



# Technologies for Commercial Vehicles

Quality and Innovation

**SCHAEFFLER**



## ENGINEERING AND PRODUCTION – CLOSE TO THE CUSTOMER, ALL OVER THE WORLD

Close proximity to our customers is just one of the defining characteristics of Schaeffler. At around 170 locations worldwide, we are right there where our customers need us. We offer engineering, production and service on the ground, in the region and for the region. Together with our customers, we develop exactly those solutions that precisely fulfill the necessary functions and thus contribute to perfect meshing of all the components. In this way, our individually applied know-how sustainably supports the valuable brand promise of our customers. Our manufacturing locations provide seamless supply through short responsive times and customer-oriented service.

The Schaeffler division Automotive Aftermarket has worldwide responsibility for replacement parts business and service in the automotive sector. Our specialists provide innovative repair solutions, initiate service concepts, focus on the transfer of know-how and offer practice-oriented training for workshop and distribution business.

## LEAD COMPETENCE FOR COMMERCIAL VEHICLES

We have achieved a leading position in the development and production of forward-looking solutions for the automotive industry and industrial sectors. Our precision elements and systems, developed under the strong brands INA, LuK and FAG, fulfill the challenging requirements of the automotive future. They also serve as a reliable source of solutions for the commercial vehicle industry, customized to the requirements of trucks, buses and mobile working machinery.

In partnership with our customers, a wide range of products is already finding its way into the vehicles of tomorrow: from powerful engines with low maintenance and emissions, through transmissions to chassis applications.

## What we stand for: quality, technology and innovation

### Quality – precise and reliable

Through its manufacturing competence and comprehensive quality management, Schaeffler ensures product quality far superior to the market average. The criterion here is the zero defects principle, which stands for the stabilization of processes and continuous improvement. The high standard of quality is confirmed by numerous awards from customers and certificates in accordance with international standards.

### Technology – successful and pioneering

In its manufacturing facilities, Schaeffler has extremely wide-ranging know-how and a full range of modern technologies for the highest cost-effectiveness and precision. With a high degree of vertical integration, Schaeffler produces precision products in its 74 manufacturing plants all over the world. In many production areas, such as cold forming, forging or surface and heat treatment, Schaeffler is a technology leader in the sector. The building of assembly and production lines is supported by the company's own special machinery facilities.

### Innovation – advanced and forward-looking

In 17 Research & Development centers, about 6700 employees work to develop new products, technologies, processes and methods for solutions that fulfill the needs of the market. With more than 2300 patent applications in 2015 and about 24,000 patents and patent applications currently active, Schaeffler is currently in second place among the most innovative companies in Germany according to the German Patent and Trade Mark Office and is thus an innovation leader in industry.

# LIVING THE SYSTEMS PHILOSOPHY

Intelligent solutions drive progress in commercial vehicles. Technology, quality and innovation are our strengths, sustainability is our goal.



## Truck

All leading truck manufacturers trust in products from Schaeffler under the brands FAG, INA and LuK. With good reason: in commercial freight transport, the loads that trucks are subject to can only be supported by products of the highest quality. Components from Schaeffler for trucks are effective and reliable, from the clutch through the wheel bearing to the tension pulley.

## Bus

Bus transport is characterized by particular conditions. Products from Schaeffler are precisely matched to the requirements occurring in operation: flywheels ensure smooth running and effective damping, strong belt components withstand continuous load, heat and contamination. Power steering pumps also give first class service.

## Light Commercial Vehicle

Thanks to Schaeffler, delivery vehicles up to 3,5 tons are both agile and stable. Our valvetrain components make an important contribution to reducing operating costs and emissions, while our self-adjusting clutches ensure comfort and robustness. The dual mass flywheel has become a classic solution for quiet running at low speeds.

## Mobile machinery

Whether it is durable standard bearings or specifically developed seed disk bearings for heavy clay soils – Schaeffler knows the requirements in agricultural equipment. Our extensive portfolio of easy-to-fit, maintenance-friendly products saves time and money over the entire product life cycle. The construction industry requires particularly effective solutions. Rolling and plain bearings from Schaeffler ensure that construction machinery of all types achieves top performance worldwide. The products are characterized by high performance density, long operating life and in many cases zero maintenance.



# SYSTEMS COMPETENCE IN EVERY DETAIL

Our systems competence for optimizing the powertrain covers every detail. This is shown by our calling card, the wide product portfolio from Schaeffler, encompassing precision components and systems in the engine, transmission and chassis for all vehicles. The whole range also matches the requirements for reduction in CO<sub>2</sub> emissions and fuel consumption – another way we give optimum support to our customers.



## Engine systems

Valvetrain, camshaft phasing adjustment, belt drives, water pump bearings, exhaust/air management systems, rolling bearing arrangements



## Transmission systems

Main bearings, needle roller bearings, synchronization, gearshift systems, clutches, torsional vibration damping, converters, components for auxiliary drives



## Chassis systems

Wheel bearing applications, differential, kingpin bearing arrangements, brake applications, driveshaft, auxiliary drives and interior equipment



## Mobile machinery

Components and systems for the powertrain, bearings for traction drives, bearings and precision parts for hydraulic systems, bearing arrangements for tillage and harvesting, bearings for construction machinery, mechatronic modules



VALVETRAIN



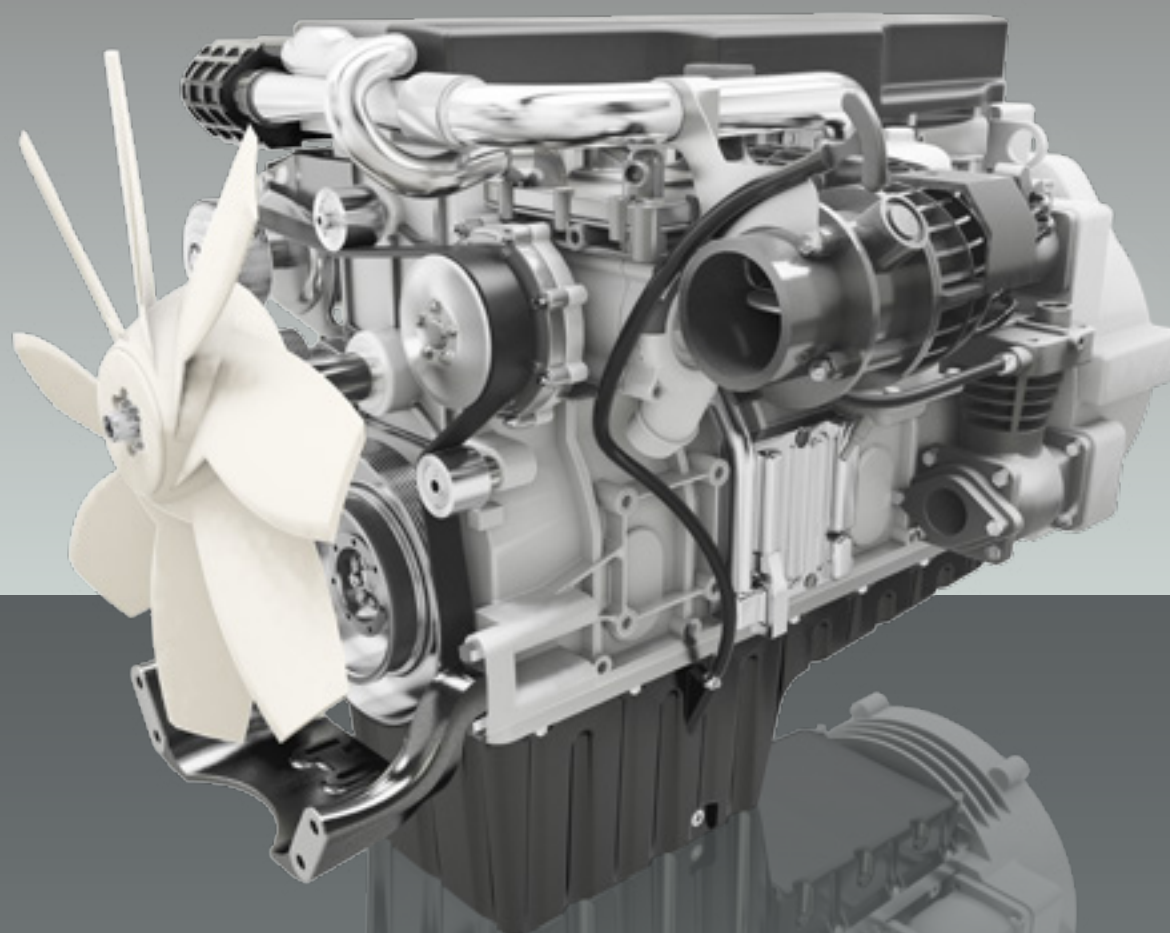
CAMSHAFT PHASING ADJUSTMENT



BELT DRIVE

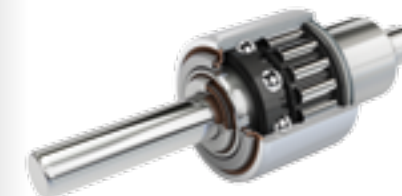


## COMPONENTS AND SYSTEMS FOR ENGINES



Our precision products make a decisive contribution to ensuring that engines consume less fuel and comply with increasingly strict exhaust standards. At the same time, they increase travel comfort and dynamics, as well as extending maintenance intervals and service life. Our products include valvetrains, camshaft phase adjusters, belt drives, water pump bearings, exhaust/air management systems and rolling bearing arrangements.

WATER PUMP BEARINGS



EXHAUST/AIR MANAGEMENT SYSTEMS



ROLLING BEARING ARRANGEMENTS IN ENGINE APPLICATIONS



## VALVETRAIN



Hydraulic flat and roller tappets · Hydraulic finger followers and rocker arms · Switchable valvetrain · Fully variable electrohydraulic valvetrain system UniAir

### Very high performance from start to finish

Elements for valve lash adjustment allow constant timings – maintenance-free over the entire engine life. Schaeffler Automotive develops and manufactures valvetrain components with hydraulic valve lash adjustment for engines with overhead and bottom-mounted camshafts and thus makes an important contribution to reductions in operating costs and emissions.

## CAMSHAFT PHASING ADJUSTMENT



Hydraulic camshaft phasing adjusters · Hydraulic valves

### Maintenance-free and robust

Camshaft adjustment systems contribute to further reductions in fuel consumption and emissions. They optimize valve timings over the entire load and speed range of the engine. Systems are available that can adjust just one camshaft, both camshafts synchronously or two camshafts independently of each other.

## BELT DRIVE



Belt drive systems · Auxiliary drives · Mechanically damped belt tensioner · Tension and idler pulleys · Overrunning alternator pulley

### Precise and resilient

Schaeffler produces belt drives that can withstand very high loads. Tension and idler pulleys have highly precise belt guidance, where the steel idler pulley gives reliable resistance to external influences. Optimized mass and a large grease reservoir ensure long service life, even in our low-noise, mechanically damped belt tensioners and our consistently high performance overrunning alternator pulleys.

Water pump bearings for truck applications · “Double decker bearings” for adjustable water pumps · Triple row bearings for high loads · Water pump impellers

### Ready-to-fit – saving fuel – reducing CO<sub>2</sub>

In addition to the established standard designs of water pump bearings for classic coolant pumps, Schaeffler can supply so-called double decker bearings for viscosity control coolant pumps that ensure cooling of the engine matched to requirements.

Corrosion-resistant throttle flap bearings

### Superior on CO<sub>2</sub> emissions

Throttle flap bearings are drawn cup needle roller bearings that are greased, sealed on both sides, airtight and have a particularly small section radius. Due to their low frictional torque and superior air management, they give significant reduction in the exhaust emissions of an engine. The outer rings and the needle roller and cage assemblies are made from corrosion-resistant steel.

Rolling bearings for turbochargers · Rolling bearing arrangements in the engine, e.g. gear train · Camshafts

### Less friction in the engine

Schaeffler Automotive develops innovative rolling bearing arrangements for all rotating components in the engine, thus contributing to reductions in fuel consumption and emissions.

## WATER PUMP BEARINGS



## EXHAUST/AIR MANAGEMENT SYSTEMS



## ROLLING BEARING ARRANGEMENTS IN ENGINE APPLICATIONS





MAIN BEARINGS



NEEDLE ROLLER BEARINGS



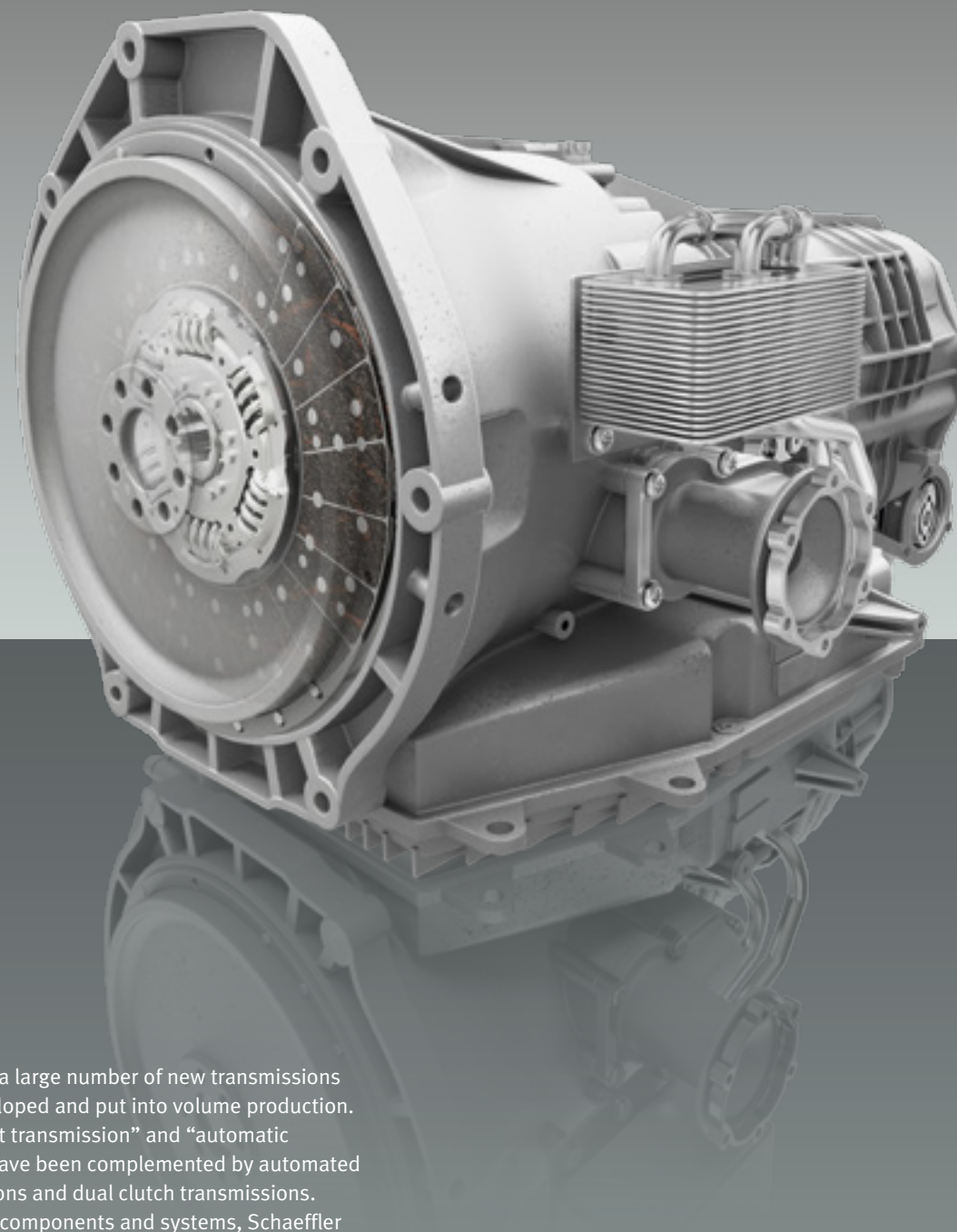
CLUTCH RELEASE SYSTEMS



GEARSHIFT SYSTEMS



## COMPONENTS AND SYSTEMS FOR TRANSMISSIONS



In recent years, a large number of new transmissions have been developed and put into volume production. The classic “shift transmission” and “automatic transmission” have been complemented by automated shift transmissions and dual clutch transmissions. With innovative components and systems, Schaeffler Automotive is decisively driving forward development in all designs and concepts: for increased travel comfort and lower consumption.

CLUTCHES



TORSIONAL VIBRATION DAMPERS



HYDRAULIC TORQUE CONVERTERS



COMPONENTS FOR AUXILIARY DRIVES



## MAIN BEARINGS



## NEEDLE ROLLER BEARINGS



## CLUTCH RELEASE SYSTEMS



## GEARSHIFT SYSTEMS



Ball bearings · Cylindrical roller bearings · Drawn cup bearings · Tapered roller bearings · Direct bearing arrangement · Dual clutch transmission

### Optimized friction and durable

The special design of our tapered roller bearing without an outer ring is matched to special requirements and space conditions. Designed for optimized friction, this tapered roller bearing is characterized by excellent durability. The integrated additional function offers the customer high performance density, long service life and reliability with low-friction running. In order to achieve this performance capability, our development department matches the main bearings to each other for all operating points.

Axial needle roller bearings · Drawn cup needle roller bearings · Needle roller and cage assemblies · Full complement needle roller bearings · Spacer sleeves · Inner rings · Planetary gear sets

### Perfection for extreme conditions

For extreme requirements, our freewheel bearings are the first choice. Irrespective of the individual requirements or the dominant factors such as temperature, load or speed, customers will always find the perfect, lasting solution at Schaeffler.

Synchro ring · Detents in gearshift systems · Selector sleeves · ARRES · Clutch release systems / clutch release bearings

### Robust design and perfect sealing

The pilot bearing supports the transmission input shaft in the flywheel. This requires a long service life, which Schaeffler achieves by means of optimum sealing. This prevents clutch wear dust entering the bearing. The large grease reservoir guarantees a long running life, while the design is convincing through its insensitivity to axial motions.

Detents · RLF rotary/linear guide · Other gearshift components

### Wear-free and high precision

Our solutions give optimum gearshift feel and low-friction operation for all movable parts in the gearshift system. Bearings for longitudinal and rotational motion allow precise, defined gearshift. We also offer precisely fitting detents for all space conditions and requirements. Due to their low friction, they are particularly resistant to wear.

Clutch systems including release bearings · Self-adjusting clutches · Solutions for dual clutch transmissions and automated shift transmissions

### Optimum gearshift

At the interface between the engine and transmission, clutch systems give rapid, secure and defined gearshift. Clutches with self-adjusting wear compensation, torsion dampers optimally matched to the powertrain and friction linings with low wear and high picking resistance combine comfort and robustness for applications in all torque classes. For the development of new dual clutch transmissions, we are a strong partner in the commercial vehicle industry.

Centrifugal pendulum absorber on flywheel · Bow spring dampers · Wide angle dampers · Dampers for front end systems

### Smooth running in the powertrain

The centrifugal pendulum absorber on the flywheel calms the engine and thus enables fuel savings by means of downsizing combined with a reduction in noise emissions from the vehicle. Wide angle dampers give an additional increase in torsional vibration insulation and service life in all forward-looking concepts for truck transmissions. Vibration-damping components are now also available for the belt drive on the engine.

Torque converters · Lock-up clutches · Converter dampers

### Perfect drive dynamics, low consumption

The new generation of converters with a mass-optimized sheet steel construction developed by Schaeffler for HCV automatic transmissions offers maximum efficiency in launch and gearshift operations. In combination with the integrated damper technology as well as compact, high performance multi-disk lockup clutches, they provide both excellent travel dynamics and a significant reduction in consumption.

Rolling elements · Fine blanked parts · Plain bearings · Spacer ring · Spherical plain bearings · Roller clutches · Disk sets for CVT · Coatings · Chain for CVT · Linings · Dampers for dual clutch applications

### Ready-to-fit and easy to fit

A hydraulic pump is driven by means of the internal teeth on the bearing unit. The unit shown can transmit torques of more than 1000 Nm. Its modular concept aids assembly at the customer. The internal oil flow is controlled by means of radial holes, the seal and the baffle plate, which can all be designed to individual requirements.

## CLUTCHES



## TORSIONAL VIBRATION DAMPERS



## HYDRAULIC TORQUE CONVERTERS

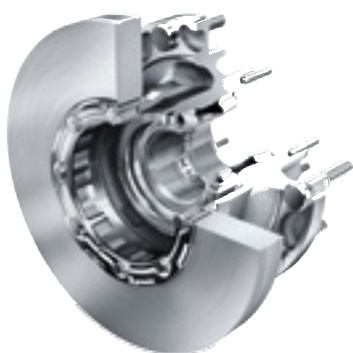


## COMPONENTS FOR AUXILIARY DRIVES





WHEEL BEARING APPLICATIONS



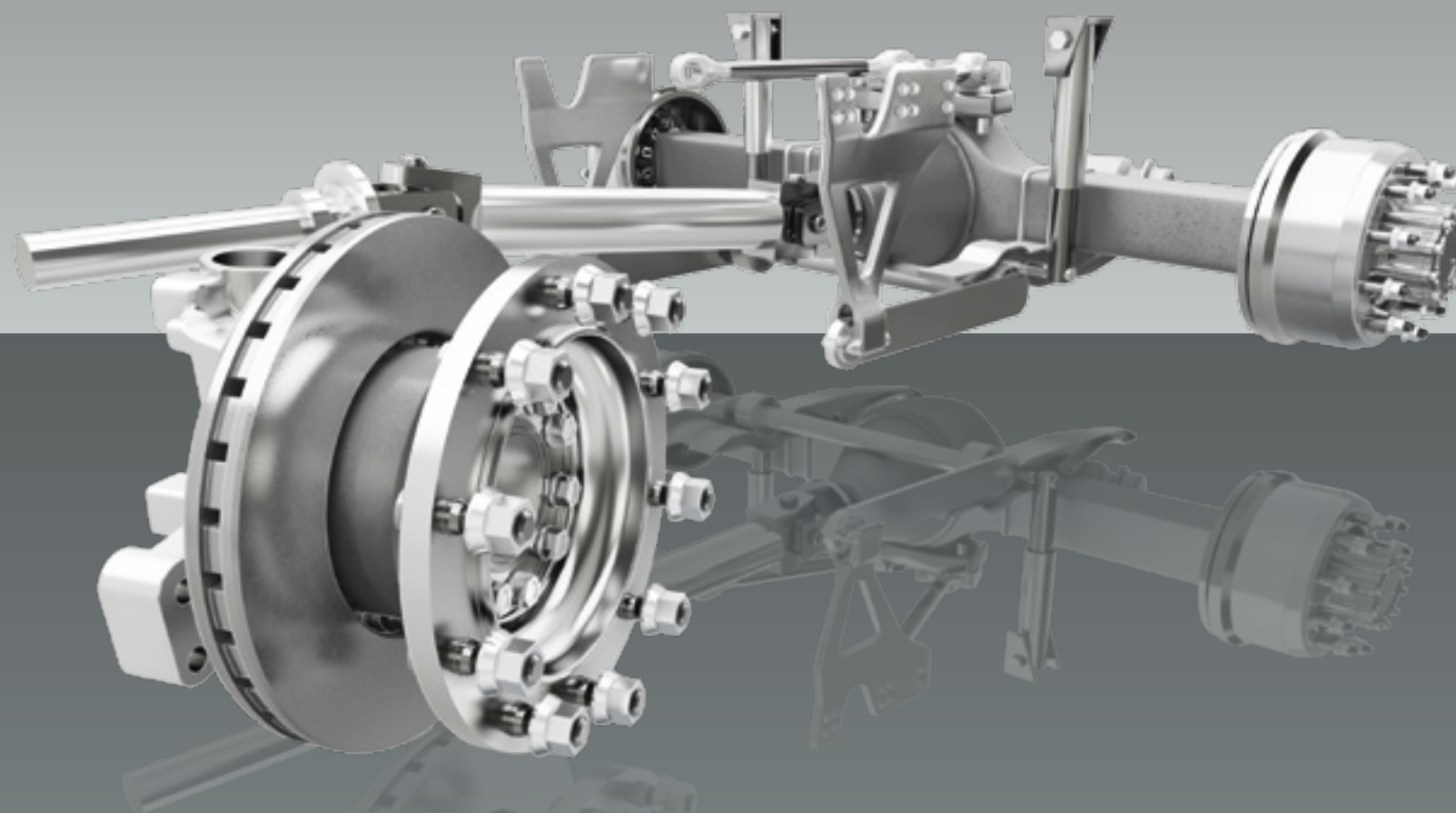
PINION AND DIFFERENTIAL BEARINGS



KINGPIN BEARING ARRANGEMENT



## COMPONENTS AND SYSTEMS FOR CHASSIS AND AUXILIARY DRIVES



Our solutions for the chassis are now far more than just bearings. Schaeffler offers maintenance-free for-life system solutions that can be used to achieve optimum reliability and service life. Our market leadership on fuel efficiency makes it possible for our customers' vehicles to comply not only with the Euro 6 emissions regulations but also achieve the highest level in relation to Transport Performance. With the aid of our solutions, truck operators can achieve a significant reduction in TCO (Total Cost of Ownership). Our product spectrum is rounded out by bearings for auxiliary drives and special applications for commercial vehicles.

COMPONENTS FOR BRAKE APPLICATIONS



COMPONENTS FOR DRIVE SHAFTS

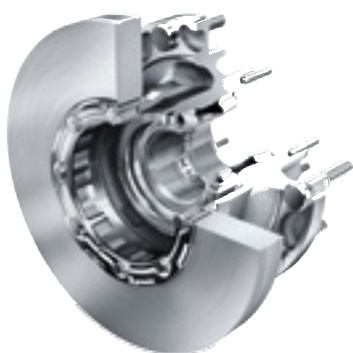


AUXILIARY DRIVES AND INTERIOR EQUIPMENT





## WHEEL BEARING APPLICATIONS



## PINION AND DIFFERENTIAL BEARINGS



## KINGPIN BEARING ARRANGEMENTS



Tapered roller bearings · Insert tapered roller bearing units · Single Bearing Unit · Truck Axle Module · Hub Unit Offset Design

### Innovative wheel bearing solutions

Insert wheel bearing units form the basis for maintenance-free commercial vehicle wheel bearing arrangements. Due to the hub collar, even high lateral forces occurring in cornering are securely supported by the bearing. Mounting without setting work and the clamping of the inner rings against a stop lead to a highly rigid wheel head with precise wheel guidance. Fully developed greases and the highly efficient sealing system ensure problem-free usage for the whole life of the vehicle. New, customer-specific special solutions with a special combination of material and heat treatment give a further increase in performance capability. Together with a revised, low-friction sealing system, these have become our “X-life plus” design. Both fuel consumption and emissions have been reduced as a result.

Pinion bearings · Crown wheel bearings · Pinion support bearings (full complement)

### Top performance through flexibility

Due to special heat treatment, our pinion and differential bearings have a high deformation capability of the raceway surface. If local overload damage occurs, for example through overrolling of foreign particles in the unfiltered axle drive oil, this allows “self-healing” and thus a long service life. Special designs combine “Low Friction” and “Maximum Performance” in our “X-life plus” design.

Kingpin bearings · Axial cylindrical roller bearings · Needle roller bearings · Drawn cup needle roller bearings · Thrust washer

### First class features

Our kingpin bearing arrangements combine the best characteristics of axial and radial bearings and are used not only in trucks but also in conveying equipment and agricultural machinery. They are solid, resilient and protected against contamination and moisture by a particularly high performance grease.

Half-shell bearings · Axial needle roller bearings · ABS sensor ring · Brake adjusters · Sleeves · Axial washers · Axial ball/needle roller and cage assemblies

### Compact and precise

Brake applications from Schaeffler are used in the components of well-known truck suppliers. One example is our brake adjusters for truck disk brakes: a compact design, engagement accuracy and greasing for life makes them a reliable teammate in the vehicle. Schaeffler also supplies special products such as cold formed half-shell bearings that can withstand high static load.

Joint bearings BBUA / BBUB / BU · Drive shaft support bearings

### Safety in all sizes

Cardanic shafts for trucks are subject to heavy loads and best perform their function with universal joint bearings. These maintenance-free components are in use in their millions worldwide. One reason is that their seal package is extremely reliable and another is that, in addition to the sizes offered, special versions can be produced. The product range is enormous.

Deep groove ball bearings · Four point contact bearings · Angular contact ball bearings · Needle roller bearings · Thrust bearings

### The right bearing solution for every requirement

Auxiliary drives are decisively influenced by the classic assessment criteria such as power, torque, mass, consumption and cost-effectiveness. On the basis of these requirements, Schaeffler works in close partnership with customers to develop and manufacture bearing components for auxiliary drive applications such as starters, airconditioning compressors and throttle valves as well as braking and steering systems. Due to Schaeffler’s many years of experience and competence, it can often respond at very short notice to a wide range of customer specifications.

## COMPONENTS FOR BRAKE APPLICATIONS



## COMPONENTS FOR DRIVE SHAFTS



## AUXILIARY DRIVES AND INTERIOR EQUIPMENT



## COMPONENTS AND SYSTEMS FOR THE POWERTRAIN



## BEARINGS FOR TRACTION DRIVES



## BEARINGS AND PRECISION PARTS FOR HYDRAULIC UNITS



# COMPONENTS AND SYSTEMS FOR MOBILE MACHINERY



The new exhaust standards TIER 4 (US) and STAGE 4 (EU) have since 2014 specified a significant reduction of up to 90 % for Non-Road Mobile Machinery (NRMM) covering the pollutants CO, HC, NOx and PM. This is only one reason that mobile machinery must be operated with ever greater efficiency, the others being increasing cost-effectiveness and ever higher working loads that require measures to increase performance density.

The work functions of mobile machinery require comprehensive optimization in power branching to ensure the efficient drive of working equipment such as excavator scoops or lifting gear.

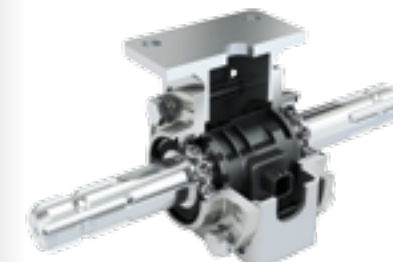
## BEARING ARRANGEMENTS FOR TILLAGE AND HARVESTING



## BEARINGS FOR CONSTRUCTION MACHINERY



## MECHATRONIC MODULES





## COMPONENTS AND SYSTEMS FOR THE POWERTRAIN



## BEARINGS FOR TRACTION DRIVES



## BEARINGS AND PRECISION PARTS FOR HYDRAULIC UNITS



Bearings for transmissions and axles · Components for transmission synchronization, engines and auxiliary drives · Clutches · Torsional vibration dampers

### The whole system in view

In order to fulfill the new legal guidelines, not only the post-treatment of exhaust gas but also optimum operation of the diesel engine in all speed ranges and load profiles is of decisive importance. For powertrains in mobile machinery, Schaeffler offers a product range that is similarly comprehensive to the one for road vehicles – and beyond this for the drives that provide power to the work functions. In development partnerships with our customers, we develop new products that are ideally matched to customer needs and optimize the interaction of all components in the complete system.

Full complement needle roller sets · Needle roller and cage assemblies · Cylindrical roller bearings with and without outer ring · Angular contact ball bearings · Tapered roller bearings

### Robust and compact

Due to its compact construction, the planetary transmission is particularly suitable as a traction drive, for example on the rear tractor axle with two planetary gear stages per axle side, or as a Turas drive in chain-driven construction machinery. Cage bearings are used for high speeds and guide normal accelerations, while full complement planetary roller bearings are used for heavy loads and low speeds. A proven measure for preventing slippage at reduced load is coating with Durotect B – a coating system developed by the experts in our surface technology center.

Tapered roller bearings · Cylindrical roller bearings · Pivoting cradle bearings LSGS · Infeed ground inner rings · steel sealing rings · Ball rings

### Precise and efficient

The energy efficiency of the powertrain can be significantly improved if adjustable hydraulic equipment is optimally controlled and fitted with low-friction, energy-saving sliding and rolling contacts. Rolling elements and precision parts matched to each other, specially developed in some cases for hydraulic equipment, allow precise and highly accurate setting of the volume flow, minimize leakage and seal erosion and ensure good controllability.

Four point contact bearings and angular contact ball bearings for seed disks · Flanged housing units for plow disks, rolls and harvesters · Tapered roller bearings

### Weatherproof and economical

Different soil conditions, plant juices, continuous vibrations and shocks, dust, sand and moisture are a tough test for the mechanical strength of all machine parts. Bearings must therefore be extremely robust and well sealed. This is particularly the case if they work in close proximity to the soil or crops. Multi-piece seals or sealing units offer the best possible protection here. Some bearing arrangements for agricultural equipment are products that have been optimized to the application, which were originally developed for the automotive sector: wheel bearings became plow and seed disk bearings, water pump bearings became trailing wheels.

Rope sheave bearings · Unbalance bearing arrangements · Spherical plain bearings for articulation/swivel joints and lift masts · Plain bearings and spherical plain bearings for hydraulic cylinders

### Reliable and durable

Construction machinery includes a wide variety of designs: excavators, wheeled loaders, vibratory machinery, cranes - wheel-driven or track-driven. The components are subjected to a wide range of requirements: while the most important include robust, compact and operationally reliable, they must also be economical, low-maintenance and easy to fit. One example: for the support of rope sheaves, such as those used in sets in a mobile crane to raise and lower the heaviest loads, we have developed full complement cylindrical roller bearings with a special geometry, an anti-corrosion coating and a particularly moisture-resistant grease for heavy loads.

Modules comprising a shaft, bearing, sensor technology and housing for capturing

### Integrated and intelligent

With intelligent bearing solutions, important operating states of a machine or a product can be captured and made available to the controller. We have developed ready-to-fit modules that, for example, measure the torque of a drive shaft without contact and with long term stability, which is then transferred to a controller. An application example: the module is integrated in the spinner drive of a fertilizer spreader and captures the flow quantity directly during the spreading process. As a result, the precise quantity of fertilizer required is always spread. Precise data collection at a central point of the process is possible on almost all drive shafts.

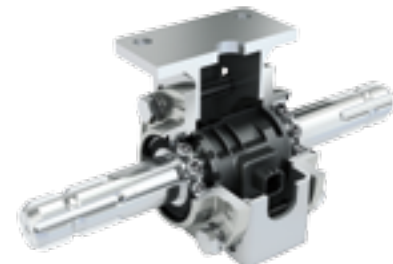
## BEARING ARRANGEMENTS FOR TILLAGE AND HARVESTING



## BEARINGS FOR CONSTRUCTION MACHINERY



## MECHATRONIC MODULES





## HIGH MOBILITY WITH LOW OPERATING COSTS

### Solutions from Schaeffler Automotive Aftermarket for commercial vehicles

Schaeffler is a leading supplier worldwide of intelligent solutions for commercial vehicles not only in original equipment manufacture but also in the open replacement parts market with its division Automotive Aftermarket and the brands LuK, INA and FAG. The fact is: trucks, buses or tractors are capital goods that require a high level of utilization and must be ready for operation in any circumstances. The operating costs (Total Cost of Ownership) are therefore a focal point for fleet operators and transport companies.

This is precisely the goal for the products and repair solutions from Schaeffler Automotive Aftermarket for powertrain, engine and chassis. First class product quality and repair solutions appropriate to workshops are vital in order to achieve extended service intervals, lower downtime and ultimately high mobility. Orienting itself to the needs of customers, the division is continuing to develop its extensive portfolio.

The portfolio of our aftermarket specialists also includes extensive services for distribution and workshops. The online catalog is kept up to date on a daily basis and offers a rapid, user-friendly search tool for replacement parts. And on the workshop portal REPPERT, workshop experts can find everything they need to make their day-to-day work even easier – from product updates to repair guidelines.

## MOBILITY FOR TOMORROW

URBAN MOBILITY



INTER-URBAN MOBILITY



ECO-FRIENDLY DRIVES



ENERGY CHAIN



Globalization, urbanization, digitalization, scarcity of resources and the growing demand for affordable mobility are leading to increasingly dynamic market requirements. Based on these megatrends, the Schaeffler Group has developed its pan-regional strategy concept “mobility for tomorrow” for the Automotive and Industrial Divisions.

Schaeffler is actively involved in shaping “mobility for tomorrow” through its own research and development and is providing its customers and business partners with an attractive product portfolio. Eco-friendly drive technologies encompass a large number of products for optimization of the combustion engine-based powertrain as well as for hybrid and electric vehicles. As a leader in innovation and technology, the Schaeffler Group is making a decisive contribution to the mobility of the future.

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