



ZF-Axle Systems

Commercial Vehicle Technology



ZF Independent Suspensions

RL 82 EC for city buses



RL 75 E for coaches



RL 80 EM for recreational vehicles



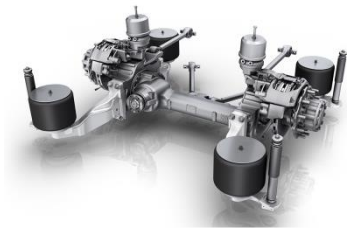
RL 55 E for midibuses



- ZF has developed and produced independent suspensions since 1990
- Modular concept
- Customers worldwide
- More than 130,000 units delivered
- Current annual production volume: 20,000 units

ZF Rear Axle Systems for City and Intercity Buses In Low-Floor or Low-Entry Buses

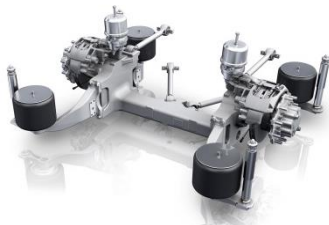
AV 133



AV 110



AVN 132



A 132



AV 132 T



AVE 130



- ZF has developed and produced low-floor axles since 1982
- Modular concept for solobuses and articulated buses
- Customers worldwide: North America, Europe, Asia
- More than 300,000 units delivered
- Current annual production volume: 25,000 units

ZF Axles for Everyone

The World's Largest Independent Specialist for Axle Systems



Front axle – Rear axle – Tag axle

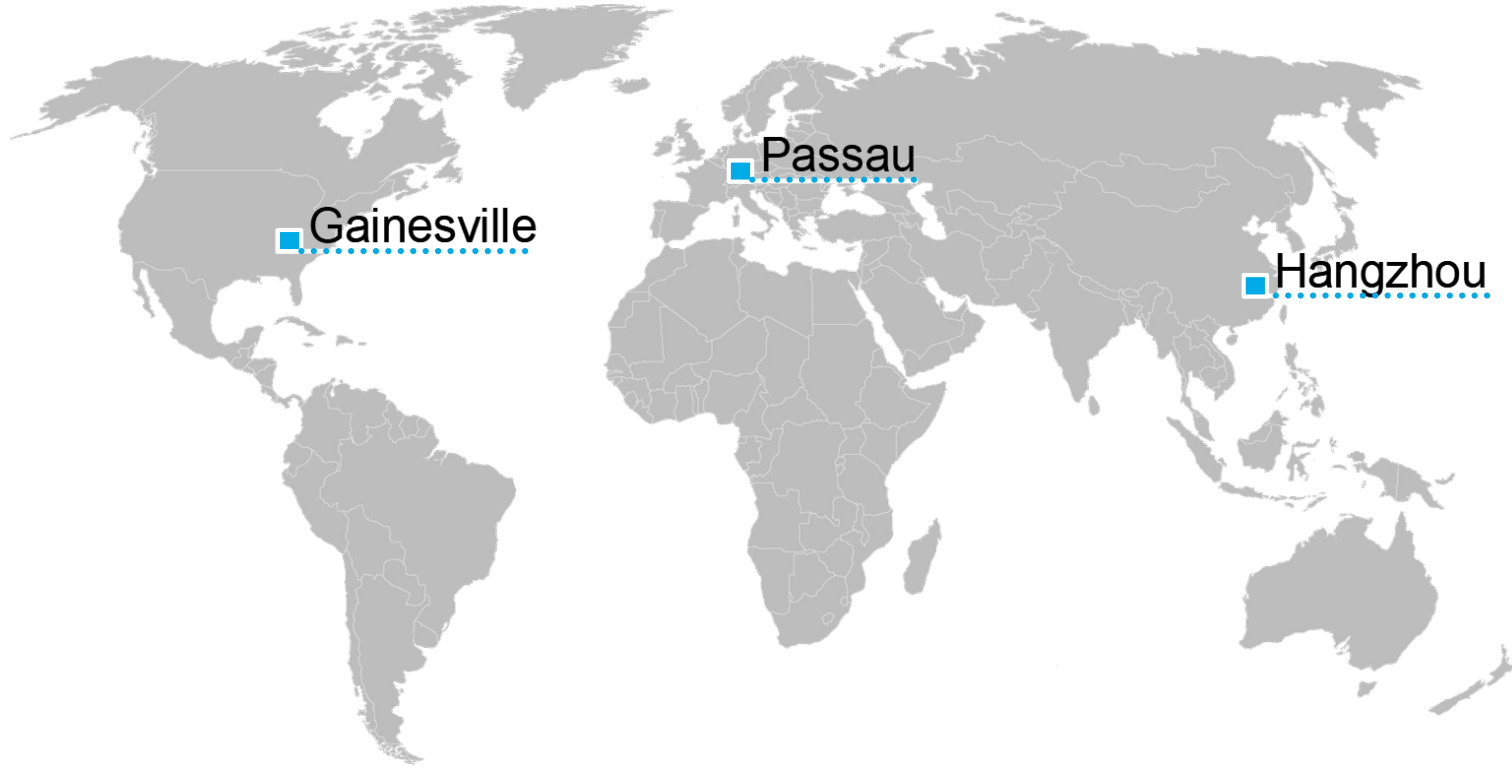
- Solobus (SLF and LE)
- Articulated bus
- Double-articulated bus
- Double-decker
- City bus
- Intercity bus
- Coach
- Diesel bus
- Liquefied-gas bus
- Hybrid bus
- Electric bus
- Fuel cell bus
- Trolleybus
- Chassis
- Integral bus
- Right-hand drive
- People-transport trailer
- Motorhomes
- Truck

The World Drives ZF Axles



Axle Systems

Production Locations



ZF Axle Systems

The Highlights (Customer Value)

ZF axle systems stand for:

- Innovation
- Cost-effectiveness
- Safety & comfort
- Reliability
- Environmental friendliness



ZF Axle Systems

Advantages for Bus Manufacturers

- Pooled cost efficiency
- Complete product range
- Fine-tuned system
- Extensive service network



ZF Front Axle Systems

Advantages for Bus Operators

- Cost-efficiency/Cost-effectiveness
- Ease of maintenance
- Lower road load
- Reduced spare-part variance
- Quick reaction when repairs are needed
- Fits in the existing infrastructure
- Quicker boarding and exiting
- ...



ZF Axle Systems

Advantages for Bus Drivers

- Precise steering behavior
- Good maneuverability
- Low body roll
- Well-balanced ride comfort
- ...



ZF Axle Systems

Advantages for Passengers

- ZF driven axles help to
- Reduce fuel consumption
- Reduce emissions
- Reduce noise
- All ZF axles use
- solvent-free, water-based paints



ZF Axle Systems

Advantages for the Environment

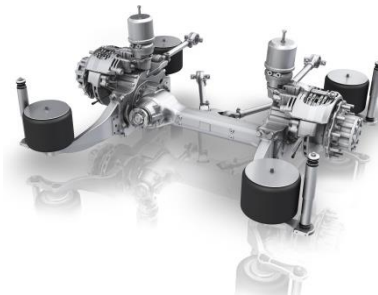
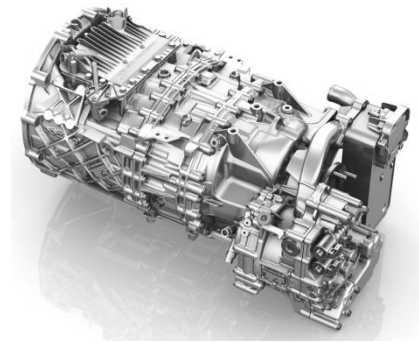
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Perfectly Matched – Axles and Transmissions From a Single Source

Combination of tailor-made axle ratio and closely stepped transmission ratio

- Perfectly matched components ensure
 - Minimum fuel consumption
 - Long service life
 - Low noise level
- High spread of the transmission
 - Preserves the gearing of the axle
 - Increases the service life of the axle
- Smooth transfer of the braking torque between the transmission retarder and the wheel brakes on the axles
 - For smooth deceleration



Front, Rear and Tag Axles in Coaches

Low-noise operation and reduced weight – increased comfort and improved cost-effectiveness



A 132



RL 75 E



RL 75 EC tag axle



RL 75 A active

- Noise optimization through ground bevel gearsets
- Weight reduction (without service life reduction)
- Lower unsprung masses increase driving comfort
- Easy maneuverability and reduced tire wear with actively steered tag axles

City Buses

Floor Height Above Roadway



**Up until
1985**

750 mm



City buses up until 1985

- Entrance height and center-aisle height approximately 750 mm
- Additional step with raised bench seat at the rear



Today

< 400 mm
approx.
320 mm



Low-floor city buses today

- Entrance height less than 400 mm, less than 300 mm possible with kneeling
- Center aisle continuously barrier-free to the rear

Axle Systems in City Buses and Coaches

Current platform concepts in bus applications

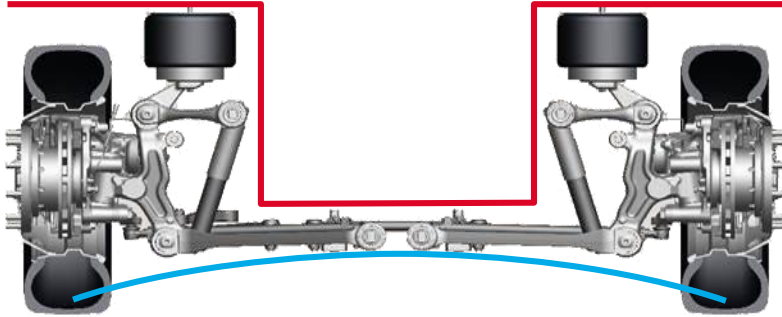


Floor height above street:

Coach		Intercity bus		City bus	
Overall vehicle 1,200 mm		Up to rear axle / Above rear axle < 400 mm / 800 mm		Overall vehicle < 400 mm	
Front axle	Rear axle Tag axle	Front axle	Rear axle (Low-entry)	Front axle	Rear axle (Full low-floor)
RL 55 EC RL 75 E	A 132 RL 82 EC tag axle RL 75 A tag axle	RL 55 EC RL 82 EC RL 75 A	AV 132 T AV 110 A 132	RL 55 EC RL 82 EC RL 75 A	AV 110 AV 133 AVN 132

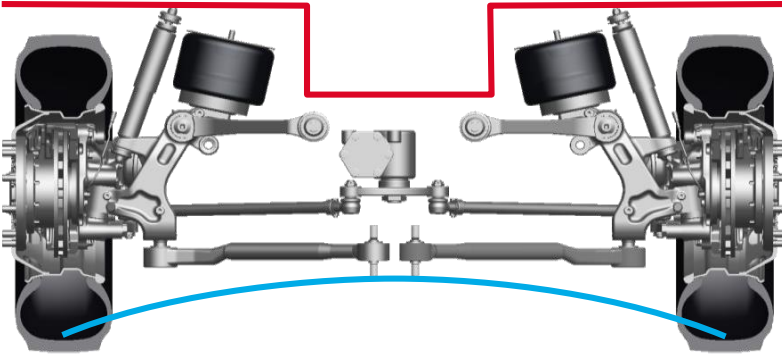
Front Axles for City Buses and Coaches

Installation Situation



Low-floor city bus

- RL 55 EC
- RL 82 EC



Coach

- RL 75 E

Low-floor bus

- Floor in the passenger cabin is continuously flat and barrier-free (except for above the wheel cases)
- Entrance height:
 - < 400 mm above the roadway (center-aisle height of 350 mm possible)
 - < 300 mm possible with kneeling

Axle Systems in City Buses

Advantages of Low-Floor Buses

For passengers

Comfort and safety

- Getting on and off nearly step-free
- Floor on one level throughout the entire vehicle
- Easier entrance for older or handicapped passengers, or for people with strollers

For operators

Cost-effectiveness

- Faster passenger flow
- Entrance behind the driven axle possible
- Shorter stopping times at bus stops

