LIEBHERR

Press information

Large Diameter Bearings by Liebherr for Construction Machinery

March 2014 – Liebherr is a leading global manufacturer and supplier of large diameter bearings and has almost 60 years of experience in the development, design and manufacture of ball bearing slewing rings and roller bearing slewing rings. Large diameter bearings are produced in our facilities located in Biberach an der Riss, Germany and Monterrey, Mexico, in various dimensions and designs in accordance with customer specifications.

The current product range includes large diameter bearings which may be single row or double row four-point contact bearings, triple row roller bearings or special bearings. Liebherr currently manufactures and supplies bearings with a diameter range of 16'' to 236'' (400 mm to 6,000 mm). Other sizes may be available on request. Our large diameter bearings are utilized in a wide array of applications such as earthmoving machinery, wind turbines, mining equipment, maritime applications and vehicle technology, as well as machine tool applications.

Large diameter bearings are key components in many types of construction machinery. They must work reliably and safely under constantly changing loads and in some instances under extremely arduous ambient conditions. Four-point contact bearings are primarily used in earthmoving, building and civil engineering machinery, while roller bearings are typically utilized in mobile cranes due to their special requirements.

To guarantee reliable operation throughout the service life of the large diameter bearing, Liebherr pays particular attention to three important factors regarding the production of components: The reliable design of the bearing, the control of the production processes and the systematic quality control using the very latest test methods.

Reliable design of large diameter bearings

The major challenges when designing a bearing for economical use in construction machinery include ensuring optimal adaptability to the environment in which it is used

as well as its adaptability to the service life of the machinery. Safety related aspects of the application must also be considered.

In order to achieve these goals, the inner load distribution must be determined. Conventionally, axial forces and bending torque are calculated using equations from technical mechanics, whereby the large diameter bearing is treated as a thin section tube, assuming ideal adjacent assembly structures are in place. The influences of the design of the adjacent constructions above and below the bearing are not taken into account.

The adjacent constructions on the uppercarriage and undercarriage of mobile cranes, for example, have greatly differing rigidities as well as large variations in rigidity which can be detected at the circumference of the adjacent construction. Under load, this leads to uneven strain on the internal and external ring in addition to differing contact angles in the area of the highly stressed rolling elements. As a worst case scenario, this could lead to the bearings' racetrack running on its edge and/or restraints in the racetrack system. These effects lead to detrimental influences on the service life of the bearing and therefore must be investigated with the help of conventional analytical configuration methods. For application cases which cannot be calculated sufficiently with conventional methods, Liebherr examines large diameter bearings much more precisely by using the finite element method (FEM).

The programs employed by Liebherr enable our engineers to produce precise CAD models of the adjacent assembly structures (e.g. the uppercarriage or undercarriage). In addition to analyzing the complete system, Liebherr employs FEM to analyze the forces and contact angles acting on the individual rolling elements. An in-house developed software is used to evaluate the Hertzian pressure and stress acting on the material. This intensively scrutinizes the probability of the bearings' racetrack running on its edge as explained above. The design and calculation procedure is supplemented by bolt calculations and investigations of the load-bearing behavior of the gearing. The product is optimally configured by accounting for all pertinent application details.

Control of critical hardening process

A wide range of production processes are employed during the manufacturing of high-quality large diameter bearings. However, the greatest influence on the quality of any bearing is the hardening process. Its flawless execution is critical to the service life of a large diameter bearing. When it comes to large diameter bearings for construction machinery, the raceway and gearing are hardened via induction heating. In this process, all influencing parameters, such as the frequency and induction voltage, the feed rate of the induction tool, the coolants' temperature and flow as well as the timing of the quenching must be precisely coordinated. Only then will undesirable tension fractures be systematically and reliably avoided.

The optimal required hardening depth and degree of hardness are determined on the basis of strength assessment. In addition to the highly sophisticated manufacturing processes utilized by Liebherr, the company also relies on employing skilled personnel with extensive training and experience in the production of large diameter bearings. With state-of-the-art technology and specially developed induction tools, Liebherr consistently manufactures high quality bearings up to 236'' (6,000 mm) in diameter.

Systematic and comprehensive quality control

Liebherr supplements the ideal design for large diameter bearings and the use of efficient production technologies with systematic quality control. Certification in accordance with DIN EN ISO 9001 is the minimum standard. Moreover, Liebherr employs a consistent, computer-based quality management system which documents the process and work flow in our production facilities. Liebherr has the latest testing and measuring tools at its disposal such as magnetic particle inspection testing, developed exclusively for the company. This enables potential hardness cracks in the magnetized bearing rings to be made visible with UV light. Liebherr has furthermore invested in a unique air-conditioned measuring room in which a 3D-portal machine measures bearings of 236'' (6,000 mm) diameter with precision of only a few micrometers. Every bearing at Liebherr is subjected to crack tests and a 100% dimensional test.

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