Rothe Erde® Slewing Bearings.
Application: Rail vehicles and articulated buses.
The consequent conversion of concepts into up-market, innovative products combined with whole-hearted customer support have been our strength for more than a century. Our success proves that we are on the right track in pursuing our goal of continuing to manufacture bearings of globally renowned excellent quality.
Planning, development and design are all part of an on-going dialogue with our customers. Optimum solutions are discussed and carved out not only with regard to specific applications and designs but also in economic respects. We believe that our customers have a right to get the best quality and every possible assistance from us. This guiding principle is the basis of a partnership that we trust is able to survive well into the future.

Our production program comprises ball and roller bearing slewing rings, turntables and seamless rolled rings from steel and non-ferrous metal.

Total commitment to quality is the central concern throughout our production operations. From application consulting to design and production including comprehensive customer service we are proud to be certified to the international quality standard DIN EN ISO 9001:2000.

Rothe Erde slewing bearings are top-quality products reflecting a highly advanced bearing technology to international leading standards and offer the further advantage of worldwide availability.

Our production facilities in Germany and abroad make it easy for rail vehicle construction companies to meet requirements of individual purchasers with regard to local procurement. In addition, Rothe Erde has its own sales agencies and representations in all major industrialised countries.

Rothe Erde operates the world-wide largest testing facility for slewing bearings. Our company has repeatedly inspired bearing technology with novel ideas and offered innovative future-oriented solutions to the market by intensive spot-on research and development. Rothe Erde experts continue to put all their expertise, power and creativity into further technological advancement.

*Cobra* running gear
Rothe Erde slewing bearings.
Structural components for rail vehicles.

Rothe Erde slewing rings became first known in the fifties as rotary elements in bogies. The greater lengths of railway cars and the resulting multi-axle bogie designs made it necessary to have a rotary element between car body and bogie. The tight curve radii which are quite frequent in short-distance transport and require low structural height, good functionality and drag resistance in a single component, could only be coped with by using slewing bearings.
This resulted in the typical bogie bearing, sectors of which are resting on a so-called bolster beam on the bogie side, while the inner ring can be screwed to the car body all around its circumference.

All rail vehicle designers are primarily concerned with improving already achieved quiet running characteristics, extending service life and reducing maintenance requirements. The use of slewing bearings instead of pivot bearings or bogie pins with their lateral slide blocks offered decisive advantages and created new design trends in this field of application.

The development of semi-low-floor and ultra-low-floor vehicles has boosted the use of slewing bearings in bogies.

Characteristic challenges on slewing rings concern their diameters and load capacities as well as special sealing systems to protect them from dirt, water and dust.

Semi-low-floor vehicles are now profiting from the new full-cross-section slewing rings with regard to load capacity but with very small diameters. Due to their short distance from the ground they have to meet special requirements on their sealing systems.

Another special application is the articulation in multi-articulated low-floor vehicles.
Rothe Erde slewing bearings.
Development and advantages.

In 1950, the first ball bearing slewing ring was installed into a tramway bogie with such success that since then almost all bogies and articulated bogies in tramway cars are being equipped with Rothe Erde slewing rings. Following today’s request for comfortable boarding and unboarding, Rothe Erde slewing rings are being used in low-floor tramway cars – especially in articulated bogies.
Rothe Erde slewing bearings offer the following decisive advantages:

- Possibility of adaptation to rotational drag and damping
- Ready-to-install bearing unit with low structural height, low weight and high load capacity
- Bearing gaps protected against dust and splash water by effective sealing systems
- Easy installation
- Open centre of slewing rings permits passage of other structural parts
- Transmission of all loads through one structural element
- When a tramway car is lifted, its parts are held together by the self-retaining slewing ring.
When installing a slewing ring into a bogie, several conditions should be met in order to assure smooth operation.

The characteristic bogie design usually requires two segments parallel to the direction of travel for mounting the slewing ring on the bogie bolster. However, this component is only fitted into high-floor vehicles which are used in combined service as underground railway cars as well.

As a rule, the bearing support on the chassis cross-beam should cover 360°. Deviating designs require joint technical evaluation by manufacturer and user.

The slewing ring must be fastened to the vehicle body and bolster by means of high-strength quality bolts, which are dimensioned by Rothe Erde.

To relieve the bolted connection from high horizontal forces as they are likely to occur under buffer impact, it is recommended to weld catches transversely to the direction of travel underneath the vehicle body and on the bolster, destined to engage into matching recesses milled into the bearing flanges (see Fig. “Articulated bogie”).

Another possibility – as mentioned before – is to provide centering devices on both bearing rings to engage into corresponding centering shoulders on the companion structure. Catches and centering devices must be designed for close metal-on-metal contact during braking to assure that the bolted connection is relieved from horizontal forces.

Fastening boreholes and recesses may be arranged in sections of 4 x 0° permitting to reinstall the bearing offset by 90° after a certain period of operation. This is a method to shift the stress sectors in the raceway of the bearing. An off-set reinstallation of the bearing is generally performed during main inspection.
The contact surfaces for the bearing rings on car body and bolster must be absolutely flat, which can be achieved by respective machining.
Application examples.
Tramways and city railways.

The necessity of thorough rationalisation measures faced by all public transport organisations has led to the development of large-capacity vehicle units offering a good personnel/efficiency ratio. Car length and capacity are adapted to the specific traffic structures of each city. Mono-directional or bi-directional cars are designed as 6-axle one-articulation or 8-axle two-articulation tramway cars.
For instance, an 8-axle two-articulation car consists of a three-part car body with 4 bogies. The 2 central free bogies assure the articulation between the front and rear motor cars and the central car.
Application examples.
Low-floor tramways.

Continued development in tramway systems has given us the modern low-floor tramway car. Low-floor vehicles are only possible in the tramway sector. The platforms of underground railways require greater boarding heights.
Low-floor tramways with extremely low entrance levels allow easy entry and exit of passengers and, thereby, shorter stopping times. The purpose of Rothe Erde slewing rings in low-floor tramway cars is mainly to provide articulation.

The modular structure of low-floor vehicles allows to join as many single components as desired to provide the capacity wanted by the customer. There is no problem in building either mono-directional or bi-directional tramway cars.
Application examples.
City railways.

City railway, type Oslo

Ball bearing slewing ring, type Oslo

Bogie, type Oslo
Tramway, type San Francisco

Bogie, type San Francisco

Slewing ring, type San Francisco
Application examples.
Suburban trains and subways.

Tramway, type Boston

Bogie, type Boston
Suburban trains running on railway tracks (above-ground transport) as well as on tramway or subway tracks (innercity transport) are the consequent evolution of a modern large-city transport systems. The narrow curve radii in innercity traffic need bogies with respective slewing bearings.
Application examples. Articulated buses.

Rothe Erde slewing rings are not only installed in rail vehicles but also in articulated buses.

Articulated buses are also experiencing a trend toward low-floor vehicles. This development goes hand in hand with new dimensional requirements, i.e. the slewing ring diameter must become smaller and the structural height lower in order to fit into the space available.

The majority of articulated buses are so-called pushers, i.e. motor and entire drive unit are located in the rear section, i.e. in the trailer.

This concept puts a lot of specific requirements on the articulation such as buckling stability, for instance, which is achieved by means of a complicated electronically-controlled damping system.

Articulated bus, type O 405 G Mannheim

Articulated slewing ring
The quite intricate design of this bus demands a very specific performance from the slewing rings installed. In contrast to rail vehicles, we are dealing here with much higher tilting moments and radial forces.

Joining forces with the vehicle manufacturers we have developed various concepts assuring trouble-free transport service.
Rothe Erde slewing bearings.
Maintenance.
Prior to delivery, our bogie bearings are filled with specially suitable and proven long-time greases.

These grease types have an excellent adhesive power and ageing resistance and provide therefore a good protection against corrosion.

The respective grease type can be taken from the Mounting, Greasing and Maintenance Instructions.

For normal operating conditions, the following maintenance instructions are applicable:

**H.F. High-Floor**
- Maintenance-free up to an operating time of 3 years
- Check of the seals and re-lubrication of the raceway
- Main inspection
  - Removal of the bearing and check at Rothe Erde

For more details regarding inspection of our bearings see our maintenance instructions.

For distances with extreme operating conditions, shorter re-lubrication intervals should be taken into account (for example in connection with other maintenance work in the depository as the change of the wheel rims etc.).

Depending on the operating conditions, installed bearings should be re-lubricated through all lubricating nipples as the limited rotary movement of the bearing permits only a restricted grease distribution.

For re-lubrication, only the grease types specified in the maintenance instructions should be used.

Lubrication and inspection intervals should only be changed after consultation with Rothe Erde since the effects of a number of influential factors are difficult to assess, e.g. the kilometric performance, the respective operating time, the condition of the railtracks, etc.

Since the operating conditions for tramways, subways, and articulated buses differ widely, sufficient relevant experience can only be gained by systematic observation over an extended period of time before being able to determine whether and to what extent changes in maintenance and inspection intervals for slewing rings are necessary.

Whether a bearing is to be re-installed after a main inspection or not depends on a variety of factors.

The slewing bearing is the connecting element between car body and bogie. In this function it is rarely subjected to rotational stress, i.e. the bogie bearing is mainly exposed to permanent vibration.

These vibrations result in so-called fretting corrosion. The constant friction of the rolling elements over a specific area causes material abrasion in the raceways. The resulting ripple marks give the impression of indentations caused by overloaded rolling elements.

However, such ripples are indeed quite common in bogie bearings and are not the result of indentations from rolling elements due to overload. Although a certain volume of the hardened metal is removed by abrasion, the underlying metal structure is not affected at all.

If the ripple marks found are ranging up to 0.4 mm in depth, the bearing may continue to be used. In high-floor vehicles with bolster beam, the bearing should be re-installed displaced by 90°.

Ripple formation cannot be avoided because of the prevailing service conditions.
The integrated management system put in place at Rothe Erde includes the following elements:

- Quality assurance system to DIN EN ISO 9001:2000,
- Environmental protection to DIN ISO 14001 and
- Industrial safety to OHSAS 18001.

The basis of the management system is the documentation of all processes and sequences in procedural and work instructions, taking account of the requirements of statutes, statutory regulations, guidelines, specifications and agreements.

We can only achieve effective quality assurance, environmental protection, industrial and plant safety with motivated employees. The consciousness of employees at all levels is enhanced by a regular exchange of experiences, and by training and further education, that they are able to act with competence and responsibility.
### Offices in Germany

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