear**

Modern single-stage bevel gearbox for low-floor trams

Benefits

- High comfort: Fully sprung single-wheel drive
- Compact design: Sleek gearbox concept for limited envelope space
- Easy to maintain: External driveline, easy to access

Engineered for Maximum Speed

High-speed trains redefine mobility by connecting cities and regions at unprecedented velocity. As travel speeds increase, demands on performance, efficiency and reliability rise significantly. Driveline technologies must deliver exceptional power while ensuring stability and long-term durability.

ZF highspeed gearboxes are engineered to meet the extreme demands of next-generation rail travel. Building on decades of experience and proven performance in operation, ZF combines precision engineering with a highly modular design approach that allows maximum flexibility across different train platforms and speed classes.

This modularity enables operators and manufacturers to realize multiple performance levels with

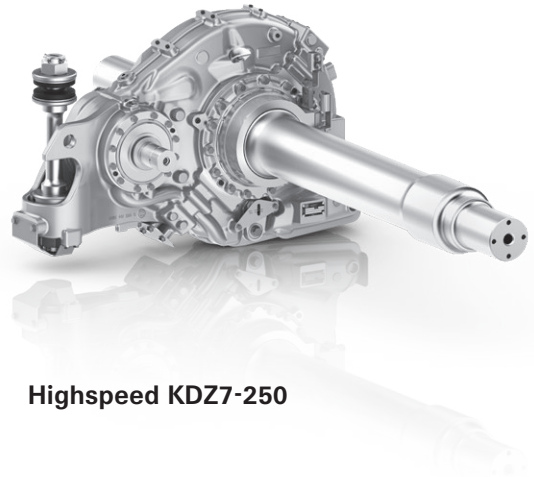
a single transmission concept – reducing complexity while increasing efficiency in development and operation. At the same time, the optimized design ensures outstanding running smoothness, reliability and durability even under extreme dynamic loads. Designed for both current and future requirements, ZF high-speed solutions provide the technological foundation for faster and efficient long-distance mobility.



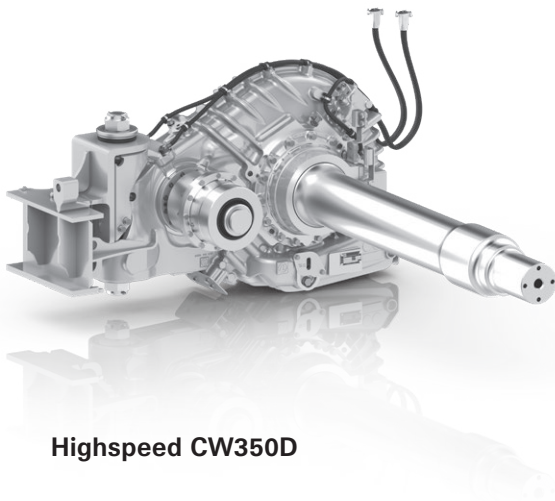
High-speed train



Highspeed CRH380



Highspeed KDZ7-250



Highspeed CW350D



Highspeed CR450

ZF highspeed gearboxes
are already successfully in
operation with almost

14,000  **units**

Highspeed gearboxes

For high-speed trains

Benefits

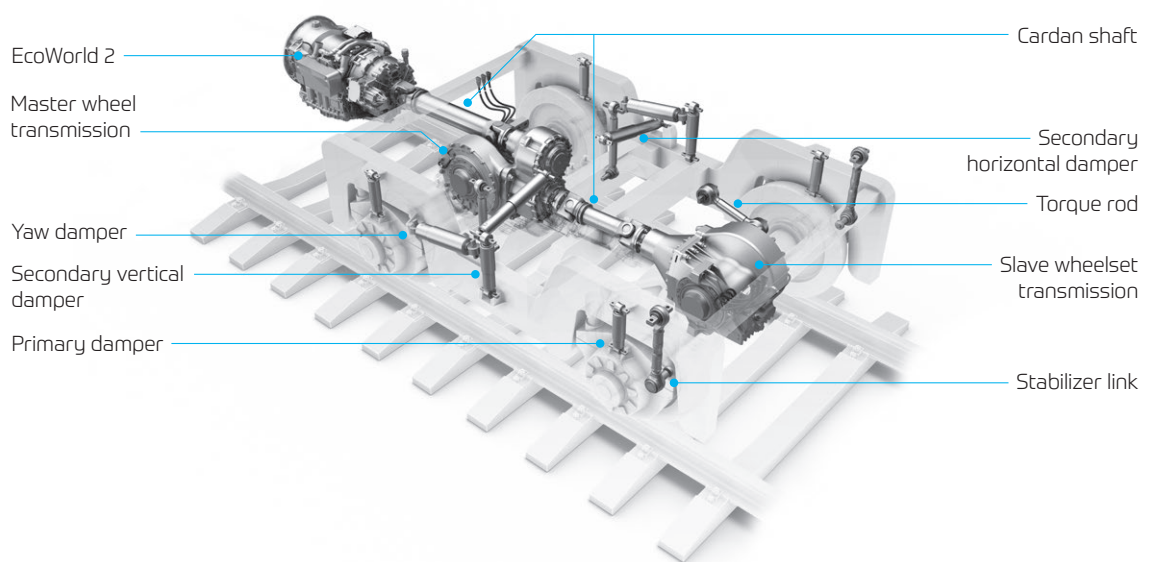
- Modular: Proven components and design
- Future-proof: For maximum speeds of up to 450 km/h
- Cost-efficient: Low lifecycle costs thanks to reduced oil quantity

Efficiency Meets Proven Performance

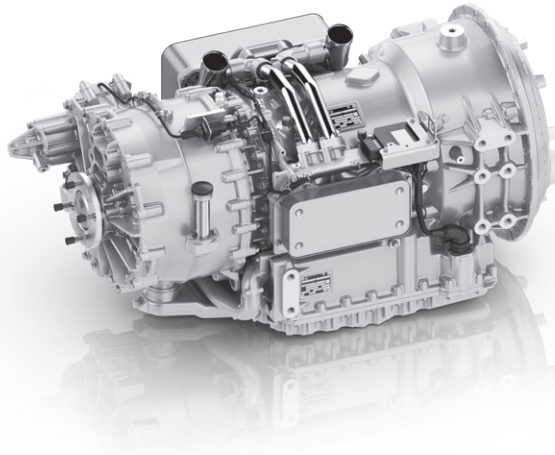
Diesel multiple units (DMU) remain essential for non-electrified rail networks worldwide. They provide reliable mobility in regional and rural areas where flexibility and efficiency are key. Operators require solutions that reduce fuel consumption while maximizing comfort and uptime.

ZF combines extensive expertise from rail and commercial vehicle applications to deliver highly efficient and robust driveline systems for DMU. This cross-industry know-how enables the development of solutions that are not only powerful and reliable but also optimized for fuel efficiency and reduced emissions.

With advanced automatic transmissions, integrated retarder systems and modular drivetrain concepts, ZF improves ride comfort while significantly reducing wear on mechanical components. The result is smoother operation, lower maintenance costs and increased availability across a wide range of operating conditions.



DMU

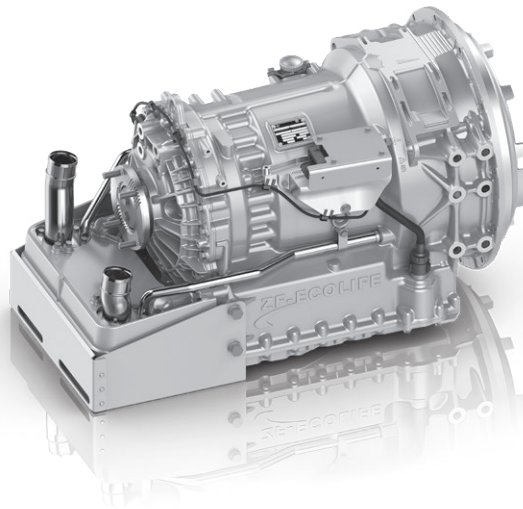


EcoWorld 2

Powershift transmission for DMU

Benefits

- Fuel efficiency: Up to 20% lower fuel consumption compared to a hydrodynamic transmission*
- Optimal acceleration: Torque converter makes the starting process efficient
- Cost efficiency: Repowering extends service life and reduces operating costs

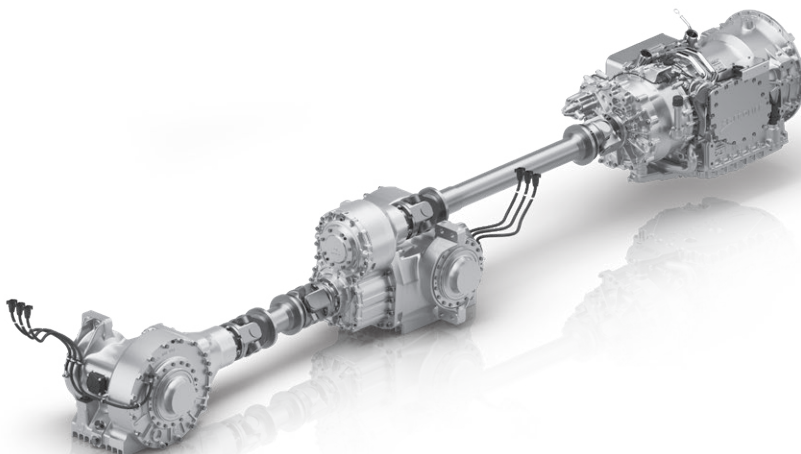


EcoLife Rail 2

Powershift transmission for DMU

Benefits

- Fuel-efficient: Up to 20% lower fuel consumption compared to a hydrodynamic transmission*
- Economical: Significant reduction of lifecycle costs
- Comfortable: Torque converter ensures smooth starting process



Wheelset gearbox

Suitable for slow-speed operations and fast rail vehicles in long-distance transport

Benefits

- Utmost reliability: Robust and tested components
- High torque density: Maximum input torque of 12,000 Nm
- Digitalization: Prepared for additional sensoric and ZF's digital solutions

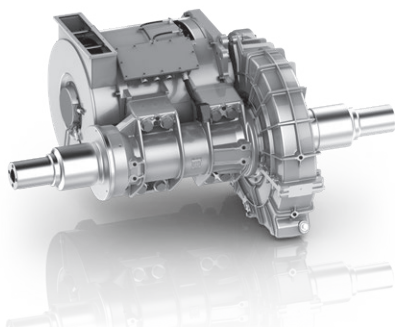
*Based on a ZF internal comparative test. Results vary depending on vehicle configuration, route profile, engine, load and operating conditions.

Built to Move Heavy Loads

Locomotives are the driving force behind global passenger and freight transport. They must deliver high traction, durability and efficiency across long distances and demanding operating conditions. Reliability and cost-effectiveness are critical for competitiveness in modern rail logistics.

ZF driveline technologies are specifically designed to handle the high loads and demanding duty cycles of modern locomotives. Combining robust engineering with proven components, ZF ensures reliable and efficient power transmission, even under the toughest operating conditions in freight and passenger transport.

Locomotive

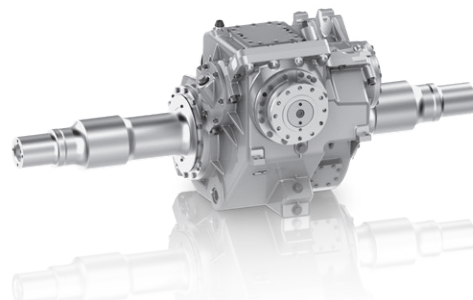


Axle-hung gearbox

For passenger and cargo locomotives

Benefits

- Reliable: Sturdy, tried-and-tested design
- Flexible: Available in different power ranges
- Suitable for use both in heavy freight operation and in passenger operation at up to 160 km/h



Axle drive

For diesel locomotives

Benefits

- Powerful: Design and splash lubrication for all operating conditions
- Reliable: High availability due to proven design
- Low-maintenance: Components are designed for low wear and long lifetime

Precision for Special Applications

Multiple purpose vehicles and skytrain systems operate in highly specialized environments with unique technical requirements. Whether in infrastructure maintenance or urban cable-supported transport, precision, reliability and efficiency are key.

ZF develops specialized driveline solutions tailored to the unique operational requirements of multiple purpose vehicles and skytrain systems. These applications demand highly customized technologies that combine compact design, high durability and precise performance under often challenging environmental conditions.



Multiple purpose vehicle & skytrain

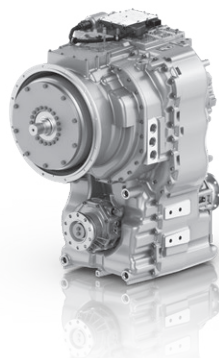


EcoWorld 2

Powershift transmission for multiple purpose vehicles

Benefits

- Fuel efficiency: Up to 20% lower fuel consumption compared to a hydrodynamic transmission*
- Optimal acceleration: Torque converter makes the starting process efficient
- Cost efficiency: Repowering extends service life and reduces operating costs

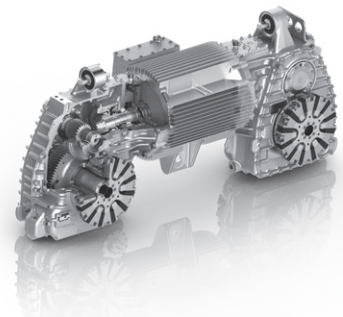


ERGOPOWER Rail

Powershift transmission for special vehicles

Benefits

- Efficient: Lower fuel consumption compared to the previous technology
- Fuel-efficient: Engine speed reduction of up to 15%
- Powerful: High load capacity



Bevel gear, axle drive

Transmission for skytrains

Benefits

- Weight-optimized: Many years of Group experience in lightweight construction
- Noise-optimized: Reduced noise emissions
- Reliable: Integrated oil pump ensures optimum bearing lubrication

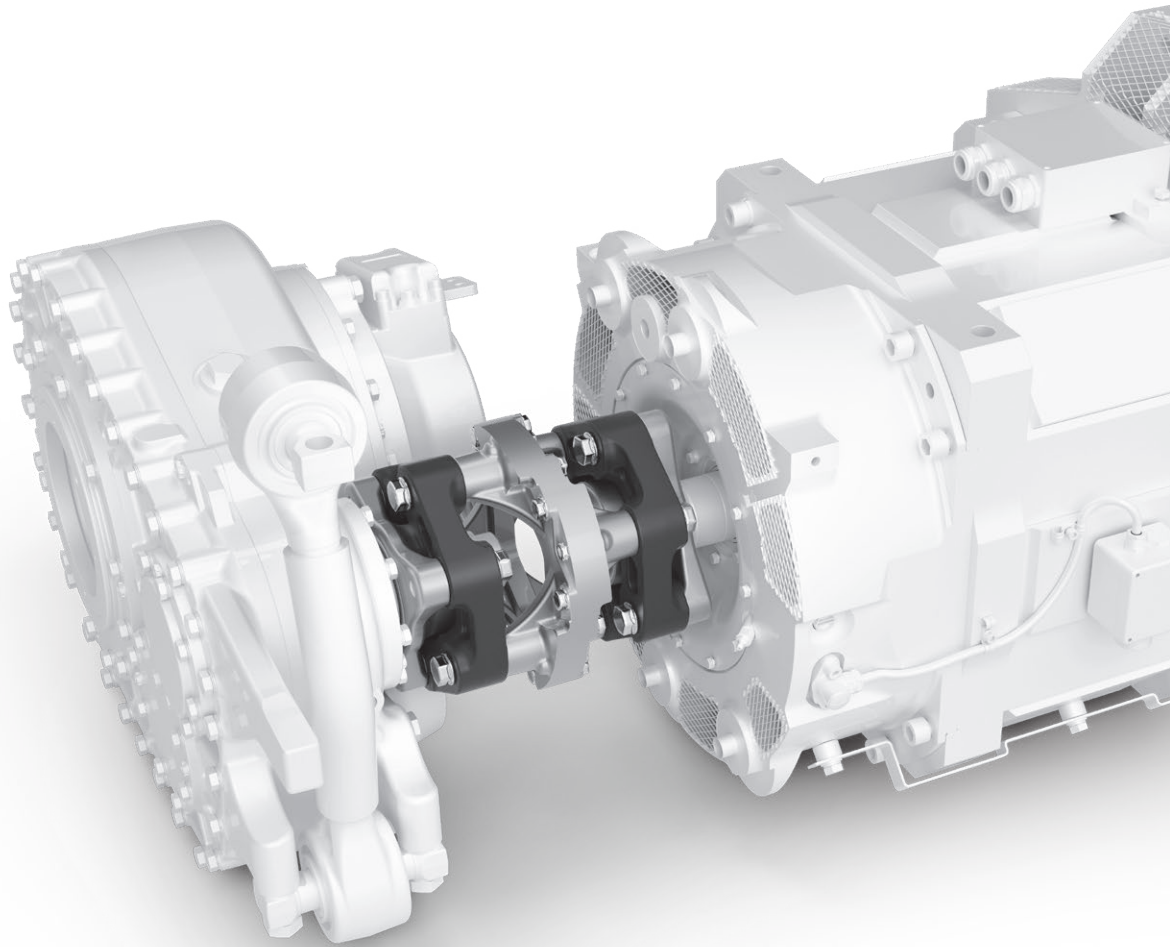
*Based on a ZF internal comparative test. Results vary depending on vehicle configuration, route profile, engine, load and operating conditions.



AI-generated

Redefining Coupling Technology

In modern electric multiple units, efficiency, reliability and low maintenance are critical performance factors. Conventional coupling systems often require lubrication and regular servicing, increasing lifecycle costs and complexity. With EcoFlex, ZF introduces a new generation of coupling technology designed to overcome these limitations.



By combining decades of rail expertise with advanced development methods, ZF has engineered EcoFlex as a breakthrough solution for modern EMU drivetrains.

The coupling has been specifically designed to handle the dynamic interaction between electric motor and gearbox, ensuring reliable torque transmission even under challenging operating conditions such as track irregularities and acceleration.

At the heart of the technology are circumferentially arranged fiber composite packages that compensate for axial and radial offsets while maintaining synchronous power transmission. This innovative design enables a new level of flexibility, durability and efficiency – without the need for conventional lubrication systems.

EcoFlex

Innovative coupling solution for EMU drivetrains

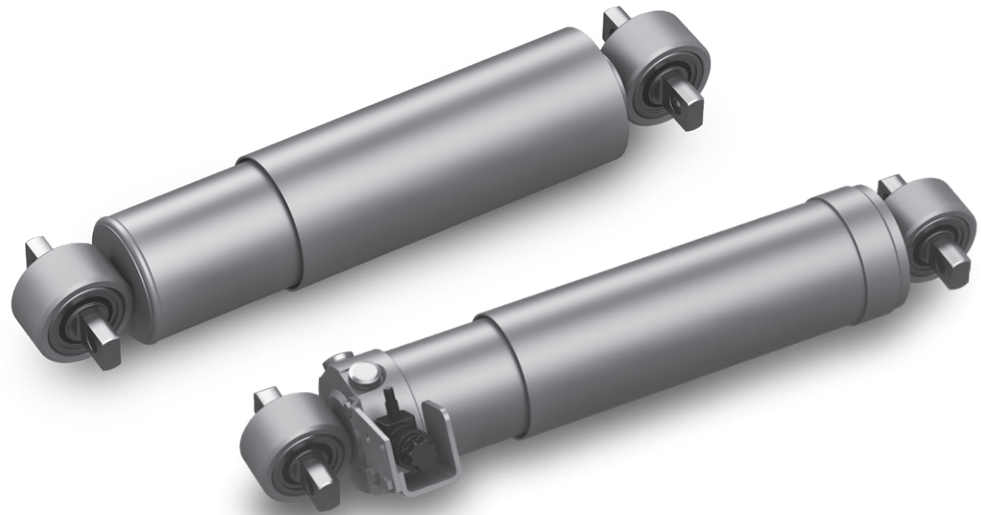
Benefits

- Easy maintenance:
No maintenance expenditure thanks to grease and oil-free coupling
- Universal application:
Easy integration and retrofitting possible
- Electrical insulation:
Resistance > 1,000 MΩ due to use of insulating materials



Advanced Dampers and Chassis Components

Drawing on decades of engineering experience, ZF offers a broad portfolio of suspension components designed to support OEMs in developing the next generation of rail vehicles. The range includes primary, secondary, and advanced yaw dampers, equipped with specific safety- and comfort-related functions.



Yaw dampers

Combining outstanding functionality, exceptional precision, and a long service life, ZF yaw dampers meet the most demanding application requirements. Yaw dampers are a specialized category of railway vehicle dampers. Their purpose is to control the sinusoidal hunting motion of the bogie and thereby ensure vehicle stability at medium and high speeds. However, the high damping forces generated by yaw dampers can impede the vehicle's ability to negotiate switches and tight curves. As a result, wheel-rail forces increase unnecessarily, leading to higher wear as well as increased maintenance and lifecycle costs.

Frequency selective yaw damper (FSC-R)

The FSC-R yaw damper is a passive hydraulic solution that does not require any electronic interface and eases the rotational movement of the bogies in tight curves, thereby reducing wheel-rail forces.

Electronically controlled yaw damper

Additionally, ZF has developed the electronically controlled yaw damper (with the option of integrated switching point control). It clearly reduces wheel-rail forces by switching a bypass valve on or off. These options significantly reduce wear-related maintenance costs for both vehicles and track sections.

Features

- Standard, mechanically and electronically controlled
- Compact design
- Reduces wheel/rail wear
- High dynamic stiffness
- Easy to overhaul



Primary and secondary dampers

Designed for maintenance-free operation, these modular twin-tube dampers are available in two sizes. The adjustable damping valves provide a broad range of damping characteristics and force levels, ensuring optimal performance across a wide variety of applications.

Primary dampers

Primary dampers are typically arranged vertically and are used to damp vibrations between the wheelset and the bogie. They ensure stable guidance of the wheelsets on the track, reduce the dynamic loads acting on both the vehicle and the infrastructure, and thereby make a significant contribution to ride quality and operational safety. Optionally, the dampers can be equipped with an integrated lift stop device that securely retains the wheelsets during bogie lifting operations as well as during rerailing procedures.

Secondary dampers

Secondary dampers are installed both vertically and horizontally between the bogie and the car body. They serve to reduce vibrations and shocks, thereby contributing significantly to ride comfort and the smooth-running characteristics of the vehicle. Their special design prevents air from entering the working chamber, particularly in horizontal installations, thus ensuring consistent damping performance throughout their entire service life.

Integrated height sensor

The secondary vertical damper is available with an integrated height sensor, which increases the robustness and accuracy of height leveling systems.

Features

- High reliability to reduce LCC
- Optional maintainable and non-maintainable versions
- Compact and robust design



Damping technology and chassis components



Spring damper element

Innovative damper technology with integrated rebound and compression spring. The compact spring damper element eliminates unwanted jolts effectively and is perfectly suitable for vehicles with little installation space.

Benefits

- More comfort: Elimination of abrupt shocks
- Compact design: Integration of rebound and compression spring
- Cost efficiency: Maintenance-free, modular design reduces lifecycle costs

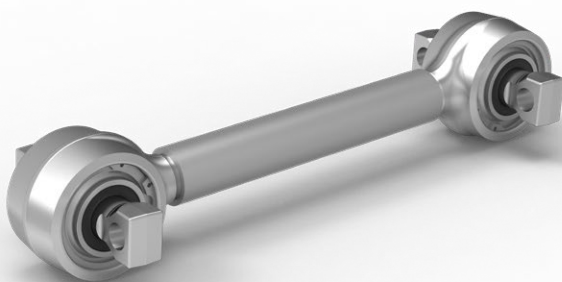


Stabilizer links

The stabilizer link is used as a flexible connection for anti-roll stabilization. It transmits the forces from the stabilizer in the bogie to the car body. It can be designed with either a vibration-absorbing rubber-metal bearing or a clearance-free ball joint and can be manufactured in both adjustable and fixed lengths. Thanks to its modular design, the stabilizer link can be flexibly adapted to fulfill customer requirements.

Benefits

- Customizable: Adaptable to specific vehicle and suspension requirements
- Flexible configuration with adjustable or fixed length
- Maintenance-free design without lubrication or servicing, for lower lifecycle costs

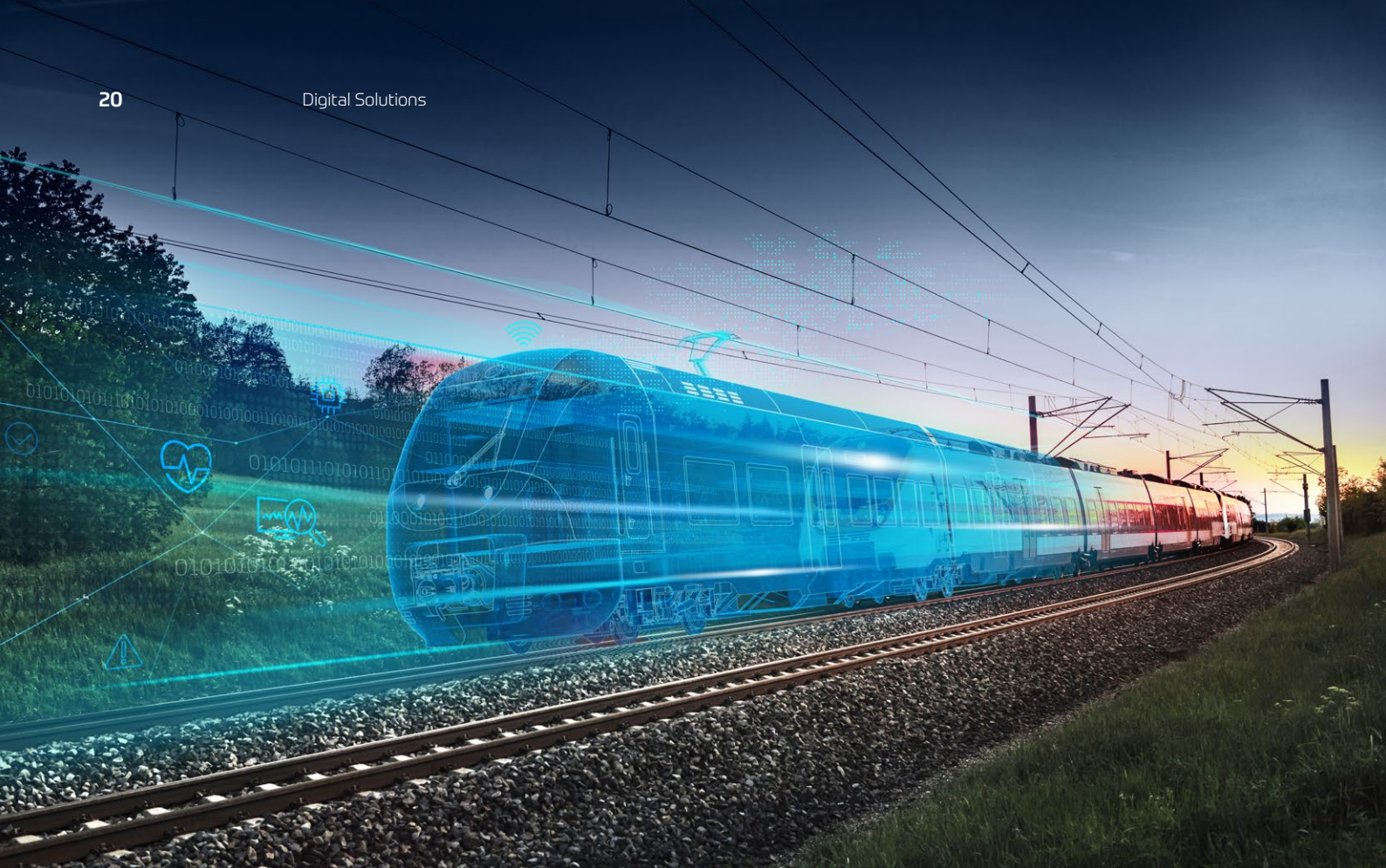


Torque rods

The torque rod is used as a transmission support in the bogie. In this function, it supports the torque from the transmission and absorbs vibrations. Thanks to its modular design, the torque rod can be flexibly adapted to fulfill customer requirements.

Benefits

- Efficient transmission of traction and braking forces
- Reduced vibration and noise levels
- Maintenance-free design and longer service life



Turning Data Into Motion

Digitalization is transforming rail transport into a smarter and more connected ecosystem. Operators require real-time insights to increase availability, optimize maintenance and reduce lifecycle costs. Intelligent data usage is becoming a key driver for efficiency, safety and reliability.

With connect@rail, ZF combines its expertise in driveline, chassis and system technologies with advanced digital capabilities. The platform not only connects vehicles, assets and infrastructure, but also brings together technology providers and operators of rail infrastructure and vehicles within a shared ecosystem. By integrating expertise and analytics solutions on one platform, connect@rail enables continuous monitoring, early anomaly detection and optimized maintenance processes.

By integrating intelligent sensors, connectivity solutions, data analytics and AI, connect@rail transforms operational data into actionable insights. This allows operators to move from reactive to predictive maintenance strategies – improving availability, increasing safety and reducing unplanned downtime.

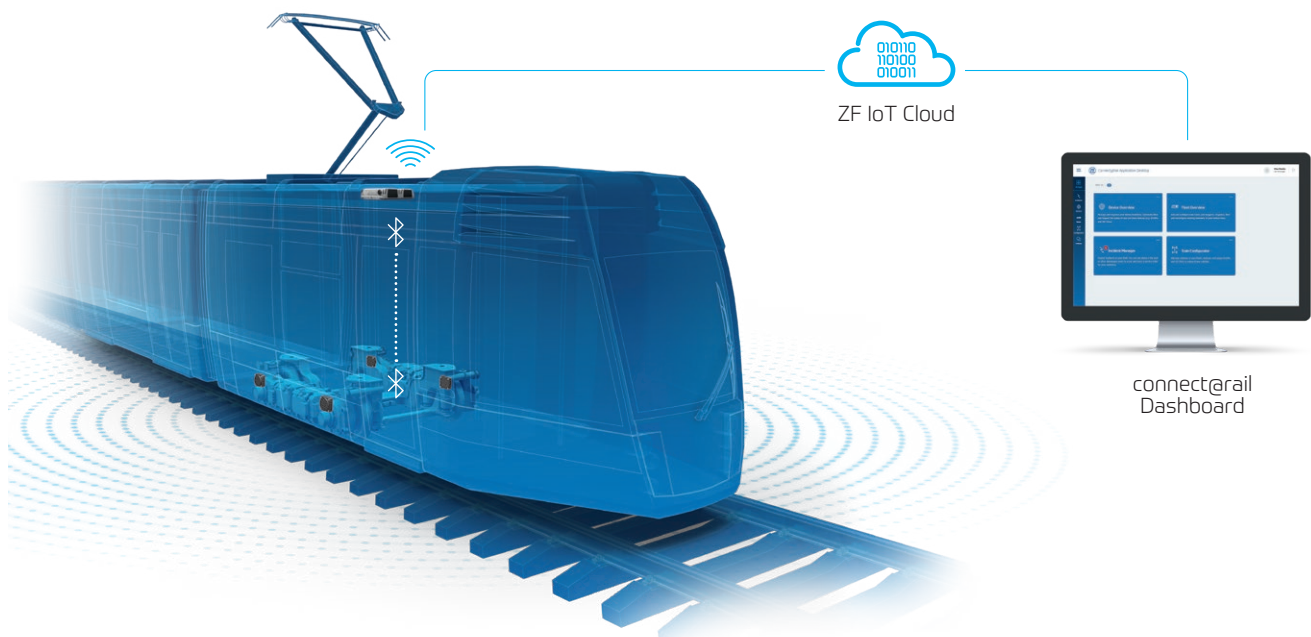
Designed as a modular and independent ecosystem, the platform can be easily integrated into new and existing vehicles. Through strong partnerships with industry stakeholders, ZF ensures seamless connectivity and scalable solutions tailored to individual customer needs.

connect@rail

Connectivity solutions for modern rail transport

Benefits

- Digital: Digitalization of fleet and maintenance management
- Modular: Customized solutions thanks to modular system design
- Condition-based: Efficient use of resources and reduction of costs



connect@rail components

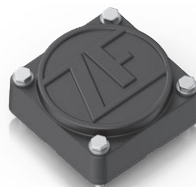


VCU Pro Onboard Unit

Telematics gateway

Benefits

- Stable and secure: Two independent processors guarantee a stable connection
- Versatile: Variety of interfaces, including Wi-Fi, GNSS
- Reliable: Secure acquisition and processing of sensor data



Heavy Duty TAG

Wireless sensor

Benefits

- Wireless: Easy integration into existing systems
- Energy efficient: Intelligent energy management for service life up to five years
- Robust: Optimized for use in rail vehicles



Smart Typeplate

Digital typeplate

Benefits

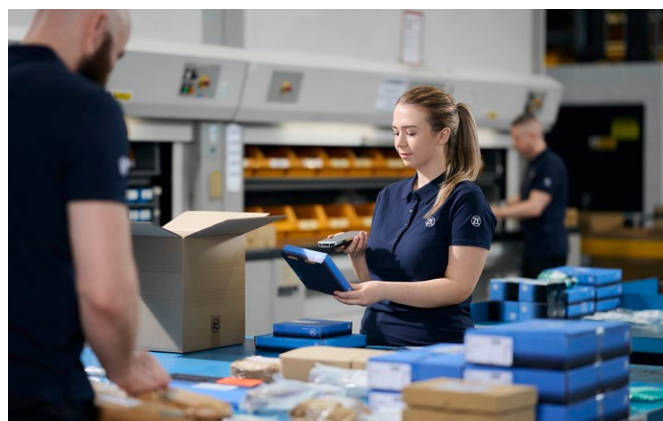
- Digital: RFID Chip digitizes fleet management
- Automated and flawless: Automatic identification without direct visual contact
- Paperless: Online documentation is accessible from anywhere

ZF Aftermarket: Your One-Stop-Shop in Rail Fleet Maintenance

Keeping rail vehicles available and extending their service life requires more than spare parts alone. With decades of rail expertise, OEM know-how and global service capabilities, ZF Aftermarket supports operators throughout the entire vehicle lifecycle. From repairs and spare parts to repowering projects, damper retrofits and multi-brand engineering solutions, we help maximize fleet availability, extend asset lifetime and reduce operating costs.



Setting the standard in rail service



Overhaul and repair

Keeping your fleet on track

ZF Aftermarket provides professional repair and overhaul services for ZF and multi-brand rail driveline systems. By combining OEM expertise, original specifications and advanced testing capabilities, we restore components to reliable operating condition and support long-term fleet performance.

Benefits

- OEM expertise and factory-standard processes
- Fully tested components for reliable operation
- Extended service life of critical assets
- Optimized maintenance planning
- Reduced downtime and lifecycle costs

Spare parts and units

Genuine quality for maximum uptime

ZF Aftermarket supplies original spare parts and replacement units for rail applications worldwide. Manufactured and tested according to the same standards as series production, our components ensure reliable performance and seamless integration.

Benefits

- Genuine ZF quality and reliability
- Perfect fit and easy installation
- Global availability through our service network
- Long service life and consistent performance
- Reduced operational risk and downtime



Repowering

Modernizing fleets for tomorrow's rail operations

Repowering enables operators to replace outdated driveline technology with modern, more efficient systems. The result is improved vehicle performance, reduced operating costs and an extended service life for existing rolling stock.

Benefits

- Up to 20% lower fuel consumption*
- Lower operational fuel-related emissions
- Reduced lifecycle costs
- Extended vehicle lifetime
- Improved reliability and maintenance efficiency

*Achieved by ZF's hydromechanical transmission compared to a hydrodynamic transmission in an internal comparative test. Results vary depending on vehicle configuration, route profile, engine, load and operating conditions.



Damper retrofitting

Flexible replacement solutions for almost every fleet

ZF Aftermarket offers retrofit damper solutions for a wide range of rail applications. Using our proven modular damper platform, we develop replacement solutions that provide greater supplier flexibility while maintaining proven performance and durability.

Benefits

- Reduced dependency on the original supplier
- Proven ZF rail technology and quality
- Increased supply chain resilience
- Long service life and optimized lifecycle costs
- Coverage of up to 95% of damper applications

3-step retrofit process

- 
1. We receive
 You provide us with a drawing or the neutral vehicle specification for the damper to be replaced.

- 
2. We design
 Our experts take over and design your retrofittable damper from our modular construction kit.

- 
3. We deliver
 Once you have approved the design proposal, we will produce your retrofittable dampers – ready to be installed.





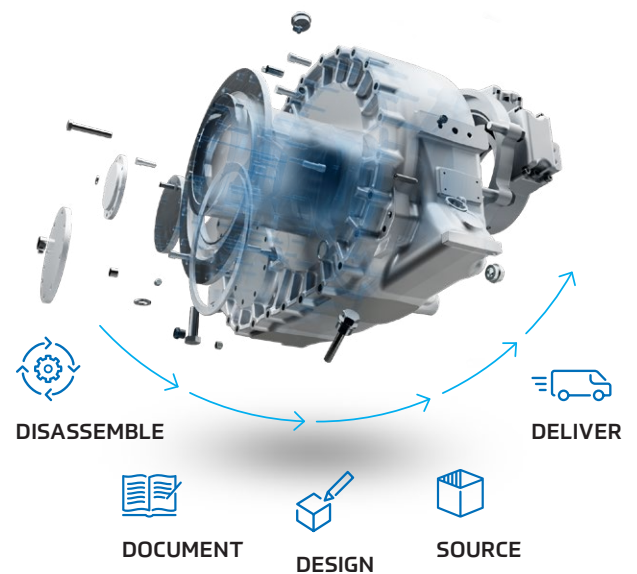
Multi-brand aftersales and reverse engineering

Engineering solutions beyond the ZF portfolio

When original parts become hard to obtain or service performance decreases, ZF Aftermarket provides reverse engineering and multi-brand support. From component analysis and recreation of manufacturing data to spare part supply and overhaul support, we help keep fleets operational.

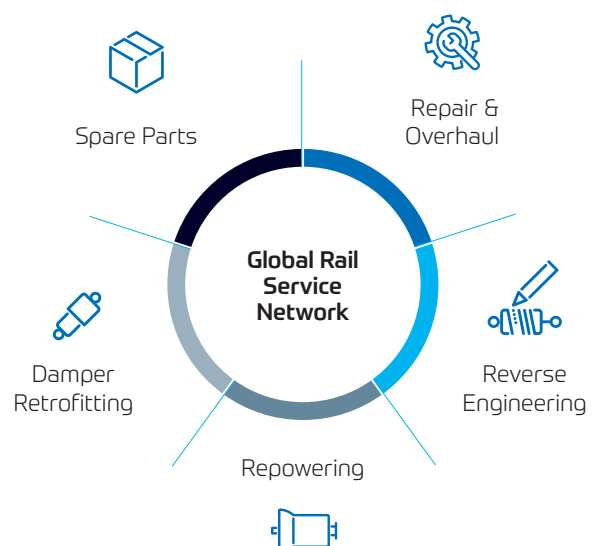
Benefits

- Continued availability of critical components
- Extended lifetime of existing assets
- Reduced dependency on limited suppliers
- Complete solution from engineering to delivery
- Proven ZF engineering expertise



Supporting every stage of the rail asset lifecycle

Rail operators need more than individual products or services. They need a partner who can support fleets throughout their entire lifecycle – from routine maintenance and spare parts supply to modernization and life-extension projects. With a global network of service locations, engineering experts and partners, ZF Aftermarket delivers local support backed by worldwide rail expertise.



Think Globally, Act Locally

If a major railway project is put out to tender anywhere in the world today, you will certainly find the name ZF as one of the companies on the list of potential technology suppliers.

Many metro lines, high-speed trains, diesel multiple units and electric locomotives are already equipped with ZF products around the globe. With development and production locations on three continents, ZF is always close to its customers. Moreover, almost every country has its own service location that performs maintenance work and supplies spare parts for ZF rail customers. With its international footprint, ZF is also pursuing its strategic focus on forward-looking, efficient technologies, intelligent mobility solutions and global growth markets in railway technology.



100+



Years of rail engineering expertise

Friedrichshafen
Schweinfurt
Dielingen



115

Countries supported by
ZF Aftermarket globally

Coimbatore
Pune

Beijing
Shanghai



650+

ZF Aftermarket and Service Partner
locations close to our customers



 ZF rail production locations

 Countries with ZF Aftermarket locations

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