

FAG Traction Motor Bearings and INA Plain Spherical Bearings in “Combino®” Articulated Low-Floor Tramcars

Examples of Application Engineering

Publ. No. WL 07 536 EA



Schaeffler Group
Industrial



Combino® five-section, articulated low-floor tramcar built by Siemens AG, Transportation Systems – Light Rail, Germany

Photo: Siemens AG

The Combino’s powered running gear with its two outboard drives features a low center of gravity, minimised unsprung masses and a running performance that was improved 100% over that of conventional low-floor running gear by means of longitudinal coupling of the wheels.

The opposite pairs of wheels are mechanically decoupled, reducing the longitudinal slip which causes wear when the vehicle negotiates curves.

The SF30-TF driving bogie, which was designed for a 10 t. axle load, is driven by two modern IGBT pulse width modulated inverters, low-wear three-phase induction motors and a 32-bit traction control unit. An improved energy balance is achieved as a result of the low vehicle mass (1100 kg per running meter) and the recovery of braking energy.

Central joints connect the individual superstructures of the motor car with each other.

The lower central joint (angular contact spherical plain bearing) transmits all dynamic and static loads from the superstructures, in particular from the so-called “sedans” (no separate bogie). The upper central joint (radial spherical plain bearing) ensures that the superstructures do not topple sideways. **FAG Kugelfischer AG has supplied the current insulated traction motor bearings. INA-Schaeffler KG has supplied the plain spherical bearings for the central joints.**

FAG product – traction motor bearings

Technical data

Car unit

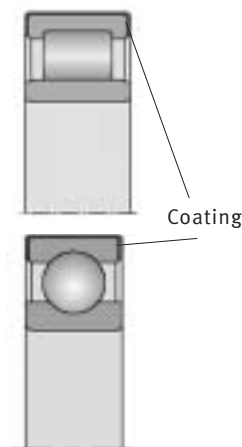
Wheel arrangement	Bo'2'Bo'
Traction adhesion	65 %
Track gauge	1,000 mm
Distance between wheel pairs	1,800 mm
Vehicle length over buffers	31,480 mm
Max. weight when full	56 t.
Max. axle load	8.3 t.
Max. speed	60 km/h
Wheel diameter (new/worn off)	600/520 mm
Min. track radius	14.5 m
Floor height	300 mm
Low floor component	100 %

Traction motor

Traction motors	4 x 100 kW (nominal operating point)
Max. speed	4000 min ⁻¹
Traction motor inverters	2 IGBT pulse width modulated inverters
Gear ratio	5.4444

Bearing arrangement

The traction motors are equipped with an **FAG NU215E.TVP2.J20A** cylindrical roller bearing at the drive end (floating bearing) and an **FAG 6215M.C3.J20A** deep groove ball bearing at the opposite end (locating bearing). Both bearings are protected against damage from current sparkover by an oxide ceramic coating (> 0.2 mm thick).



Bearing life

The traction motor bearings were designed for a theoretical mileage of more than 2 million kilometers.

Drive unit

The Combino drive unit consists of: motor, brake disk, spring-loaded brake, motor-gear coupling, bevel gearing, quill shaft, wheel-gear coupling. Each wheel is driven via a quill shaft with two rubber-metal couplings.

Current insulation/coating, in general

Current insulated bearings prevent damage from current sparkover in the event of potential gradients between the rotor and stator of an electric motor. The oxide ceramic coating, which was applied by means of plasma spraying, features a hardness of > 2000 HV. It is wear-resistant and a good heat conductor. With the J20A coating, the disruptive voltage with direct current is > 1000 V.

INA product – radial/angular contact spherical plain bearings

The lower central joint (angular contact spherical plain bearing) transmits all dynamic and static loads: e. g. weight, acceleration/brake forces, and buffer impact loads.

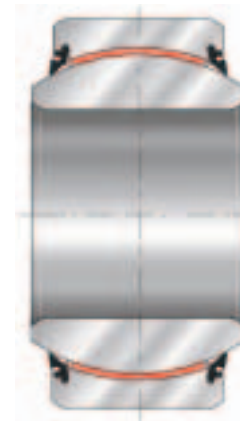


Lower central joint:

The main bearing is an angular contact spherical plain bearing **GE 100 SW-W10** maintenance-free (DIN ISO 12240-2); lift-off prevention using a special bearing similar to GE 3 AW-W10

- swivel angle $\pm 30^\circ$
- max. tilting/rolling angle $\pm 6.5^\circ$
- max. radial load 280 kN (buffer impact loads according to VDV 152 and EN 12663)
- sliding contact surface: hard chromium/ ELGOGLIDE®

The upper central joint (radial spherical plain bearing) also permits all swivel, tilting and rolling motions that occur when the vehicle negotiates curves, rounded hill-tops and dips.



Upper central joint:

radial spherical plain bearing **GE 50 UK-2RS** maintenance-free, sealed, (DIN ISO 12240-1- dimensional series E)

- sliding contact surface: hard chromium/PTFE
- sliding material: ELGOGLIDE®

Advantages/benefits

- Reduced life cycle costs thanks to the maintenance-free PTFE sliding layer
- Excellent suitability for low-floor vehicles (small mounting space, low cross section height)
- High static and dynamic load carrying capacity
- Minimised bearing friction
- Very long life

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