ZKL NEWS

December 2024, Issue No. 66

ZKL GROUP

INTERACTIVE KIOSKS

Read more about production digitization on page 3.

Read further in this issue:

Opening speech

Dear business partners,

As the year 2024 draws to a close, I would like to take this opportunity to update you on our activities through the latest issue of the ZKL News magazine. The ZKL brand has a tradition spanning more than 100 years. Despite the unfavourable development of industry in Europe, where decarbonization is leading to a general slowdown, our manufacturing companies have a sufficient volume of orders. We can therefore look forward to increased revenues in 2025 compared to 2024.

The ZKL Group consists of two main divisions. The first is the manufacturing division, which focuses on the production and sale of bearings. The second is the real estate division, which manages residential buildings, leases storage and manufacturing spaces, and develops new properties for lease.

Below, you can find the development of our financial indicators over the past five years.

KPI (CZK thous.)		2020	2021	2022	2023	2024
Rolling bearing division	Revenue	1 100 165	1 263 036	1 203 541	1 173 081	1 244 836
	EBITDA	101 677	125 288	117 141	153 034	146 063
Real estate division	Revenue	83 139	89 831	102 882	121 134	125 546
	EBITDA	57 711	65 572	71 435	80 017	92 166
TOTAL	Revenue	1 183 304	1 352 867	1 306 423	1 294 215	1 370 382
	EBITDA	159 388	190 860	188 576	233 051	238 229

Rolling bearing division

Due to the transformation of the industry in Europe, the sales portfolio is undergoing changes. Large-size bearings used in heavy industries such as mining, steel, and energy are in decline in Europe. Currently, the main market for these bearings is in East and South Asia. The manufacturing program is increasingly regulated by new EU directives and Czech government legislation. Over the past two years, we have observed a gradual decline in demand from the EU. We are compensating for this loss with new opportunities in North America, Eastern Europe, the Middle East, and South and East Asia, where a significant portion of our customers are relocating. In Europe, the ZKL brand continues to grow its market share in the railway program. We are currently investing in expanding our production capacities to better respond to increasing demand.

In 2024, we successfully completed investments in production capacities for double-row tapered roller bearings for railway axle bearings, including automated inspection lines for surface and subsurface defects at the ZKL Brno plant. We also finalized the investment in automatic grinders for rolling element shells, including an inspection line for surface defects. Additionally, we are in the final stages of process development for capacity planning tailored to the needs of the Brno production facility.

At the ZKL Klášterec nad Ohří plant, we achieved a 30% increase in cylindrical roller bearing production compared to 2023. We secured a significant contract to supply axle bearings for freight wagons for Ukrainian Railways, scheduled for execution in 2025. As part of further development, we plan to invest in expanding production capacities in 2025, and we are preparing to recruit skilled workers to operate modern automated grinding lines.

From a research and development perspective, we are primarily focusing on advancing our know-how in electrically insulated bearings, where we are already securing our first major orders worth tens of millions of Czech crowns. At the same time, we are centralizing expertise in technical production preparation. The goal is to establish an organization by 2026 that will expertly handle comprehensive research, design development, and technological-production advancement. This will prepare us for the efficient transfer of production know-how in the event of manufacturing capacity expansion outside the European Union, while retaining product know-how within the Czech Republic.

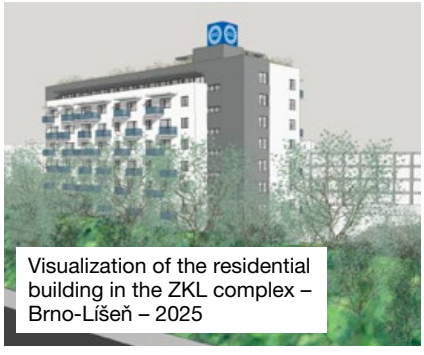
The ZKL Group has also made progress in reducing the carbon footprint of its bearing production. In 2024, we installed photovoltaic panels with a total capacity of 1800 kWp at both manufacturing plants, which is expected to reduce energy consumption by up to 30%.

In our commercial activities, we successfully completed the integration of business operations under ZKL Bearings CZ in 2024, achieving further productivity gains in management. In terms of revenue, we continue to strengthen our brand position in China, India, and the Middle East. Due to the economic crisis, our exports to Argentina have declined, but this shortfall is being offset by new orders from the United States. Unfortunately, the machinery sector in the Czech Republic and the European Union is experiencing negative trends. We see a significant decline in orders, particularly in the energy, mining, and steel industries. In 2024, we showcased our company at trade fairs in the Czech Republic, Germany, and Latin America.

Real estate division

In 2025, we plan to complete the construction of a residential building in Brno, adding 50 new units. Additionally, we are working to obtain a building permit for the Likus project in Brno, which could result in up to 200 residential units.

In Klášterec, we are finalizing the renovation of the gatehouse building and planning the construction of additional residential buildings for rental housing in the area.



Visualization of the residential building in the ZKL complex – Brno-Líšeň – 2025

Dear business partners,

Thank you for your trust and support throughout this year. We deeply value our business cooperation and look forward to further developing new opportunities together.

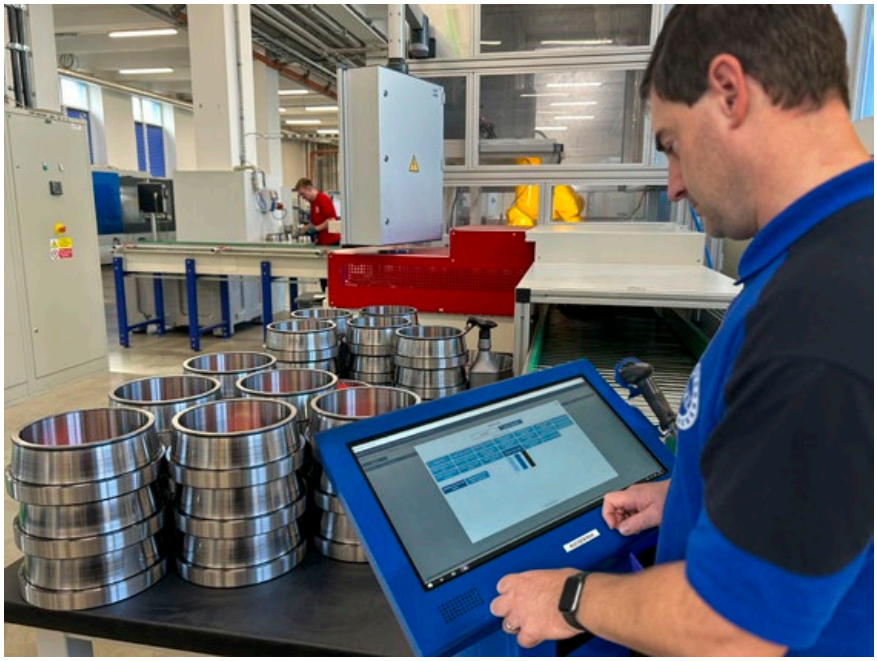
I would also like to express my gratitude to all ZKL employees for their excellent work in 2024 and for their continued loyalty to our company during these challenging times.

Ing. Jiří Prášil
CEO of ZKL, a.s.

Interview on manufacturing digitalization at ZKL: How interactive kiosks are transforming processes

Digitization of production is now a key factor influencing the competitiveness and efficiency of industrial companies. The implementation of modern technologies, such as interactive kiosks, allows for the optimization of work processes, simplification of administration, and faster flow of information. In an environment where every minute counts and quick responses to changes in orders or production conditions can result in significant cost savings, digitization is an indispensable tool.

ZKL is fully aware of this, which is why the company has decided to modernize its production processes by introducing interactive kiosks that provide workers with access to important information and tools directly on the production line. In the following interview, **Petr Procházka, system administrator** from ZKL's process engineering department, will explain how this project is unfolding and the specific benefits it brings.



■ ***Mr. Procházka, could you please explain how this entire project began?***

The project started in 2022 when our department was tasked with implementing interactive kiosks in our production facilities in Brno and Klášterec nad Ohří. The goal was to streamline our production processes while also providing workers with easy access to important information and tools they use in their daily work.

■ ***What needed to be arranged before the kiosks could be put into operation?***

First, we had to conduct a detailed analysis of the requirements for the kiosks, both in terms of technical specifications and user interface. Based on this analysis, we began selecting a supplier at the end of 2022. The goal was to find a solution that would be technically advanced while also providing simple and intuitive controls for our operators. After a successful tender process, we ordered the kiosks in March 2023, equipped with modern computers, touchscreens, barcode scanners, RFID chip readers, and thermal printers. For the supplied kiosks, we configured and fine-tuned the operating system, including the specific kiosk applications.

■ ***How was the deployment of the kiosks carried out?***

The first kiosks were launched in test mode in April 2023 to verify and fine-tune the functionality of the applications and peripherals used. In June 2023, we began the full operation of one kiosk at the line for roller bearings in Klášterec nad Ohří. We gradually deployed more kiosks in other production areas. Today, we have 9 kiosks in operation at ZKL Klášterec and 12 kiosks at ZKL Brno. The kiosks are continuously improved and updated with new applications and features to achieve maximum efficiency.

■ ***What applications are available on these kiosks, and how do they help workers?***

The kiosks provide applications that streamline and monitor work processes, as well as applications that grant access to data and information from other IT systems. For example, the feedback application allows operators to immediately record what has been completed after finishing a task, which speeds up the updating of order statuses. Another application enables tracking the status of production orders at individual workstations or monitoring performance standards. There is also an application for attendance tracking, ordering lunch in the company canteen, and reporting machine malfunctions for faster communication with maintenance staff.

■ ***Can you mention some specific benefits the kiosks have brought to the production process?***

The greatest benefit lies in speed and efficiency. Thanks to the kiosk applications, all the necessary information is easily accessible, significantly speeding up processes that were previously time-consuming. We have also simplified administration—for example, feedback on completed tasks is now faster and more accurate. The kiosks have become an integral part of our daily operations and have helped us modernize our production processes.

■ ***And what about security? How is data protection and access to sensitive information handled?***

This was, of course, one of the key areas we focused on. The kiosk software is carefully secured to prevent unauthorized use. Both the applications and the operating system are configured to protect sensitive data, with access controlled through user identification and assigned permissions. Data security is always our top priority, both within the applications and the hardware.

■ ***What are your future plans? Can we expect any expansion?***

Yes. The kiosks are a flexible tool that we continue to improve. In the future, we plan to add more applications to further enhance work process efficiency, improve integration with other company systems, and increase information accessibility. We want the kiosks to serve as central hubs for all the necessary information and processes that support and simplify production activities for our workers.

Thank you for the interview, and we wish the entire team much success in the further development of this project.

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Phone: +420 544 135 403
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Ing. Hana Luxová,
Ing. Libor Nohál, Ph.D.
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ESG: The path to sustainability and social responsibility

ZKL is committed to sustainability and social impact, which is why the company has decided to prepare its first ESG report for the year 2024. It will be released in May 2025 as part of the annual report.

In line with the Paris Agreement, the European Union has committed to achieving "climate neutrality" by 2050, meaning it will only produce as many greenhouse gases as ecosystems can absorb. To support this policy, ESG reporting (Environmental, Social, and Governance) has become a key tool. ESG reports are essential for increasing transparency and accountability in companies, helping investors, consumers, and other stakeholders better understand how a company incorporates environmental and social factors

into its business practices and governance. At the same time, ESG reporting contributes to the long-term, sustainable development of businesses and markets.

For several years, ZKL has been committed to a sustainable approach in its operations. In terms of environmental protection, the company focuses on integrating new technologies that reduce both energy consumption and environmental impact. Waste sorting is implemented across all its buildings and production sites, and solar panels have been installed on the roofs of its facilities. Additionally, ZKL is actively working to minimize any harmful effects on the surrounding environment.

On the social side, the company is dedicated to fostering diversity within its workforce, hiring employees regardless of their gender, age, or religious beliefs. This commitment is part of a broader initiative to create a workplace that promotes respect, equality, and openness.

In line with this philosophy, a whistleblowing policy was introduced earlier this year, a key step in building stronger communication and trust among employees. This tool allows for the anonymous sharing of concerns, ideas, and suggestions, helping to improve the workplace atmosphere and ensuring more effective problem-solving.

The company intranet plays a vital role in keeping our employees up to date with the latest happenings within the organization. It provides easy access to essential information, news, and updates, which fosters greater engagement and collaboration across teams.

Our Code of Conduct is another cornerstone of our company culture, outlining the standards and values that guide our decisions and actions. Clear guidelines help our employees make ethical choices and support a work environment built on integrity and trust. Together, these initiatives play a key role in fostering a positive and productive workplace.

To strengthen relationships among employees, we regularly organize company events. Our annual sports team-building day brings employees together for some fun, while our pre-Christmas gathering celebrates the achievements of the year, recognizing and rewarding outstanding employees for their hard work and dedication.

At ZKL, we aim to offer our employees a wide range of benefits that not only make their work more convenient but also add to their overall well-being. In 2023, we introduced the MultiSport card, which grants employees access to a variety of sports and relaxation facilities, helping them stay active and recharge.

Among the most popular benefits is our meal allowance, which is highly appreciated by our staff. We also celebrate milestones such as work anniversaries and personal achievements with special rewards. To support their financial well-being, employees can benefit from contributions to life insurance and pension plans. We offer flexible working hours, as well as five weeks of vacation each year.

For employees with children, we provide support for their children's recreational activities. Additionally, some roles offer the flexibility of occasional remote work, depending on the nature of the job.

As part of our educational program, we offer courses designed to enhance employee motivation, build on their existing knowledge, and help them acquire new skills that can be directly applied in their work. This initiative includes language courses in English, Spanish, and German, which are available throughout the year at ZKL. These benefits are just part of our commitment to making ZKL not only a place to work but also a great place to grow and thrive.

What can be said in conclusion? **ESG is not just an empty word for our company, but a real commitment that brings positive changes both for the company itself, its employees, and the environment around it.**

Ing. Tomáš Popek
Quality and EMS manager of the ZKL Group

Investments

Solar energy fuels our manufacturing

At ZKL, we are adopting an energy conservation policy. As part of our long-term strategy and environmental commitment, we are gradually reducing CO2 emissions, and the energy demands of our production processes. Solar power plants are being installed on the roofs of our facilities, and with their activation in 2024, we will make significant progress toward achieving carbon neutrality.

In the summer of 2022, we took advantage of a grant opportunity and applied for a subsidy from the National Recovery Plan, under the "Photovoltaic Systems with/without Accumulation I. Call – Activity a)" program, which is co-financed by the European Union. The investment involved the installation of a photovoltaic power plant on the roof of building No. 35 at the ZKL Klášterec nad Ohří, a.s. site. In 2023, the project "Improvement of Thermal-Technical Properties" was completed on this production hall, which included the replacement of window fillings, insulation of the outer shell, and roof insulation with the replacement of roof skylights. Logically, the next step in reducing CO_2 emissions is the acquisition of a photovoltaic power plant, which will produce electricity from renewable sources.

A total of 1,610 photovoltaic panels with a total installed capacity of 925 kWp were placed on the roof of the building, which has a total area of 14,936 m². The area covered by the photovoltaic panels is over 4,150 m². The panels are oriented to the southwest with a 15° tilt. This orientation allows electricity production from as early as 6 a.m. until 8 p.m., even on partially sunny days. The electricity generated will be used solely for our own needs, with no storage, and production is estimated to cover 10 % of the production plant's own consumption, which is certainly a significant portion.

The goal of the program is to reduce CO_2 emissions, but especially to achieve financial savings, as expressed in the slogan of our photovoltaic system supplier (NELUMBO Energy, a.s.) – "The Sun doesn't send bills.".

Ing. Jarmila Bůchová
Project manager ZKL Klášterec nad Ohří, a.s.

A glimpse into corporate life

The ZKL Family Day

The ZKL Family Day is one of our most popular company events, bringing together employees and their families. Every year, we gather at our production sites in Brno and Klášterec for a fun-filled day.

On June 22 the weather was perfect in Brno. The popular bouncy castles were packed with children, and their faces were bright with not only beautiful drawings but, most importantly, big, happy smiles. There was plenty of delicious food and drinks—and, of course, cotton candy! Throughout the morning, we held competitions for both children and adults, and the ever-popular plant tours were also on offer. Can you guess what fascinated the kids the most? The bearing assembly!

This year, we introduced a new activity—a fire safety simulation, featuring the Fire and Rescue Service, where participants got to try their hand at extinguishing a burning house. Though it wasn't an easy task, thanks to the patience and determination of the young participants, it was a huge success.

In Klášterec nad Ohří, the Family Day took place on June 15th. Along with our current employees and their families, we were also delighted to welcome former colleagues who had spent many years at ZKL—from their apprenticeship to their well-earned retirement. We were thrilled to have 55 former employees join us for the event. To celebrate their time with us, we prepared historical yearbooks and a collection of old photos.

Both events were a success, and our guests left with big smiles and happy memories. We truly appreciate all the heartfelt thanks we received. A big thank you to everyone who attended, and to both organizing teams for their outstanding work in making these events possible.

A glimpse into corporate life

Team building: The ZKL cycling trip

Every June, we organize a popular company team-building event that brings together colleagues from all our companies and both production sites. It's an opportunity to connect, discuss both work and non-work topics, and enjoy some active time together. This year, our hosts were the scenic Buchlov Hills, specifically the charming village of Modrá near Velehrad.

We formed several sport teams, with most routes leading through the historic Buchlov Castle, Buchlovice Chateau, and pilgrimage site Velehrad. While each group chose a slightly different path, we all gathered in the evening back at the hotel for a festive dinner. As always, this event added a refreshing and memorable break to our work routines.

Celebrating key career and life anniversaries

Opinions on whether staying at one company for many years is beneficial may differ, but we're certain of our stance! At ZKL, we deeply value the loyalty of our colleagues and are dedicated to creating an environment where they feel appreciated. We focus on cultivating a motivating and supportive workplace that helps our employees grow and fully realize their potential. As a company with a long-standing tradition, we're committed to providing stability and a solid foundation as a reward for hard work and dedication.

Our teams rely on the expertise of our long-term employees, who share their valuable knowledge with younger colleagues. To express our gratitude to those who have been with us for many years, we present a small gift to each jubilarian. This year, we're proud to have colleagues celebrating 30, 25, and 20 years at ZKL. Congratulations, and thank you for being part of our journey!

Blood donation: Thank you for helping

World Blood Donor Day is celebrated annually on June 14 to emphasize the vital role of blood donation in society and to thank all those who choose to donate and help others. Blood donation is essential, as it allows doctors to save lives in emergencies, surgeries, and the treatment of serious illnesses.

At ZKL, we also want to express our sincere thanks to all blood donors for their generosity and commitment. Regular blood donation is an act that deserves both recognition and respect. We are proud of our employees who have made the choice to donate blood and contribute to this noble cause. Several of our colleagues have been donating blood for years, as shown by the plaques they have earned.

Solidarity in action: Helping Northern Moravia after the floods

In September of this year, Northern Moravia was struck by devastating floods that caused extensive material damage and disrupted the lives of many families. In response to this challenging situation, some of our colleagues stepped forward to offer their help. With great dedication, they actively participated in clearing the flood debris and contributed wherever help was most needed. For those unable to assist directly at the scene, they sent supplies, baked cakes, and fried schnitzels—proving that every act of kindness makes a difference.

Their selflessness and determination to support the affected communities inspire us all and remind us that solidarity and mutual support are vital, especially in times of hardship. Thank you.

2024: Strengthening global connections

This year, we have once again increased our participation in trade fairs and exhibitions. Our focus has been primarily on international events, where we aimed to strengthen brand awareness for ZKL in key markets and showcase our latest innovations tailored to specific industries.

In remote regions like India and Latin America, we capitalized on synergies with our partners and co-exhibited at their stands. For instance, in January, through our master distributor, ZKL Bearings (India) Pvt. Ltd., we took part in the **NATIONAL EXPO 2024** in Raipur, India—an important national exhibition for the steel, mining, energy, and cement industries.

In September, thanks to our subsidiary ZKL Rodamientos S.A. in Latin America and in collaboration with our exclusive representative in Peru, IDRE S.A., we participated in **EXPOMINA 2024**. This specialized fair focuses on the mining and extraction sectors.

One of the most significant exhibitions for us is **InnoTrans** in Berlin—the largest international railway transport fair in Europe. The size and importance of the event are evident from this year's figures: 2,940 exhibitors from 59 countries, a record-breaking 170,000 visitors from 133 countries, 42 exhibition halls, 133 vehicles on the outdoor display and tracks, and 11 buses. The fair also featured 226 world premieres, and the opening ceremony was attended by over 1,200 guests from around the world.

At our stand in Hall 23, we showcased a comprehensive range of ZKL bearings for railway applications and presented our solutions for more reliable, safer, and more sustainable mobility for the future. On display were WJ/WJP tapered roller bearings for freight wagons with axle shaft diameters of 120 mm and 130 mm. These are modern railway bearings that ensure high safety and reliability, better energy efficiency, and lower maintenance costs for applications in Y25-type bogies and others. We also featured railway roller and tapered units, as well as double-row spherical roller bearings for locomotive axles. The main highlight was a pair of axle roller bearings for rolling stock manufacturers, which were recently approved by the Ukrainian Railways Commission.

We closed the trade fair season in October in Dortmund at the **Recycling-Technik** fair for recycling technologies. Here, we presented our products that ensure maximum reliability and increased cost efficiency in this rapidly growing industry. Specifically, we showcased bearings for crushers, vibrating screens, and conveyor belts. You can read more about these products in the article on page 10.

One of the main events in the Czech Republic is the international railway transport fair **Rail Business Days**, which takes place every June in Ostrava. The representative building of Trojhalí Karolína offers beautiful exhibition spaces, and the outdoor area with railway tracks provides excellent facilities for both exhibitors and visitors. The three-day event also includes a specialized conference and a career day for students, as well as ample opportunities for networking. We were, of course, present at this event as well.

This year's trade fairs were not only a commercial success but also a valuable opportunity to deepen our connections with existing partners and forge new relationships. They allowed us to showcase ZKL's innovative solutions and reinforce our position as a trusted industry leader. Our active participation demonstrated our commitment to staying at the forefront of the market and highlighted the ongoing importance of trade fairs in our strategy to connect, collaborate, and grow.

We would like to express our thanks to everyone who visited us at the mentioned trade fairs and took the time to engage in discussions about our products and innovations. Your interest and feedback are invaluable to us. A special thanks also goes to our partners for their outstanding representation of the ZKL brand in international markets, helping us strengthen our global presence and further build trust with customers around the world.

Ing. Hana Luxová
marketing ZKL Bearings CZ, a.s.

The future of Czech bearings – Excellent research in Brno

Even in times of economic and geopolitical crisis, it is essential to seek new approaches and added value for the products offered in a dynamically evolving world. Thanks to the localization of part of the production and technological centre of the group in Brno, we at ZKL are able to closely collaborate with R&D centres of excellent global standards.

How can we achieve better performance for Czech bearings? The answer lies in several scientific fields that have historically been among the most successful in Brno's academic community. Together with ZKL's long-standing know-how, we are working on innovations with several research teams. I would like to mention two of them.

The key element of an excellent bearing is its material and the surface of the functional areas – the rolling and contact surfaces inside the bearings. For many years, we have been collaborating with the research group "High-Performance Materials and Coatings for Industry" at the Central European Institute of Technology,

led by Associate Professor Čelko. The individual projects focus on nanostructural heat treatment of bearing steels and various types of coatings that give bearings additional properties: electrical insulation, lower friction losses, higher durability, and wear resistance, among others. These activities bring us deep know-how while contributing to the development of this scientific field in response to industrial needs.

We are also working with another team to improve the energy balance of our bearings, enhance lubrication, and adapt the design to the specific operating conditions of unique customer applications. The research team led by Associate Professor Svoboda, under the direction of Professor Hartl, guarantees professional and efficient collaboration, not only in the field of tribology. Current projects focus on the lubrication of slow-speed bearings, which are used in renewable energy sources, wind and tidal power plants, as well as the development of know-how for controlled lubrication and bearing units with mechatronic systems.

ZKL's involvement in the national competence centre MESTEC II is also very beneficial. This centre is based on a combination of interdisciplinary research specialties, with its application primarily aimed at engineering production for the 21st century.

Some of the products being developed are currently in the testing phase and will be available for the broader market in the near future. At this point, I would like to thank our development partners, who are helping us advance technologically and, through our collaboration, inspiring and attracting new colleagues to develop Czech bearings.

Ing. Libor Nohál, Ph.D.
Technical director of ZKL Group

Bearing rescue after floods

In September this year, severe flooding affected several areas of the Czech Republic. Water knows no boundaries, reaching homes, businesses, and warehouses of distributors and manufacturers. Among the affected were our customers, who approached us for assistance in inspecting bearings from flooded facilities.

How does such an inspection work? Can bearings be saved? And how quickly does water-induced corrosion spread?

The customer sent bearings from affected warehouses, which had clear signs of damage. Upon unpacking, it was evident that water had infiltrated not only through the damaged cover box but also into the inner layers of the packaging.

We conducted a thorough inspection. Beneath the protective covering, we found that the anti-corrosion agent, which typically protects the bearings' surfaces, had reacted with the water, forming an emulsion. This emulsion lost its protective properties, and the risk of corrosion became immediate. Immediate intervention was required to prevent permanent damage.

After detailed analysis, we discovered that the corrosion had only affected the surface layer. Thanks to the expertise of our technicians, we were able to remove all contaminants and corrosion. This process was challenging, but essential for restoring the bearings' functionality.

Once fully restored, the bearings were like new again. We successfully saved all 12 bearings, valued at approximately 200,000 CZK. The customer was able to use bearings without any limitation.

This story proves that even in seemingly hopeless situations, solutions are possible. If you're facing bearing-related issues, our experts at the ZKL Testing Laboratory are here to help. For more information on bearing restoration, visit our website.

Jakub Němeček
Head of Testing Laboratory

Fractography as a part of bearing damage cause analysis

Even in an era when automation, sensors, digitalisation, and diagnostics are everywhere, we still encounter bearing damage of a different cause than fatigue wear. Customers are often interested in understanding what happened within their application—whether they followed proper procedures during the machine or system startup, if the issue was a random occurrence, or if there was a problem with installation, operation, design, or neglected maintenance.

A key element of such analysis is the visual inspection of the bearing components. This involves examining the condition of raceways, mounting surfaces, and any discontinuities detected or directly pointed out by the customer. Discontinuities—such as cracks or fractures—are vital sources of information for determining the primary cause of failure.

The analysis of such damage, known as fractography, is a broad field. To define what fractography entails, we asked ChatGPT. The information we obtained are presented in the blue box.

We asked Jakub Němeček, Head of the Testing Laboratory, for his thoughts on the topic of fractography as described by artificial intelligence. Additionally, we inquired how fractography is utilized both internally in our manufacturing processes and as a service for our customers.

Did AI describe fractography accurately?

The AI output provides a relatively good general description of fractography, which aligns with the initial request. However, it has its limitations. For instance, the claim that pitting is a type of corrosion is not accurate; it is a form of fatigue damage.

Can you share a few notable examples from practice?

In our analysis of customer components, we've encountered various integrity issues. One example is discontinuities and cracks that originate during manufacturing processes—for instance, in forged blanks where so-called folds can occur (see photo 1). Folds are undesirable and can lead to further problems with bearing components, not only during subsequent machining but also as a potential primary cause of complete bearing failure during operation.

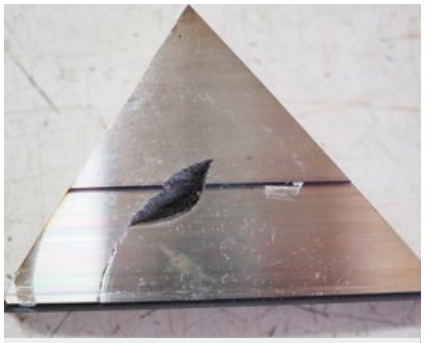
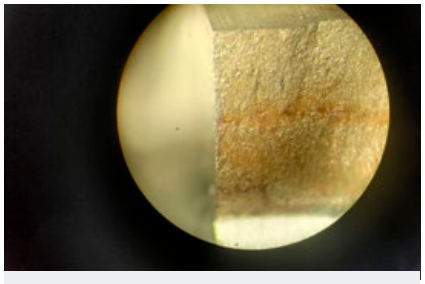


Figure of a defect occurring during forging – fold

Another manufacturing defect can be cracks caused by heat treatment. During the analysis of special surface heat treatment processes, it was found that the already hardened material layer was re-exposed to heat. This re-heating caused additional tempering, reduced material hardness, induced stress, and ultimately resulted in a crack.



Crack occurred after grinding

Another example is a crack formed during the grinding of heat-treated parts. Such cracks lead to financial losses for the company, because the finished part can be relatively expensive.

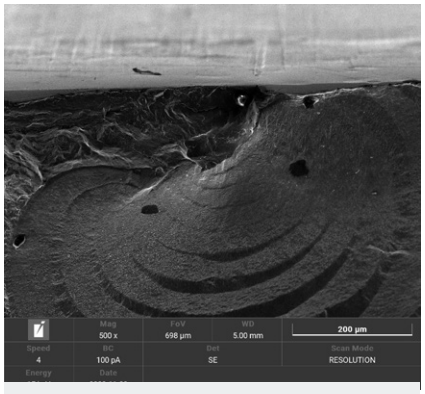


Figure from a scanning electron microscope – case of a fatigue crack initiated at a subsurface material defect

Scanning electron microscope

What can your department offer to customers?

Based on the analysis of cracks, we can determine the primary cause of part damage—this applies not only to bearing components but also to other steel mechanical parts. We assist our customers in resolving claims for non-conforming parts, optimizing product designs or manufacturing processes, and overall quality control.

Where do you conduct damage analysis, and what equipment do you have available?

For collaboration in solving issues with damaged parts, our fully equipped laboratory is available to customers. Last year, it was expanded with a TESCAN VEGA scanning electron microscope, which allows us to monitor:

Fractography on bearing components

Fractography is a scientific field focused on the study of fracture surfaces of materials and their analysis to determine the causes of damage. In engineering and manufacturing, fractography is often applied to bearing components, which are critical elements in many mechanical systems. This article will explore the main causes of bearing components damage and how fractographic analysis helps uncover these issues.

Main causes of bearing component damage

1. Material fatigue

Bearing components are continuously subjected to cyclic loads, which can lead to material fatigue. Over time, microcracks develop, eventually resulting in fractures. Fractographic analysis reveals characteristic fracture patterns indicating fatigue as the cause of damage.

2. Improper lubrication

Insufficient or inappropriate lubrication can lead to increased friction and wear on bearing components, causing overheating and subsequent damage. Fractography can uncover signs of thermal damage on fracture surfaces, such as oxidation or material melting.

3. Corrosion

Corrosion may occur due to moisture or aggressive chemicals encountering bearing components. Fractographic studies can identify the type of corrosion present (e.g., pitting or uniform corrosion) and how it affected the overall integrity of the part.

4. Overloading

When bearing components are subjected to loads exceeding their design limits, plastic deformation or immediate fracture may occur. Fractography can reveal distinctive features, such as coarse fractures or signs of plastic deformation.

5. Geometry and Installation Issues

Incorrect bearing placement or improper part geometry can result in uneven force distribution. This can lead to damage from localized overloading. Analysis of fracture surfaces can help identify improper installation or manufacturing defects.

6. Contamination

Dust, sand, or other foreign particles can cause abrasion and surface damage to bearing components. Fractographic methods allow for the identification and characterization of abrasion on fracture surfaces, aiding in understanding the impact of contamination.

1. The surface microstructure with nanometer-level resolution.
2. Surface topology using a combination of detectors, including the evaluation of material discontinuities (fractures, inclusions).
3. The chemical composition of the material using an EDS detector, including the analysis of material composition and surface layers.

And what can be said in conclusion?

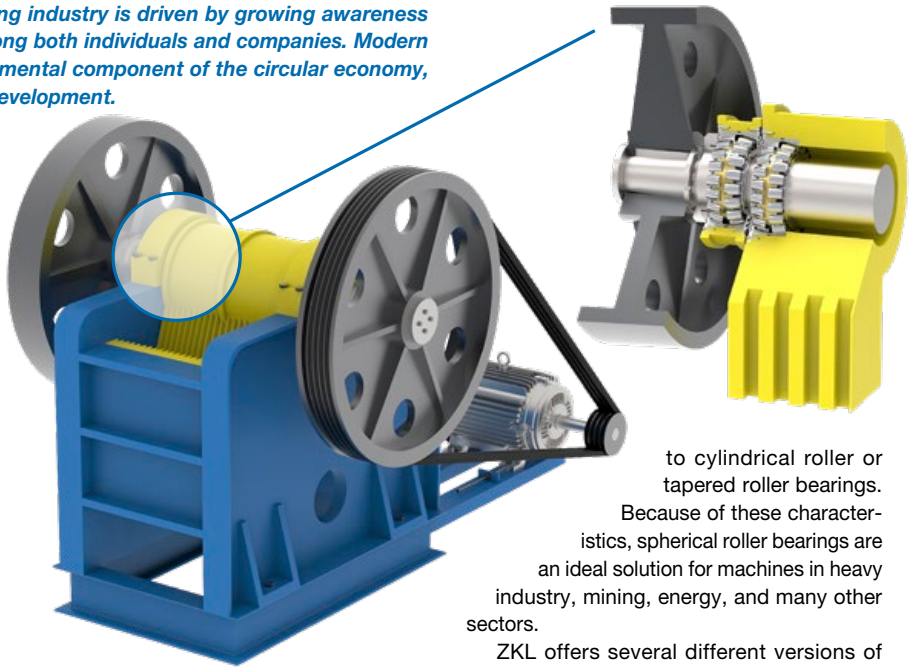
Fractography is a valuable tool for identifying the causes of bearing component damage. Through the analysis of fracture surfaces, it is possible to determine whether the damage was caused by fatigue, improper lubrication, corrosion, overloading, geometric issues, or contamination. Understanding these causes is crucial for improving the reliability and lifespan of bearing components and for preventing future failures in mechanical systems.

Are you interested in these analyses? We can allocate our available capacity to meet your specific needs. Feel free to contact me, and for a full range of services offered by the ZKL Testing Laboratory, please scan the QR code.

Jakub Němeček
Head of Testing Laboratory
+420 544 135 371
jakub.nemecek@zkl.cz

Bearings for recycling technologies

The increasing significance of the recycling industry is driven by growing awareness of the need for environmental protection among both individuals and companies. Modern recycling technologies have become a fundamental component of the circular economy, which is essential for sustainable economic development.



At ZKL, we are attuned to this trend and have tailored our bearing portfolio to include solutions for crushers, vibrating screens, and belt conveyors—critical components of systems designed for efficient recycling and the added value of sorted materials from waste. These solutions are widely utilized by established recycling firms, municipalities, and manufacturing companies.

ZKL bearings for crushers

Crushers are devices used to crush large pieces of material, typically stone, into smaller fragments. However, their use is not only limited to the mining industry, but they are also used to simplify recycling or waste disposal processes. There are many types of crushers, each with its specific application depending on the characteristics of the crushed material. The most used types include jaw crushers, impact crushers, and cone crushers.

High-quality bearings play a crucial role in the failure-free operation of crushers. Crushing rock or other material occurs high impact loads on the crusher bearings, which, combined with a dusty environment, creates very demanding working conditions. Spherical roller bearings of the series 231, 223, and 232 are mostly mounted on the eccentric shafts of crushers. Due to vibrations, bearings with a massive brass cage in the EMH design are used. Regular maintenance is also important for the proper operation of bearings, especially the correct continuous relubrication with grease.

Spherical roller bearings are designed to handle high radial and axial loads in both directions. Due to the spherical shape of the outer ring's raceway, they can compensate angular misalignment caused, for example, by shaft deflection. A disadvantage of this type of bearings is the lower maximum speed compared to cylindrical roller or tapered roller bearings. Because of these characteristics, spherical roller bearings are an ideal solution for machines in heavy industry, mining, energy, and many other sectors.

ZKL offers several different versions of spherical roller bearings suitable for different applications, such as with steel cage, a single-piece or two-piece brass cage, cylindrical or tapered bore, etc. ZKL continuously works on the development of spherical roller bearings and the optimization of their internal geometry to achieve the highest possible load capacities and further increase their reliability. These newly developed bearings are branded as NEW FORCE and are comparable in performance parameters to premium brands on the market.

Spherical roller bearings for crushers	Bearing dimensions			Load ratings		Mass
	Inner diameter	Outer diameter	Width	Dynamic	Static	
	d [mm]	D [mm]	B [mm]	C_r [kN]	C_{0r} [kN]	m [kg]
23224EKW33MH C3 NF	120	215	76	750	1020	11,8
23126EW33MH C3 NF	130	210	64	620	913	8,6
23238EKW33MH C3 NF	190	340	120	1730	2530	45,1
23140EW33MH C3 NF	200	340	112	1630	2410	41,5
23264EKW33MH C3 NF	320	580	208	4650	7590	232
23168EW33MH C3 NF	340	580	190	4240	7080	207
22330EW33MH C3 NF	150	320	105	1520	1850	41,1
22356EW33MH C3 NF	280	580	175	3840	5340	214
22380EW33MH C3 NF	400	820	243	7060	11010	603

ZKL bearings for vibrating screens

Vibrating screens are devices used for sorting and separating various materials according to their particle size. Using vibrations, the material moves across the screen surface. Finer particles fall through the screen, while coarser particles move down the screen and return, for example, to the crushing phase. Vibrating screens are used in various industrial sectors, such as mining, construction, and waste recycling.

The vibrations are usually generated by an eccentrically unbalanced shaft, which causes a circular or elliptical oscillatory motion of the entire screener. Bearings must therefore withstand rotating loads, high vibrations, elevated temperatures, and typically also dusty environ-

Spherical roller bearings for vibrating screens	Bearing dimensions			Load ratings		Mass
	Inner diameter	Outer diameter	Width	Dynamic	Static	
	d [mm]	D [mm]	B [mm]	C_r [kN]	C_{0r} [kN]	m [kg]
22309EMHD2 NF	45	100	36	184	194	1,5
22312EMHD2 NF	60	130	46	304	315	3
22314EMHD2 NF	70	150	51	376	402	4,4
22320EMHD2 NF	100	215	73	750	842	12,8
22322EMHD2 NF	110	240	80	868	1000	17,7
22326EMHD2 NF	130	280	93	1180	1380	27,7
22330EMHD2 NF	150	320	108	1520	1850	41,9
22336EMHD2 NF	180	380	126	1950	1530	66,8

ment. These demanding conditions require very high-quality bearings with specific properties. For this reason, ZKL has developed a special type of double-row spherical roller bearings for vibrating applications, designated with the suffix EMHD2.

Double-row spherical roller bearings EMHD2 have all the advantages of the standard spherical roller bearings. They can bear large radial and axial loads and are able to compensate shaft´s deflections. Unlike conventional spherical roller bearings, they have a single-piece brass cage guided on the outer ring. Almost all EMHD2 bearings are of the 223 series, with some exceptions in the 233 series, with bore diameters ranging from 40 to 200 millimeters. For bearings with bore diameters of 100 millimeters and above, the central part of the cage is modified to reduce its weight. Thanks to the C4 radial clearance, which is standard for this type of bearings, they can compensate large thermal expansions caused by vibrations. EMHD2 bearings have an increased precision grade both of their internal geometry and their inner and outer diameters. In applications with vibration accelerations exceeding 5 g, the EMHD2 design is irreplaceable.

ZKL bearings for conveyors belts

Conveyor belts ensure efficient transportation of materials of various shapes and weights over both short and long distances. They are essential components not only in many industrial sectors, such as mining and food processing, but also in supermarkets, airports, and many other common locations. In recycling operations, they are used for an effective sorting of the recycled materials and waste transportation.

Tension rollers of industrial conveyor belts are typically mounted using double-row spherical roller bearings. Although these bearings are not exposed to extremely high speeds or loads, they often cause conveyor shutdowns due to the extremely harsh environmental conditions. To maximize the reliability of the conveyors´ operation, ZKL offers sealed spherical roller bearings with up to three times longer service life compared to open bearings.

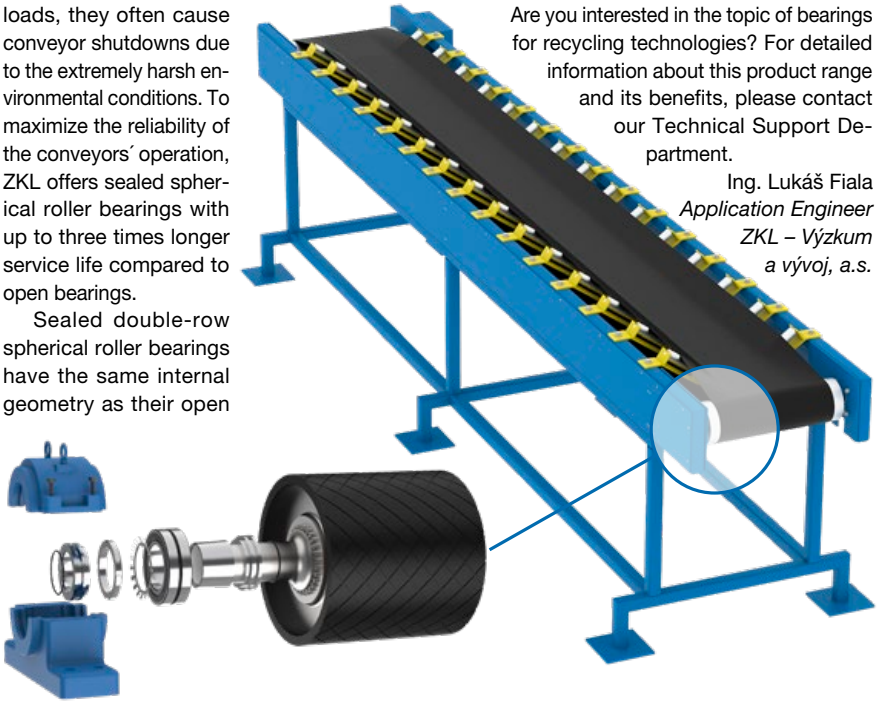
Sealed double-row spherical roller bearings have the same internal geometry as their open variants. They can bear large radial and axial loads and allow limited misalignment between the inner and outer rings. Compared to open bearings, some sealed bearings have a larger width (prefix B2), which must be considered while choosing the bearing´s housing or during planned replacements.

Thanks to the seal, external contamination does not enter the bearing, which significantly increases the service life. The ideal solution for the maximum service life of ZKL bearings is a three-barrier protection, which consists of:
1. sealed double-row spherical roller bearing,
2. bearing housing filled with high-quality grease,
3. external labyrinth seal.

ZKL supplies bearings already filled with high-quality plastic grease SHELL (suffix TM), so immediate assembly is possible. In many applications, it is not even necessary to change or refill the lubricant. The sealing is made from NBR (max. 120 °C, suffix 2RSN) or HNBR (max. 150 °C, suffix 2RSH). The disadvantage of the sealing is the contact between the inner ring and the sealing edge, which reduces maximum revolutions compared to standard open bearings. Maximum permissible revolutions are in the table section. ZKL sealed spherical roller bearings are available with both cylindrical and tapered bores.

Are you interested in the topic of bearings for recycling technologies? For detailed information about this product range and its benefits, please contact our Technical Support Department.

Ing. Lukáš Fiala
Application Engineer
ZKL – Výzkum a vývoj, a.s.



Sealed spherical roller bearings for conveyor belts	Bearing dimensions			Load ratings		Speed	Mass
	Inner diameter	Outer diameter	Width	Dynamic	Static		
	d [mm]	D [mm]	B [mm]	C_r [kN]	C_{0r} [kN]	RPM	m [kg]
B2-2205-2RSN TM NF	25	52	23	47,5	50,2	3600	0,2
B2-2216-2RSN TM NF	80	140	40	246	295	1200	2,5
B2-2220-2RSN TM NF	100	180	55	417	510	900	5,8
22228-2RSHK TM NF	140	250	68	822	1080	670	14,1
22232-2RSHK TM NF	160	290	80	1080	1440	600	22,7
22252-2RSHK TM NF	260	480	130	2650	3690	340	103
23134-2RSH TM NF	170	280	88	1070	1620	480	21,5
23152-2RSH TM NF	260	440	144	2560	4130	320	90,5
23164-2RSH TM NF	320	540	176	3560	6150	250	166

Contact details:
ZKL – Výzkum a vývoj, a.s.
Technical Support Department
support@zkl.cz
www.zkl.eu
+420 544 135 412

ZKL: A brand with a century-long tradition

Since the end of last year, the iconic Zbrojovka Z9 vehicle has been proudly displayed in the reception area of ZKL's main building in Brno-Líšeň. But why is it here, and what's the connection between Zbrojovka and ZKL? We'll uncover the story behind this fascinating display in the following article.

The story behind the Zbrojovka Z9 car and its arrival to ZKL

We acquired the car as a tribute to the historic connection between Zbrojovka Brno and the ZKL Group, from Mr. Jiří Kohlíček, the former chairman of the Central Moravian Club of Automobilists and Motorcyclists in Olomouc. Mr. Kohlíček obtained the car from an acquaintance who had bought it "in working condition" from a used car dealership near the German border. Remarkably, it was almost in its original state, including its paint and upholstery.

Cars of this era typically had a wooden frame covered with sheet metal, and this particular model also featured a roof covered with artificial leather. However, once transported to Moravia, it became clear that the wooden structure was so severely damaged that the vehicle would require significant restoration. As a result, Mr. Kohlíček took on the challenge of reviving this veteran car, dedicating several years to professionally restore it and make it roadworthy again.

During the restoration, he made every effort to preserve as much of the original vehicle as possible, including the wooden frame, metal panels, and upholstery. Only parts that were beyond repair—rotten or heavily rusted—were replaced. With the help of an experienced carpenter, he expertly repaired the damaged sections of the wooden frame and sourced original parts that were missing from the car. He also worked to match the original color of the bodywork as closely as possible, as Z9 cars with this type of body were only delivered in dark blue or dark green.

All the bearings in the restored car were replaced with new ones, with the original bearings displayed in a case at the reception. The engine received a complete overhaul, and worn parts of the chassis were either repaired or newly fabricated. The leaf springs were re-tempered, and all chrome parts were re-plated. Thanks to these extensive repairs, the car is now fully restored and runs reliably once again.

A glimpse into the history of Zbrojovka car manufacturing

Zbrojovka cars have a rich history, with production beginning in 1924. The first model, the DISK, was marketed as a "people's car," but it didn't achieve significant success. It was followed by the Z18, known as the "indestructible eighteen" – a reliable and affordable car that became well-regarded. The Z18 also marked a milestone as the first mass-produced car in Europe to feature a two-stroke engine.

Despite the Z18's success, Zbrojovka felt the increasing pressure from competition and set out to create a new model. In late 1929, they introduced the luxurious Z9, powered by a two-stroke M 12 engine with a rotary valve. It was a reliable and comfortable car, but the timing couldn't have been worse. The economic crisis made the Z9's price tag of 42,000 CZK far out of reach for most people. To put it into perspective, a textile worker earned around 158 CZK a week, a miner made 235 CZK, and a government clerk's average monthly salary was just 1,367 CZK.

Between 1930 and 1932, only around 850 units of the Z9 were produced in different body styles. Although the car performed well in long-distance reliability tests, its sales never really took off.

In an effort to keep production going, Zbrojovka quickly introduced a new model – the Z4, also known as the "strong four." This more affordable, compact car, priced at 22,000 CZK, became a hit with the public. The Z4 quickly gained popularity, and a total of 2,680 units were produced over five series.

Then, in 1935-1936, Zbrojovka launched the Z5, a high-performance model that earned the nickname "Express of Our Roads" due to its speed and acceleration. However, at a price of 37,500 CZK, it was too expensive for most buyers. So, in parallel, a smaller and more affordable model, the Z6, was introduced.

The Z6, also known as "Hurvínek" after the famous wooden puppet, was the last model produced by Zbrojovka in 1935–1936. With a price tag of 19,600 CZK, it was meant to be a more budget-friendly option, but it didn't quite match the driving performance of the larger Z4, which likely contributed to its limited popularity.

And what does veteran car enthusiast Jiří Kohlíček say about car production at Zbrojovka?

"Between 1924 and 1938, just over 7,000 cars were produced at Zbrojovka Brno. While this number may seem modest in the history of automotive manufacturing, its contribution to the development of the automotive industry in Czechoslovakia is undeniable. The DISK was a true Czechoslovak "people's car," with a unique transmission design featuring a friction drive and powered by a four-cylinder two-stroke engine. Although it was unsuccessful in sales, it was still produced! The Z18 can boast of being the first mass-produced car with a two-stroke engine in Europe. The Z9 has a very interesting valve

system with a rotary cylinder valve – another advancement in two-stroke engine development. The 'strong four' was the first mass-produced car in Czechoslovakia with front-wheel drive (move over, Aero…). The Express also holds a milestone as the first production car with a four-cylinder two-stroke engine in Czechoslovakia. For the skeptics, there's nothing left to do but show them these beautiful and, for their time, truly remarkable cars, such as the Z6 model, the Hurvínek."

The connection between Zbrojovka and ZKL

Bearing production began in Brno at the parent factory of Zbrojovka. From 1926 to 1937, two types of double-row bearings, series 3305 (then labelled as BB40), were produced for use in the engine housings of the "Z18" and "Z9" car models. Due to the approaching Second World War, car production was halted and shifted to wartime production.

After the war, Zbrojovka transitioned its production to peacetime operations. The company began manufacturing a new model of Czechoslovak tractor, the T25. However, a shortage of imported bearings for the new tractor factory prompted the development of the first five prototypes of bearings in 1947. This led to the establishment of a new bearing plant in Brno-Líšeň.

For a deeper look into the history of ZKL Group, we invite you to read the previous edition of the ZKL News magazine, issue No. 64.

Ing. Hana Luxová
marketing ZKL Bearings CZ, a.s.

Technical specifications of the Z9 car

Manufacturer: Zbrojovka Brno a.s.
Year of manufacture: 1929
Engine: Two-cylinder, cylinders in a single block, two-stroke with rotary valve
Engine displacement: 1000 cc
Engine power: 22 hp
Top speed: 80 km/h
Body: Two-door factory limousine of American COACH type – 2 cars with this body style remain
Bearings: Ball bearing connecting rods
Total production: Approximately 850 cars