

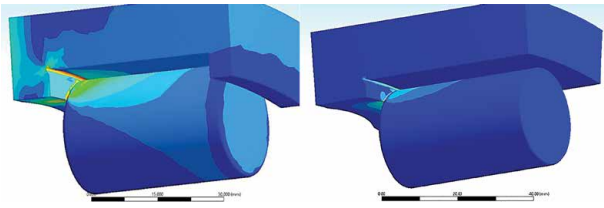
Study and maximization of the outer ring rib robustness in multi-row cylindrical roller bearings used in roughing mill stands



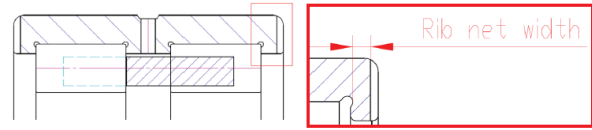
In roughing rolling mill stands, bearing reliability directly affects mill availability and production continuity. These applications operate under high radial loads, shock loading, vibration, contamination, and repeated transient overloads generated during rolling.

In a recent technical support case, Engineer Alberto Barilli of the RKB technical team assisted a steel producer operating a 2Hi horizontal roughing stand following the catastrophic failure of a multi-row cylindrical roller bearing. The failure caused an unplanned production stop and required a detailed evaluation of the bearing design and operating conditions. The inspection of the failed bearing outer ring showed multiple sites of fatigue crack growth with progression marks (beach marks), nucleating from the most stress-sensitive areas of the outer ring rib section. Based on the failure analysis, the investigation focused on a critical parameter of the bearing internal design for this application: the net width of the outer ring rib.





+ Comparative FEM analysis of AF2D (left) vs GB2D (right) with roller pushing axially on the rib



+ Outer ring rib net width

Importance of outer ring rib geometry

In multi-row cylindrical roller bearings used in rolling mills, the outer ring rib can become highly stressed due to increased friction, misalignment, and impact loading.

In these special cases, the rib section can become critical since stress concentration increases and may promote fatigue crack propagation under severe cyclic loading.

To evaluate the influence of rib geometry, RKB compared two bearing designs with the same main boundary dimensions: a conventional double-pronged cage design and an RKB window-type cage design with reinforced rib geometry.

The conventional design had a rib net width of approximately 6.2 mm, while the RKB design increased this value to approximately 12.3 mm, corresponding to an increase of about 98%. In theory, a larger rib section shall reduce the notch effect and consequently the related stress, improving the outer ring rib fatigue resistance under specific working conditions.

FEM validation

RKB performed a comparative Finite Element Method (FEM) analysis to evaluate the stress distribution in both bearing designs under axial loading acting on the inner surface of the outer ring rib.

The FEM results showed that the increased rib width in the reinforced design reduced the Von Mises stress in the most critical section, showing a reduction in the notch effect. Based on the analysis, RKB recommended field testing of the reinforced design in the customer's roughing stand application.

Special RKB technical proposal featuring a reinforced bearing design.

The proposed solution was the RKB R 313822 GB2DXS1ZBAVH/4/L6, a multi-row cylindrical roller bearing outer assembly developed for severe rolling mill conditions.

The design combines reinforced rib geometry with a window-type cage configuration that improves roller guidance and reduces roller displacement during assembly and disassembly. Additional features include bainitic heat treatment to improve toughness, superfinished raceways and rollers to improve rolling contact, and optimized raceways microgeometry for demanding rolling mill applications.

Moreover, the reinforced cage and rib configuration is particularly beneficial in applications requiring repeated maintenance and handling of bearing assemblies.

Heat treatment and surface finishing

In rolling mill applications, bearings are exposed to impact loading, vibration, contamination, lubrication instability, and localized stress peaks. Under these conditions, material toughness and surface integrity are critical for bearing reliability.

RKB's bainitic heat treatment improves resistance to crack propagation under severe operating conditions, while superfinished raceways and roller surfaces improve lubrication film behaviour and reduce surface distress, especially when the bearing works in an improper boundary lubrication regime.

RKB general recommendations for the customer

RKB recommended periodic inspection of cover contact surfaces, chock abutting faces, mating surface flatness, bearing seating conditions, and lubrication system and related parameters. Although the bearing design is reinforced, it remains essential



that it operates under the best possible conditions to maximize its service life.

Conclusions and future perspectives

The engineering evaluation showed that the original failure mechanism was consistent with fatigue crack propagation in the outer ring rib section. For this roughing mill stand application, the reinforced RKB window-type design provided a more reliable solution due to its increased rib net width, improved stress distribution, and rolling mill-specific design features.

This case demonstrates that bearing selection for severe rolling mill stand applications often requires a careful evaluation not only of dimensional interchangeability but also of bearing-specific working conditions that, in many cases, can be very demanding for standard bearing designs. This task is not straightforward and requires close collaboration between the customer and a highly skilled and experienced supplier in the field. RKB has gained extensive expertise in this field and is able to provide customized solutions for critical customer equipment where standard market solutions do not achieve satisfactory performance.