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RESEARCH :

A real-world view of hybrid bearing life

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Working Together for Systematic Thinking

Industry 4.0 is upon us and causing us to rethink workflows, technology and their automation. As with all revolutions, the forth revolution brings with it significant challenges and opportunities to production processes; companies are finding new ways to achieve a level of flexibility in the production process that have previously been unthinkable. The concept of combining elements of mass production with those of bespoke tailoring is becoming a key request from customers. For machine builders, this means machines have to be flexible and guarantee the fastest possible production time with minimal cost. Today it's about combining cutting-edge technologies in a creative way.

Connected thinking

The potential for this combination is exhibited in a new demonstration unit, showcasing Staubli's robotic arm (TS2-60), HepcoMotion's GFX Guidance System and the Beckhoff eXtended Transport System (XTS) all cooperating in one cell demonstrating the joint potential they offer.

Stäubli's fast and precise robot interacts with an XTS linear transport system from Beckhoff, which is capable of individual carriage (mover) control and allows asynchronous process steps to be coordinated. With the combination of these two technologies, maximum through-put time can be achieved in a production cell. Hepco's GFX Guidance for XTS delivers a durable and accurate guidance system for use in conjunction with Beckhoff's XTS system. This powerful, reliable and accurate system, with its simple re-adjustment of carriages, provides the foundation to the system that guarantees smooth and efficient operation in a production unit.

Each of the component systems in the demonstration unit offer flexibility: the TS2-60 allows the manual change of various gripping arms, Beckhoff's XTS system facilitates change in cycle times and patterns in order to integrate additional processes, and GFX offers spatial flexibility, making it possible to adapt to what would usually be considered limited working envelopes. The combination of these systems has the potential for productivity optimisation of a manufacturing cell.

Practical examples:

Gefasoft, Germany, a developer of automation systems, designed a system for the inspection of automotive diffusers in such a way that batch sizes can be changed and, if required, additional work steps can be integrated to the process. This was achieved with the combination of Beckhoff's XTS system and Hepco's GFX system. Thanks to the ability to individually control movers

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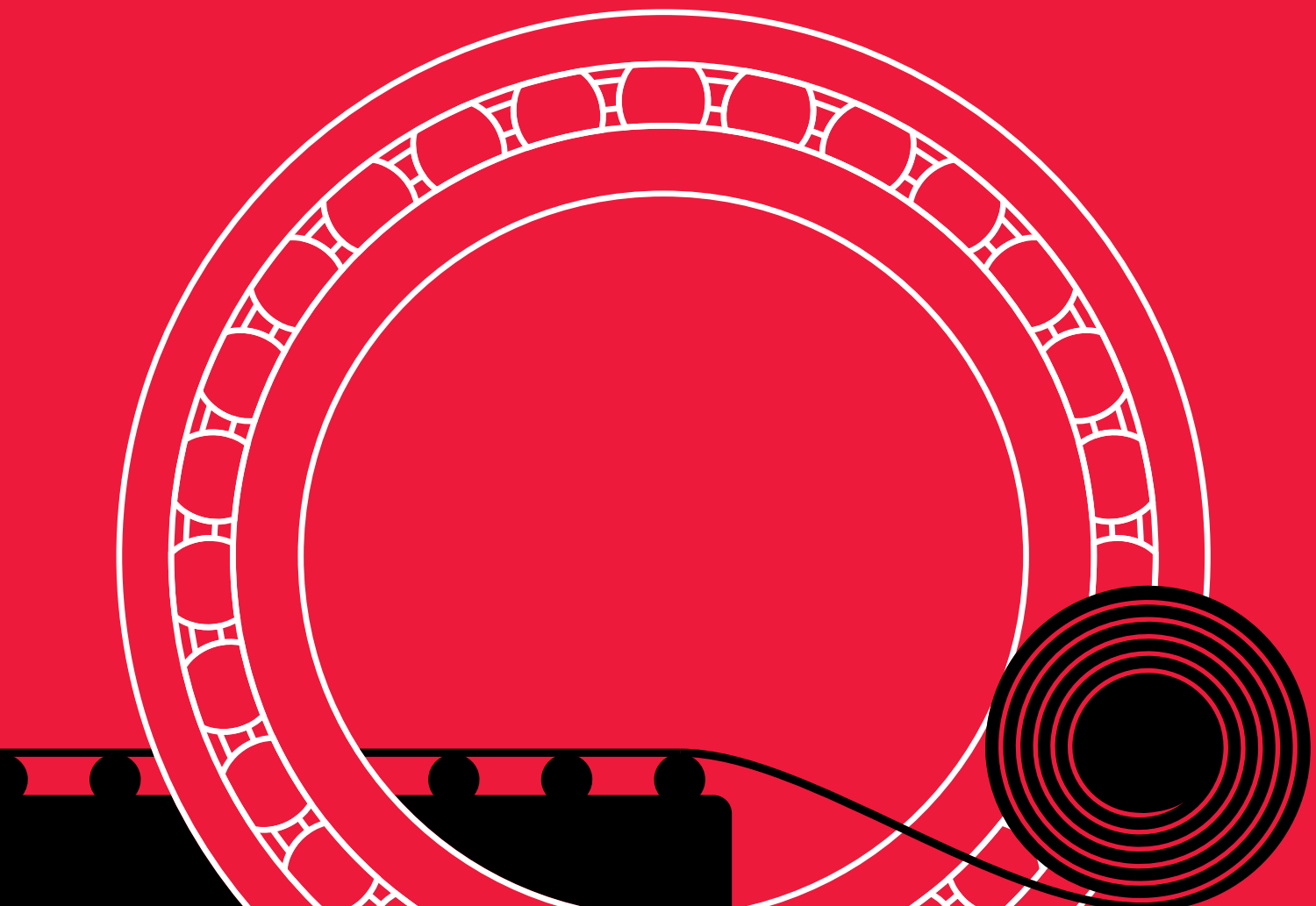

on the XTS, on the fly product changes are possible and additional steps can be included with the modification of software. The HepcoMotion 1-Trak-based GFX system was the perfect companion; the GFX system can accommodate higher loads and accelerations with improved life capacity whilst maintaining the positioning accuracy required. In addition, the carriages on the GFX system can easily be adjusted and maintained thanks to a small section of removable track, something of great importance in this system.

For Bosch Packaging Technology, the GFX and XTS systems were the ideal solution for combining three functions in a single machine. The Integrated Topload Cartoner, Kliklok ITC, straightens, loads and seals boxes of confectionary. With the combination of various individual functions in a single machine, it was necessary to maintain flexibility, for example allowing different sizes of carton to be processed. Hepco's three-bearing GFX mover is a lightweight carriage which offers smoother, quieter and faster movement than could be achieved with conventional guide systems.

These examples show the potential for the combination of different cutting-edge technologies and the ability of systems to be flexible to production changes. With the increasing complexity of production cells, the quality of each of the components in a machine is all the more important. Ultimately, the combination of components in a system determines its long term success.

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A real-world view of hybrid bearing life

A new modelling approach is helping engineers pick the right bearing for the right application

Hybrid bearings, which use ceramic rolling elements on steel raceways have some well-known advantages over their all steel counterparts. Those advantages include low weight, good electrical resistance and good performance under demanding lubrication and contamination conditions, characteristics that have earned hybrid bearings an important niche in specialist applications like high speed machine tool spindles for more than 50 years.

Over time, the range of possible uses for hybrid bearings has grown. In part this has been due to advances in manufacturing technology, which have brought down costs. But users have also found that in many circumstances ceramic rolling elements can outperform those in all-steel bearings. For example, they generally exhibit lower operating temperatures, are more resistant to surface damage from particulate matter, and do not suffer from the potential risk of steel-to-steel surface welding, which can occur in traditional bearings under extreme conditions. Additionally, hybrid bearings have a lower boundary-lubrication coefficient of friction, which allows them to function more efficiently in applications with poor lubrication.

Until now, however, it has been difficult for engineers to know in advance whether a hybrid bearing will outperform a steel one in their application, or whether the possible performance benefits are worth the extra cost. According to Guillermo Morales-Espejel, Principal Scientist as SKF Research and Technology Development, that's because the existing equations engineers normally use to calculate the rating life of a bearing don't reflect the real-world performance of hybrid designs.

"The conventional bearing life model is based on sub-surface fatigue," he explains. "As bearings rotate, their components are continually loaded and unloaded. Over millions of cycles, fatigue accumulates in the material, eventually leading to failure." Because fatigue behaviour is well-understood, engineers can plug information about the loads and speeds expected in their application into an equation to determine the rating life of a given bearing design. The dynamic load rating C, which can be found for any bearing in the SKF general catalogue or in the online product catalogue, is mainly used to quantify the sub-surface performance of the bearing."

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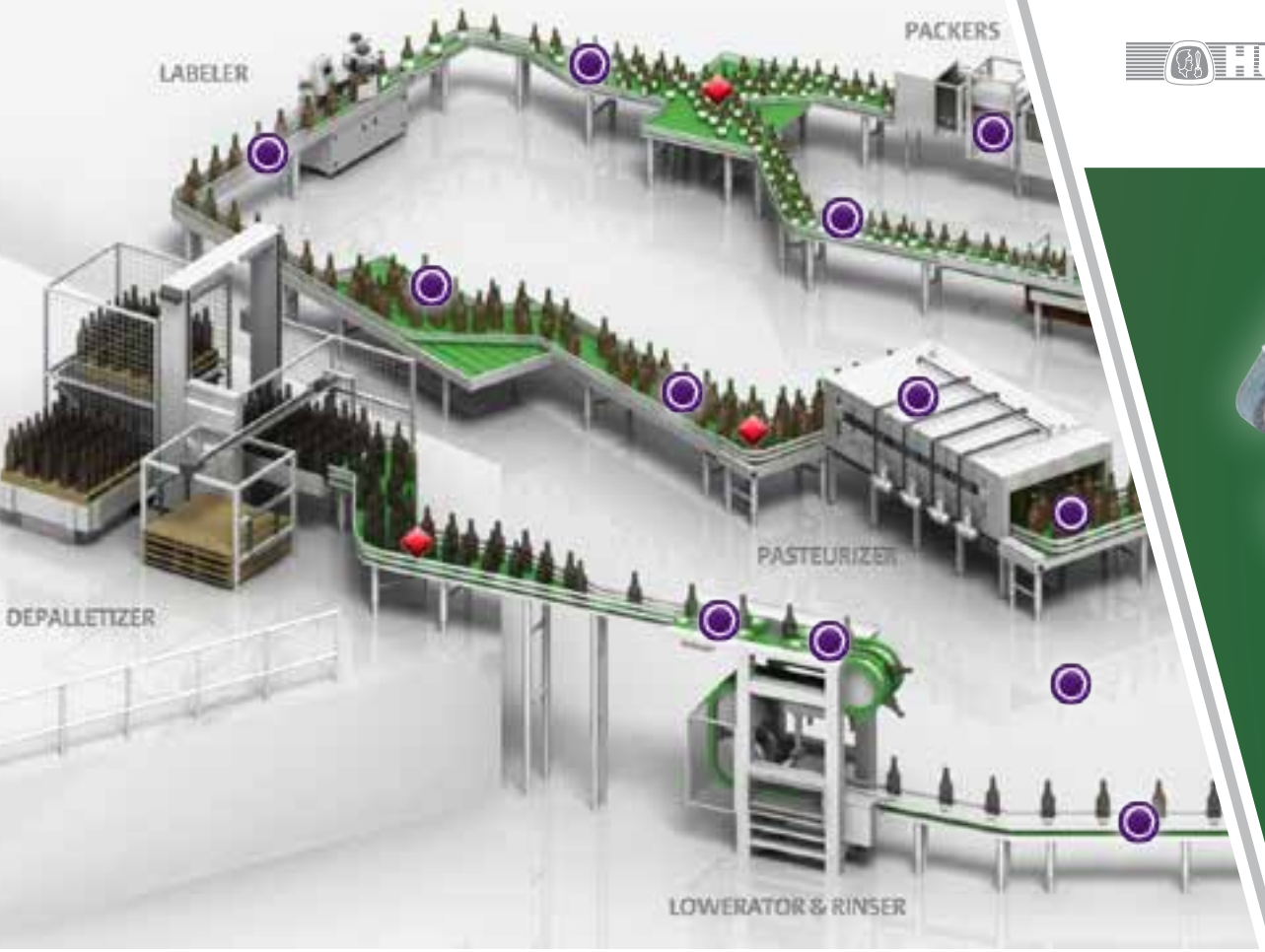

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This traditional model is widely used and incorporated into international standards, but Morales-Espejel notes that it doesn't show hybrid bearings in the best light. "Because the ceramic rolling elements are stiffer than steel, they deform less under load. That means loads are concentrated over a smaller area of material, increasing stress and accelerating sub-surface fatigue."

More significantly, however, real-world experience doesn't always align with the traditional model. "We know from experience in the field that the majority of bearings fail due to problems at the surface, not in the body of the material," explains Morales-Espejel. "The root cause is usually damage caused by poor lubrication or contamination." Nobody disputes that analysis, and modern standards such as ISO 281 include correction factors in an attempt to accommodate these effects.

A new model

Those correction factors didn't attempt to represent the real behaviour of bearings in service, however, so in 2012, Morales-Espejel and colleagues at SKF set out to do better. To create a new bearing life model, he says, they needed three things. "The first was a model of sub-surface fatigue within the material, which we already had. The second was a model for failure at the surface. The third was data from endurance tests that we could use to calibrate and validate our model."

The SKF team worked on the new model over the next two years, drawing on decades of study in materials science and tribology. The approach required a detailed understanding of the behaviour of bearing surfaces, from their friction characteristics to the way dirt particles indent them under load.

Although an initial concept model was presented as a Generalized Bearing Life Model (GBLM) in 2015 at the Hannover Messe, at that time it did not cover the modelling of hybrid bearings.

"One needs data to calibrate and then validate any bearing life model. To collect enough data for this, however, there is no substitute for hard craft. We needed data on the operating life of bearings over a wide range of loads and surface conditions," explains Morales-Espejel. "We were trying to build behaviour curves. For each point on the curves we needed to test around 30 bearings, with the expectation that several of them would fail." The SKF team also needed to compare bearings with steel

and ceramic rolling elements, and bearings operating with poor lubrication and in contaminated environments.

All this added up to hundreds of tested bearings. In total, the test programme and the adaptation of the concept model required a further four years of effort by scientists and technicians at SKF's facilities in the Netherlands and Austria.

The SKF team completed its new Generalized Bearing Life Model for hybrid bearings in mid 2018. The approach has since been tested and approved by an important group of company's application engineers, who used prototype versions of the model alongside conventional

bearing life estimation techniques, and compared its outputs to their real-world experience on customer projects.

Real life insights

What does the new model mean for engineers and designers? "We already knew that hybrid bearings had advantages in many commonly experienced conditions," explains Morales-Espejel. "When a bearing is heavily loaded, but able to run in a clean, well-lubricated environment, sub-surface fatigue is likely to be the ultimate failure mode, and a steel bearing may perform better than a hybrid. But a lot of bearings operate under lighter loads, but with a greater likelihood of poor lubrication or contamination. Our model will show if a hybrid solution would offer a longer life on those applications and will quantify the difference."

In a scientific paper presented earlier this year, Morales and his colleagues have run those calculations for four representative real-world applications. In the case of a pump bearing running with oil-bath lubrication and diluted oil resulting in poor lubrication, the rating life of a hybrid bearing was eight times longer than a steel equivalent. For a screw compressor bearing running with contaminated lubricant, the hybrid offered a rating life time a hundred times greater than a conventional steel bearing.

In the other two cases, which looked at an electric motor operating in clean, well-lubricated conditions under two different load regimes, the rating life of the hybrid bearing was very similar to the conventional bearing. The paper's authors note, however, that in these cases other potential benefits of hybrid technology, such as electrical resistance or a longer grease life, might be the decisive factors in bearing selection.

Morales-Espejel and his team have developed two variants of their Generalized Bearing Life Model for hybrid bearings: One version is set to be incorporated into the webtool "SKF Bearing Select" that SKF offers to its customers on-line and through dedicated software applications. A second, more sophisticated and complex variant, will be used by the company's application engineers to support customer projects.

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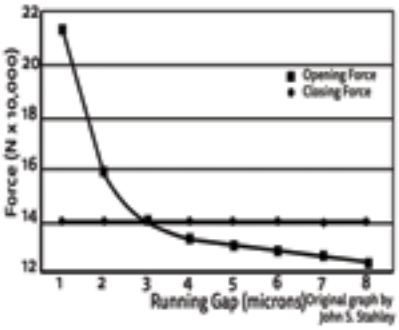
A New Way of Force Balancing Mechanical Seals

Pumps are one of the largest users of mechanical seals. As the name suggests, mechanical seals are contact-type seals, differentiated from aerodynamic or labyrinth non-contact seals. Mechanical seals are also characterized as balanced or unbalanced. This refers to what percentage of, if any, process pressure can come around behind the stationary seal face. If the seal face is not pushed against the spinning face (as in a pusher-type seal) or process fluid at the pressure that needs to be sealed is not allowed to get behind the seal face, the process pressure would blow the seal face back and open. The seal designer needs to consider all operating conditions to design a seal with the requisite closing force but not so much force that the unit loading at the dynamic seal face creates too much heat and wear. This is a delicate balance that makes or breaks pump reliability.

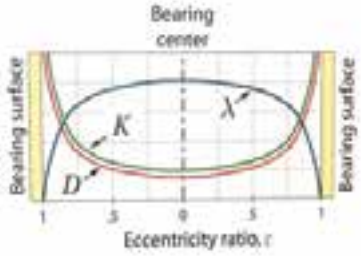
This article will describe a new or unconventional way to balance the contact forces of the dynamic seal faces by enabling an opening force rather than the conventional way of balancing the closing force, as described above. It does not eliminate the requisite closing force but gives the pump designer and user another knob to turn by allowing unweighting or unloading of the seal faces, while maintaining the needed closing force, thus reducing heat and wear while widening the possible operating conditions.

Dry Gas Seals (DGS), often used in compressors, provide an opening force at the seal faces. This force is created by an aerodynamic bearing principle, where fine pumping grooves help encourage gas from the high-pressure process side of the seal, into the gap and across the face of the seal as a non-contact fluid film bearing. As the closing force on the faces goes up, this aerodynamic bearing layer will get thinner but stiffer, as shown by Stahley (Image 1).



— Image 1 - The aerodynamic bearing opening force of a dry gas seal face. The slope of the line is representative of the stiffness at a gap. Note that the gap is in microns.

The same phenomenon occurs in the hydrodynamic oil bearings that support most large centrifugal compressors and pump rotors and is seen in rotor dynamic eccentricity plots shown by Bently (Image 2). This effect provides a stable back stop and is an important element in the success of hydrodynamic oil bearings and DGS. Mechanical seals do not have the fine pumping grooves that might be found in an aerodynamic DGS face. There may be a way to use externally pressurized gas bearing principles to unweight the closing force from the seal faces.



— Image 2 - Qualitative plots of fluid-film bearing parameters versus journal eccentricity ratio. Stiffness, K, and damping, D, are minimum when the journal is at the center of the bearing. As the journal nears the bearing surface, stiffness and damping increase dramatically.

Aerodynamic vs. Aerostatic

Externally pressurized aerostatic gas bearings employ a source of pressurized gas, whereas dynamic bearings use the relative motion between the surfaces to generate gap pressure. The externally pressurized technology has at least two fundamental advantages. First, the pressurized gas may be injected directly between the seal faces in a controlled fashion rather than encouraging the gas into the seal gap with shallow pumping grooves that require motion. This enables separating the seal faces before rotation starts. Even if the faces are wrung together, they will pop open for zero friction starts and stops when pressure is injected directly between

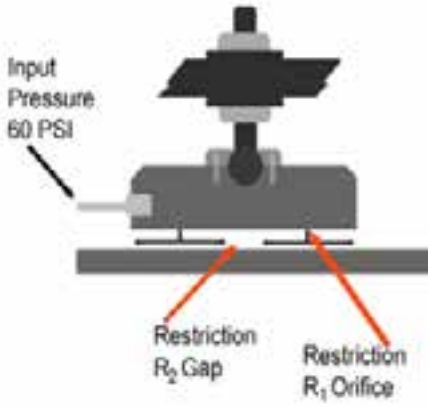
them. Additionally, if the seal is running hot, it is possible with external pressure to increase the pressure to the face of the seal. The gap then would increase proportionally with pressure, but the heat from shear would fall on a cube function of the gap. This gives the operator a new capability to leverage against heat generation.

There is another advantage in compressors in that there is no flow across the face as there is in a DGS. Instead, the highest pressure is between the seal faces, and the external pressure will flow into the atmosphere or vent into one side and into the compressor from the other side. This increases reliability by keeping the process out of the gap. In pumps this may not be an advantage as it can be undesirable to force a compressible gas into a pump. Compressible gases inside of pumps can cause cavitation or air hammer issues. It would be interesting, though, to have a non-contacting or friction-free seal for pumps without the disadvantage of gas flow into the pump process. Could it be possible to have an externally pressurized gas bearing with zero flow?

Compensation

All externally pressurized bearings have some sort of compensation. Compensation is a form of restriction that holds pressure back in reserve. The most common form of compensation is the use of orifices, but there are also groove, step and porous compensation techniques. Compensation enables bearings or seal faces to run close together without touching, because the closer they get, the higher the gas pressure between them gets, repelling the faces apart.

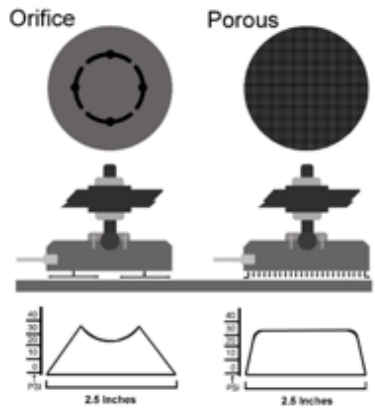
As an example, under a flat orifice compensated gas bearing (Image 3), the average pressure in the gap will equal the total load on the bearing divided by the face area, this is unit loading. If this source gas pressure is 60 pounds per square inch (psi) and the face has 10 square inch of area and there is 300 pounds of load, there will be an average of 30 psi in the bearing gap. Typically, the gap would be about 0.0003 inches, and because the gap is so small, the flow would only be about 0.2 standard cubic feet per minute (scfm). Because there is an orifice restrictor just before the gap holding pressure back in reserve, if the load increases to 400 pounds the bearing gap is reduced to about 0.0002 inches, restricting flow through the gap down 0.1 scfm. This increase in the second restriction gives the orifice restrictor enough flow to allow the average pressure in the gap to increase to 40 psi and support the increased load.



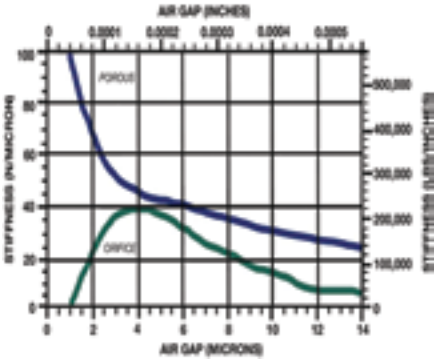
— Image 3 - This is a cutaway side view of a typical orifice air bearing found in a coordinate measuring machine (CMM). If a pneumatic system is to be considered a "compensated bearing" it needs to have a restriction upstream of the bearing gap restriction.

Orifice vs. Porous Compensation

Orifice compensation is the most widely used form of compensation (Image 4). A typical orifice may have a hole diameter of .010 inches, but as it is feeding a few square inches of area, it is feeding several orders of magnitude more area than itself, so the velocity of the gas can be high. Often, orifices are precisely cut from rubies or sapphires to avoid erosion of the orifice size and so changes in the performance of the bearing. Another issue is that at gaps below 0.0002 inches, the area around the orifice starts to choke the flow to the rest of the face, at which point collapse of the gas film occurs (Image 5). The same occurs at lift off, as only the area of the orifice and any grooves are available to initiate lift. This is one of the main reasons externally pressurized bearings are not seen in seal plans.



— Image 4 - The even pressure profile of porous gas bearings makes them more suited for application to sealing technology.



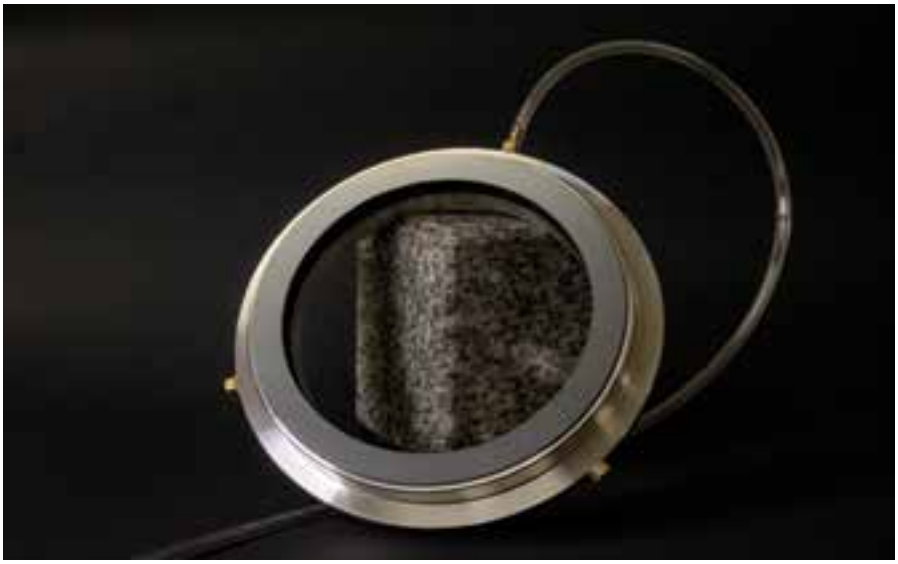
— Image 5 - Lift vs. load chart comparing orifice and porous externally pressurized gas bearings. At small gaps orifice bearings collapse but porous bearings behave as dry gas seals and oil bearings.

This is not the case for the porous compensated bearing, instead the stiffness continues to increase as load increases and the gap is reduced, just as the case with DGS (Image 1) and hydrodynamic oil bearings. In the case of externally pressurized porous bearings, the bearing will be in a balanced force mode when input pressure times the area equals the total load on the bearing. This is an interesting tribological case as there is zero lift or air gap. There will be zero flow, but the hydrostatic force of the air pressure against the counter surface under the face of the bearing still unweights the total load and results in a near zero coefficient of friction—even though the faces are still in contact.

For example, if a graphite seal face has an area of 10 square inches and 1,000 pounds of closing force and the graphite has a coefficient of friction of 0.1, it would require 100 pounds of force to initiate motion. But with an external pressure source of 100 psi ported through the porous graphite to its face, there would be essentially zero force required to initiate motion. This is despite the fact that there is still 1,000 pounds of closing force squeezing the two faces together and that the faces are in physical contact.

A class of plain bearing materials such as: graphite, carbons and ceramics such as alumina and silicon-carbides that are known to the turbo industries and are naturally porous so they can be used as externally pressurized bearings that are non-contacting fluid film bearings. There is a hybrid function where external pressure is used to unweight the contact pressure or the closing force of the seal from the tribology that is going on in the contacting seal faces. This allows the pump operator something to adjust outside of the pump to deal with problem applications and higher speed operations while using mechanical seals.

This principle also applies to brushes, commutators, exciters, or any contact conductor that may be used to take data or electric currents on or off rotating objects. As rotors spin faster and run out increases, it can be difficult to keep these devices in contact with the shaft, and it is often necessary to increase the spring pressure holding them against the shaft. Unfortunately, especially in the case of high-speed operation, this increase in contact force also results in more heat and wear. The same hybrid principle applied to mechanical seal faces described above can also be applied here, where physical contact is required for electrical conductivity between the stationary and rotating parts. The external pressure can be used like the pressure from a hydraulic cylinder to reduce the friction at the dynamic interface while still increasing the spring force or closing force required to keep the brush or seal face in contact with the rotating shaft.



—Image 6 – A mechanical seal face of porous graphite that has been lapped flat.

—Image 7 - A mechanical seal face of porous graphite showing air bleeding out of the flat lapped face. The input pressure may be adjusted to create a hydrostatic force reducing contact pressure.

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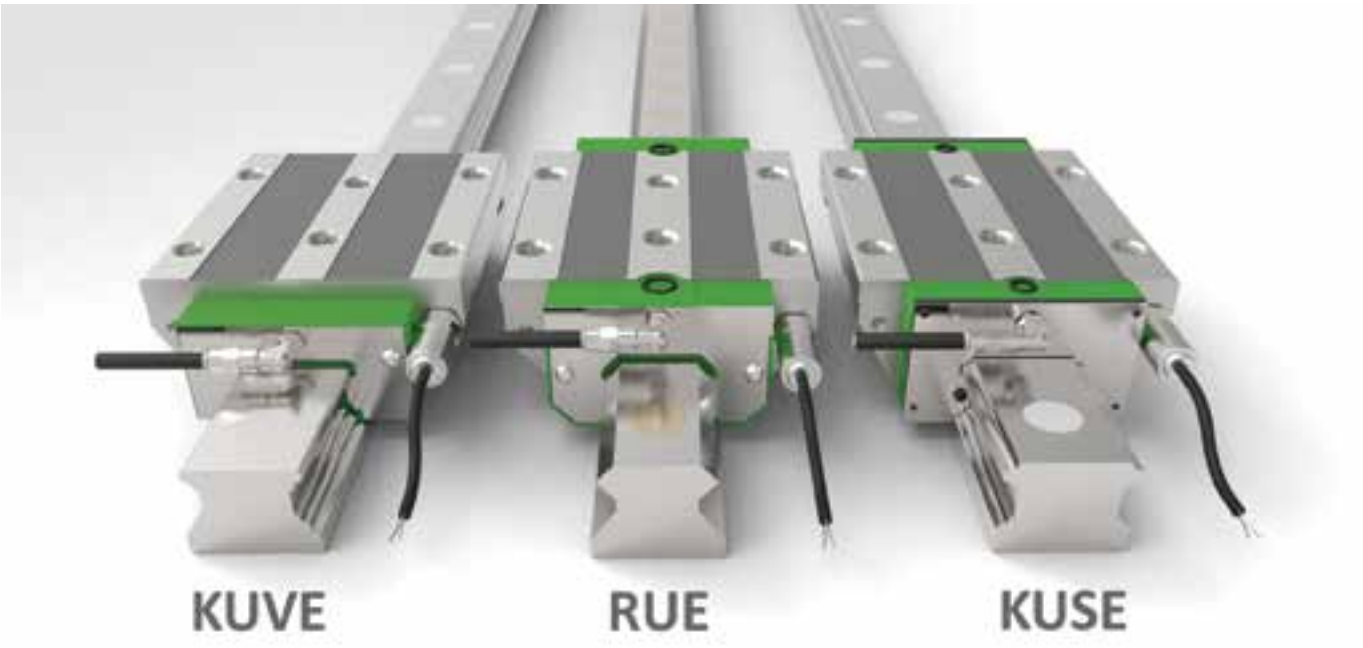
- Electromechanical linear actuators with planetary screw drives replace pneumatic and hydraulic drives
- ProLink condition monitoring system: Multi-channel solution for condition monitoring and universal gateway for Industry 4.0 solutions

Drive technology, industrial automation, and IT continue to grow closer together. This integration offers great potential for machine manufacturers and operators to increase performance and productivity and reduce costs. According to the organizers of Hannover Messe, "Industrial Intelligence" is a decisive factor in achieving this. At Schaeffler, outstanding mechanical expertise, comprehensive understanding of systems, and decades of experience in the condition monitoring of machines and equipment are directly integrated into the development of products and systems, whether mechanically or digitally. Customers experience the added value resulting from this in the form of reduced development times for their units, higher-performance machines, more flexible and reliable production close to the maximum capacity, and additional cost savings thanks to longer maintenance intervals. With innovative components, ready-to-install systems, and specific Industry 4.0 solutions, Schaeffler presented various new developments at the Hannover Messe, with which customers can get the maximum performance throughout the entire product lifecycle.



— Schaeffler's complete DuraSense range for the requirement-based automated relubrication of monorail guideway assemblies (KUVE four-row linear recirculating ball bearing and guideway assemblies, RUE linear recirculating roller bearing and guideway assemblies, and KUSE six-row linear recirculating ball bearing and guideway assemblies).

— The electronic evaluation system allows up to seven sensors to be connected in order to optimally monitor lubrication conditions in INA monorail guideway assemblies.

Digitalizing and accelerating the development process

Transferring gearbox models with the click of a mouse: Schaeffler has co-developed the new REXS data interface and implemented it in the company's own BEARINX calculation program. The engineers at the trade show booth demonstrated how quickly and easily gearbox data can be exchanged between CAE tools and the standardized interface. Development times are thus significantly shortened and a basis created for the generation of digital twins that can be used to analyze operating data as part of Industry 4.0 solutions, for example.

— Thanks to the standardized REXS data interface, repeated gearbox modeling processes are eliminated. Development times are thus significantly shortened and a basis created for the generation of digital twins that can be used to analyze operating data as part of Industry 4.0 solutions, for example.

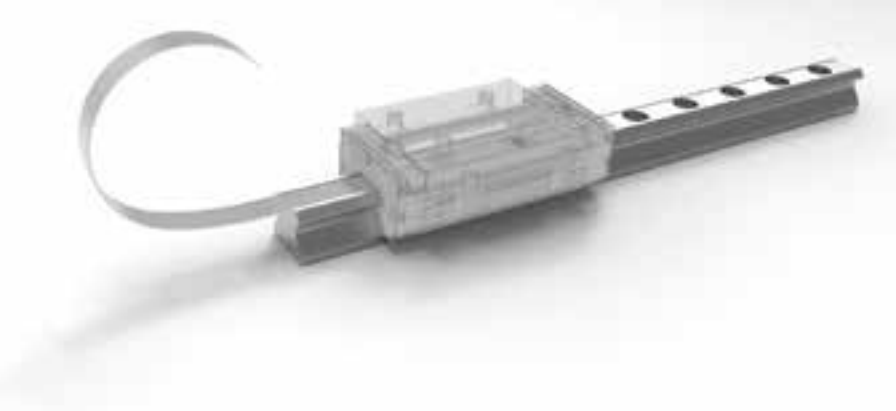
Reducing the range of variants and components

Interchangeable in the same design envelope: Schaeffler will be presented rolling bearings of different designs but with identical dimensions for modular gearbox systems. In this way, the different requirements for a bearing position regarding rigidity and load carrying capacity can be met without making any modifications to the design. The identical outside dimensions mean that special adapters and component variations (particularly for the shafts, housings, and housing covers) are no longer required. The reduced range of variants means larger quantities, lower unit costs, and shorter development and delivery times for gearbox manufacturers.

— Lower costs for modular gearbox systems: Gearbox bearings in different designs but with identical outside dimensions allow bearing supports to be optimized in terms of load carrying capacity, speed range, and rigidity.

Reducing up to 90 percent in mounting times

Installing the innovative sealing solutions for profiled guide rails is very easy: The new plastic closing plug can even be installed in a vertical position quickly and safely while the new cover strip provides free access to the fixing screws and allows alignment of the guide rail even while the carriage is still mounted. The first pilot customers have confirmed that mounting times are reduced by up to 90 percent.



— The new slide-in steel cover strip: Flexible enough for easy mounting while maintaining a high load carrying capacity when mounted.

—The new cover strip's innovative fixing system allows the entire length of the guide rails to be used by the guide carriages.

25 times the operating life

Two new materials are able to withstand very high forces: Spindle bearings achieve 25 times the operating life thanks to Vacrodur's extraordinarily high mechanical and thermal load carrying capacity, through which productivity of machine tools can be significantly increased. The maintenance intervals of extruder gearboxes can be extended from five to ten years by using carbonitrided bearings made from Mancrodur. Integrated in a linear actuator, Schaeffler's planetary screw drives (PWG) make a convincing case with their power density, which the example of an electromechanical riveting press illustrates. Compared with pneumatic drive solutions, an increase of up to 100 percent in output and a much more flexible process control have been realized here.

Industry 4.0 – optimizing operation and maintenance

For the first time, Schaeffler will be presenting its TorqueTracking system, which is an Industry 4.0 solution package for industrial drives. With a combination of vibration analysis and torque measurement, the drive can be operated reliably and close to its maximum capacity while maintenance can be planned and carried out based

— TorqueTracking: The new system comprising the Schaeffler TorqueSense and the Schaeffler SmartCheck offers automated, frequency-selective vibration analysis and temperature, speed, and torque values for condition and system monitoring.

— Schaeffler is currently developing an initial pilot project for Bonfiglioli's geared motors of yaw drives for wind turbines. In this application, the load data that are condensed using the Schaeffler SmartCheck are compared with predefined limit values and the results are transmitted wirelessly to Bonfiglioli via a gateway.

on the load conditions. This generally means that intervals are extended and maintenance costs are thus reduced.

With the new ProLink condition monitoring system (CMS), Schaeffler presented its new generation of a multi-channel system for the condition monitoring of complete production facilities using four to 16 channels, for example, in the paper and steel sectors or for machine tools. In addition, the ProLink CMS can be used as a universal gateway for connecting the sensor level with the control and management levels and even cloud applications.

— The main processor module and extension modules in Schaeffler's ProLink CMS are simply mounted on the switch cabinet's top hat rail. Thanks to its configuration assistant, templates, and self-learning test phase, customers no longer require any knowledge of signal recording or vibration analysis.

FASTER, BETTER, MORE USER-FRIENDLY: The New FVA-Workbench 5.5

Version 5.5 of the simulation platform for transmission systems, released in May, accelerates development processes and provides even more detailed calculation results.

This unique software includes the latest results from the FVA research network – new calculation methods for fast, precise results.

Fast development processes thanks to powerful performance and intuitive operation

The new FVA-Workbench is significantly faster and easier to use. Individual gearbox components to complete systems can be developed in the shortest time possible. During the calculation process, built-in wizards automatically suggest suitable values which can then be adjusted manually.

Simple modeling of complex planetary stages

Even complex planetary stages can now be modeled at lightning speed thanks to add-in wizards. Users can model very complex planetary gear designs (e.g., Ravigneaux and Wolfrom sets), from consideration of installation conditions to automatic calculation of dependent variables (such as center distances and addendum modifications), in the shortest time possible.

Flexible and adaptable to special designs

Values automatically assigned by wizards can be adapted to individual requirements at any time, so that symmetrical systems as well as planetary gears, in which the planets are distributed asymmetrically, can be calculated. Variations, such as bore tolerances for planet pins or stiffness-dependent load distribution, can also be considered.

New features improve the accuracy and detail of results

Operationally stable gear design with load spectra

In the new version of the software, load spectra are considered in system-level calculations for the first time. Users can determine the service life of cylindrical and bevel gears as well as rolling bearings, enabling operationally stable gearbox designs.

New features:

- Specification of Woehler S/N curves or calculation according to ISO 6336 and ISO 10300
- Calculation of scuffing and wear damage according to AGMA 925-A03
- Flank fracture calculation according to ISO 6336-4
- Wear calculation according to Plewe (1980)

FEM feature enables importing and meshing in seconds

In addition to planet carriers and gearbox casings, wheel bodies can now also be imported in many common CAD formats. First, the wheel body is automatically adapted to the FEM mesh of the gear. The FEM meshing as well as positioning and connection to the gear model are then performed in just a few seconds. Automation, interactive user navigation, and user-friendly assistants make these steps extremely simple.

“FEM feature enables importing and meshing in seconds
In addition to planet carriers and gearbox casings, wheel bodies can now also be imported in many common CAD formats. First, the wheel body is automatically adapted to the FEM mesh of the gear. The FEM meshing as well as positioning and connection to the gear model are then performed in just a few seconds. Automation, interactive user navigation, and user-friendly assistants make these steps extremely simple.”

Dr. Christoph Löpenhaus, Chief Engineer Gear Technology, Laboratory of Machine Tools (WZL) of RWTH Aachen

Realistic modeling of planet carriers, casings, and wheel bodies

Planet carriers, casings, and wheel bodies are realistically modeled using FEM. This also allows for problem-free interpretation of the calculation results. FE bodies are displayed in 3D, making it much easier to verify the validity of results.

New bevel gear calculations for fast, highly detailed analyses

The newly integrated BECAL 6 feature enables highly detailed analysis of bevel and hypoid gears. The results of FVA research projects 223 XII (local load capacity calculation) and 223 XV (contact pattern measurement) have also been integrated as calculation features.

New features:

- Local scuffing load capacity calculation according to Klein (FVA 519)
- Local micro-pitting resistance calculation according to Hombauer (FVA 516)
- Calculation and output of the dimensions of the numerically calculated contact pattern
- Quantitative comparison of the target and actual states of the shape and position of the contact pattern

> *The new BECAL 6 makes bevel gear calculations in the FVA-Workbench even more powerful and user-friendly. The available features make it possible to perform calculations according to the latest cutting-edge research.*
>
> *Dr. Stefan Schumann, Technische Universität Dresden, Institute of Machine Elements and Machine Design*

Easy output of results with drag-and-drop reports

With the reporting feature in the FVA-Workbench, customized reports can easily be created using drag & drop. Complex relationships are clearly visualized in structured sections, enabling effective evaluation of results.

Impress customers with even more report graphics

Version 5.5 includes more than 40 new display options for load spectra, force excitation of cylindrical gear stages, pressure distribution of worm stages, and more. Particularly impressive, the graphics of the HTML reports can be rotated and zoomed, and value pairs can be read directly. This provides customers and users the same interactive experience, and gear design modifications can be discussed as early as the product development phase.

About FVA GmbH:

FVA GmbH is a joint venture between FVA e.V. (Forschungsvereinigung Antriebstechnik, the Research Association for Drive Technology) and GzF (Gesellschaft zur Förderung des Maschinenbaues mbH, the Association for the Promotion of Mechanical Engineering) within VDMA (Verband Deutscher Maschinen- und Anlagenbau, the Mechanical Engineering Industry Association). Founded in 2010, FVA GmbH works hand-in-hand with top-level German research institutions and leading companies from the drive technology industry toward the active transfer of knowledge gained from FVA research projects into industrial practice. The company's core competencies are the development of calculation and simulation software for drive technology, the processing and migration of legacy code structures into modern software architecture, professional service and support, and technical seminars and conferences.

www.fva-service.de/en
#FVAWorkbench #FVADriveTechnology

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15 - 17 October 2019
Booth 3737

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We are proud to be a committed European manufacturer of Bearings,Transmissions and Linkages, we believe in the future of European manufacturing and will continue to focus and further enhance the requirements and expectations of our customers globally.

Therefore we are pleased to announce our latest product range of Dunlop premium 'Housed Bearing Units'. Manufactured in the UK and although of the highest quality priced to compete with all mid-level to high end competitor's brands.

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- **100% precision testing of alignment torque**
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- **Low noise retainer and low noise grease**
- **Tighter dimensional tolerances reduce vibration so that it dramatically increases bearing life**
- **Suitable for high speed applications**
- **UCPE has solid base for greater rigidity**
- **Nylon patched grub screw is proven to provide greater locking power between the bearing and shaft**
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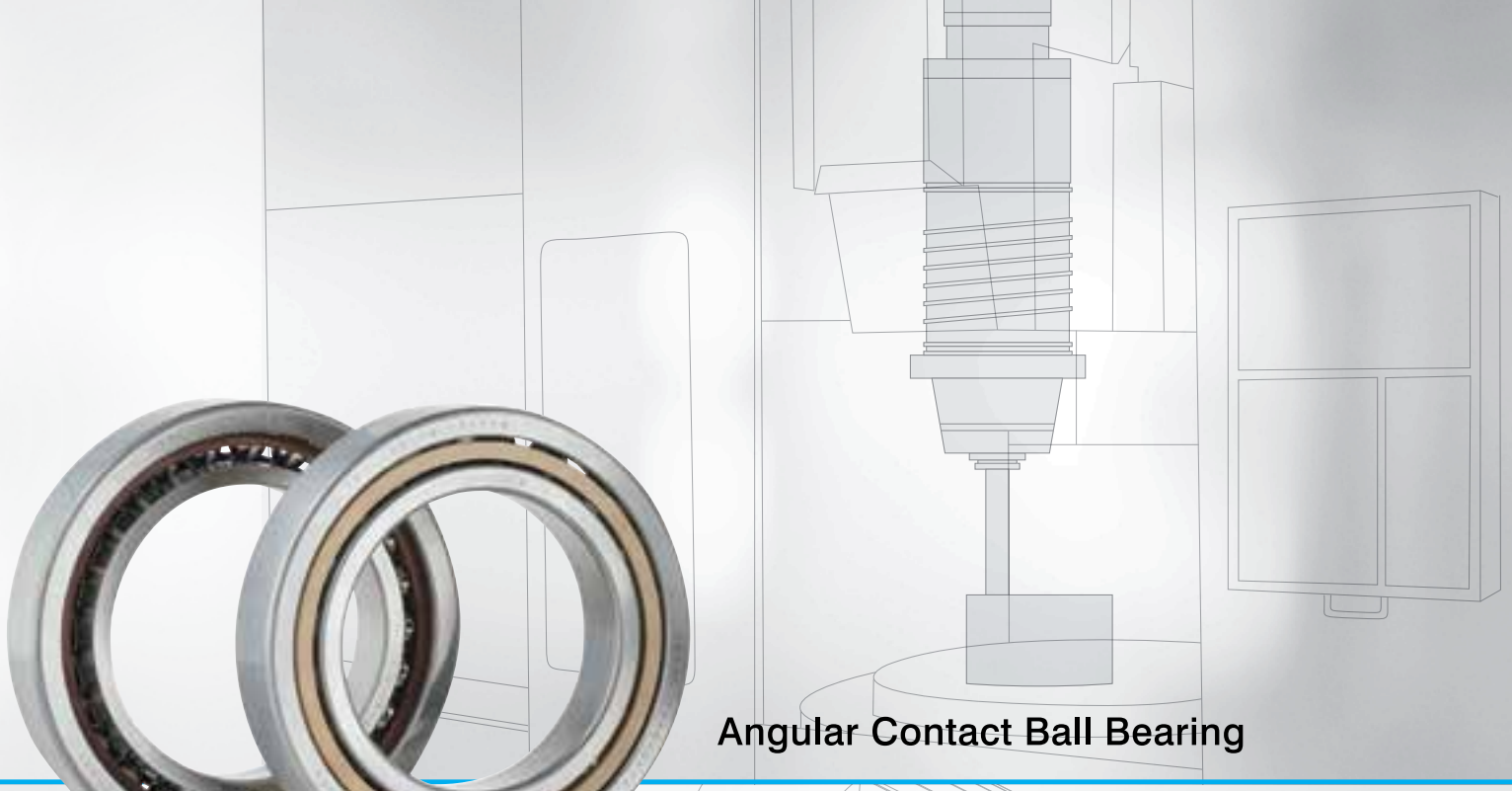

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JUNE - DECEMBER

2019 EVENTS EXHIBITIONS CONFERENCES

2019 AGENDA

EVENTS, EXHIBITIONS & CONFERENCES

JUNE

CONDITION MONITORING

IMVAC / CBM
03 Jun - 06 Jun 2019
Antwerp / Belgium

Condition monitoring and relibaility professionals conference & exhibition

www.thecbmconference.com/eu/

AUTOMOTIVE

AUTOMECHANIKA
04 Jun - 06 Jun 2019
Birmingham / UK

International automotive parts exhibition

www.automechanika-birmingham.com

CONSTRUCTION

CTT
04 Jun - 07 Jun 2019
Moscow / Russia

Part of BAUMA network

www.ctt-moscow.com

MEDIA PARTNER Bearing NEWS

MACHINE TOOLS

ITM POLSKA
04 Jun - 07 Jun 2019
Poznan/ Poland

Machine tools and metal working exhibition

www.itm-polska.pl

MINING

UGOL ROSSI&MINING
04 Jun - 07 Jun 2019
Novokutznetsk / Russia

Coal and metals mining, processing, handling expo

www.ugol-rossii.com

Bearing NEWS

AUTOMATION

ALL AUTOMATION
05 Jun - 06 Jun 2019
Essen / Germany

Regional automation show of Essen

www.automation-essen.com

2019 AGENDA

EVENTS, EXHIBITIONS & CONFERENCES

JUNE

AUTOMOTIVE

AUTOMECHANIKA

10 Jun - 12 Jun 2019
Dubai / UAE

International automotive parts exhibition

www.automechanikadubai.com

MATERIALS HANDLING

EXPO PACK

11 Jun - 13 Jun 2019
Guadalajara / Mexico

Mexican packing technology show

www.expopack.com.mx

MEDICAL TECHNOLOGY

MD&M EAST

11 Jun - 13 Jun 2019
New York / USA

Cutting-edge medical technology

www.mdmeast.mddionline.com

AEROSPACE

PARIS AIR SHOW

17 Jun - 23 Jun 2019
Paris / France

International aerospace exhibition

www.siae.fr

MOLDING

ROSMOULD

18 Jun - 20 Jun 2019
Moscow / Russia

Mold making machinery and tooling

www.rosmould.com

PACKAGING

ROSUPACK

18 Jun - 21 Jun 2019
Moscow / Russia

Exhibition for the packaging machinery

www.rosupack.com

INDUSTRY

MIDEST LYON

05 Mar - 08 Mar 2019
Lyon / France

Maintenance, subcontracting
and industrial equipment

www.midest.com

MANUFACTURING

FUTURE FACTORY

11 Mar - 12 Mar 2019
Mumbai / India

The SMART manufacturing event of India

www.futurefactoryindia.com

INDUSTRY

MANUFACTURING EXPO

12 Mar - 14 Mar 2019
Lagos /Nigeria

Manufacturing and equipment expo

www.nigeriamanufacturingexpo.com

MINING

DRC MINING WEEK

19 Jun - 21 Jun 2019
Lubumashi / Congo

The largest mining and industrial
platform in the DRC.

www.drcminingweek.com

FOOD & BEVERAGE

FISTAL TECNOLOGIA

25 Jun - 28 Jun 2019
Sao Paulo / Brazil

Food and beverage machinery
& processing event

www.fispaltecnologia.com.br

MOTION ELECTRONICS

PCIM ASIA

26 Jun - 28 Jun 2019
Shanghai / China

Power Conversion, Intelligent Motion
event in China, for specialists
in power electronics and its
applications in drive technologies

www.pcimasia-expo.com.cn

2019 AGENDA

EVENTS, EXHIBITIONS & CONFERENCES

JUNE

MOTION & DRIVE

IAMD SHENZEN

26 Jun - 28 Jun 2019
Shenzen / China

The largest and most influential motion & driven show in South China

www.ia-shenzhen.com

MEDIA PARTNER Bearing NEWS

JULY

TEXTILE MACHINERY

GFT

03 Jul - 06 Jul 2019
Bangkok / Thailand

Textile machinery exhibition

www.gftexpo.com

FOOD & BEVERAGE

FOOMA

09 Jul - 12 Jul 2019
Tokyo / Japan

Food & beverage exhibition

www.foomajapan.jp

AUTOMOTIVE

DRITEV

10 Jul - 11 Jul 2019
Bonn / Germany

Drivetrain system for vehicules and transmission developers conference

https://bit.ly/2AuNRLH

AUTOMOTIVE

AUTOMECHANIKA

10 Jul - 12 Jul 2019
Mexico City / Mexico

International automotive parts exhibition

www.paaceautomechanika.com

AUGUST

MACHINE TOOLS

DELHI MACHINE TOOL EXPO

08 Aug - 11 Aug 2019
New Delhi / India

The machine tool exhibition for North india

www.mtx.co.in

TEXTILE MACHINERY

GARTEX INDIA

10 Aug - 12 Aug 2019
New Delhi / India

GARTEX- complete garment manufacturing solutions show

www.gartexindia.com

MARINE

MARINTEC SOUTH AMERICA

13 Aug - 15 Aug 2019
Rio de Janeiro / Brazil

Maritieme maintenance and shipbuilding

www.marintecsa.com.br

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Shanghai

on 13– 16 May 2020

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2019 AGENDA

EVENTS, EXHIBITIONS & CONFERENCES

AUGUST

SEPTEMBER

AUTOMOTIVE

AUTOMECHANIKA MIMS MOSCOW

26 Aug - 29 Aug 2019
Moscow / Russia

23nd International Exhibition of Automotive Parts, Components, Car Maintenance Equipment and Products

www.mims.ru

MARINE

INAMARINE

28 Aug - 30 Aug 2019
Jakarta / Indonesia

Shipbuilding, offshore, marine equipment and machinery expo

www.inamarine-exhibition.net

MEDIA PARTNER Bearing NEWS

OFFSHORE

OFFSHORE EUROPE

03 Sep - 06 Sep 2019
Stavager / Norway

Biggest offshore event of Europe

www.offshore-europe.co.uk

FOOD & BEVERAGE

FOODWORLD ISTANBUL

04 Sep - 07 Sep 2019
Istanbul / Turkey

27th International Food Products & Processing Technologies Exhibition

www.worldfood-istanbul.com

MEDIA PARTNER Bearing NEWS

MARINE

BALTEXPO

09 Sep - 11 Sep 2019
Gdansk / Poland

Technologies and solutions available for the maritime industry.

www.baltexpo.ztw.pl

MACHINERY

TURBOMACHINERY & PUMP

10 Sep - 12 Sep 2019
Houston / USA

Turbomachinery & pump symponia

https://tps.tamu.edu

HUSUM WIND

HUSUM WIND

10 Sep - 13 Sep 2019
Husum / Germany

Wind industry exhibition

www.husumwind.com

INDUSTRY

MANUFACTURING EXPO

12 Mar - 14 Mar 2019
Lagos /Nigeria

Manufacturing and equipment expo

www.nigeriamanufacturingexpo.com

MINING

ELECTRA MINING BOTSWANA

10 Sep - 12 Sep 2019
Gaborone / Botswana

Mining, Industrial, Construction and Electrical Engineering Exhibition

www.electramining.co.bw

MANUFACTURING

HYBRID / COMPOSITES EUROPE

10 Sep - 12 Sep 2019
Stuttgart / Germany

Production of hybrid components and applications

www.hybrid-expo.com

AUTOMATION

ALL AUTOMATION

11 Sep - 12 Sep 2019
Leipzig / Germany

Regional automation show of Hamburg

www.automation-leipzig.com

2019 AGENDA

EVENTS, EXHIBITIONS & CONFERENCES

OCTOBER

PUMP & VALVES

PUMPS & VALVES
02 Oct - 03 Oct 2019
Rotterdam / Netherland

Pump and valves show of The Netherlands

www.easyfairs.com

AUTOMATION

MOTEK
07 Oct - 10 Oct 2019
Stuttgart / Germany

International trade fair for automation in production and assembly

www.motek-messe.de

GENERAL INDUSTRY

MSV Brno
07 Oct - 11 Oct 2019
Brno / Czech Republic

International engineering fair

www.bvv.cz

FOOD & BEVERAGE

AGROPRODMASH
07 Oct - 11 Oct 2019
Moscow / Russia

Machine & equipment for food and beverage industry

www.agroprodmash-expo.ru

MANUFACTURING

METALEX
10 Oct - 12 Oct 2019
Ho Chi Minh / Vietnam

Metalworking, components and subcontracting.

www.metalexvietnam.com

BEARING & POWER TRANMISSION

BEARING EXHIBITION
15 Oct - 16 Oct 2019
Mumbai / India

International bearing and power transmission industry exhibition and conference

www.bearing-expo.com

ORGANISER Bearing EXPO & Conference

INDUSTRY

HANNOVER MESSE SINGAPORE
22 Oct - 24 Oct 2019
Singapore / Singapore

Industrial transformation show

www.industrial-transformation.com

MEDIA PARTNER Bearing NEWS

POWER TRANSMISSION

PTC ASIA
23 Oct - 26 Oct 2019
Shanghai / China

Power transmission and control exhibition

www.ptc-asia.com

MEDIA PARTNER Bearing NEWS

BEARING & POWER TRANMISSION

BEARING CONFERENCE & PAVILION
23 Oct - 26 Oct 2019
Shanghai / China

International bearing industry conference

www.bearing-expo.com

ORGANISER Bearing EXPO & Conference

MATERIALS HANDLING

CEMAT ASIA
23 Oct - 26 Oct 2019
Shanghai / China

Material handling, automation, transport/logistics fair

www.cemat-asia.com

PACKAGING

EURASIA PACKAGING
23 Oct - 26 Oct 2019
Istanbul / Turkey

International packaging machinery fair

www.packagingfair.com

METAL

ANKIROS
25 Oct - 27 Oct 2019
Istanbul / Turkey

International Iron-Steel, Foundry and Non-Ferrous Metals Technology, Machinery and Products Trade Fair

www.messe.de

2019 AGENDA

EVENTS, EXHIBITIONS & CONFERENCES

SEPTEMBER

ENERGY

EPOCH 2019
16 Sep - 17 Sep 2019
Thessaloniki / Greece

Exploration and offshore production congress hub

www.oilepoch.com

MACHINE TOOLS

EMO HANNOVER
16 Sep - 21 Sep 2019
Hannover / Germany

International trade fair for metalworking

www.emo-hannover.de

MEDIA PARTNER Bearing NEWS

MACHINE TOOLS

MWCS
17 Sep - 21 Sep 2019
Shanghai / China

Metalworking and CNC Machine Tool Show

www.metalworkingchina.com

CONSTRUCTION

KAZCOMAK
18 Sep - 20 Sep 2019
Almaty / Kazakhstan

Kazakhstan road and heavy construction machinery exhibition

www.kazcomak.kz

MINING

MINING WORLD CENTRAL ASIA
18 Sep - 20 Sep 2019
Almaty / Kazakhstan

Central Asian mining exploration & mining equipment exhibition

www.miningworld.kz

MEDIA PARTNER Bearing NEWS

AUTOMATION

IAS
17 Sep - 21 Sep 2019
Shanghai / China

Largest industrial automation show of China

www.industrial-automation-show.com

MEDIA PARTNER Bearing NEWS

AUTOMOTIVE

AUTOMECHANIKA
18 Sep -21 Sep 2019
Johannesburg / South Africa

The World's Leading Trade Fair for the Automotive Service Industry

www.automechanikasa.co.za

MATERIALS HANDLING

CEMAT RUSSIA
24 Sep - 26 Sep 2019
Moscow / Russia

International Exhibition for materials handling, warehousing equipment and logistics

www.cemat-russia.ru

POWER TRANSMISSION

EPTDA CONVENTION
25 Sep - 27 Sep 2019
Tenerife / Spain

Annual event of the EMEA Power Transmission Distributors Association

www.eptda.org

MEDIA PARTNER Bearing NEWS

AUTOMATION

AUTOMATION EXPO
25 Sep - 28 Sep 2019
Mumbai / India

India's leading automation and instrumentation exhibition

www.automationindiaexpo.com

2019 AGENDA

EVENTS, EXHIBITIONS & CONFERENCES

NOVEMBER

MARINE

EUROPORT

05 Nov - 08 Nov 2019
RotterdaM / Netherland

Event focuses on specialised ships and the smart solutions

www.europort.nl

AGRICULTURE

AGRITECHNICA

10 Nov - 16 Nov 2019
Hannover / Germany

The leading agriculture machinery event

www.agritechnica.com

MEDIA PARTNER Bearing NEWS

ENERGY

POWER-GEN EUROPE

Paris / France
Shanghai / China

Power generation equipment, environmental control equipment and services

www.powergeneurope.com

COAL POWER PLANT

CICEME

21 Nov - 23 Nov 2019
Beijing / China

International Coal Equipment and MIning Technology Exhibition

www.ciceme.com

WINDPOWER

WINDEUROPE OFFSHORE

26 Nov - 28 Nov 2019
Copenhagen / Denmark

Wind Energy Exhibition

www.windeurope.org

DECEMBER

PAPER

PAPEREX SOUTH INDIA

03 Dec - 06 Dec 2019
New Delhi / India

Paper Industry Trade Fair

http://india.paperex-expo.com/Home

CONSTRUCTION

EXCON

10 Dec - 14 Dec 2019
Karnataka / India

Construction Equipment Exhibition

www.excon.in/aboutevent.php

MEDIA PARTNER Bearing NEWS

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Aerospace technology prolongs your bearing life

A beverage bottling plant was experiencing failures on the standard cam followers used in a case packer. Due to the environment, excessive corrosion was resulting in reduced bearing life, which required the cam followers to be replaced every three months.

The standard cam followers were replaced with McGill® CRES CAMROL® stainless steel cam followers, which were dimensionally interchangeable with standard cam followers.

In addition to the standard McGill CAMROL cam follower bearing features, CRES CAMROL cam followers utilize stainless steel materials, LUBRI-DISC® + seals and H1 food grade grease. Our seal design incorporates aerospace technology to help prolong bearing life in a variety of corrosive environments.

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PTC MDA ASIA

23-26 October 2019 ▪Shanghai, China

BearingEXPO Pavilion at PTC ASIA 2019

Bearing EXPO & Conference

The second edition of the International BearingEXPO & Conference in Shanghai will be held this year during the PTC ASIA show between 23 – 26 October 2019. After the successful introduction in 2018, the concept will be enlarged with the BearingEXPO Pavilion and B2B meetings, designed for the International bearing manufacturers, distributors, end-users and solution providers.

1,300+ exhibitors (2018)

70,000 sqm display area (2018)

100,616 visits (2018)

Previous big brands at PTC ASIA

C&U Cooperation and Unity · LYC · TIMKEN · SCHAEFFLER · ZWZ · SKF

Facts & Figures of PTC ASIA

Date	**23-26 October 2019**
Scale	**9 halls with nearly 100,000 sqm**
Exhibitors	**Around 1.500 exhibitors expected**
Visitors	**Over 100.616 visitors (2018)**
Location	**Shanghai New International Expo Center (SNIEC)**

Product categories of the BearingEXPO Pavilion

Bearings, Lubrication, Heating Equipment, Bearing Mounting Tools, Bearing Components, Various Solutions

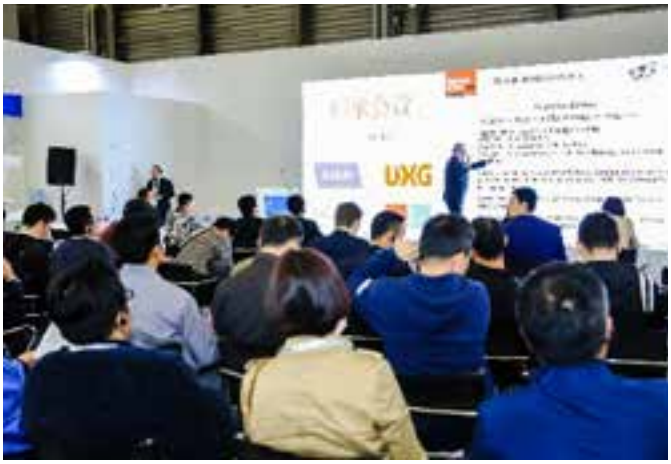
PTC MDA ASIA

PTC ASIA 2019
Location: SHANGHAI
Date: 23-26 October 2019

This event includes:
- BearingEXPO Pavilion
- Bearing Conference
- B2B Meetings

www.ptc-asia.com

BearingEXPO Pavilion at PTC ASIA 2019



What is BearingEXPO & Conference

BearingEXPO & Conference Shanghai at the PTC ASIA 2019 is the meeting point for the bearing and rolling equipment components industry during a 4 days exhibition, conference and B2B meeting sessions – serving a wide scope of local and International audience of bearing manufacturers, distributors, solution providers and end-users.

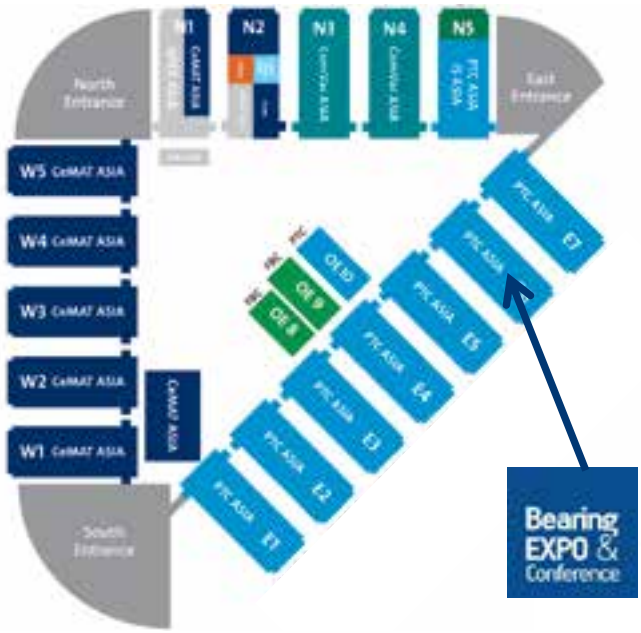
The bearing and power transmission industry is worldwide in a transformation and undergoes a rapid change due to various conjunctural developments, rising protectionism, environmental issues, digitalization and increasing steel prices – which creates both threads and opportunities for companies. China is the fastest rising global economy with many investments in local manufacturing, increasing demand for bearing and power transmission products and growing imports and exports at the same time.

BearingEXPO aims to create synergy between the participating sector companies by exchanging ideas for common challenges during the exhibition and B2B meeting sessions and sharing the latest available market knowledge, technologies, innovative products and services during the conference – all dedicated for the bearing, power transmission, lubrication and maintenance domains.

Top 7 reasons to attend

- **Meet potential customers for your offered solutions and products**
- **Increase your brand's visibility with the PTC ASIA's and BearingEXPO sponsorship opportunities**
- **Meet potential suppliers and diversify your product and solutions portfolio**
- **Gain inside information, share and generate new ideas, and discuss industry related issues with professionals during the conference**
- **Stay up-to-date on new technologies from international key note speakers**
- **Develop powerful connections with local and international bearing and PT/MC industry contacts**
- **Enjoy China and gather inspiring impressions from your stay in Shanghai**

Map of exhibition grounds



www.ptc-asia.com

BearingEXPO Pavilion at PTC ASIA 2019

BearingEXPO Pavilion

Stand price	RMB/sqm (incl. 6% VAT)
Unit price (1 sqm)	2,125.30
6 sqm	12,751.80
9 sqm	19,127.70
18 sqm	38,255.40

BearingEXPO Pavilion stand package includes:

- Carpeting
- Reception table with 1 barstool
- Round table
- 3 black leather arm chairs
- Waste basket
- Fascia board
- 500 W socket
- Storage room (for 9 sqm and 18 sqm stand)
- Stand building system (4 m height)

BearingNews.com and the exhibition organizer offer exhibitors extensive support to make a participation as easy and convenient as possible. Potential exhibitors will be informed about all possible participation and additional service options. In addition to the group pavilion, BearingNews.com will also offer speaking possibilities at the BearingEXPO Conference and matchmaking services during the exhibition.

Reserve a spot until **June 31st!**

To sign up or for more information about BearingEXPO at PTC ASIA, please contact us!

Kenan Özcan
Founder of BearingNews.com

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Email info@bearing-expo.co
Web www.bearing-expo.com

www.ptc-asia.com

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Bearing EXPO & Conference

India 2019

15 - 16 October

"International Event for Bearing & Rolling Equipment Components Industry"

www.bearing-expo.com/india2019

Connect to the worldwide bearing industry network

ORGANIZED BY Bearing NEWS Bearing CLOUD.com

What is BearingEXPO India 2019 ?

BearingEXPO India is the meeting point for the bearing and rolling equipment components industry during a **2 days exhibition, conference and B2B meeting sessions** – serving a wide scope of local and International audience of manufacturers, distributors, solution providers and end-users.

The bearing and power transmission industry is worldwide in a transformation and undergoes a rapid change due to various conjunctural developements, rising protectionism, environmental issues, digitalization and increasing steel prices - which creates both threads and opportunities for companies. India is the fastest rising global economy with many investments in local manufacturing, increasing demand for bearing and power transmission products and growing imports and exports at the same time.

BearingEXPO aims to create synergy between the participating sector companies by exchanging ideas for common challenges during the exhibition and B2B meeting sessions and sharing the latest available market knowledge, technologies, innovative products and services during the conference - all dedicated for the bearing, power transmission, lubrication and maintenance domains.

Facts & Figures

2500+ m2
display area

2.000+
trade visitors

30+
countries

15+
speakers

120+
exhibitors

Why Attend BearingEXPO ?

TOP 10 REASONS TO ATTEND

BearingEXPO India covers every facet for the bearing manufacturer, distributor, solution providerand end-user in one single event.

1. **Meet potential customers** - find new customers for your offered solutions and products

2. **Increase your company visibility** - promote your company, products and solutions with the exhibition and sponsorship opportunities

3. **Expand sales network** - expand your distributors network in India and abroad

4. **Meet potential suppliers** - meet new potential suppliers and diversify your product and solutions portfolio

5. **Gain insight information and generate ideas** - share ideas, knowledge and discuss industry related issues with professionals during the workshops, conference presentations in order to generate ideas to address specific needs

6. **Stay up-to-date on new technologies** - get new ideas and insight information from International key note speakers

7. **Experience all facets of your industry** - get in touch with the manufacturing, distribution, solutions and application examples of bearing and related products for 2 days

8. **Develop powerful connections** - exchange ideas with colleagues and expand professional relationships with local Indian and International bearing and PT/MC industry contacts

9. **Plan company visits** - visit potential customer and supplier companies before or after the event

10. **Enjoy India** - enjoy your time in Mumbai

WHO ATTENDS

Make your plans now to attend the BearingEXPO India exhibition, B2B meetings and conference to network with and exchange information from the following audience:

Exhibitors

- Global & Local Bearing Manufacturers
- Power Transmission Companies
- International and Local Distributor Companies
- Lubrication Companies
- Equipment Manufacturers
- Bearing Production Machinery Companies
- Solution Providers
- Engineering Companies
- Associations and Service Organizations

Exhibition Visitors / Conference Attendees

- Manufacturers
- Distributors
- Service Providers
- Mechanical Engineers
- Reliability Engineers
- Lubrication Engineers
- Maintenance Engineers
- Machinery Engineers

Industries

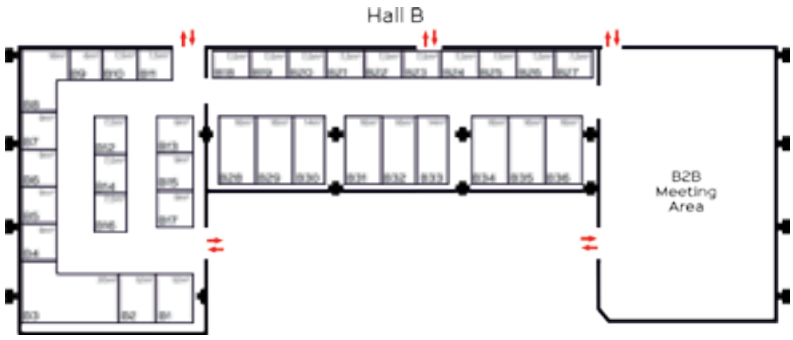
- Bearing and Power Transmission
- Motion and Drives
- Maintenance
- Energy Industry
- Automotive Components
- Steel Production
- Cement Plants
- Mining Professionals
- Food and Beverage Production
- Off-highway and Construction

Exhibition & B2B Meetings

THE BEARING WORLD AT ONE PLACE

Visit the extended exhibition halls and discover products, tools and solutions among the comprehensive group of global and local companies representing various aspects of the bearing and power transmission industry.

With more than 2.500m² of exhibit hall space, visitors can meet more than 100 exhibitors highlighting unique solutions and services for 2 days. Network with colleagues during the exhibition, lunch breaks, coffee breaks and B2B meetings to expand professional relationships.



EXHIBITORS & SPONSORS

CONFERENCE SPONSORS

MEDIA PARTNERS

Conference

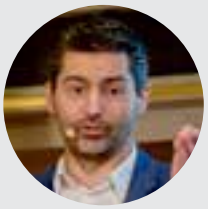
KEY NOTE SPEAKERS AND TOPICS

The bearing conference will exist out of both commercial and technical presentations focusing on the current market situation - development of bearing suppliers and quality control processes - bearing rout cause failure analysis for heavy applications - technical insights about Industrial IOT - precision engineering techniques and new technologies.

The commercial topics will cover the first half day, while the technical and engineering topics will cover 1,5 day of the 2 days conference incl. the workshops designed for engineers and end-users.

More speakers and topics will be shared closer to the event date.

Dave Hull
Pcomponents (USA)



Steve Quintijn
Regal Beloit (Belgium)

Hagen Elgeti
Elgeti Engineering (Germany)

Trinath Sahoo
India Oil

Cheng Kai
UXG Bearing factory (China)

Vikas Manral
Bearing Expert (India)

Per Arnold Elqvist
Tribologia (Sweden)

Bhagwan Shekhawat
URB (India)

David Beattie
DASH Engineering (Australia)

more speakers
will be announced...

Venue & Accommodation

NEHRU CENTRE

The BearingEXPO India event will be held at the Nehru Centre which has two large exhibition halls on the ground floor and three halls on the second floor of the "Discovery of India" building. The bearing conference will be held at the "Hall of Culture" on the main floor.

Several national and the international exhibitions and conferences are held in these air-conditioned facilities, which is located close to the centrum of Mumbai.

Location Map of Nehru Centre
Dr. Annie Besant Road, Worli 400018 Mumbai – India

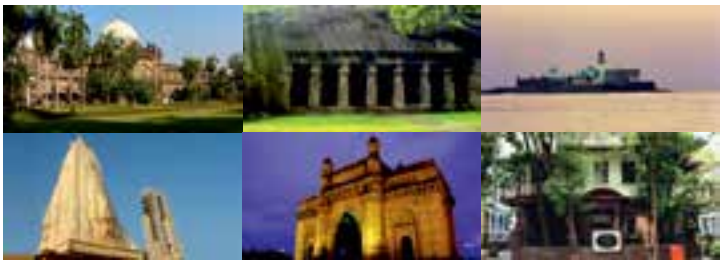
TRIDENT, NARIMAN POINT

The accommodation and daily bus transfers to the Nehru Centre will be organized for international and local participants from the Trident Hotel, Nariman Point. The hotel is nestled in the heart of vibrant and bustling Mumbai. Soaring 35 storeys high, it offers panoramic views of Marine Drive and the ocean.

With its 555 rooms and suites - Trident, Nariman Point is ranked amongst the best hotel in Mumbai. Head to one of the hotel's award winning restaurants - Frangipani or "India Jones", which offers cuisine ranging from Indian to Italian and Asian. You can relax and rejuvenate in the calm environs of the Trident Spa or recharge with an energising workout in the fitness centre.

EXPLORE MUMBAI

Mumbai or Bombay, the capital of Maharashtra, is the largest city in India. With an estimated population of 17 million, it is also one of the largest cities in the world. Mumbai is a vibrant, fast paced city, always on the move. Referred to as the 'Maximum City' , it is the business and commercial capital of India. A cosmopolitan hub home to a unique blend of cultures, it also nurtures the Hindi film industry, popularly referred to as 'Bollywood'.



Registration & Participation Options

RESERVE YOUR BOOTH

The key booth locations go fast, so reserve your exhibition space now! Spending 2 days at the BearingEXPO exhibition hall is equivalent to months of travel and hours of phone calls and meetings.

BearingEXPO India 2019 will provide the perfect setting for prospective customers to come to you.

BECOME A SPONSOR

Increase your visibility before, during and after the BearingEXPO India 2019 event. Contact us for your customized onsite, print and online marketing support.

BearingEXPO India 2019 Options

Exhibition Visitors	Conference Registration	B2B Meetings	Exhibitor Registration
FREE Registration	On Invitation	550$	Contact Us

How to register

Check the most up-to-date information and register online at www.bearing-expo.com/india2019	Send us all your questions concerning BearingEXPO India 2019 at info@bearing-expo.com	You can call us Monday - Friday 9 a.m - 6 p.m. (GMT) 0032 489 328 521

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ENGINEERING TABLE	
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outer)	27.5° Ref.
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Made-to-print **CUSTOM** Bearings

- Unique Materials
- Shorter Lead Times
- Application Engineering Support
- Small and Large Quantities





✓ ISO9001 CERTIFIED

✓ AS9100 CERTIFIED

✓ NADCAP CHEMICAL PROCESSING

Submission deadline for
abstracts: 15 September, 2019

Call for Papers

BEARING WORLD by FVA

3rd International FVA-Conference

The Expert Forum for Bearings – Rolling and Plain Bearings!

31 March – 1 April, 2020 in Hannover, Germany

FVA sharing drive innovation

#BEARINGWORLD
#FVABearings

fva-net.de
bearingworld.org

INVITATION

**BEARING WORLD presented by FVA –
Third expert forum "Industrial Research and Science in Dialogue with Practical Application" focusing on the topic of bearings in theory and application.**

Ladies and gentlemen,

In technology, wherever there is movement, rolling element and plain bearings are an essential. This is true for general mechanical engineering, the automotive industry and others. Bearings transmit operating forces between moving machine components, and therefore play a crucial role in functionality, efficiency, and service life of the overall machine or system. The stresses on rolling bearings in particular are very high, and will continue to increase in the future, as will expectations of reliability. Therefore, appropriate bearing selection and dimensioning as well as the optimal design of the bearing environment are indispensable. This requires constant growth in expertise based on practical experience and scientific knowledge. This includes, for example, bearing installation to ensure optimum clearance and preload, lubrication and sealing design, corrosion protection, condition monitoring, and targeted improvements based on extensive failure analysis.

BEARING WORLD focuses on all aspects of bearings.

The goal of BEARING WORLD is to promote the exchange of knowledge and experience between universities and engineers from the industry who are involved in or responsible for the design, development, manufacturing and assembly, or the practical operation or maintenance of bearings.

Be part of it! Contribute to the programme by providing your knowledge and experience, and take advantage of the opportunity to share information!

We look forward to receiving your proposals for the FVA-BEARING WORLD.

The BEARING WORLD Programme Committee

PRIMARY TOPICS

BEARING WORLD focuses on all facets of bearings and all involved components, with special emphasis on rolling bearings – in combination with or comparison to plain or magnetic bearings.

» Drive technology applications and challenges to bearings
» Calculation and bearing dimensioning
» Life and durability
» Energy efficiency
» Rolling bearing dynamics
» NVH (noise, vibration, harshness)
» Bearing damage
» Protective seals for rolling bearings
» Manufacturing aspects, tolerances
» Validation
» Lubrication
» Lab testing vs. field performance
» Smart bearings
» Model-based systems engineering

Trade exhibition

Offer the participants further information about your presentation at your company stand at the trade fair. Information on the exhibition can be found at **bearingworld.org.**

Programme Committee

Dirk Arnold, Forschungsvereinigung Antriebstechnik e.V.
Dr. Victor Aul, ZF Friedrichshafen AG
Dr. Elmar Busche, Volkswagen AG
Prof. Brigitte Clausen, Leibniz-Institut IWT Bremen
Dr. Ralf Dinter, Siemens AG
Wolfgang Gläntz, SKF GmbH
Dr. Christoph Hentschke, RENK AG
Prof. Georg Jacobs, MSE RWTH Aachen University
Prof. Eckard Kirchner, pmd TU Darmstadt
Dr. Oliver Koch, Schaeffler Technologies AG & Co. KG
Prof. Erhard Leidich, IKAT TU Chemnitz
Prof. Gerhard Poll, IMKT Leibniz Universität Hannover
Dr. Volker Rombach, NTN Wälzlager (Europa) GmbH
Prof. Bernd Sauer, MEGT University of Kaiserslautern
Prof. Hubert Schwarze, ITR TU Clausthal
Prof. Sandro Wartzack, KTmfk Uni Erlangen-Nürnberg
Andreas Weber, Vestas Nacelles Deutschland GmbH

Scientific Board

More than thirty renowned scientists from 11 countries from all over the world are gathered here. They review and evaluate the conference presentations before they are published in the Bearing World Journal. In addition, some of them will be available at the conference as moderators, speakers and discussion partners.

Industrial research and science in dialogue with practice – this is what makes the international FVA-Expert Forum Bearing World a special event you shouldn't miss.
Be there – whether as a speaker or participant.
See you in Hannover 2020!

Image Sources: FVA e.V., juergenmai.com, Schaeffler Technologies AG & Co. KG, SKF GmbH

SUBMISSION CONDITIONS

Please submit your abstract by
15 September, 2019

» Please use the online portal at bearingworld.org to submit your abstract. Abstracts must include the name, address, telephone number and e-mail address of all authors and must be assigned to one of the main topics.
» The conference will be held in English.
» Conference report for the conference proceedings in English.
» Presentation slides in English.
» Each presenter will be allocated 20 minutes for presentation plus 5 minutes for discussion.
» Participants will receive download links for authorised presentations after the conference.

Key Deadlines

Deadline for abstracts: **15 September, 2019**
Submission of Conference report: **31 January, 2020**

Process

All abstracts will be submitted to the Programme Committee for selection.

Peer-Reviewed Bearing World Journal

Additionally, it is possible to publish your contribution as extended paper in our high-class scientific "Bearing World Journal", which will be published after the congress. Please mark the checkbox in submission form if you are interested in that.

Benefits for Presenters

» Free participation in the conference
» Refreshments and evening event
» Free copy of the conference proceedings
» Optional publication in scientific "Bearing World Journal"
» Free copy of scientific "Bearing World Journal"

Organisation

Head of Programme Committee and Scientific Board, Editor of Bearing World Journal
Prof. Gerhard Poll, IMKT Leibniz Universität Hannover

Conference Organisation

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Technical Sponsor
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Lyoner Strasse 18, D-60528 Frankfurt

Organiser
FVA GmbH, Lyoner Strasse 18, D-60528 Frankfurt

More information at fva-net.de

Media partner:

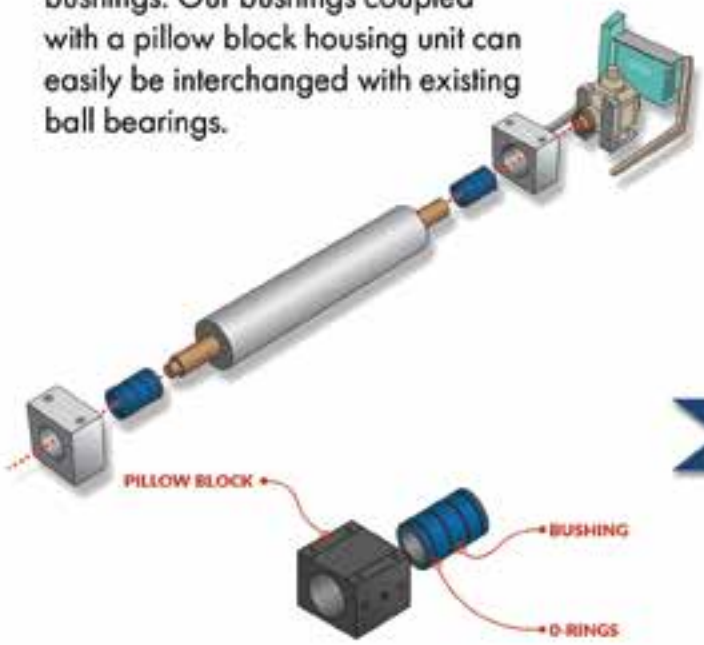
NEWWAY®
air bearings

AIR BUSHINGS 101

Your primer on this versatile energy-efficient component with all the benefits of Frictionless Motion®

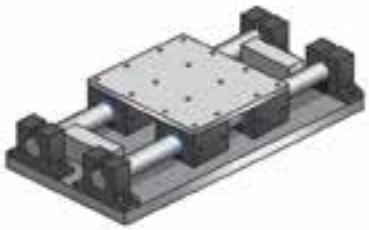
RETROFIT OPTIONS

You don't need a new system to experience the benefits of air bushings. Our bushings coupled with a pillow block housing unit can easily be interchanged with existing ball bearings.



AIR BUSHING APPLICATIONS

Versatile in nature, air bushings can be used in linear and rotary applications and often are found where precision in both motions are required concurrently.



LINEAR MOTION

ROTARY MOTION

POROUS MEDIA TECHNOLOGY

New Way Porous Media™ Technology distributes air evenly through millions of sub-micron sized pores across the entire bearing face. This is easily demonstrated by holding the bearing underwater.

OPERATIONAL BENEFITS

ENERGY SAVINGS

80% reduction in energy draw
Air bearings are silent

ULTRA PRECISE

Zero friction for infinite motion resolution
No asynchronous motion for excellent axis of rotation precision

OIL FREE

No oil to collect dirt
No maintenance
No product contamination

IMPROVED RELIABILITY

No moving parts, No physical contact
Carbon is a good plain bearing in the case of contact

BEARING & GEARBOX SEMINARS

USA (INDIANA) SEPTEMBER 2018

SEMINAR PROGRAM

BEARINGS

7th of October 2019
Development of bearing suppliers and quality control during purchasing

8th of October 2019
Basics of bearing technology

9th of October 2019
Bearing failures: Investigation and analysis of practical examples

GEARBOXES

10th of October 2019
Preventive maintenance and condition monitoring of industrial gearboxes

11th of October 2019
Supplier development for large industrial gearboxes and quality control during purchasing

BEARING SEMINARS

Development of bearing suppliers and quality control during purchasing

7th of October 2019, 10:00 a.m. – 05:00 p.m.

Global sourcing of bearings opens plenty of opportunities for optimization of supply chains. However, any new supplier approval goes along with a certain quality risk. Therefore, this seminar is focused on the following subjects:

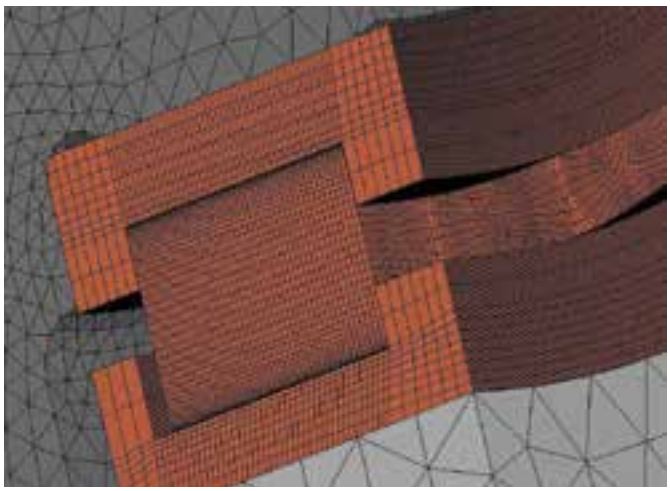
1. Definition of quality requirements, technical specifications
2. Approach during supplier visits and audits
3. Requirements related to documentation of production
4. Methods for incoming inspection
5. Concepts for quality control

Basics of bearing technology

8th of October 2019, 10:00 a.m. – 05:00 p.m.

This one day seminar provides basic knowledge especially for design of bearing arrangements and for quality assurance during purchasing. Lectures shall focus especially on:

1. Types, Properties, Concepts
2. Basics of Tribology
3. Raceway crowning
4. Material properties
5. Sample assessement



Bearing Failures: Investigation and analysis of practical examples

9th of October 2019, 10:00 a.m. – 05:00 p.m.

Identification and understanding of failure root causes is necessary in order to initiate the required counter measures. Therefore, this seminar shall show based on practical examples how damage characteristics can be identified and to which conclusion they lead. Main topics are especially:

1. Methods for damage investigation
2. Damage mechanisms
3. Quality characteristics of bearings
4. Examples from numerous applications

GEARBOX SEMINARS

Preventive maintenance and condition monitoring of industrial gearboxes

10th of October 2019, 10:00 a.m. – 05:00 p.m.

In many technical systems, breakdowns of particular components lead to enormous subsequent costs as production will be affected significantly. Detection of damages at early stages can lead to minimization of downtime and helps to avoid secondary damages by which overall breakdown costs can be highly reduced. Therefore, this seminar refers to the following topics:

1. Investigation of lubricants
2. Regular inspection and endoscopy
3. Vibration measurement and analysis of obtained results
4. Automation of shutdown in case of detected defect

Supplier development for large industrial gearboxes and quality control during purchasing

11th of October 2019, 10:00 a.m. – 05:00 p.m.

Large industrial gearboxes are typically produced in small series while frequently, individual solutions are requested which require close collaboration between supplier and customer. Here, especially clear communication of requirements, verification of technical concepts and of course the general assessment of production processes are essential. Accordingly, the topics of this seminar are:

1. Structure and content of technical specifications
2. Verification of technical documents such as drawings, stress and lifetime calculations of shafts, gearings, bearings and housings
3. Approach during supplier visits and audits
4. Requirements related to documentation of production
5. Methods for incoming and production related inspection

“Special Deals“

BEARING PACKAGE

- ☑ Development of bearing suppliers and quality control during purchasing
- ☑ Basics of bearing technology
- ☑ Bearing failures: Investigation and analysis of practical examples

GEARBOX PACKAGE

- ☑ Bearing failures: Investigation and analysis of practical examples
- ☑ Preventive maintenance and condition monitoring of industrial gearboxes
- ☑ Supplier development for large industrial gearboxes and quality control

GROUP-RATES

- ☑ Special rates for groups of the three people.
- ☑ For larges groups, individials quotes will be prepared.

You can download the registration form and all the seminar details on the Elgeti Engineering website at **www.elgeti-engineering.de** in order to susbcribe for one or more of the training seminars or contact Ms. Carolin Cosler on **cc@elgeti-engineering.de** or call **+49 241 169 193 25**

Elgeti Engineering USA Inc.
Ms. Carolin Cosler
2909 Village Lane #3C
Valparaiso, IN-46383
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Fax: +49 241 169 193 0

Ring Specialist

for Bearing Application

Dimensional Range from 3 to 300 mm

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PROSINO

The best choice among bearing producers

NSK launches J-Line

– a new range of JIS standard bearing units

NSK is expanding its existing RHP branded Self-Lube® range of bearing units to include products made to the JIS standard. With this new J-Line series, NSK also introduces a new packaging design.

— NSK J-Line units comprise a wide selection of bearings and housings

The J-Line bearing units comprise six of the most popular housing types: pillow block with/without feet, square and round flange, two-hole flange, and take-up unit. Also available are three pressed-steel housings and five inserts (wide and narrow set screw, wide and narrow lock collar, and adaptor sleeve) covering bore diameters that range from 12 to 90mm. The units are built on demand, offering the highest flexibility for customers.

J-Line bearing units will be easily identifiable in their new, fresh NSK packaging design for the European market.

Ready to ship from April 2019, J-Line bearing units are suitable for use in sectors that include agriculture, cement, construction, food, material handling, packaging, paper, steel, textiles and many others.

To help simplify selection, NSK has published a new Bearing Unit Catalogue containing both J-Line and Self-Lube ranges. An electronic version will be placed on the NSK website ready for download.

About NSK Europe

NSK Europe Ltd. is the European organisation of the Tokyo-based bearing manufacturer NSK, which was founded in Japan in 1916 and today employs around 31,000 people in its worldwide operations. The products and solutions provided by the industrial and automotive supplier can be found wherever things move. In addition to nearly all types

of rolling bearings, the company's portfolio includes housed bearings, linear technology, wheel bearing units, transmission and engine bearings and steering systems. The company is oriented to perfection in all of its business activities. Its aim is quality leadership in its industry, which it strives for through a continuous process of improvement, excellent product development, optimised production processes and customer-oriented service processes.

www.nskeurope.com

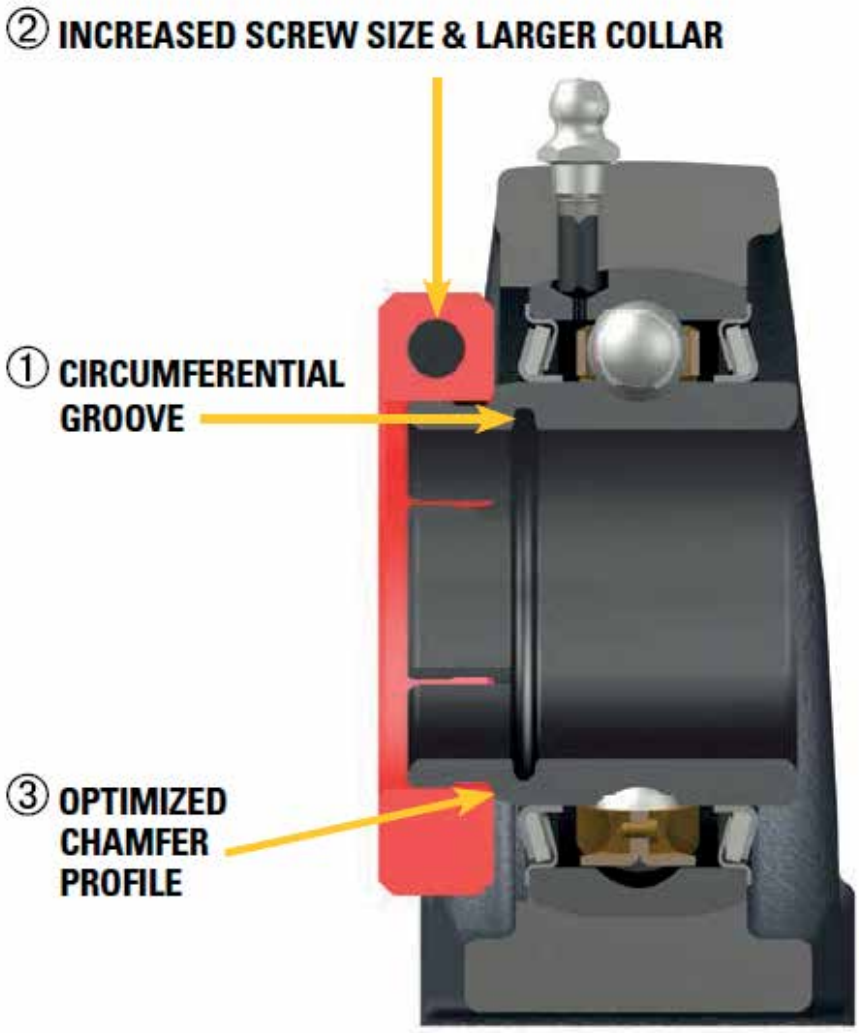
— The new packaging for NSK J-Line bearings

What If...
YOU COULD IMPROVE LOCK RELIABILITY?

Sealmaster® Next Generation Skwezloc® Concentric Lock Design

Originally designed and patented in 1966, Sealmaster® SKWEZLOC® concentric lock has become synonymous with concentric locking. Through extensive research, it has been found that an overwhelming majority of Sealmaster customers prefer concentric locking for ease of installation but were seeking a design that met their shaft tolerances, ultimately leading to the Next Generation Skwezloc design. The Skwezloc concentric locking collar has been redesigned to provides improved lock reliability on turned, ground and polished (TG&P) shaft tolerances and now accommodates commercial turned and polished (T&P) shafting.

Due to the innovative circumferential groove on the inner ring bore that improves shaft grip, this locking collar clamp results in near perfect concentricity of the shaft to bearing bore and maintains near perfect ball path roundness. A larger cap screw and collar also improves the clamping force and holding power to the shaft. By reducing stress on the inner ring and adding a groove the decouples from the inner ring to improve elasticity, the next generation Skwezloc locking collar has a design that meets the customer shaft tolerance need.



This design utilizes the same simple single screw installation of preceding models that prevents axial movement while also eliminating the risk of preloading the bearing, which are concerns when using an adapter lock design. The collar has a TORX® Plus head cup screw that outlasts stripping 12 times longer than hex head cap screws.

In laboratory push off testing, the Next Generation design resulted in a 113% holding force improvement on commercial grade Turned and Polished shafting versus the leading competitor. For original equipment manufacturers and end users that are currently using TG&P shafts, a 25% to 35% cost savings on shafting might be possible if the shafting specification is changed to commercial T&P!

The Sealmaster next generation Skwezloc concentric lock design is one of the newest innovations from Regal that puts our customers one step closer to creating a better tomorrow.

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