Bearing designs -
Bearing capabilities

Extract from the Railway technical handbook, volume 1, chapter 4, page 73 to 75

Bearing designs

SKF offers a wide choice of axlebox bearing designs for all kinds of railway rolling stock, from high-speed trains to diesel and electric locomotives, diesel and electrical multiple units, passenger coaches, freight cars and mass transit vehicles like metro cars and tram cars.

Bearing capabilities

The reason for the choice of a specific bearing design can be quite different and depends on various criteria:

- specific area/country/railway operator's standards that have to be considered
- field experience
- established maintenance routines in the maintenance workshops
- new vehicles equipped with existing bogie and bearing designs

Some railway standards require extensive laboratory and field testing programmes for implementing new axlebox bearing designs and also for design or customer specification changes of existing bearings. These requirements have to be fulfilled before reaching a conditional, and later on, an unconditional approval for using a specific bearing design/size for a specific vehicle application.

Different bearing designs are used, such as:

- tapered roller bearing units
- cylindrical roller bearings and cylindrical roller bearing units
- spherical roller bearings

For some decades, these three designs were used in many vehicle types and applications in parallel, following individual customer preferences, requirements, specifications and standards. There is now an established worldwide trend to use factory pre-lubricated and sealed bearing units for new axlebox and bogie designs. These units can be in principle based on both tapered and cylindrical roller designs. SKF has played a leading role in introducing these unit designs to the worldwide railway industry.

Unit design principle

The main benefit of the pre-lubricated and sealed bearing unit's design is that it is much easier to handle and install. These units are already pre-lubricated in a very clean environment and fitted with highly specialized seals. Today, maintenance is performed more often by specialized bearing workshops than it was in the past. Another benefit is the clear system responsibility of the bearing supplier to take care of not only the bearing design but also sealing and lubrication. In many applications, prolonged service life can be achieved due to extended maintenance intervals that can result in reduced life cycle costs (→ **page 17**).

SKF offers a global network of highly specialized railway bearing remanufacturing workshops where bearing maintenance is performed in different grades following specific customer requirements (→ **page 192**). Tapered and cylindrical roller bearing units can be used for all kinds of rolling stock and preferences are sometimes connected with preferences of manufacturers and operators, which correlate with different regions and countries where specific requirements are applied.

On the other hand, so-called “open bearings”, which have to be greased and mounted separately by highly trained fitters working in a very clean workshop environment, are used for some established axlebox and bogie designs or for after-market requirements.

Axlebox bearing unit design benefits

- ready-to-mount unit
- easy handling and installation
- factory greased and sealed solution
- higher reliability and safety

Bearing capabilities

	Very high-speed trains	High-speed trains and locomotives	Diesel and electrical locomotives		Multiple units (EMU[1] and DMU[2]), passenger coaches		Metro cars, light rail and tramways	Freight cars with closed axlebox	Freight cars with adapter design
Max. speed km/h	301 to 400	201 to 300	121 to 200	up to 120	161 to 200	up to 160	up to 120	up to 120	up to 120
TBU Tapered roller bearing units	■	■	■	■	■	■	■	■	■
CRU Cylindrical roller bearing units	■	■	■	■	■	■	■	■	
Cylindrical roller bearings				■			■	■	
Spherical roller bearings								■	

1) Electrical multiple unit
2) Diesel multiple unit

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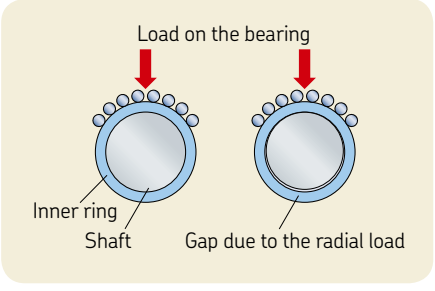
Journal design

Bearing / journal fits

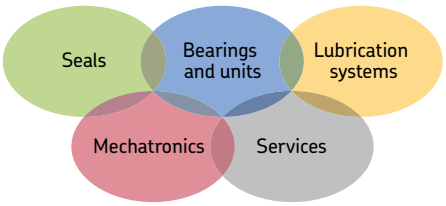
Most axlebox applications have rotating shafts. To prevent creep (wander), the inner rings of axlebox bearings need to be fitted with an interference fit, in many cases for massive journals a p6 fit is applied. In absence of an appropriate interference fit, the inner ring could creep on its journal seat, leading to lamination and wear of the journal. A worn seat could finally lead to fracture of the axle.

Some selection criteria for journal interference fit selection are:

- massive journal or hollow journal shaft
- bearing clearance after mounting
- operating temperature
- inner ring hoop stress and contact pressure in the inner ring bore/journal contact surface



Inner ring/journal interference fit (left) and without (right)



The Power of Knowledge Engineering

Drawing on five areas of competence and application-specific expertise amassed over more than 100 years, SKF brings innovative solutions to OEMs and production facilities in every major industry worldwide. These five competence areas include bearings and units, seals, lubrication systems, mechatronics (combining mechanics and electronics into intelligent systems), and a wide range of services, from 3-D computer modelling to advanced condition monitoring and reliability and asset management systems. A global presence provides SKF customers uniform quality standards and worldwide product availability.

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