Large diameter bearings by Liebherr

Application-specific ball bearing and roller bearing slewing rings of the highest quality

Liebherr-Component Technologies AG, with headquarters in Bulle, Switzerland, is responsible for all activities involving the components sector within the Liebherr Group. The companies and corporate units belonging to this sector are specialized in the development, design, manufacture and reconditioning of high performance components in the field of mechanical, hydraulic, and electrical drive as well as control technology.

Long Years of Experience

Liebherr has decades of experience in the field of top quality components, for use in cranes, construction machinery, in the mining industry, maritime applications, wind turbines, automotive engineering, the aerospace sector, and in transport technology. Synergy effects from the other product sectors of the Liebherr Group of Companies are put to rational use in driving ahead with constant technological further development.

The Right Solution for Every Need

Thanks to the in-depth manufacturing techniques and the use of the most modern and flexible production resources, Liebherr can provide customers with tailor-made solutions. Every component is developed to meet individual wishes and requirements. Liebherr is your partner for achieving success together, from the product idea to development, manufacture, and taking into service, and right on up to series manufacture. For the mechanical and hydraulic drive train components Liebherr offers reconditioning in different stages from a specialised works.

Liebherr-Component Technologies

System Solutions from One Source

Components from Liebherr are perfectly matched to one another in their functional performance, and in combination they achieve maximum total levels of effect and efficiency. Depending on the requirement, individual components from the broad product selection can be extended up to the complete drive train. This creates system solutions with real conviction, which can be integrated into a whole range of applications.

Quality and Cutting Edge Technologies

All components meet the highest demands for functional reliability and long service life, even under the toughest conditions. A refined quality management and extensive inspection and testing procedures are applied throughout the entire development and manufacturing process. So they ensure the reliability and long life of the components. Highly qualified staff with a real sense of responsibility plays their part in achieving the fine Liebherr quality standard.

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Biberach: large diameter bearings, gearboxes, control technology, electrical machines

Bulle: diesel engines, splitter boxes, hydraulics

Lindau: electronics

Ettlingen: exchange components

Kirchdorf: hydraulic cylinders

Monterrey: large diameter bearings
The Liebherr group is one of the leading global manufacturers of large diameter bearings and has almost 60 years experience in the development, design and manufacture of ball bearing and roller bearing slewing rings. Since company founder Hans Liebherr developed the first ball bearing slewing ring for cranes in 1955, approximately 300,000 large diameter bearings have been produced for use worldwide in the most diverse applications.

Customers particularly value the wide product range, the customized design and the outstanding quality of large diameter bearings by Liebherr. The bearings are produced in the factories at Biberach an der Riss, Germany and Monterrey, Mexico, in various dimensions and versions in accordance with customer specifications.
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Large diameter bearings by Liebherr are available in various designs with a diameter range from 400 mm to 6,000 mm.

Liebherr designs and produces both ball bearing and roller bearing slewing rings. The dimension of the rolling elements is based on the bearing loads.
Large diameter bearings by Liebherr are available in a wide range of designs and dimensions and have been tried and tested in a variety of applications, and under the harshest environmental conditions. All large diameter bearings are carried out with induction hardened, finely machined raceways and, depending on the application, also with induction hardened gear teeth. They have a sealed raceway system with grease lubrication.

Large range of dimensions

Large diameter bearings by Liebherr are available in a diameter range from 400 to 6,000 mm. The internal and external gear teeth of the bearings, which weigh up to 25 t, can be designed with a gear module of up to 50. Balls with diameters of between 20 mm and 70 mm or rollers with diameters of between 10 mm and 100 mm are used as rolling elements. State-of-the-art production facilities provide for efficient manufacture of all design sizes, both in small and large batch production.

The most varied of designs

The current product range includes ball bearing slewing rings, which can be designed as single-row or double-row four-point bearings as well as triple-row roller bearings with or without internal or external gear teeth. Besides standard designs, a large variety of special customer and application-based models have already been made. In addition to anti-friction bearings, geared rings and ring segments as well as high-precision worm gears for machine tools, made from composite materials, are also available.

Wide range of applications

The areas of application, in which the large diameter bearings by Liebherr are used, are as diverse as the designs. They include construction machines such as excavators and drilling rigs, mining equipment, cranes (construction, mobile and offshore), vehicles, machine tools, wind turbines and maritime applications. Liebherr bearings have been tried and tested in the harshest environmental conditions, in a wide temperature range (-50 to +80°C) and under the strictest mechanical loads in both dusty and maritime environments.
For calculations according to FEM, the adjacent constructions are also included and a large number of individual calculations are carried out.

On a specially developed, large diameter bearing test bench, the deformations calculated using FEM are verified, and friction and breakaway torques are examined.
The latest design procedures and finite element methods are used when designing and making calculations for Liebherr large diameter bearings. In principle, application-specific criteria are the focus during the design implementation process.

| Application-specific design | The design of each large diameter bearing is largely determined by the expected environmental conditions. In this respect, in addition to the 42CrMo4 alloy, Liebherr also uses steels with adjusted alloy components as a base material for bearings in low temperature applications. For a defined ball and roller element position, bearing cages made of steel or brass alloy can be used instead of the Polymer spacers at the request of the customer. Special sealing systems and coatings for reliable protection against corrosion and increased wear are in constant further development by Liebherr. The lubrication ports are placed in accordance with the customer’s requirements and installation situation. The gears are primarily designed as spur gears, but helical and worm wheel gearing are also possible. |
| Analytical competence | The design engineers at Liebherr examine all influential factors when designing products in order to completely optimise large diameter bearings and adjacent constructions. FEM calculations are therefore essential, and normally contain calculations of the load behaviour of raceways, rolling elements, gears and screws, as well as the force transmission into the adjacent sub-assembly. Depending on the application, further analyses are conducted, for example on sealing gap expansions and strength tests for ensuring that the hardening layer cannot become detached (core-crushing). As a result, the customers benefit from a precise bearing size with a high power-to-weight ratio. |
| Highest quality, down to the last detail | All individual components of the large diameter bearings are selected in accordance with the application, and are subject to the highest quality standards. Raw material and components are only supplied by qualified suppliers which are regularly audited. For certain raw materials (e.g. rolled steel rings), Liebherr applies its own factory standards, which go beyond conventional industry norms. |
Liebherr attaches great importance to a high level of vertical integration. This particularly applies to processes which influence quality such as inductive hardening of the raceways and gear teeth of large diameter bearings.

Employee entering measurement values at a CAQ terminal (CAQ = Computer Aided Quality Assurance)
Outstanding quality has always been a trademark of Liebherr products. All company procedures are designed to ensure that the quality standards achieved in the design, using Finite Element Methods (FEM) and Failure Mode Effects Analysis (FMEA), are also maintained in subsequent processes. This starts with the selection of the suppliers and is maintained right through to the after-sales service. Quality management at Liebherr-Components Biberach GmbH is certified according to DIN EN ISO 9001:2008.

**Continuous quality management**

All production and assembly processes are documented in a computer-aided operating data recording system. This is also used as a central quality management system that records production and assembly measurements. This allows comprehensive control, monitoring and traceability. A wide range of evaluations not only quickly detects and corrects process deviations but also contributes to the continuous improvement of processes.

**Key process: hardening**

The service life of a large diameter bearing is largely determined by the execution of the hardening process. With state-of-the-art system technology and inductors developed in-house, Liebherr produces consistently high quality, even with bearings 6,000 mm in diameter. The degrees of hardness and the depths of hardness are subject to continuous quality testing.

**Unique measuring equipment**

In addition to the standardised equipment which is regularly monitored with computer-aided support, Liebherr also has a wide range of highly specialised measuring equipment. In recent years, for example, the company has invested in a state-of-the-art crack detection system using high frequency magnetisation and a fully climate-controlled large diameter bearing measuring chamber. The way of the 3D measurement process for large diameter bearings up to 6,000 mm in diameter is unique in the world.

**Classifications**

Classifications of the components by special certification companies such as Germanischer Lloyd (GL), Det Norske Veritas (DNV) or the American Bureau of Shipping (ABS) are standard particularly for maritime applications and in the wind industry. Liebherr will provide the required test certifications upon request.

100 % measurements are carried out for particularly critical properties such as the hardness and the depth of hardness of the large diameter bearing raceways.

Quality assurance begins with raw material suppliers, who must supply the seamless rolled rings with a certificate, which contains the batch, material analysis and ultrasound results.
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Single-row four point bearing, with internal gear with through holes

Single-row four point bearing, with external gear with blind holes

Single-row four point bearing, without gear

Double-row four point bearing with internal gear and bearing cage
Ball bearing slewing rings by Liebherr are available in single-row and double-row models, both with external or internal gears as well as without teeth. The ball bearing slewing rings are designed as four-point bearings which are characterised by four defined points of contact per rolling element, through which bilateral axial and radial forces and thus also a tilting moment can be transferred. Thanks to their simple design, four-point bearings are an efficient solution for various applications with small to medium-sized loads.

Polymer spacers are conventionally used as intermediate pieces between the rolling elements, however there are also bearing models with steel or brass bearing cages available.

**Single-row four-point bearings**

This extremely robust and efficient design offers a high level of operational safety and is insensitive to shape deviations of the adjacent construction. Single-row four-point bearings are used in a variety of applications, where they provide for example for the swivelling of excavators or the jib movement of tower cranes. They are, however, also used as drive elements of large rope winches.

**Double-row four-point bearings**

Double-row four-point bearings have a second ball raceway and can therefore accommodate considerably higher loads than single-row four-point bearings with the same diameter. They are used in applications with high static loads and very limited installation space, for example in the rotor blade adjustment of wind turbines.

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<tr>
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<th>Single-row four-point bearing</th>
<th>Double-row four-point bearing</th>
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<tbody>
<tr>
<td>External diameter</td>
<td>400 - 6,000</td>
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<tr>
<td>Gear module</td>
<td>8 - 50</td>
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<tr>
<td>Weight</td>
<td>25 - 15,000</td>
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Double-row four-point bearing, with external gear

Double-row four-point bearing without gear
Liebherr roller bearing slewing rings are ideal for medium to high loads. They come in a triple-row design with two axial and one radial roller raceway as standard, but other models are also possible depending on the application. Thanks to the linear load transmission, they can transmit far more torque than four-point bearings in the same installation space and are therefore ideal for larger diameters. Roller bearing slewing rings are characterised by a high power density but tend to have stricter requirements in terms of the stiffness of the adjacent construction.

Roller bearing slewing rings by Liebherr can be supplied in all gear versions. Typical applications are mining excavators or large crawler cranes, offshore and mobile harbour cranes. Roller bearings by Liebherr have also been tried and tested in drilling rigs and civil engineering machines.

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Roller bearing slewing ring with bolt connection to the adjacent construction

Ball bearing slewing ring with multi-level sealing package

Ball bearing slewing ring with adapted contact angle for heavy radial loads

Combined ball and roller bearing slewing ring
The category „special rings“ includes four-point and roller bearing slewing rings with special adjacent constructions or special design configurations and raceway systems tailored to the application. Furthermore, geared rings and ring segments are included under special rings. Liebherr-Components Biberach GmbH also produces worm gears for table drives in gear cutting machines, which consist of several connected bronze and steel rings.

Special adjacent constructions

The bearing geometry can be flexibly adjusted to the adjacent constructions, for example the design of the internal and external ring is possible in completely different heights or with an offset against one another. Roller bearing slewing rings with bolt connection or bayonet connection are available for easy dismantling of superstructure and undercarriage of construction machines and cranes. For maritime applications, drilling rigs, machine tools and similar applications, there are bearings with special, multi-level sealing packages.

Special raceway systems and designs

The raceway systems of ball bearing and roller bearing slewing rings can also be adapted according to the application. Combined roller ball bearing slewing rings are available for example. For large radial loads, slewing rings can also be designed as ball bearings with adjusted contact angle. Angular contact roller bearings which act as bogie wheels for a heavy lift crane have also been produced in Biberach.

Geared rings and ring segments

Instead of anti-friction bearings, Liebherr also produces geared rings which are used to drive rope winches or as friction bearings in the yaw adjustment of wind turbines. The geared rings are also carried out in segments at the customer’s request.

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Examples of use

Earthmoving and deep foundation machines
For earthmoving and deep foundation machines, Liebherr mainly supplies ball bearing slewing rings which are used to swivel the machine. Possible applications are mobile or crawler excavators, duty cycle crawler cranes or drilling rigs. In the articulated truck shown on the left, the large diameter bearing is used in the articulated joint.

Mining equipment
In mining excavators, it is mainly roller bearing slewing rings which are used for the swivel movement of the machine due to the high loads.

Material handling technology
Ball bearing and roller bearing slewing rings can be used in conveyor belts, spreaders, stackers/reclaimers and bucket-wheel excavators for the swivel movement of the superstructure and the conveyor arms.

Tunnel boring machines
Special roller bearing slewing rings, which have a special sealing system due to the high dust load, allow for the rotational movement of tunnel boring machines.
Examples of use

**Mobile cranes, construction cranes and lifting equipment**
Depending on the size and model of the crane (construction, self-erecting, mobile or crawler crane), four-point bearings, roller bearing slewing rings or special bearings are used for the slewing movement.

**Maritime applications**
In the maritime sector, large diameter bearings by Liebherr are primarily used in the slewing units of harbour, ship and offshore cranes. Special bearings, however, are also used in Azipod® ship propulsion systems.

**Energy technology**
In the field of energy technology, large diameter bearings are mainly required by the wind industry, which uses single-row and double-row four-point bearings for the rotor blade and yaw adjustment of wind turbines.

**Machine tools**
In machine tools, worm gears produced by Liebherr are used in the table drives, but also tool magazines are rotated by means of four-point bearings by Liebherr.

**Special vehicles and machines**
Liebherr bearings are ideally suited to the most various special vehicles and machinery - e.g. turntable ladder vehicles are supplied with ball bearing slewing rings.
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