ZF Friedrichshafen AG
Division Commercial Vehicle Technology
Business Unit CV Axle Systems
94030 Passau
Germany
Phone +49 851 494-5611
Fax +49 851 494-5676
sales.ta@zf.com
www.zf.com/buses

EN 0000.762.180 — 2012

Driveline and Chassis Technology

Systematic Innovation and Efficiency

ZF Axle Systems for City Buses and Coaches

People who depend on city buses, buses running in line service, or coaches, are entitled to maximum safety and comfort. Here, it is primarily technology that plays a major role: Transmission, chassis, and steering technology by ZF form a precise, coordinated, and correlated complete system. This makes the bus what it is today: One of the safest, most economical, comfortable, and environmentally friendly means of transport available.

With Innovations of Great Value, ZF significantly contributes to fulfilling the requirements of demanding passengers with regard to modern buses.

Contents

In Focus: Progress and Economy	Page 4
Bus Electrification	Page 6
Going Faster. With Bus Rapid Transit.	Page 8
Axle Systems for City Buses	Page 10
Front Axle Systems	Page 12
Rear Axle Systems	Page 14
Axle Systems for Coaches	Page 16
Front Axle Systems	Page 18
Rear Axle System	Page 20
Tag Axle Systems for City Buses and Coaches	Page 21
Research and Development	Page 22
On Site – Worldwide	Page 24
ZF Group	Page 25
Technical Annex	Page 26

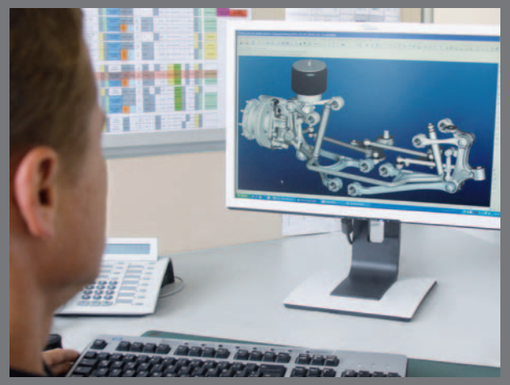
In Focus: Progress and Cost-Effectiveness

ZF is the technological leader for efficient axle systems, transmissions, and steering systems that are delivered to the customer as ready-to-install, tailor-made system solutions. Thanks to the electrically driven low-floor axle, vehicle manufacturers are now fit for the future – also in the area of e-mobility!

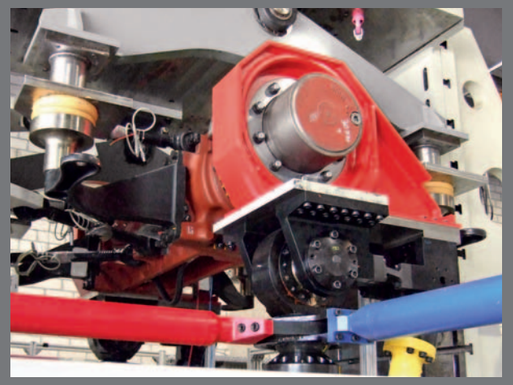
As a worldwide leading automotive supplier for Driveline and Chassis Technology, ZF claims to successfully meet the high market requirements and demands of passengers for comfort and safety. ZF products set benchmarks and continually improve standards through innovations; these are particularly discernible when looking at its sophisticated system approaches in the area of e-mobility. Thus, ZF is making a substantial contribution to present and future mobility. For modern city buses and coaches, ZF axle systems offer a high degree of riding comfort, smooth running, and active safety.

For bus operators, environmental compatibility, low maintenance effort, and cost-effectiveness in operation are furthermore important. Consequently, ZF delivers complete axle systems adapted to individual transmission and steering system solutions for city buses and coaches.

Using the extensive know-how of the ZF Group, both individual components and complete axle systems benefit from the continuous evolution and optimization, so that ZF customers can always rely on the latest technology. In order to meet the requirement for ultimate efficiency, system solutions are accurately harmonized with one another, already during the development phase. Highly specialized individual components are combined to form complete axle systems; these will then be perfectly fine-tuned and checked and, subsequently, delivered to customers. Here, ultimate efficiency is always at the center of attention. Thus, front axles for city buses and coaches can be equipped with the ZF-Servocom or ZF-Servocomtronic, the ball-and-nut power steering systems. The modular system setup enables detailed adaptation to the customer vehicle's installation situation. Vehicle manufacturers profit from reduced logistics, assembly, and handling costs by purchasing ready-to-install systems that have been precisely aligned, fine-tuned, and factory tested.

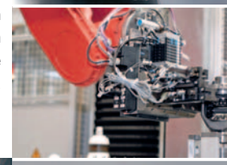


Virtual product development
ZF engineers employ 3D CAD programs to design components directly using a representation depicting both, functions and process features. Therefore, components are designed concurrently with computer-aided planning of production, quality control, and assembly processes. In parallel, engineers benefit from computer-assisted simulation of functions and durability.



Testing under real conditions
On the test benches, real conditions are replicated by load histograms. These duty cycles are derived via vehicle measurements during operation. The knowledge gained is incorporated into the on-going development of current volume production.

Especially ground and tested bevel gears ensure quiet running.



High-tech production guarantees premium precision for all ZF axle systems.

ZF's technology in buses has already won several international awards.

Bus Electrification

Use QR-Code for more information on electrification.

Today, electrically powered city buses enable high energy efficiency which can be realized with different drive concepts. For this purpose, ZF offers an especially advantageous solution: the AVE 130 electric driven drop center axle.

Urban public transport makes an important contribution to emission reduction in cities since it avoids individual transport. The AVE 130, ZF's electrically driven low-floor axle, enables modern vehicle concepts with electric drives that, compared to conventional concepts, also contribute to the significant reduction of noise and emissions by increasingly using braking energy.

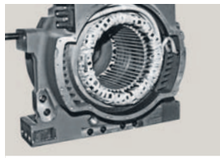
Battery
Thanks to the continuous improvement of batteries and innovative charging technologies (quick-charge or contactless charging technologies), range and economy of battery-driven coaches are getting better and better. This increases the application options and the attractiveness of purely electrically driven vehicles.

Tram wire
Also completely electrically powered, the trolley bus is provided with energy coming from overhead contact lines. Combined with electrical energy accumulators, the route network can also be left temporarily, extending the application options significantly.

Fuel cell hybrid
In fuel cells, hydrogen and oxygen react to form water vapor. The electrical energy generated in the process is used for powering the vehicle or it is stored. Hydrogen can be generated through renewable energy sources like wind or solar energy.

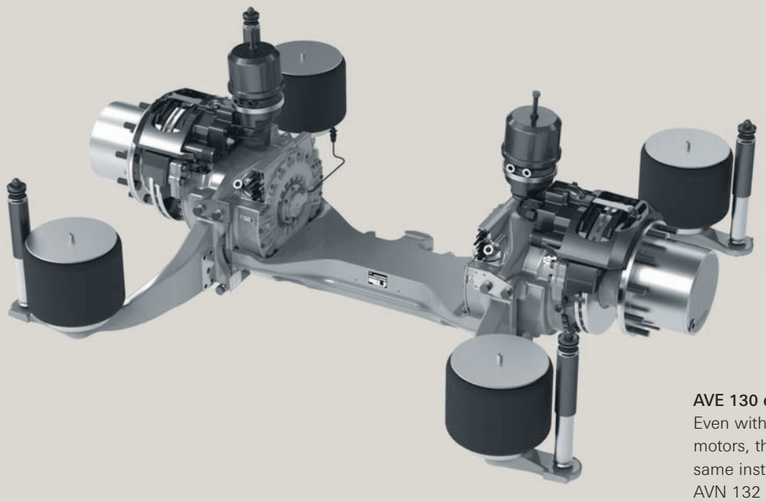
Diesel hybrid
To achieve extensive operating ranges, combustion engines and electrical energy accumulators are successfully combined. For this reason, this serial hybrid is especially suitable for city buses, delivery vehicles, and refuse collection vehicles which are frequently setting off and braking.

AVE 130 electric driven drop center axle
Using the wheel hub drive of the AVE 130 electric driven drop center axle, all these trendsetting drive concepts can be implemented for an axle load of 13 tons. In the ZF concept, each wheel is driven by a high-speed, liquid-cooled asynchronous motor in combination with a two-stage ratio which can also be used for recuperation; thus, it saves energy as well. Available per axle: Short-term, maximum drive power of 240 kW and continuous power of 120 kW. The AVE 130 is especially easy to maintain thanks to its standard components from high volume production, namely the brakes, brake disks, wheel bearings, and seals/gaskets. Compared to conventionally driven axles, the AVE 130's outline was further optimized.
With almost no restrictions, all additional components can be arranged in the vehicle. Thus, new design opportunities are provided for vehicle engineering.



Each wheel is driven by a high-speed, liquid-cooled asynchronous motor.

Optimized installation space: Passengers in the rear instead of the powerpack



AVE 130 electric driven drop center axle
Even with the powerful, integrated electric motors, the AVE 130 can be fitted in the same installation space as ZF's AV 132 and AVN 132 standard drop center axles. The interfaces to the chassis remain unchanged.

Going Faster.
With Bus Rapid Transit.

Use QR-Code for more information on BRT.

Fast-growing megacities struggle with the same problem throughout the world: traffic congestion due to increasing individual traffic. The only way to counteract this development is the installation of an efficient and flexible passenger transport system, such as Bus Rapid Transit (BRT).

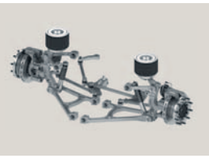
BRT is based on the regularly scheduled routes with buses that run on exclusive lanes. It allows for a large number of people to be transported quickly and reliably from the outskirts into the city center. One possibility of implementing BRT particularly cost-effectively is by using low-floor buses. Since buses with ZF's low-floor axle systems also allow for step-free boarding and disembarking at standard bus stops, it is no longer necessary to build special elevated platform bus stops. Moreover, the center aisle is designed without a platform or steps. Thus, waiting times at bus stops are approximately cut by half. This makes BRT superior to rail-based local transport because its design and maintenance costs are lower, planning and construction times are shorter, and expansion is more flexible.

For the BRT concept, low-floor buses with ZF technology provide for worldwide advantages. Low-floor technology by ZF enables powerful BRT systems:

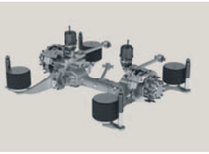
- Beijing (China): In the run-up to the Olympic Games 2008, the Chinese capital extended its BRT lines once again. 350 BRT buses with ZF low-floor technology are in service on three routes. Today, already 21 BRT lines in China rely on ZF axles.
- Istanbul (Turkey): By the year 2013, more than 2,000 buses with ZF low-floor technology will drive on the roads of Turkey's capital.
- Seoul (South Korea): Around 1,900 BRT buses with ZF low-floor axles are currently in service on the streets of the South Korean capital.
- Taipeh (Taiwan): More than 1,400 city buses of Taiwan's capital are driving with ZF low-floor axles.
- South America: More than 2,000 low-floor buses are currently in service in different South American cities. South America is considered to be the region of origin of BRT systems.

Important components for low-floor buses:

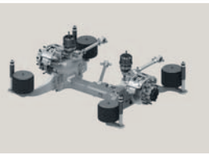
RL 75 EC
independent suspension



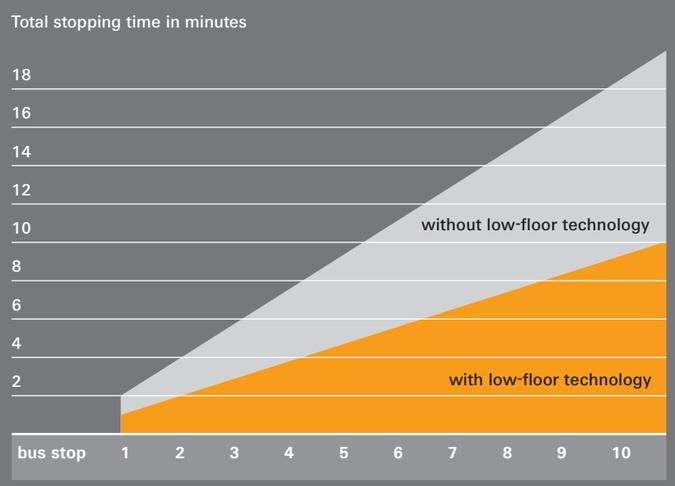
AV 132
rear drop center axle



AVN 132
rear drop center axle
(non-driven)



Low-floor technology increases the average speed in city bus transportation
Low-floor technology cuts the time spent at bus stops by half. With stopping times of e.g. two minutes for high-floor buses, the advantage of low-floor technology becomes more and more evident with correspondingly higher number of bus stops.



AVE 130 electric driven drop center axle for city buses

Axle Systems for City Buses

ZF offers harmonized front axle, drive, and tag axle systems for city buses. They excel through weight optimization, noise reduction, and ultimate driving/ride comfort. Compared to other traffic concepts, low-floor buses with ZF technology are perfectly suitable for Bus Rapid Transit (BRT) thanks to their versatility, low space requirements, and short implementation times.

Use the QR-Code for more information on ZF axle systems for city buses.

Front Axle Systems for City Buses

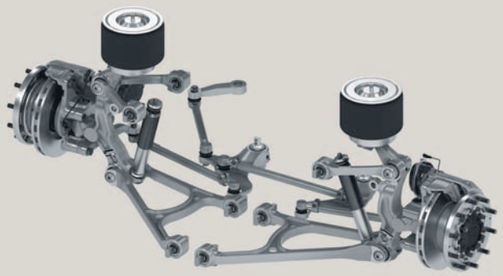
ZF's independent front suspension for city buses improves ride comfort. The low-floor design enables low and convenient boarding for passengers.

The ZF independent front suspension has successfully established itself as the leading front axle system for full low-floor, low-entry, and double-decker buses.
Kinematics' design freedom and leeway for optimization is efficiently expanded when compared to beam axles; in parallel, vehicle handling is also improved. As a result of higher roll stiffness, i.e. smaller roll angles when cornering, the RL 75 EC and RL 55 EC independent suspensions are especially suited for double-decker buses and other vehicles with a high center of gravity, like e.g. gas-powered buses. In general, front-axle stabilizers can be dispensed with.

ZF offers two versions of the classic front beam axle. In addition to the RL 85 A, which has been produced for years, the new RL 75 A is now offered. Maintenance-free, unitized wheel bearings and optimized steering kinematics are the main features of this front-axle system. Thus, ZF lives up to its claims regarding ultimate cost efficiency and economic viability. Furthermore, both version are available as complete axle suspension systems.

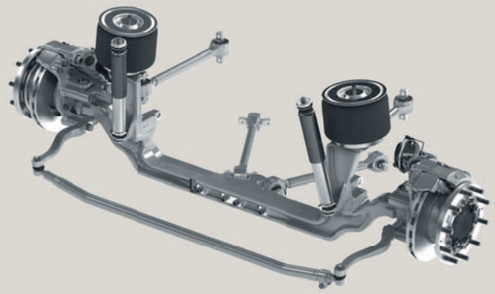
RL 75 EC / RL 55 EC
The upright is the central component of the ZF independent suspension. It transmits vertical forces via the air springs and shock absorbers to the chassis; thus, no vertical loads are put onto the wishbone. In the course of the steering process, the wheel head rotates about a designated kingpin with lowfriction roller bearings, whereby the bump motion is separated from the steering motion. This arrangement leads to optimal suspension response and perfect steering precision as well as directional stability and steering return. All components have been optimized for weight and durability on the basis of extensive calculations and testing routines. Combined with an optimal design of the spring and shock absorber system, they stand for outstanding ride comfort and driving safety. The wishbones are connected to the chassis by maintenance-free rubber-metal bearings which efficiently isolate the vibrations from the passenger compartment. ZF lives up its warranty commitments, even with roughest road surfaces.

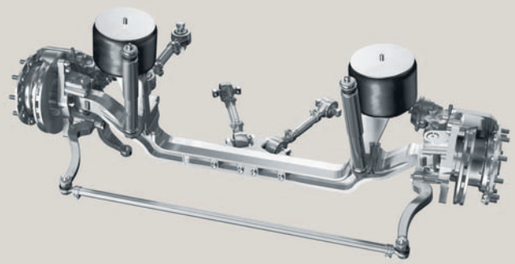
RL 75 A / RL 85 A
Thanks to the design of the axle support, a wide center aisle is possible between the front wheel arches in conjunction with a floor height of no more than 350 mm. The exact kingpin bearing and fine tuned kingpin inclination and caster ensure precise steering. The arrangement of longitudinal rods and V-rods optimized with regard to kinematics guarantees precise axle control in all driving situations. The steering angle of 55° (wheel cut: back-lock) and 40° (wheel cut: front-lock) ensures maneuverability required for city traffic.
Just as all other ZF bus axle systems, the RL 75 A and RL 85 A are equipped as standard with internally ventilated, up-to-date disk brake technology.



RL 75 EC independent front suspension for city buses
Long-time standard for coaches – full low-floor, low-entry, and double-decker buses can also profit from advantages, e.g. enhanced comfort, reduced lateral roll, and a smaller turning circle.

RL 55 EC independent front suspension for midibuses
The standard for "big" buses – but also midibuses can profit from the advantages of an independent suspension. Possible: Vehicle widths as of 2.3 meters.





RL 75 A and RL 85 A front axle systems for city buses
The classic front beam axle is characterized by its robustness and easy maintenance. Equipped with disk brakes and an ideally tuned suspension system, the new version RL 75 A (left) is characterized by low-maintenance wheel bearings and optimized steering kinematics. The version RL 85 A (right) is also available for vehicle widths from 2.3 to 2.6 meters.

Rear Axle Systems for City Buses

ZF drop center axles enable continuous stepless passenger areas with no raised platforms. Passengers find boarding and exiting easier and enjoy enhanced freedom of movement in the central aisle.

The special design of the drop center axle makes it possible to lower the floor level of the bus at the rear axle to only 405 mm. This means passengers enter and exit the bus without climbing steps, even at the third door behind the drive axle, and thus enjoy a higher level of comfort. The omission of all steps and platforms also minimizes the risk of injury in the center aisle area.
For the transport authorities, it is primarily the swift passenger change (i.e. leaving and entering the vehicle) that counts; these processes can then lead to shorter standstill times at the stops and thereby to briefer round-trip times. Moreover, the AV 132 is impressively quiet, a very welcome benefit in city buses with their rather limited noise insulation options.
In line with customer requirements, the ZF offer comprises the drive axle or even the complete system. Thus, whenever needed, the customer relies on a fine-tuned chassis system including air springs, dampers, and axle guidance.

AV 132

The wheel heads of the AV 132 are equipped with modern wheel bearings. The low-maintenance hub units (unitized bearings) also reduce the time to replace brake rotors. Altogether, the axle weight is below 800 kilograms. Especially ground bevel gears ensure quiet running and a low noise level. The wide range of ratios also covers electric drive concepts such as trolley and hybrid drives. The lowered axle support and the laterally positioned differential create additional space for a stepless center aisle.
The AV 132 is also available for right hand drive.

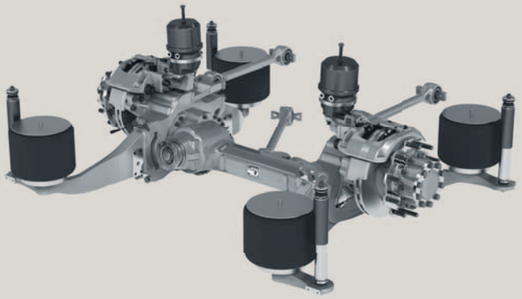
A 132 / AV 132 T-Drive

The city bus axle drive portfolio is completed by the A 132 and AV 132 T-Drives for low-entry vehicles.

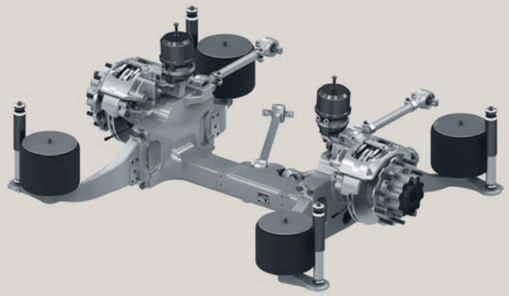
For this reason, the A 132 is equipped with an especially low V-link that reduces the floor height in the passenger compartment to a minimum.
Furthermore, for this kind of application, the axle is available with the required ratio of i>5. This axle concept is suitable for buses up to a gross vehicle weight of 20 tons.
For heavy vehicles, the AV 132 T-Drive with two transmission stages is used.
With these developments, ZF offers two additional, high-quality axle systems that vehicle manufacturers can use for conventionally configured drivelines.

AVN 132

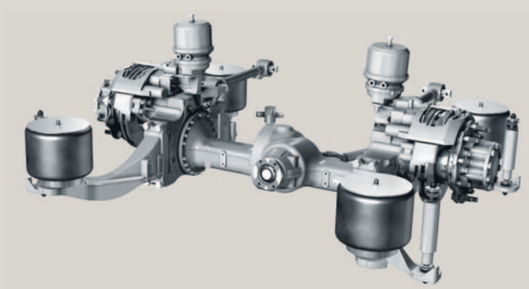
The non-driven drop center axle is designed as a central or tag axle for articulated buses and can therefore be used in pusher and puller vehicles. In terms of service and cost-effectiveness, wear part compatibility with AV components constitutes a big advantage for OEMs and operators.



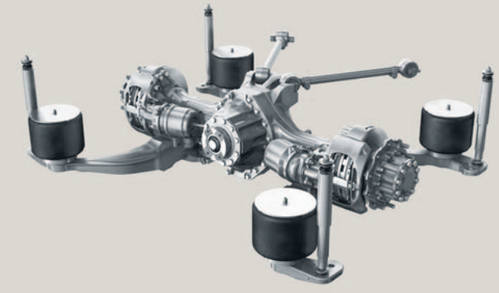
AV 132 rear axle system for city buses
Thanks to the application of the AV 132 drop center axle, the resulting low floor height allows for swift boarding and exiting; it offers enhanced comfort for passengers.



AVN 132 drop center axle
The AVN 132 non-driven drop center axle by ZF for articulated buses supplements the city bus product range.



AV 132 T-Drive
For applications with centrally arranged engines, ZF offers the AV 132 axle system as a "T-Drive" version, e.g. for heavy double-deckers and low-entry articulated vehicles.



A 132 drive axle system
The hypoid direct drive axle was especially designed for bus applications. The cast-on panel enables the use of different V-link positions in city buses.

Axle Systems for Coaches

Aspects such as weight optimization, noise reduction, safety, comfort, and maneuverability determined the development of front, drive, and tag axles for coaches. Each ZF complete system contains the pooled know-how of decades of experience in chassis technology.

Use the QR-Code for more information on ZF axle systems for coaches.

Front Axle Systems for Coaches

For coaches, ZF offers complete systems for front, drive, and tag axles. Aspects such as weight optimization, noise reduction, safety, comfort, and maneuverability determined the development.

For successfully facing up to other means of transport, vehicle manufacturers and bus operators depend on exclusivity, comfort, safety, and environmental compatibility. For more than 30 years, ZF axle systems have been co-shaping coach evolution.

ZF front and drive axle systems are based on in-house design and development principles; these are especially tailored to the requirements of coach applications. Here, efficiency, safety, environmental compatibility, and comfort play a major role. Thus, aspects such as weight and noise reduction, maneuverability, quiet running, driving stability, service-friendliness, or optimal vehicle integration characterize all ZF axle systems for coaches.

Since the introduction of ZF independent coach suspension at the beginning of the 90s, these axle concepts have been continuously adapted to rising demands. The RL 75 E and RL 85 E front axle systems provide the driver and also the passengers with supreme traveling comfort levels; thanks to their handling properties, they support the trend towards longer buses, namely from 13 to 15 m. In the midibus segment, the RL 55 EC independent suspension has successfully established itself.

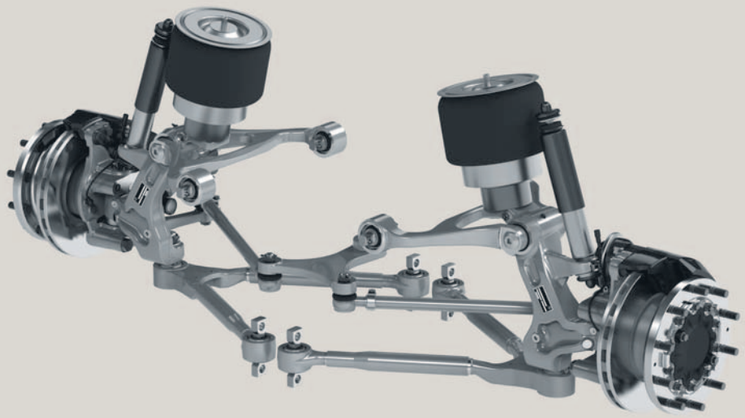
One of the key features of the RL 75 E: its large steering angle of up to 60°. This feature has proven particularly helpful in the case of narrow inner-city streets or twisty mountainside roads; here, maneuverability is considerably improved, especially for longer buses.

Precise axle kinematics are the result of complex driving dynamics calculations and on-road testing. Thus, a significant contribution is made to active riding safety in coaches. All components have been weight- and strength-optimized, on the basis of extensive calculations and testing routines. In conjunction with an optimally designed spring and damper system, outstanding comfort is guaranteed.

RL 75 E / RL 85 E / RL 55 EC

All axle/vehicle mounting points on the frame have been designed as maintenance-free molecular joints. Apart from absorbing impacts related to tire-tread hardness, they feature specific elastokinematic properties. Ease of assembly was also taken into account: For example, all bolt connections at the chassis are aligned in vehicle transverse direction. Apart from the tie rods, no further torque rods are required for wheel guidance. An ideal conjunction of air spring and damper layout including the positioning of the control arms leads to a high degree of anti-roll support and damping.

RL 75 E, RL 85 E, and RL 55 EC are available as complete systems including dampers and air bellows. High active safety is ensured through volume-produced, proven, and internally ventilated disk brakes. RL 75 E and RL 55 EC are equipped with unitized bearing wheel heads.



RL 75 E front axle system for coaches
The steering angle of up to 60° guarantees excellent maneuverability; the design and positioning of low-maintenance control arm molecular joints combine comfort and reliability in a perfect way. Here, of course, maintenance-free compact wheel bearings are used.

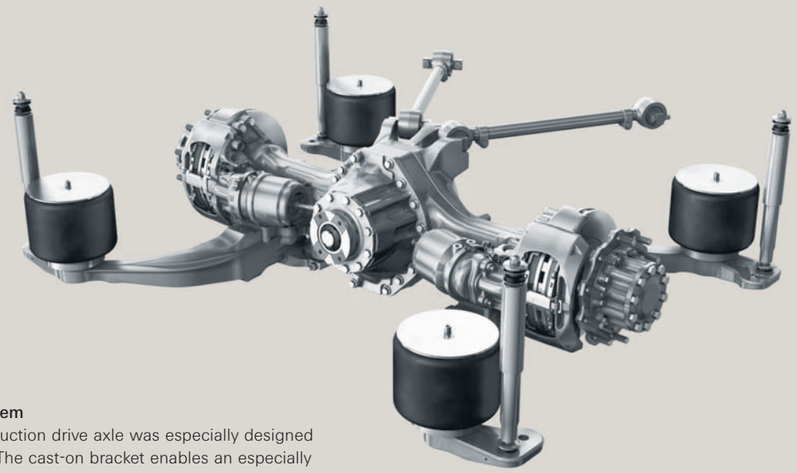
RL 55 EC independent front suspension for midibuses
The standard for "big" buses – but also midibuses can now profit from the advantages of an independent suspension: more comfort, less roll, and a smaller turning circle. Possible: Vehicle widths as of 2.3 meters.

Rear Axle Systems for Coaches

For coaches, ZF offers complete systems for front, drive, and tag axles. Aspects such as weight optimization, noise reduction, safety, comfort, and maneuverability determined the development.

The most significant advantages of the A 132 rear axle system are weight reduction, low noise emissions, and high efficiency. Without compromising stability at all, the axle system's weight – including all suspension elements – has been reduced to less than 1,000 kilograms. The reduction in unsprung masses results in improved ride comfort.

Constantly guaranteed thanks to ground bevel gearsets: Smooth, quiet running and consequently low noise emissions in the vehicle's passenger compartment. Already excellent efficiency characteristics have been further optimized on the basis of continuous driveline component development. Propshafts can be longer and the deflection angles are cut as a result of reduced installation dimensions for the axle drive unit section; thus, noise emissions are successfully further minimized. Unitized bearing units in the wheel bearings lead to a considerable reduction of maintenance costs.



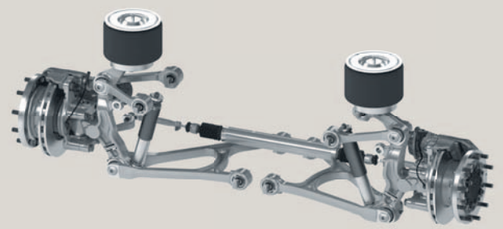
A 132 drive axle system
The hypoid single reduction drive axle was especially designed for bus applications. The cast-on bracket enables an especially high V-rod position for coach applications and therefore, guarantees high roll stiffness. A particularly wide range of ratios provides for excellent efficiency.

Tag Axle Systems for City Buses and Coaches

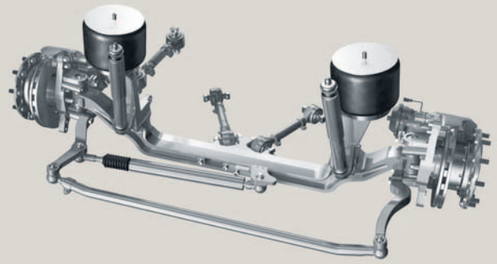
Functionality meets individuality – tag axles by ZF are unique thanks to their optimal spring characteristics and high steering precision. Weight- and strength-optimized low-floor axles provide vehicle manufacturers with new, creative leeway for bus designs.

The steerable tag axles by ZF are available as independent suspension and beam axles.
The advantage of a beam axle: Its highly integrated design, i.e. the "passive steering" version encompasses the air-operated locking cylinder as well as the steering dampers. The active, hydraulically steering variant is ready for axle-end fitting at the ZF RAS steering cylinder.

Typical for this design: The independent suspension offers excellent roll stiffness characteristics together with outstanding damping. Here, the steering components, either pneumatic locking cylinders for the passive version or hydraulic cylinders for the actively steering axle, are directly attached to the vehicle's chassis.
In line with ZF's modular concept, the wheel heads, brakes, and main wheel guidance elements are identical with those of the front axle systems.



RL 75 EC independent suspension as tag axle
The "passive" design with ZF LS pneumatic locking cylinder: Self-steering axle at minor velocities; axle is pneumatically locked and therefore remains stable on track at higher speeds. Thanks to the low-floor design, there is plenty of space available for driveline configuration.



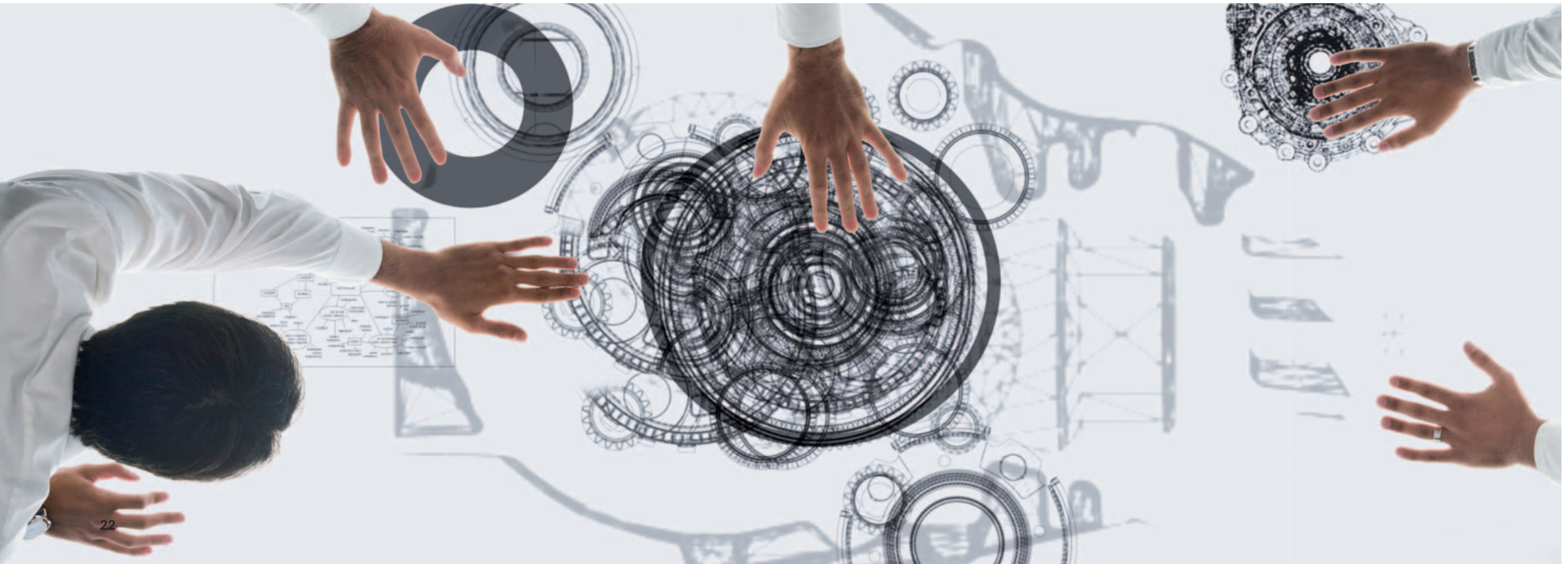
RL 75 A tag axle (here with active steering)
The axle support design enables continuous low-floor layouts from the vehicle's front to its rear. Moreover, it provides sufficient leeway for operation, e.g. for the propshaft.

Research and Development

Innovations are not a purpose in themselves for ZF; they must pay off, for manufacturers, fleet owners, and drivers, but also for the environment and society. Each new development must prove itself among the conflicting priorities of these criteria.

The ZF Group benefits from an international network of development centers: The main development locations are Friedrichshafen, Dielingen, Passau, Schweinfurt, Schwäbisch Gmünd, Northville near Detroit (USA), Pilsen (Czech Republic), and Shanghai (China). Worldwide, approximately 5,400 engineers work in Research and Development. Corporate R&D coordinates and supports the activities at the development center in Tokyo (Japan). Every year, ZF invests approximately five percent of its sales in Research and Development. With success, because innovative products from ZF set the standards for state-of-the-art technology – again and again.

Development work at ZF is organized according to decentralized and central functions. The divisions and business units focus on markets and product expertise, ensuring customer-centered, competitive technological product development. Corporate R&D works with a strong emphasis on basic research and theory and supports the functional development areas in the divisions.



Groundbreaking innovations

Over the past years, this partnership has produced product innovations that have since become benchmarks in the industry: Just some examples are 6-speed and 8-speed automatic transmissions for cars as well as hybrid transmissions and hybrid management for cars and commercial vehicles, or the CDC (Continuous Damping Control) electronic damping system. Groundbreaking innovations from ZF are in use today not just in passenger cars and commercial vehicles on the road, but also in all kinds of craft on the water and in the air.

What's more, the innovative power of ZF is set to increase in the future. Proof of this is already provided by the number of patents pending: A look at the statistics of the German Patent and Trademark Register shows that ZF occupies 8th place among applicants for patents – on a level with many large automotive manufacturers. Each year, the research departments successfully complete more than 10,000 projects, covering the full range from basic research through to product applications. This high project volume is necessary to ensure mobility in the future. The trend toward hybrid solutions already shows that green drive technology is very complex. The same is valid for pure electric drives and lightweight design engineering. Currently, ZF engineers are conducting pioneering work on alternative materials, broader approaches in design and testing, and new production processes.

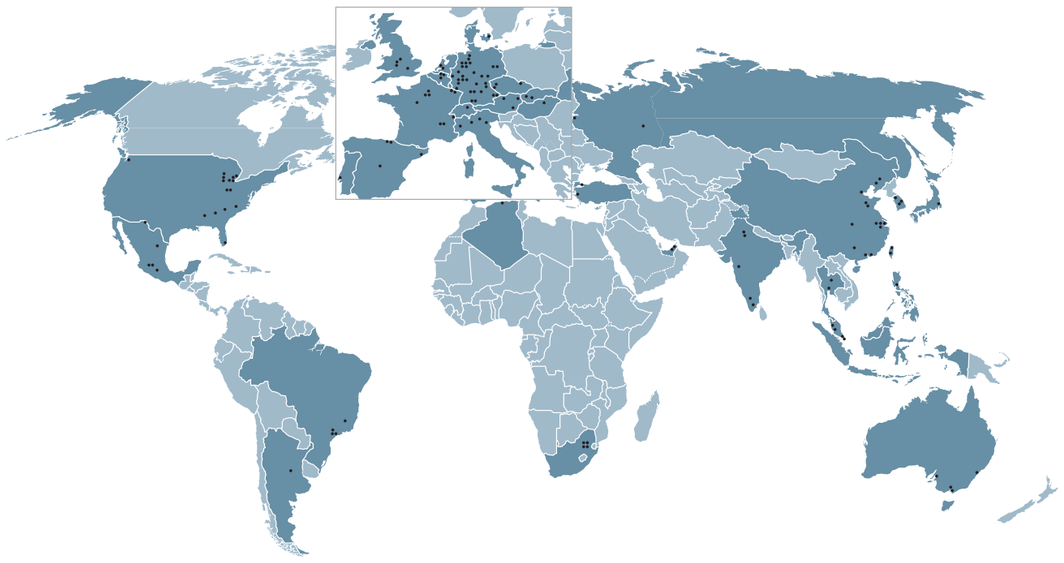
ZF CV Axle Systems at the Passau location

At the Passau location, customer-specific as well as new axle systems are developed. Systems are adapted to vehicle characteristics in close cooperation with vehicle manufacturers; here, we are always taking customer-specific product requirements into account. Continuous improvement is not just an empty phrase but proven reality, in thousands of cases.

On Site – Worldwide

Worldwide, the ZF Group has 121 production companies and 8 main development locations in 27 countries. In addition, we have 34 service companies and representative offices as well as more than 650 service partners. This enables ZF to provide a tight network of highly qualified contacts close to international customers at all levels and in all regions.

ZF is consistently expanding its global market presence. Both established market regions and new markets play very important roles. Particularly activities outside Europe will gain more importance in the future. This applies not only to the established markets in North and South America, but especially to the Asia-Pacific region and the new markets in Eastern Europe and India. Key aspects here are market development through adapting products to specific market requirements and best-cost-country considerations which play a decisive role in production and procurement. ZF supports the international expansion of established customers while also adding partners from new market regions to its customer portfolio.



ZF Group

ZF is a Worldwide Leading Automotive Supplier of Driveline and Chassis Technology.

Driveline and Chassis Technology

Powertrain Technology	Chassis Technology	Commercial Vehicle Technology	Industrial Technology	Steering Systems
Transmissions	Chassis Systems	Truck & Van Driveline Technology	Off-Highway Systems	Passenger Car Steering Systems
Axle Drives	Chassis Components	Bus Driveline Technology	Test Systems	Commercial Vehicle Steering Systems
Powertrain Modules	Rubber & Plastics	CV Axle Systems	Special Driveline Technology	Passenger Car Steering Columns
	Suspension Technology	CV Chassis Modules	Electronic Systems	Global Aftermarket
		CV Damper Technology	Marine Propulsion Systems	
		CV Powertrain Modules	Aviation Technology	
			Wind Power Technology	

ZF Lenksysteme GmbH is a joint venture of ZF Friedrichshafen AG and Robert Bosch GmbH.

Brands of ZF

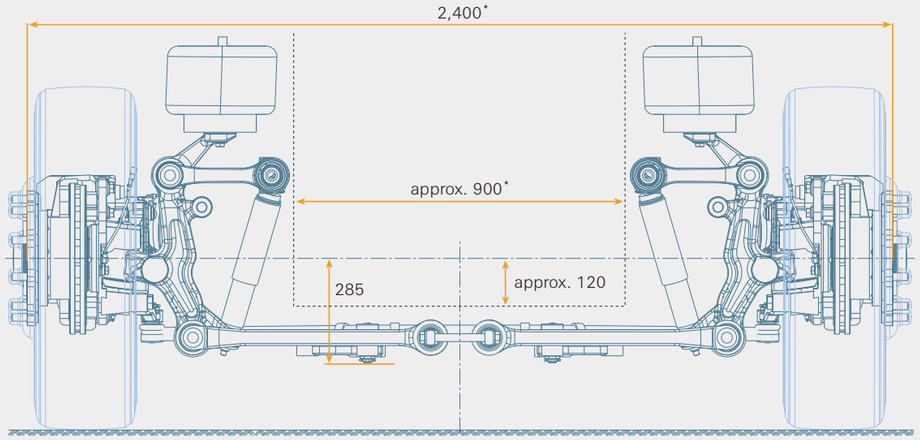
ZF Services

We develop and manufacture innovative, high-quality products and related technologies that improve the mobility of people and goods. Our products and services offer our customers clear added value through leading technologies, quality, and service. Our passionate commitment to achieving greater efficiency and resource conservation has made us a trendsetter in new markets.

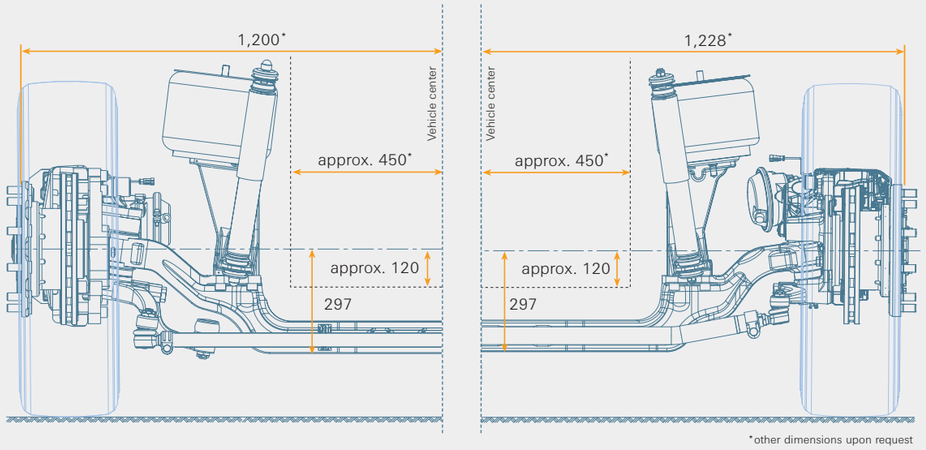
Technical Annex

Front axle systems for city buses

RL 75 EC



RL 85 A
(left)
RL 75 A
(right)



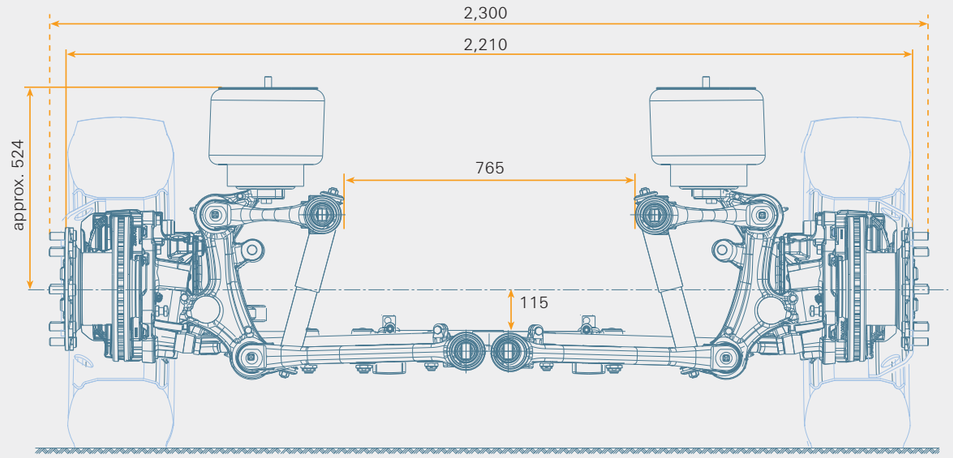
*other dimensions upon request

	RL 75 EC Low-Floor Independent Front Suspension	RL 75 A RL 85 A Low-Floor Beam Axle
Vehicle width mm	> 2,300	2 300 - 2 600
Axle load max. kg	7,500[1)]	7 500 - 8 500
Wheel travel mm	+ 90/- 100	± 85
Wheel cut (back-lock/front-lock)	max. 56°/46°	max. 55°/40°
Tire size (standard)	275/70R22.5	275/70R22.5
Wheel size (standard)	22.5" x 7.5"	22.5" x 8.25"
Brakes	disk	disk
Axle weight (kg) from	482[2)]	527[2)]

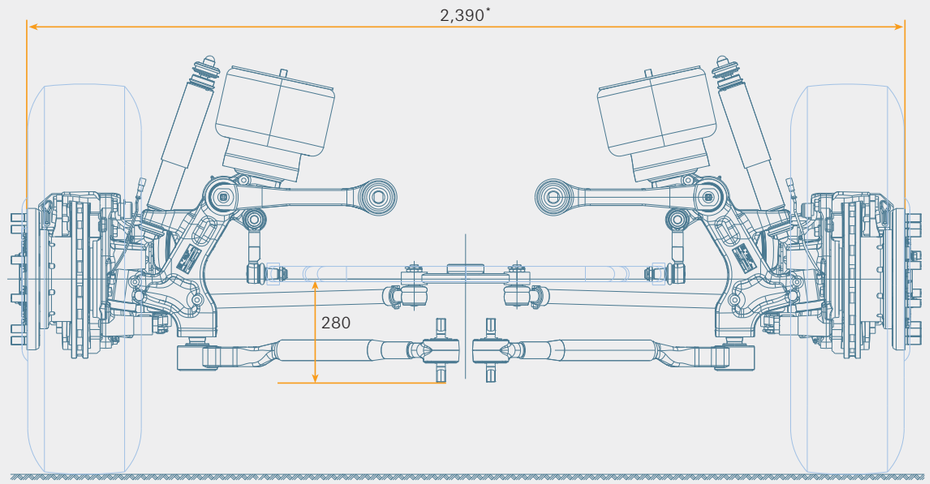
1) 8,200 kg axle load upon request
2) Total axle system weight depending on customer specification

Front axle systems for midibuses and coaches

RL 55 EC



RL 75 E



*other dimensions upon request

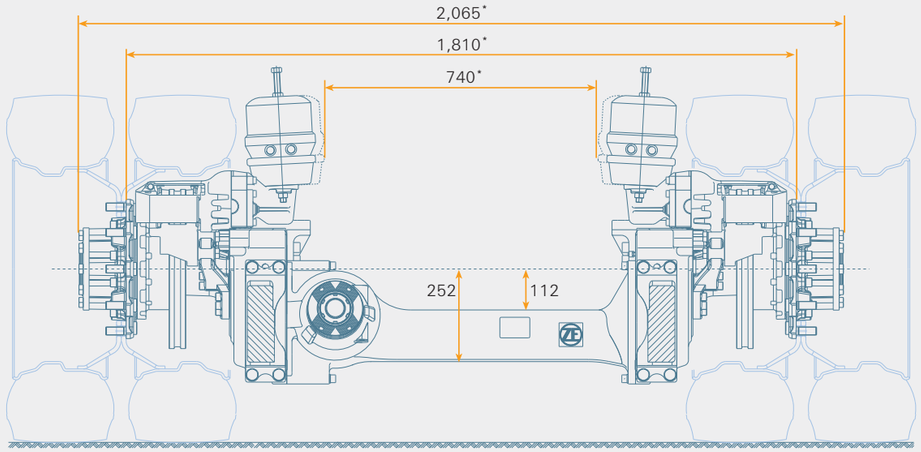
	RL 55 EC Independent Front Suspension for Midibuses	RL 75 E Independent Front Suspension for Coaches	RL 85 E Independent Front Suspension for Coaches
Vehicle width mm	min. 2,300	2,500 - 2,600	2,500 - 2,600
Axle load max. kg	5,800	7,500	8,500
Wheel travel mm	+/- 90	± 100	± 100
Wheel cut (back-lock/front-lock)	max. 55°/45°	max. 60°/46°	max. 53°/47°
Tire size (standard)	max. 285/70R19.5	295/80R22.5	295/80R22.5
Wheel size (standard)	19.5" x 7.5"	22.5" x 8.25"	22.5" x 8.25"
Brakes	disk Knorr SN6	disk	disk
Axle weight (kg) from	425	496[1)]	505[1)]

1) Total axle system weight depending on customer specification

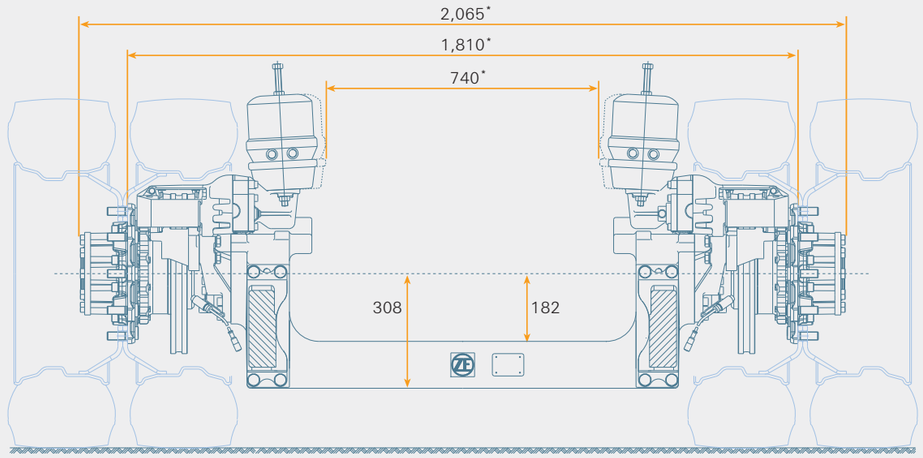
Technical Annex

Rear axle systems for city buses

AV 132



AVN 132



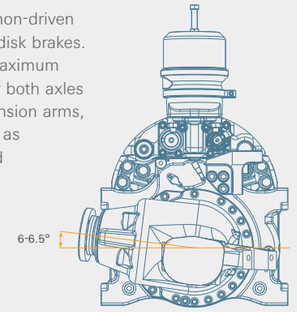
*other dimensions upon request

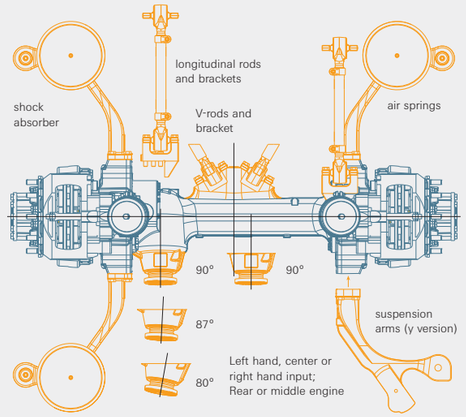
	AV 132 / 80° Driven Drop Center Axle	AV 132 / 87° Driven Drop Center Axle	AV 132 / 90° Driven Drop Center Axle	AVN 132 Non-Driven Drop Center Axle
Vehicle width mm	2,300 - 2,600	2,300 - 2,600	2,300 - 2,600	2,500 - 2,600
Axle load max. kg	11,500 - 13,000	11,500 - 13,000	11,500 - 13,000	11,500
Output torque max. Nm	50,000	50,000	50,000	–
Engine performance max. kW	260	260	260	–
Lateral collection angle[1]	6°	6.5°	7°	–
Ratio	5.13/5.74/6.20/9.82[2]	5.27/5.77/6.21[2]	5.13/5.74/6.20[2]	–
Tire size[1]	275/70R22.5 twin tires	275/70R22.5 twin tires	275/70R22.5 twin tires	275/70R22.5 twin tires
Wheel size[1]	22.5" x 8.25"	22.5" x 8.25"	22.5" x 8.25"	22.5" x 8.25"
Brakes	disk	disk	disk	disk
Axle weight (oil filled) kg from	777[3]	777[3]	777[3]	589[3]
Axle system weight kg	983[4]	983[4]	983[4]	799[4]

1) Standard type
2) Other ratios upon request
3) Total axle system weight depending on customer specification
4) Total axle system weight with disk brake including suspension arms, all rods, air springs and shock absorbers

System overview
The AV 132 can be supplied in various versions for all current vehicle and driveline concepts.

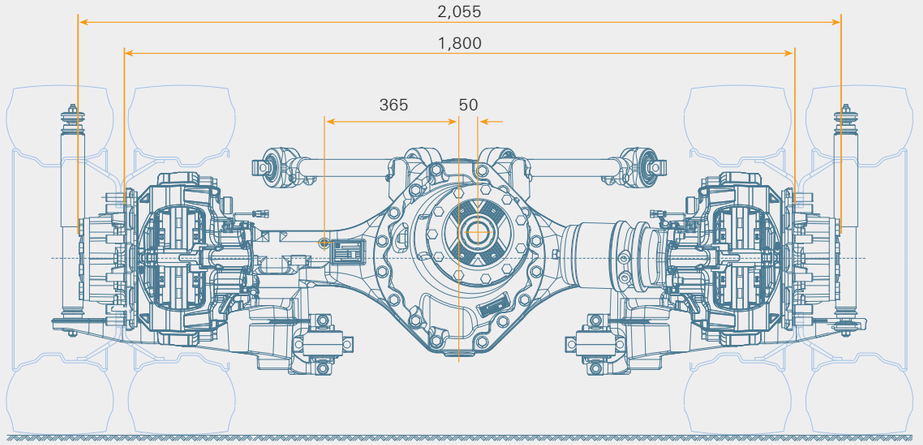
The AV 132, as well as the non-driven AVN 132 are available with disk brakes. The illustration shows the maximum available scope of supply for both axles as complete systems: suspension arms, air springs, shock absorbers as well as longitudinal rods and V-rods, including brackets.





Rear axle system for coaches

A 132



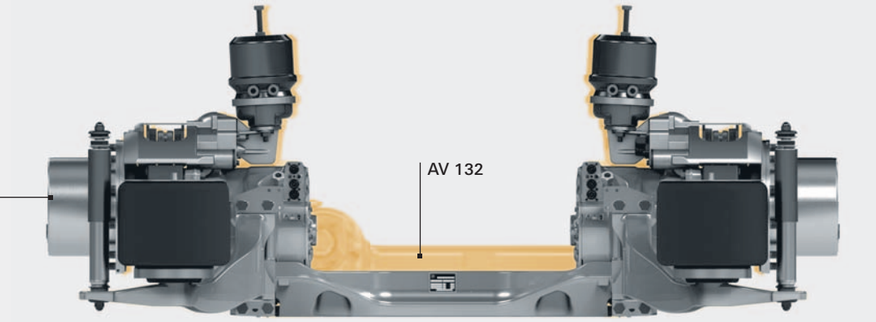
	A 132 Hypoid Single Reduction Drive Axle
Vehicle width mm	2,500 - 2,550
Axle load max. kg	13,000
Output torque max. Nm	50,000
Engine perf. max. kW	370
Ratio	2.93/3.23/3.54/5.22[1]
Tire size (standard)	295/80R22.5
Wheel size (standard)	22.5" x 8.25" twin tires
Brakes	disk
Axle weight (oil filled) from	689[2]
Axle system weight kg	998[3]

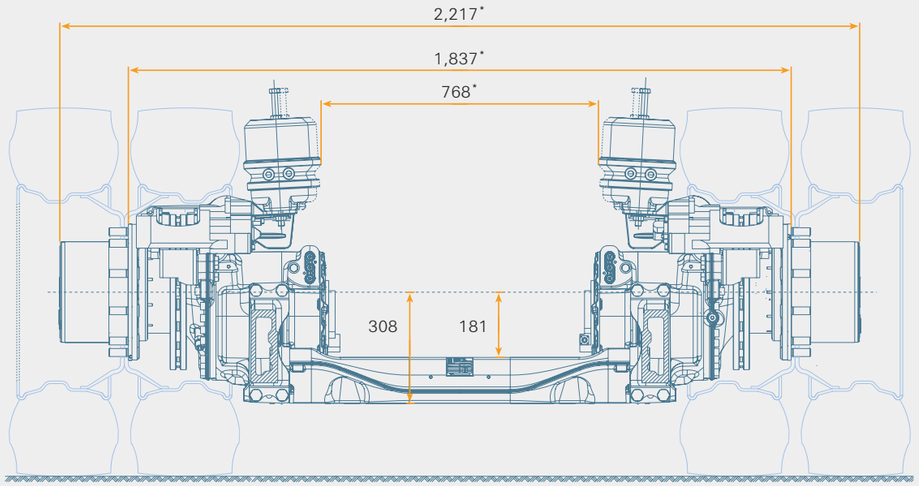
1) Other ratios upon request
2) Total axle system weight depending on customer specification
3) Total axle system weight including suspension arms, all rods, air springs and shock absorbers

Technical Annex

Electric driven drop center axle for city buses

AVE 130 electric driven drop center axle
The installation space required for the AVE 130 almost fully corresponds to those of the standard drop center axles, the AV 132 and AVN 132 for low-floor buses – despite the integration of powerful electric motors; thus, the AVE 130 can be used in a vehicle family of standard diesel buses without necessitating complex undercarriage adjustments. In articulated buses, installation of the AVE 130 as a central axle or rear axle is enabled thanks to the low axle support contour.





*other dimensions upon request

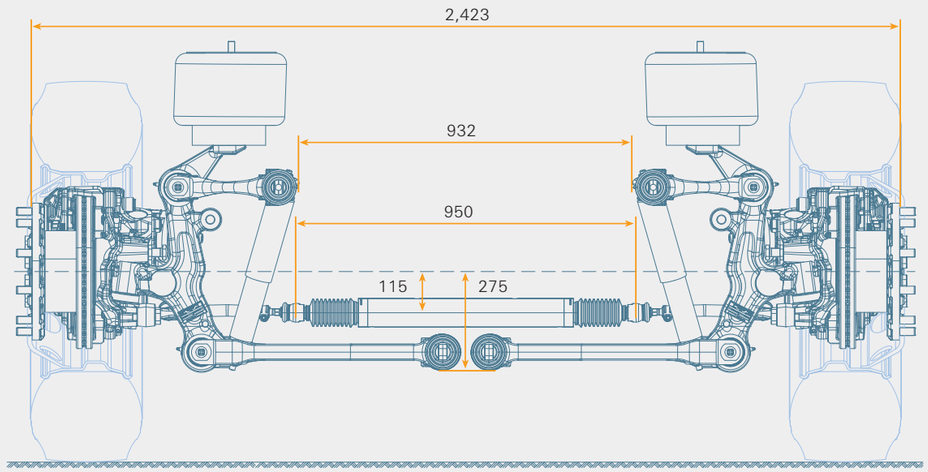
	AVE 130 Electric Driven Drop Center Axle
Axle load kg	13,000
Output torque max. Nm	2 x 10,500
Motor performance max. kW	2 x 120
Wheel speed max. 1/min	485
Ratio	22.66
Tire size (standard)	275/70R22.5
Wheel size (standard)	22.5" x 8.25"
Brakes	ventilated disk brakes

Axle weight kg	1,110[1)]
Degree of protection	IP6K9K
Cooling liquid	water/glycol 50/50
Motor	2 x asynchronous motor, 3 phases
Nominal voltage	350-420 V_{rms}
Nominal current	135 A_{rms}
Max. current	350 A_{rms}

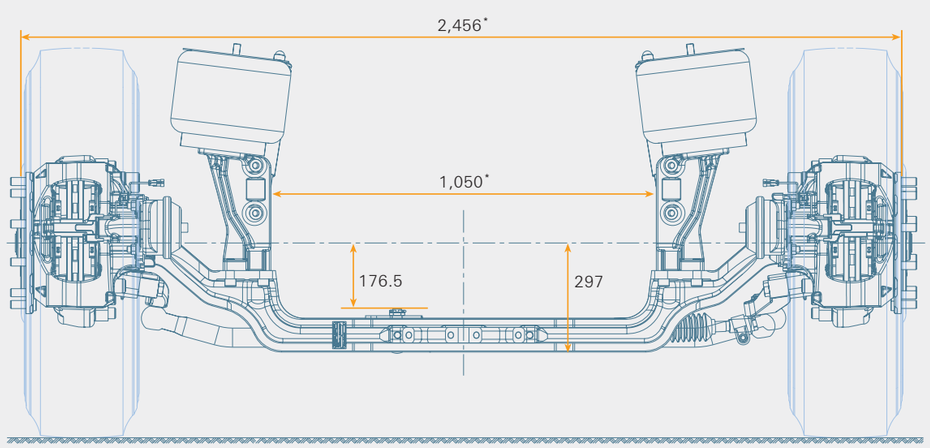
1) with suspension arms

Tag axle systems for city buses and coaches

RL 75 EC tag axle passive



RL 85 A tag axle



*other dimensions upon request

	RL 75 A / RL 85 A Tag Axle	RL 75 EC Tag Axle
Vehicle width mm	2,500 - 2,600	2,500 - 2,600
Axle load max. kg	7,500 - 8,500	7,500
Wheel travel mm	± 100	+90/-100
Wheel cut	upon request	upon request
Tire size (standard)	275/70R22.5 295/80R22.5	275/70R22.5 295/80R22.5
Wheel size (standard)	22.5" x 8.25"	22.5" x 8.25"
Brakes	Disk	Disk
Axle weight (kg) from	527[1)]	482[1)]

1) Total axle system weight depending on customer specification, without steering components