

Newsletter

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BX (Black Oxide)-coated spherical roller bearing, precision-manufactured with high-polish raceways for high radial load capacity and enhanced robustness under misalignment and mixed rolling-sliding conditions in non-locating support arrangements.

Application of BX Bearing Technology for Driven Shaft Pinion Support Optimization in Ball Mill Systems

Pioneering implementation of BX (Black Oxide) coated spherical roller bearings in a high-demand copper concentrator, delivering enhanced drive train reliability under extreme operating conditions.

Developed and implemented by Atlantic Bearing Services (ABS) in close collaboration with SKM Industrial (Chile). The system-level engineering solution features BX-coated spherical roller bearings manufactured by ACB Custom Bearings and a custom drive shaft pinion produced by MGS Gears.

Sector

Mining – Copper

Equipment

SAG & Ball Mill grinding systems

Criticality

- High dynamic gear mesh loading
- Misalignment and shaft deflection under load
- Severe lubrication regime (mixed rolling-sliding conditions)

Country

Chile



APPLICATION CONTEXT

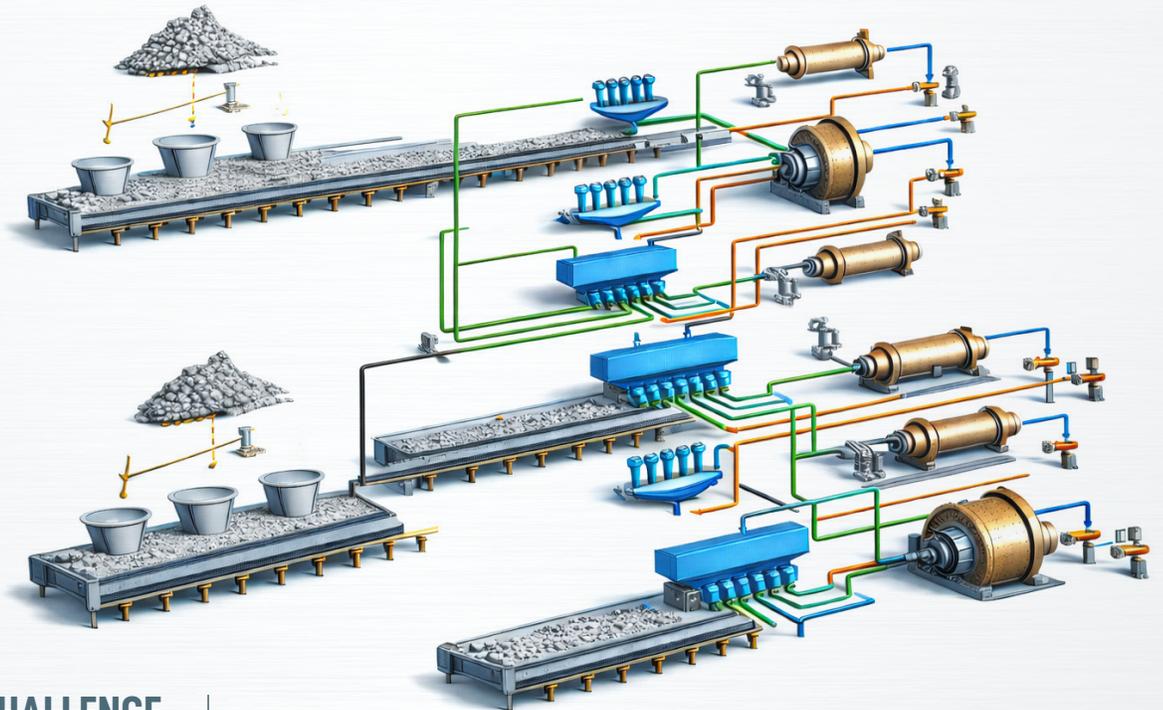
Large-scale copper concentrators operate SAG and ball mill grinding circuits under continuous duty and severe mechanical loading. In these systems, the driven shaft pinion support plays a critical role in drivetrain stability and overall process availability.

In this installation — with more than 30 years of service — load fluctuations, transient operating conditions, and lubrication regim variations increased the risk of surface distress and premature support degradation.

ABS supported the replacement and upgrade of the driven shaft pinion support system for Lines 1 and 2 without interrupting operations during the 2024–2025 production cycle. The intervention was executed during a record production period, highlighting the operational criticality of maintaining stable grinding circuit performance.



SCHEMATIC OF THE GRINDING CIRCUIT AREA



ENGINEERING CHALLENGE

The project involved replacing the driven shaft pinion support system in a SAG/ball mill circuit with more than 30 years of service, while maintaining continuous operation under high dynamic loads and strict availability targets. Conventional bearing arrangements showed sensitivity to misalignment and load fluctuations in the pinion drive, leading to localized load concentrations (edge loading) and increased surface distress under mixed rolling–sliding conditions.

Shaft and housing deflection under operating loads further amplified these effects, accelerating wear and reducing support stability. No operational precedent existed for applying BX-coated spherical roller bearings in this specific drive shaft pinion configuration, requiring rigorous, risk-controlled engineering validation prior to implementation.

ENGINEERING APPROACH

A system-level evaluation of operating loads, thermal behavior, and alignment conditions within the shaft-pinion arrangement was performed, with emphasis on radial load zones, misalignment tolerance, and shaft and housing deflection during operation. This analysis identified a BX-coated spherical roller bearing as the selected solution for the non-locating (floating) support arrangement. The configuration provides high radial load capacity and misalignment compliance, supporting stable load zones under demanding operating conditions, while axial freedom, where required, is defined by the support and fit design. Validation included a technical comparison with the previous arrangement to ensure compatibility, as well as the adaptation of bearing selection, housing interfaces, and customized sealing to the specific operating environment, with full engineering validation prior to implementation.

IMPLEMENTED SOLUTION

The implemented solution consisted of integrating a BX-coated spherical roller bearing as the core element of the driven pinion shaft support system, replacing the existing bearing arrangement within the shaft-pinion assembly. Applied in the non-locating support position, the bearing provides stable radial load capacity and misalignment tolerance under continuous operation, helping to reduce constraint-induced load concentrations within the assembly. The solution was engineered to match actual grinding circuit conditions, including mechanical loads, thermal behavior, and alignment constraints, ensuring long-term reliability in a demanding mining environment. The final configuration was implemented as a direct replacement without altering the overall drive architecture, resulting in improved functional stability and performance of the driven pinion shaft system.

ENGINEERING IMPACT IN ACTION

ABS delivered a BX-coated spherical roller bearing solution that reduced delivery lead time from 40 to 26 weeks, optimized the driven shaft pinion support arrangement, and enhanced reliability in a critical grinding operation where each hour of mill downtime can exceed USD 150,000.



ACB Bearing Housing



MGS Gears Shaft & Pinion



ACB Black Oxide-Coated Spherical Roller Bearing

One-Stop Solution for High-Engineering Critical Components



3D exploded view of the custom driven shaft pinion assembly featuring an integrated BX-coated spherical roller bearing support, engineered for high-load ball mill pinion drive applications.

ACB & MGS Gears are ABS Proprietary Brands

OPERATIONAL OUTCOMES

The non-locating support arrangement improved misalignment compliance, minimizing internal constraint forces and helping maintain stable load zones and alignment under continuous high-load operation. These improvements reduced the potential for premature surface distress and increased overall operational robustness in a critical grinding application. The solution supports sustained equipment availability and long-term reliability in environments where unplanned mill downtime carries significant operational and economic consequences.

Custom-manufactured BX-coated spherical roller bearing during final inspection. The black oxide finish on the rings improves lubricant retention, corrosion resistance, and smear protection in high-load mining environments.



In Chile, ABS has positioned itself as a reliable alternative for SAG and ball mill drive system applications at one of the world's largest copper mining operations, where production reached approximately 1.305 million tons (100% basis) in 2025.

BROADER APPLICABILITY

Beyond this installation, the combined capabilities ABS, ACB, and MGS Gears are directly transferable to other critical rotating equipment and industrial sectors facing similar challenges in support stability, load distribution, and long-term reliability under demanding operating conditions.