



Comfort and Robustness

Chassis and Driveline Technology for Special Vehicles



Table of Contents

04	Chassis Modules
06	Chassis systems
07	Steering
08	Cabin Suspension Components
10	Cabin Suspension Systems
12	Torsional Damper
14	DynaDamp

Reliable and innovative

Fuel consumption, emissions, weight, and installation space will continue to be reduced, while at the same time performance, safety, robustness and driving comfort must increase. To achieve these objectives, innovative solutions are essential. And here is where ZF demonstrates its expertise in integrated systems to provide overall solutions to the requirements posed.

Chassis Modules

Reliable in Quality and Technology.

Our design expertise guarantees fast implementation of growing safety requirements and increasing comfort standards.

We are committed to the continuous improvement of our products and processes. ZF optimizes lightweight construction with new materials and engineering processes, with innovative product design and extensive process experience. Our product innovations increase the payload, reduce fuel consumption and enhance the comfort of agriculture and construction vehicles. This is how we develop optimum chassis technology with outstanding

reliability and safety standards – the basis for problem-free working in agriculture and construction vehicles. Short development times from initial concepts to components ready for production and strict compliance with technical specifications guarantee top customer satisfaction.

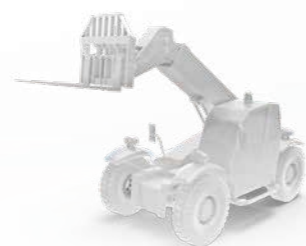
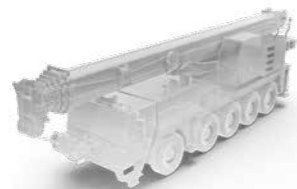
Zero maintenance

ZF links are maintenance-free. They come with the options of molecular or plain bearings and are made with precisely defined rigidity. That not only dampens vibrations, but also systematically produces elastokinematic properties.



Advantages of Chassis Modules

- Robust
- Maintenance-free
- Reduced weight
- Higher payload



Control arm



Torque rod



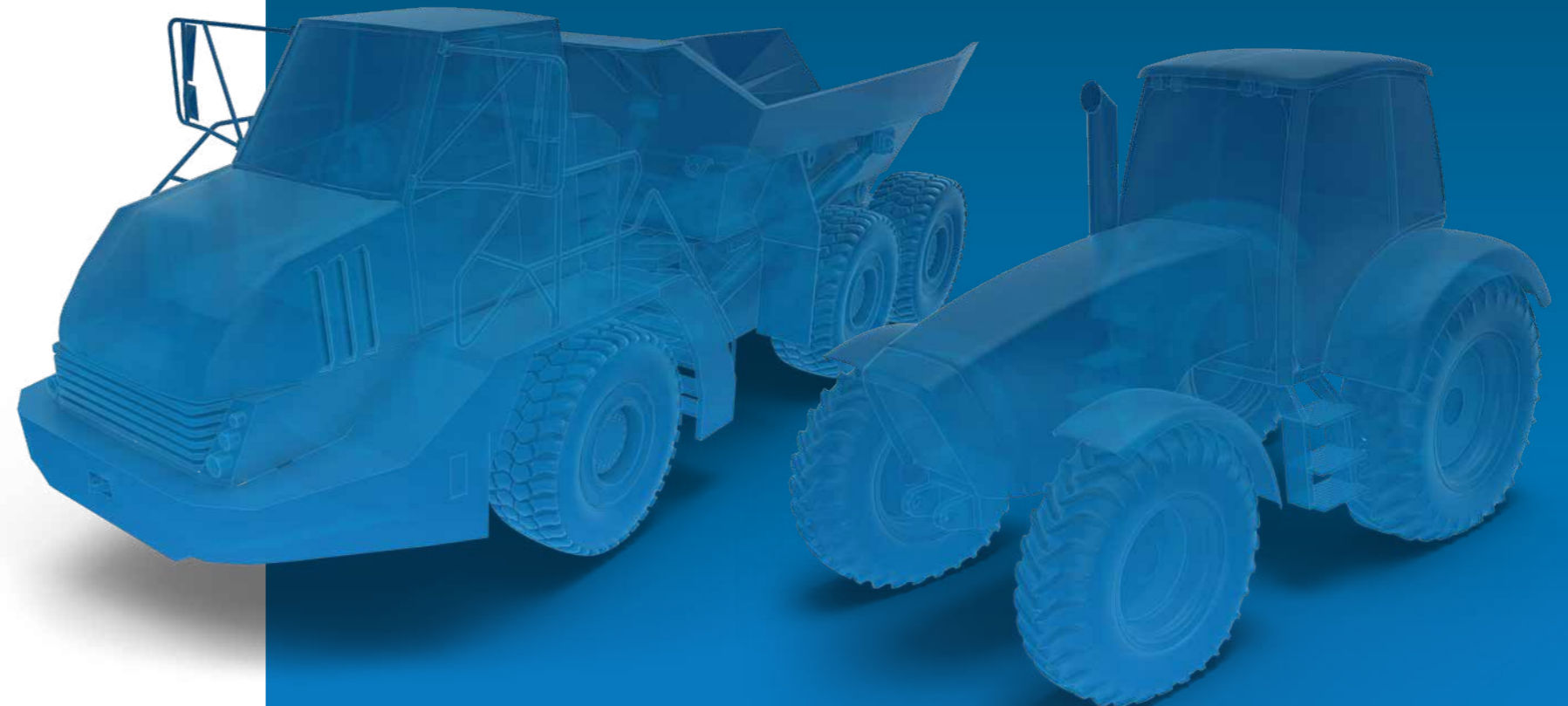
V-link



Adjustable Torque rod



Suspension joint



Chassis Systems

More efficiency and comfort in agriculture and construction vehicles.

That is why at an early stage ZF started developing independent suspension systems according to the principle of double-wishbone axles. This successful concept is being applied increasingly in special vehicles because the benefits in terms of efficiency, safety and comfort apply here as well.

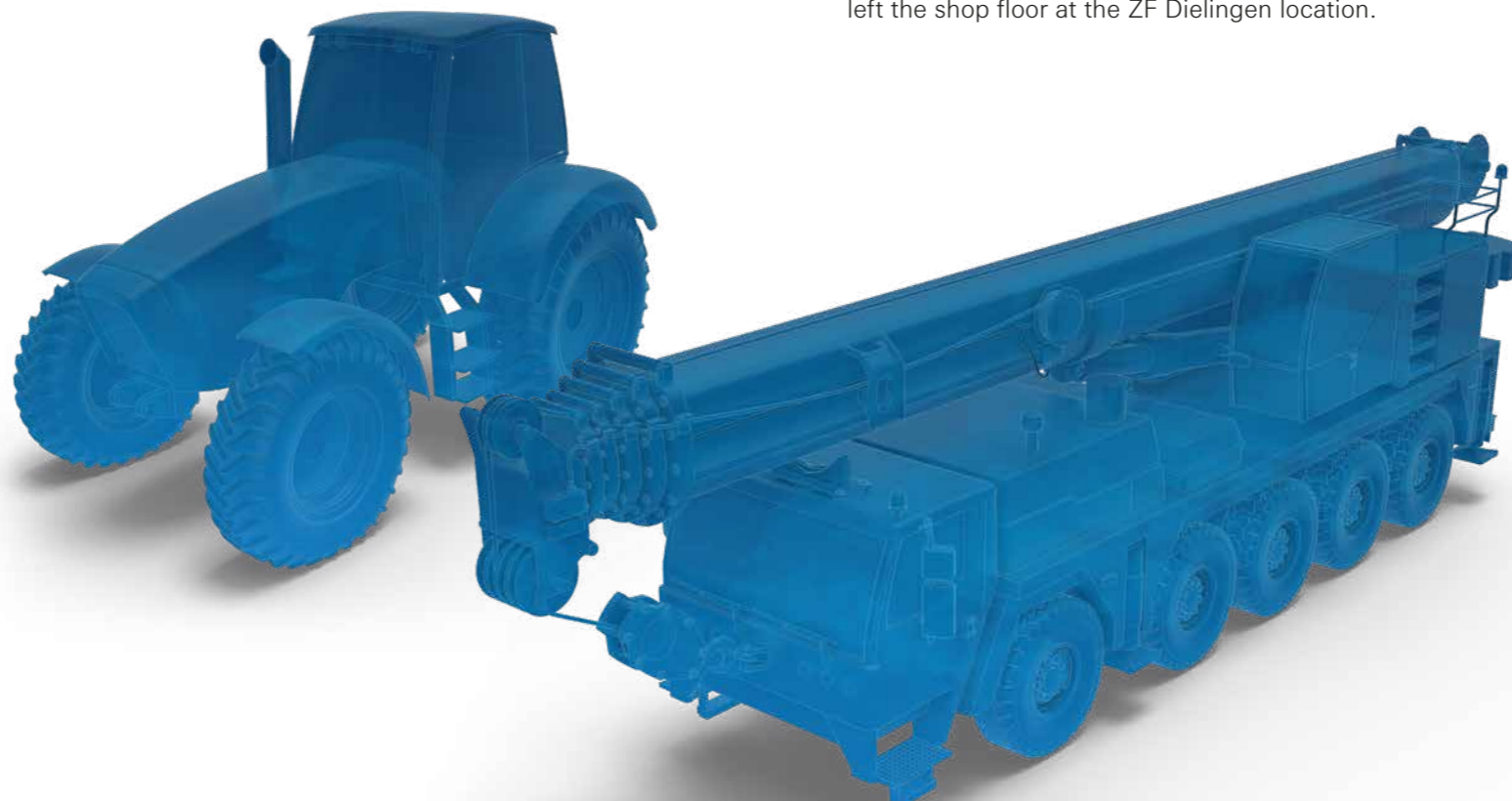
ZF offers axle suspensions with various mounting configurations, which can be combined as required. This includes the conventional axle suspension or axle suspension with stabilizer link.

You get ahead with ZF

We collaborate intensively with our customers – from development to volume production. We take on the development work right through to the design of efficient logistics concepts to give our customers the freedom to focus on their business.



Corner module



Advantages of Chassis Systems / Corner Modules

- Improved ride comfort
- Optimal handling
- Increase efficiency
- Reliable
- Robust
- Maintenance-free

Steering

Our philosophy: simply the best solutions for you.

Customized solutions and ready-to-install products for commercial vehicles have to meet high requirements. ZF finds the ideal solution even for the most challenging installation spaces. Using state-of-the-art development and manufacturing tools, we meet our customer demands.

Innovative products from ZF

When it comes to our proven ZF joint design or our fine-adjusting system for tie rods and drag links, we set the benchmark. This successful product sets new standards with its low weight and space-saving dimensions, and impresses with improved wheel guidance behavior and reduced noise. Well over 20 million joints have already left the shop floor at the ZF Dielingen location.



Advantages of Steering components

- Robust
- Maintenance-free
- Reduced weight



Axial Tie rod



Drag link



Tie rod

Cabin Suspension Components

Comfort for the Drivers Cab

Good working conditions in agriculture and construction vehicles are not a luxury but a prerequisite for getting the driver, vehicle, and goods safely to their destination.

As a system supplier, ZF develops and produces cabin suspensions for all applications in agriculture and construction vehicles – including springs, vibration dampers, and rubber-metal components. Every time, we offer you the optimal solution customized to your requirements. Drivers benefit from a more comfortable workplace with fewer jolts, pitching, or rolling motions. The various agriculture and construction vehicle fields of operation require different cabin types which in some cases differ widely in terms of dimensions, features, and weight.

Vibration damping for the drivers cab

ZF cab dampers provide greater safety, comfort, and stability. Improved comfort levels reduce driver fatigue, increasing performance and thereby driving safety. Ride comfort in commercial vehicles is considerably enhanced by cabin suspension and cabin damping which operates independently from the chassis. Vehicle cabs differ in size, equipment, and weight depending on their application. Each different cabin design requires its own individual spring/damper solution. ZF offers a range of products from dampers like steel spring NivoCab with integrated height leveling to air spring modules CALM/ eCALM (Cabin Air Leveling Modules).



Steel spring advantages

- Independent from other systems, such as air supply
- Outstanding cost/benefit ratio
- Robust design enables rough-terrain applications

NivoCab advantages

- Constant cabin height in any load condition
- Safe and easy vehicle handling
- Autonomous system, no external energy connections

Air spring advantages

- Ride height control with different cabin equipment/loading
- Constant, comfortable characteristic frequency
- Increased ride comfort

CALM advantages

- Air suspension with integrated height leveling
- Low susceptibility to external influences such as dirt and damage
- Modular design

eCALM advantages

- electronically controlled height leveling
- leveling, lowering and raising the cabin to different levels
- slope compensation



Steel spring module



NivoCab



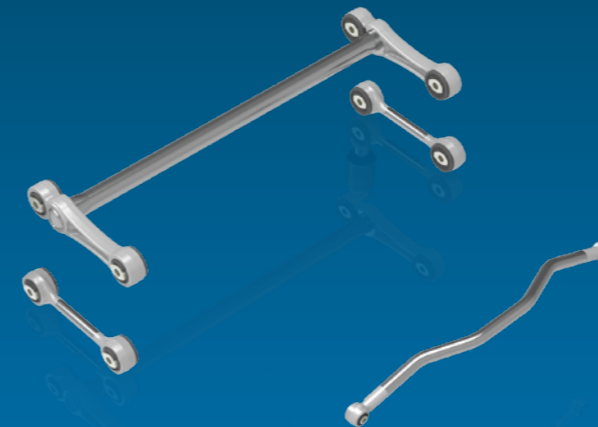
Air spring module



CALM



eCALM



Cabin stabilizer & Panhard rod



Advantages of Cabin stabilizer & Panhard rod

- Robust
- Maintenance-free
- Reduced weight



Cabin Suspension Systems

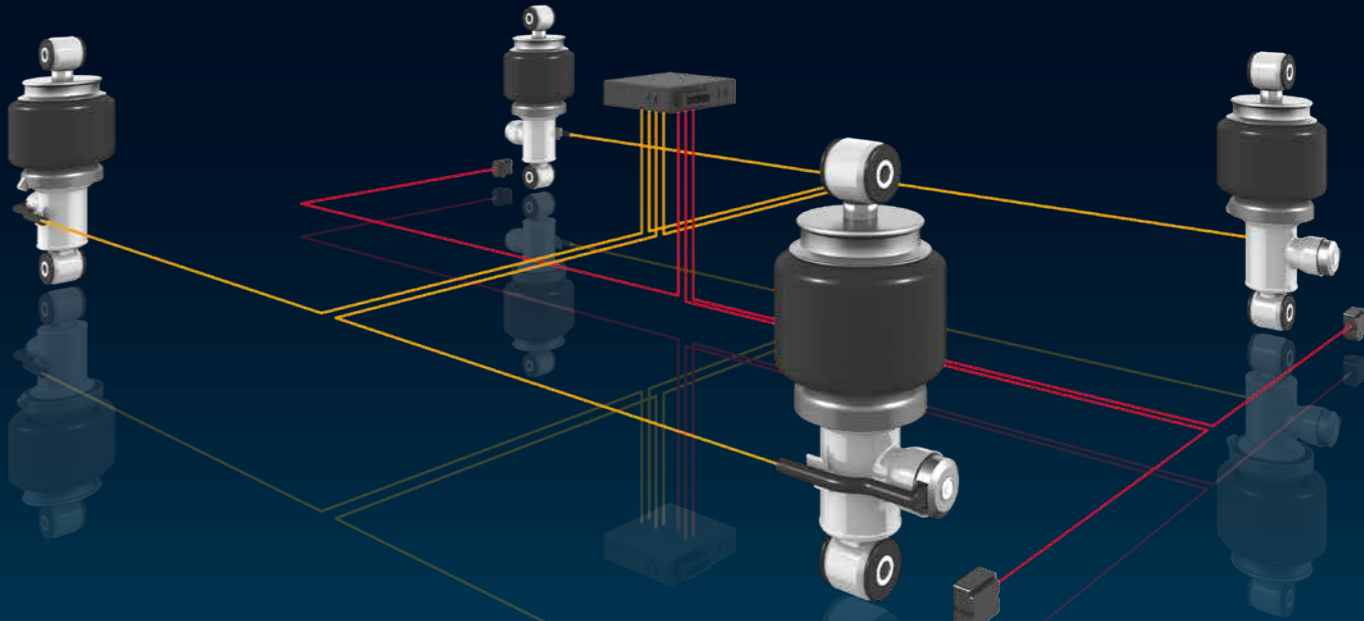
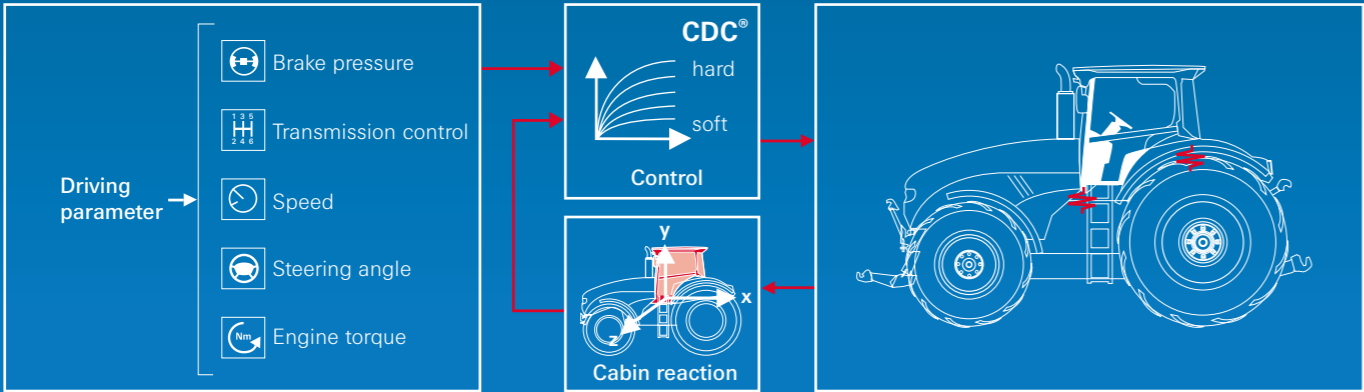
CDC – for the cabin (Continuous Damping Control)

CDC eliminates the trade-off between comfort and stability in the cabin. It solves the conflicting demands for higher suspension and damping comfort on the one hand, and for good cabin stability while accelerating, braking and cornering on the other. The damping forces are adjusted to the optimum level within milliseconds on the basis of data provided by the vehicle's sensors. At straight ahead driving on average quality roads, the electronics reduces damping forces. As a result, cabin suspension is soft and comfortable. As soon as excitation of the cabin changes due to lane changes, braking maneuvers, or gear shifts, CDC® keeps the cabin stable by increasing damping forces. The system also contributes to fuel efficiency by enabling shorter gear-shifting times and reducing tractive force interruption without compromising ride comfort, e.g. due to stronger cabin pitch.

Customized solutions for every cabin regardless of the type, size, and equipment of the driver's cab, ZF offers the best solution for cabin damping and suspension. The range extends from medium and heavy trucks of all application categories through to off-road and agricultural machinery.



- Advantages**
- Stability even in critical driving situations
 - Safe handling during dynamic driving maneuvers
 - Comfort for driver
 - Protection of vehicle body



Cabin suspension system



Torsional Damper

Bolt-on torsional dampers from ZF are built on the proven and cost optimized technology of high volume torsional dampers used in clutch disk production. They are integrated into the powertrain behind the engine. Their task is to decouple the torsional vibrations that the engine introduces into the transmission and connected components. This protects the entire powertrain from potentially damaging vibratory torque spikes and raises the level of driving comfort.

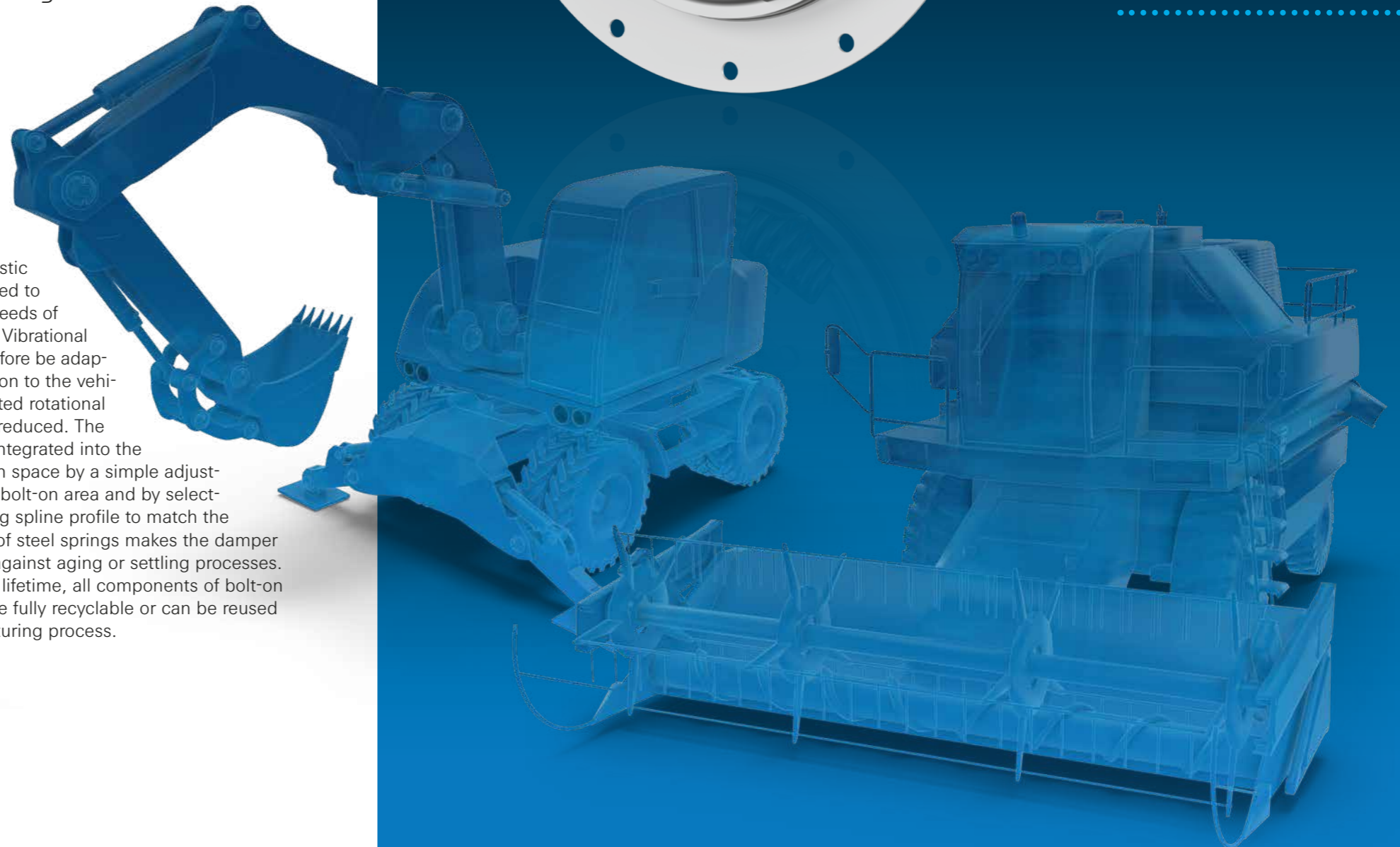
The task

Torsional dampers are placed behind the engine as vibrational dampers when the powertrain does not include a separating and starting clutch. The purpose of using a torsional damper is to keep engine torque peaks as well as operational irregularities isolated from the powertrain and connected components. Thus, every commercial vehicle with a powershift transmission or hydrostatic drive needs a torsional damper that ensures a quiet operation of the vehicle. If the forces operating in the powertrain area were not countered, driving comfort would be noticeably reduced and the powertrain components would also show considerably higher levels of wear or early failure. A standard solution today for decoupling torsional vibrations in powertrains is to use a bolt-on torsional damper that builds on the technology of torsional dampers used in clutch disks.

The technology

The torsional damper consists of a set of coil springs, positioned in windows that allow a limited amount of rotary movement between the crankshaft and the transmission input shaft. An integrated friction device is used

to diminish peak vibratory energy. By selecting the right torsional damper size and spring set, characteristic curves can be adjusted to meet the individual needs of specific applications. Vibrational decoupling can therefore be adapted in optimum fashion to the vehicle, and ignition-related rotational irregularities can be reduced. The torsional damper is integrated into the respective installation space by a simple adjustment of the external bolt-on area and by selecting the corresponding spline profile to match the drive shaft. The use of steel springs makes the damper absolutely resistant against aging or settling processes. Designed for vehicle lifetime, all components of bolt-on torsional dampers are fully recyclable or can be reused in the ZF remanufacturing process.



The Torsional Damper that lasts

- Enhanced driving comfort and protection for powertrain assemblies due to reduced engine vibrations
- Maintenance free
- Low installation space requirements
- Easy to integrate in a wide range of powertrains
- Thermal stability over the entire service life via the use of heat-resistant steel springs
- The use of large-scale series technology ensures superior product quality
- Environmentally friendly and sustainable due to completely recyclable components and the possibility for remanufacturing

DynaDamp

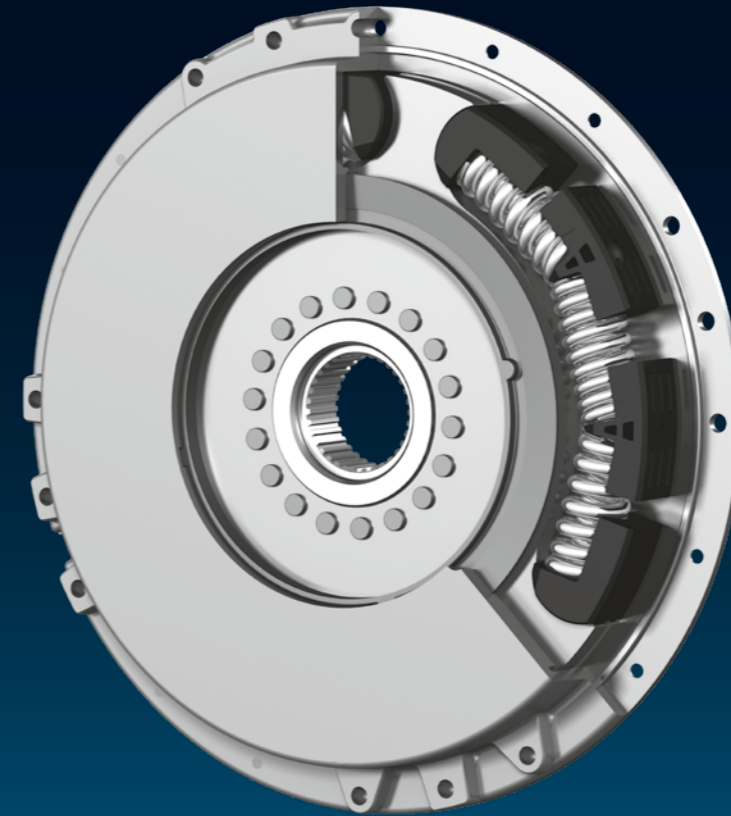
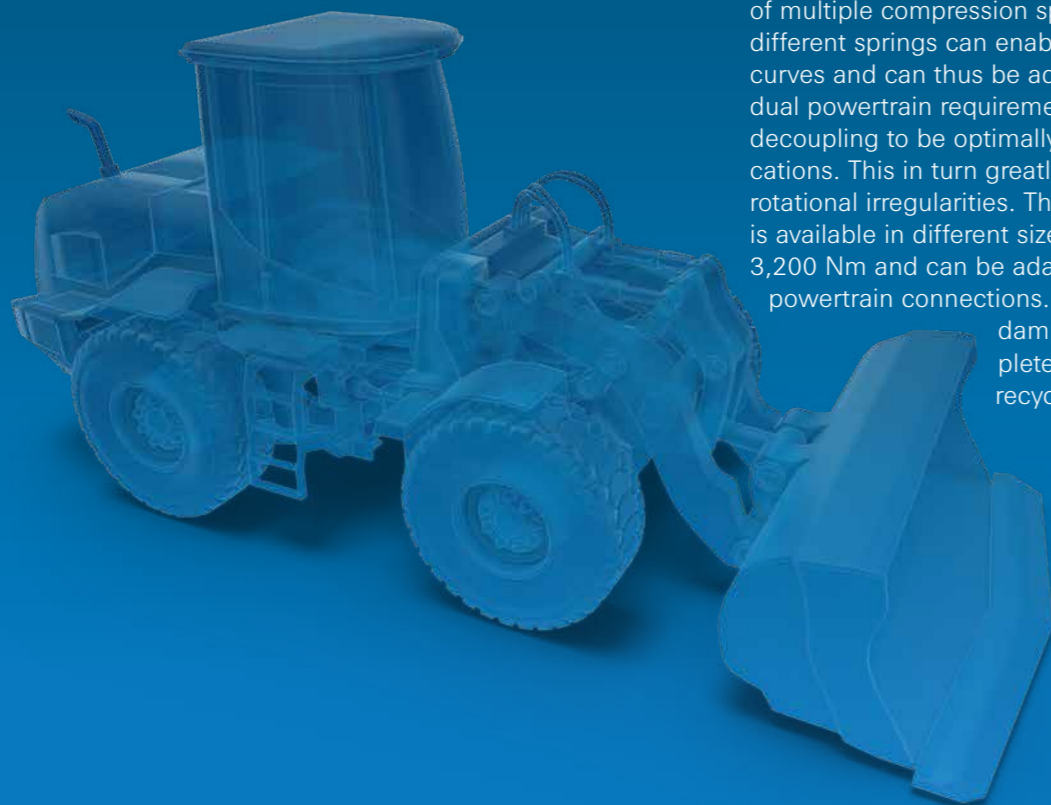
The DynaDamp torsional damper is a more advanced version of a bolt-on torsional damper. It uses the powerful ZF Dual Mass Flywheel technology to decouple vibrations in outstanding fashion, and is superbly suited for very demanding applications, including high torque ranges.

The task

For especially critical applications, bolt-on torsional dampers can reach their limits when the level of rotational irregularities in the powertrain increases. This places increased strain on the powertrain and causes disturbing noises in the vehicle. Reducing these rotational irregularities is thus a central task in order to protect the powertrain and to increase driving comfort. To meet these higher demands for decoupling torsional vibrations, the ZF DynaDamp is the right solution.

The technology

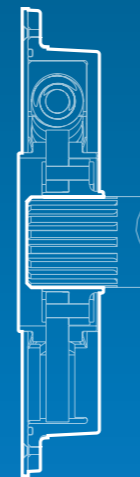
The DynaDamp is integrated between the engine and the powertrain and uses the same technology as the established Dual Mass Flywheel to decouple torsional vibrations reliably and at a high level. Due to the placement of the torsional damping springs at a large actuation radius, the DynaDamp provides a considerable increase in the ability to reduce rotational irregularities. Thanks to its modular design, the spring set allows characteristic curves to be adjusted in flexible and optimum fashion. Because the spring sets are designed to consist of multiple compression springs, the combination of different springs can enable multi-stage characteristic curves and can thus be adapted in ideal form to individual powertrain requirements. This allows vibrational decoupling to be optimally adjusted to individual applications. This in turn greatly reduces ignition-related rotational irregularities. The DynaDamp torsional damper is available in different sizes for engine torques up to 3,200 Nm and can be adapted to different engine and powertrain connections. Just like the bolt-on torsional damper, the DynaDamp is completely maintenance free and fully recyclable.



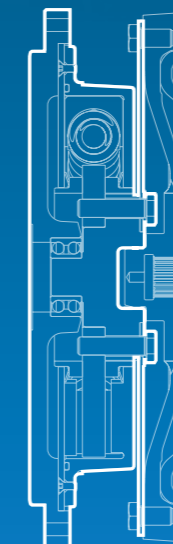
Vibration Damping on the Highest Level

- Enhanced driving comfort and protection of powertrain assemblies due to reduced engine vibrations
- Multi-stage spring characteristic curves possible
- Maintenance free
- Different available sizes allow easy integration into a wide range of powertrains
- Thermal stability over the entire service life
- The use of large-scale series technology ensures superior product quality
- Environmentally friendly and sustainable due to completely recyclable components and the possibility for remanufacturing

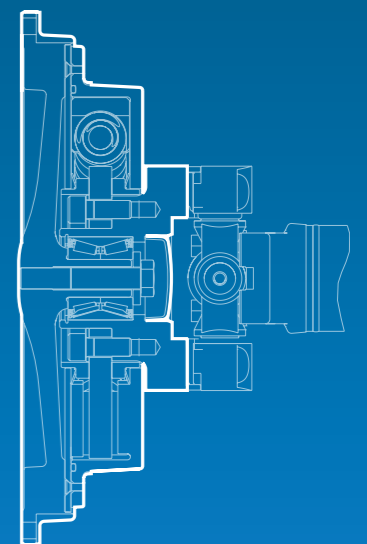
Mounting Variants



Splined hub



Flexplate for torque converter



Prop-shaft connection

ZF Friedrichshafen AG

Commercial Vehicle Technology Division
Ernst-Sachs-Straße 62
97424 Schweinfurt
Germany

Phone +49 9721 98-0
zf.com