

ENTER FOR A CHANCE TO WIN!

Win a Jura espresso machine!

Actual prize similar to image shown



CONTEST: What is the name of the new INA series for high-precision rotary table bearing supports with a directly integrated absolute-value angle-measuring system?

Please enter the correct answer on the coupon shown on the right. Complete the form and return it to:

Schaeffler Technologies AG & Co. KG
Production Machinery and Linear Technology Business Unit
IEBSWE-SM
Georg-Schaefer-Straße 30
D-97421 Schweinfurt

Fax: +49 (0) 9721 911 435
Closing date: September 30, 2014

There is no legal recourse. Employees of Schaeffler Technologies AG & Co. KG and trading partners are not permitted to take part.

Yes, please enter me in the prize drawing to win a Jura espresso machine.

SOLUTION:

Last name, first name: _____

Company: _____

Street/No.: _____

City/postal code: _____

Tel.: _____

Fax: _____

E-Mail: _____

We would appreciate your responses to the following questions: Did we get your address right? Please let us know of any changes we need to make. (Please print letters)

Who else in your company should receive "added competence"?

What improvements would you like to see in the Production Machinery and Linear Technology Business Unit of Schaeffler Technologies AG & Co. KG?

LAST BUT NOT LEAST



Presenting the Schaeffler Mounting Toolbox: Rolling Bearing Installation in Action!

When installing a rolling bearing, even miniscule mistakes can have serious and costly consequences. To help avoid such calamitous events, Schaeffler's web-based Mounting Toolbox shows how the pros mount rolling bearings. Not only can visitors of this site learn about the necessary tools and materials for such an undertaking, they can also watch short video sequences demonstrating how these tools are used. A virtual manufacturing plant serves as the site's interface and provides an interactive navigation experience. Want to look over the shoulders of the experts from Schaeffler's Mounting Services team? All it takes is an Internet connection!

You can even watch the mounting of rolling bearings on your smartphone – any time, any place.



<http://mounting-toolbox.schaeffler.de/en/index.html>

About added competence

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WHAT'S NEW

INA's New YRTSMA-Series

Rotary table bearings with integrated absolute-value angle-measuring system, Page 3



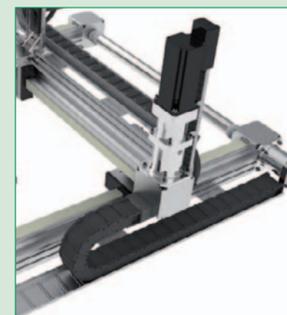
Highlights for the Main Spindle

New high-speed BAX-series main spindle bearings, Page 4



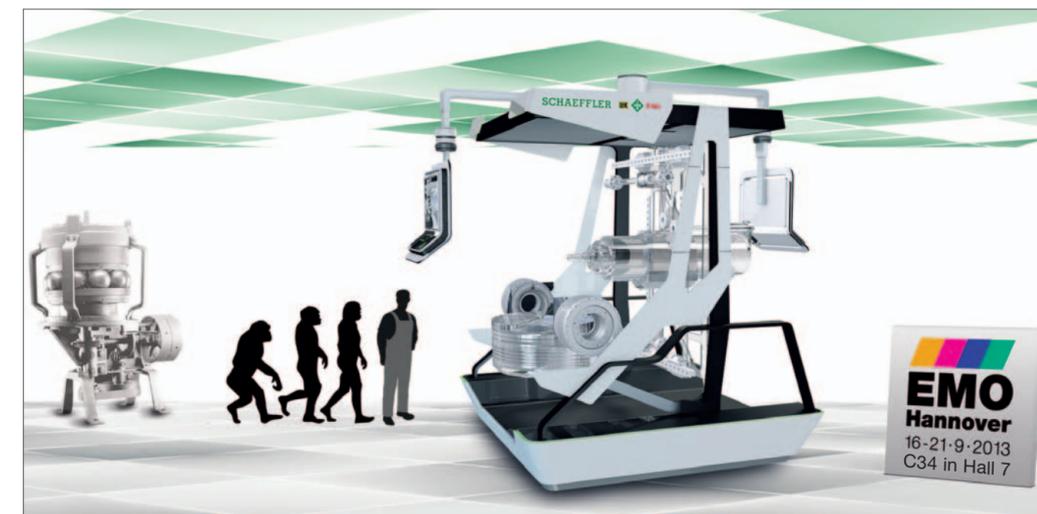
Linear Technology Highlights

Multi-axis positioning units as ready-to-fit system solutions, Page 5



Revolutions that work!

added competence for machine tools



The „transparent machine tool“ with modern Schaeffler products, a success story that began with the invention of the ball grinding machine.

A "transparent machine tool" awaits you at our booth C34 in Hall 7 at the EMO trade fair in Hannover. This ingenious display gives you a fascinating look into the heart of the machine tool, specifically the point at which the forces are transferred and the machine literally begins to do its work. You will be amazed – not only by a host of evolutionary advancements, but also by revolutionary shifts in the standards for bearings located inside the machine tool. In terms of a revolution, we offer the YRTSMA absolute angle-measuring system for high-precision rotary axes: the first of its kind anywhere in the world to be integrated directly in the bearing (see article on page 3). Our integrated magnetic travel-measuring system for linear axes (LMSA) also belongs in this "revolutionary" category.

While the many incremental yet unfailingly dependable performance improvements may draw less attention to themselves, they tend to be the primary drivers of technological progress – a process that, by its nature, is more evolutionary than revolutionary. These advancements can also be seen in the "transparent machine tool."

Innovative linear solutions
You can expect valuable insights into our innovative linear solutions (see article on page 5), such as

- Our RUE25-E lubrication-optimized linear recirculating roller bearing and guideway assembly
- The 2nd generation of our compact hydrostatic linear guidance system HLE.

Options for the main spindle
Also on display: new options for the main spindle (see article on page 4), which include

- Longer service life for greased spindle bearings
- New RS main spindle bearings with optimized friction characteristics
- Temperature fluctuation-resistant TR high-precision cylindrical roller bearings for motor spindles.

The highest-performance rotary axis
High-performance rotary tables can enable an entire machine tool to rise above the competition. To that end, we present **The world's highest-performance rotary axis** that has been – yet again – further optimized by combining our super-fast ZKLDF..B bearing with an RKI torque motor from IDAM (see article on page 3).

Extremely efficient service products for machine tools
Expressly tailored to your application needs: our extremely efficient service products for machine tools (see article on page 6), which include

- Monitoring and diagnostic systems to enhance quality and process reliability
- Our BEARINX[®] calculation program for rolling bearings – unrivaled and unmatched throughout the world!

These are some of the other products from Schaeffler Group Industrial that combine our expertise with that of our partners to deliver "added competence for machine tools." Regardless of whether our advancements are evolutionary or revolutionary – what matters is that they work extremely well, deliver a profitable return for our company and move the industry forward. Which is exactly the case with **Revolutions that work!**

For further details, please visit our special EMO website. Don't forget to take a peek inside the "transparent machine tool" at one of the upcoming trade shows (see page 8)!



PREVIEW of Issue 2014

1. TELOS for EHD lubricating film simulation
2. Magnetic paste as a universal design element

Congratulations to the Winner of Our Quiz in Issue 1/2012



Schaeffler employee Rainer Kurz (right) presents an iPad 4 to Markus Rall from the Ostfildern headquarters of our distribution partner Josef Blässinger GmbH + Co. KG.



+++ NEWSTICKER +++ NEWSTICKER +++ NEWSTICKER +++ NEWSTICKER +++ NEWSTICKER +++ NEWSTICKER

Come see the Schaeffler Group at **ITMA Asia + CITME in Shanghai** from June 16-20, 2014, at **IMTS in Chicago** from September 8-13, 2014 and at **AMB in Stuttgart** from September 16-20, 2014.



+++ NEWSTICKER +++ NEWSTICKER +++ NEWSTICKER +++ NEWSTICKER +++ NEWSTICKER +++ NEWSTICKER

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Editorial

Far More than Just a Trade Show Slogan – ^Revolutions that work!



This year's trade show slogan – ^Revolutions that work! – neatly captures not only Schaeffler's portfolio of products & services for machine tools, it also sums up the developments in this industrial sector as a whole. There is a lot going on here; sometimes, frankly, things seem to be spinning in reverse, but over the medium term, we are moving forward. This is largely due to the fact that our products work really well and offer an extremely competitive "bang for the buck." Schaeffler's bearing solutions, direct drive technology and service offerings are found in nearly every machine tool around the world – this applies to standard products as well as customer-specific components. Accordingly, you will definitely find lots of useful information for your own applications in this latest issue of our "added competence" magazine.

I believe in the above motto on a personal level as well, because after many years as President of the Production Machinery business unit, the wheel of life is turning in a 'revolutionary' manner for me as well: on August 1, 2013, I assumed the position of Industrial President Greater China in Shanghai.

My successor as President - Production Machinery, Mr. Dipl.-Ing. Martin Schreiber, presumably needs no special introduction. After all, he has held various management positions in our business unit for over 20 years. Before taking on an overseas assignment, he was Director of Business Development/Sector Management – Production Machinery. Over the past 15 months, Mr. Schreiber was responsible for

Schaeffler Industrial in the Asia/Pacific region as Senior Vice President – Sector Management & Industrial Aftermarket.

As you can see, on a personal level, both of us take a sporting approach to this ^Revolutions that work! motto. After all, we want to live up to the challenge of this rapidly accelerating globalization in our particular business by being flexible ourselves and by broadening our horizons to even better meet your expectations.

So the motto ^Revolutions that work! works on a variety of levels – on a personal level as well as in regard to products and sectors. And we hope that it works for you, too, as you flip through the pages of this magazine. Enjoy!

With my sincerest thanks for the outstanding cooperation over the past years and in joyful anticipation of the new challenges ahead with all of you,

Helmut Bode *Martin Schreiber*
Helmut Bode Martin Schreiber

President Production Machinery and Linear Technology Business Unit Schaeffler Technologies AG & Co. KG



Schaeffler Receives "Supplier of the Year" Award from Gildemeister In recognition of excellent delivery reliability and quality

Earlier this year, Gildemeister, a leading global manufacturer of cutting-machine tools offering a wide range of innovative high-tech machines, services and software solutions, named Schaeffler its "Supplier of the Year" for 2012. Robert Schullan, Member of the Executive Board at Schaeffler AG and President of Schaeffler Industrial, accepted the award from Timo Rickermann, Head of Corporate Purchasing at Gildemeister AG, in Pfronten.

After receiving the 2011 "Supplier of the Year" award in the "Quality" category, the fact that Schaeffler has now gone one better by winning the overall prize is a reflection of the company's extensive capabilities as a supplier. Because while the award is a testament to outstanding quality, it also recognizes Schaeffler's ability to innovate and deliver – on time. These are traits that apply to both companies in equal measure; they are essential for ensuring sustained competitiveness on an international level and for guaranteeing enduring customer relationships.

and efficiently, thanks to its fast response times and a high level of flexibility. Their global proximity to our Gildemeister locations also ensures optimum customer support, provided by highly capable representatives that are always close by," noted Rickermann.

The supplier award honors the successful teamwork between Gildemeister and Schaeffler. In their manufacturing processes and development projects,

both companies place their trust in each other's expertise and products. As an integral part of Gildemeister machine tools, Schaeffler's entire product portfolio of high-precision rotary table and spindle bearings, ball-screw support bearings and numerous linear technology components provide value and reliability.

According to Schullan, "As a company, we are honored that Gildemeister has once again recognized its enduring and successful partnership with Schaeffler, this time in the highest category of all. It represents yet another testament to the fact that Schaeffler, with its uncompromising quality standards and the abiding commitment of its employees, lives up to the highest standards."



The Gildemeister Award recognizes Schaeffler's outstanding quality, high level of flexibility and the enduring commitment of its employees.



Günther Bachmann (left), Managing Director of Technology and Production, and Timo Rickermann (right), Head of Corporate Purchasing (both Gildemeister AG), congratulated the Schaeffler team around Robert Schullan (5th from right), Member of the Executive Board of Schaeffler AG and President of Schaeffler Industrial.

Presenting INA's new YRTSMA-series:

The first-ever absolute-value angle-measuring system for high-precision rotary axes to be directly integrated into the bearing



INA's new YRTSMA-series: Rotary table bearings with an integrated absolute-value angle-measuring system for use in high-precision rotary axes.

Schaeffler has developed an inductive angle-measuring system – integrated inside the bearing, no less! - that is perfectly matched to the demands of highly dynamic and high-precision direct drive rotary axes used in machine tools. And while the YRTSMA is just as accurate as optical angle-measuring systems, its revolutionary design that integrates directly into the bearing offers a host of additional benefits.

INA's new YRTSMA-series is an absolute measuring system. Contrary to incremental measuring systems where the absolute position can be only identified with the help of reference travel once the machine has been switched on, the YRTSMA-series provides absolute angle information immediately upon machine startup. Knowing the absolute position is vital whenever there is a risk of collision during reference travel, such as be-

YRTSMA combines high measuring speed and accuracy in a remarkably compact and robust design. It is unaffected by contamination, offers an open passage through the center of the rotary axis, and makes a compelling case for itself thanks to minimal alignment requirements.

Extremely precise measuring accuracy – no reference-travel required!

tween the tool and the workpiece (i.e., collisions between protruding edges). One of the most common applications for the YRTSMA is in milling heads.

The new YRTSMA-series features a measuring scale located directly on the inner ring. Because the measuring scale's run-out is so true that it matches the quality standard of high-precision bearings, a second measuring head is no longer required. The ability to use just one measuring head significantly reduces the installation space requirements without compromising performance. Electronic sensors are integrated in the measuring head, enabling the system to be connected directly to the controller. Efficiently sealing out the surrounding environment, the measuring head is designed to automatically set itself at the correct distance to the encoder as it is screwed onto the bearing. The measuring head is easily accessible from the outside and can be replaced without the need for additional adjustments. INA's new YRTSMA-series bearings are available with bore diameters ranging between 200 mm and 460 mm. From a mechanical perspective, they correspond to INA's extremely rigid high-speed YRTS-series bearings.



The new benchmark for system accuracy

While optical measuring systems have long set the benchmark for angle-measuring systems used in rotary tables, their inherent potential is not the sole determining factor with respect to the accuracy of a rotary axis. Rather, the overall system accuracy that results from the interaction of all contributing factors determines the rotary axis' precision. Here, an absolute-value angle-measuring system that has been directly integrated into the bearing is unbeatable.

Pure Power and Performance:

Direct drive technology for turning/milling operations



The rotary high-performance direct drive series RKI helps to achieve outstanding performance characteristics.

With its RKI-series of rotary high-performance direct drives, INA Drives & Mechatronics GmbH & Co. oHG (IDAM) has achieved an absolutely extraordinary and heretofore unattainable level of performance. RKI drives attain torque levels that are 30% higher than conventional torque motors. Speed has been increased fourfold and mechanical output has been raised by a factor of five. At the same

time, power loss is reduced by as much as 60%, which means that less heat is generated. Consequently, energy efficiency is significantly improved, and the resulting reduction in cooling requirements profoundly lowers operating costs. Downsizing options also provide a compelling argument for these innovative drives: it is now possible to use smaller motor sizes

while maintaining the same level of performance, thereby lowering the cost of the converter and motor.

By combining the RKI direct drive with the high-speed ZKLDf..B rotary table bearing, Schaeffler currently offers the world's highest performing rotary axis for turning/milling operations in machine tools!

For compact bearing supports in rotary tables, Schaeffler has optimized the internal design of its ZKLDf..B double-row axial angular contact ball bearing to such a degree that it is now possible to achieve twice the limiting speed that was possible before. At the same time, frictional torque is reduced. Incredibly, these amazing performance improvements have not in any way compromised the bearing's high accuracy and rigidity. Especially when combined with the speed-optimized RKI torque motors from IDAM, these Schaeffler innovations



RKI-series of high-performance direct drives

offer new possibilities for turning and milling operations that were previously unattainable with standard components.



New INA axial angular contact ball bearing ZKLDf..B

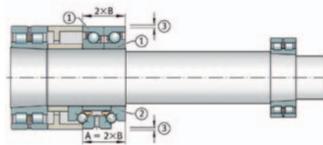
Schaeffler Highlights for the Main Spindle – The New BAX-Series

High-speed axial bearings deliver high performance and exceptional accuracy



FAG's high-speed BAX-series axial bearing

For situations where axial bearings with radial retention are combined with cylindrical roller bearings on main spindles, FAG's new BAX-series high-speed axial bearings now make it possible to achieve speeds that were previously only attainable with spindle bearings. At the same time, this bearing combination allows the axial and radial loads to be separated in the bearing support. Since this eliminates the need to support tilting moments, the kinematic characteristics under combined load are not impaired, resulting in an especially robust bearing support. Because of the high rigidity, users benefit from exceptional machining accuracy. High load-carrying capacity and superior speed capability produce excellent cutting performance



1 = Axial bearing BAX | 2 = Double-direction axial angular contact ball bearing 2344 | 3 = No radial retention

and high productivity. BAX bearings have a 30° contact angle; for applications requiring higher axial rigidity, they are also available with a 40° contact angle. To ensure low cage friction, BAX bearings are also fitted with a cage made from a hard fabric material. As a result, when BAX bearings are incorporated into this new bearing combination, speeds can be

increased by 20% with oil-air lubrication and by as much as 30% with grease lubrication.

BAX bearings are dimensionally compatible with Type 2344 double-direction axial angular contact ball bearings. They are easily interchanged and do not require modifications to the shaft and housing. Tolerance-class P4S ensures that these bearings run remarkably quiet. Available bore diameters range between 50 and 200 mm.



Updated and Beefed Up

Enhanced Packaging and Protection against Counterfeiting for FAG Main Spindle Bearings



Data Matrix Code



New packaging design for FAG spindle bearings

New and improved packaging for FAG spindle bearings! Compared with the previous design, the cardboard used in the boxes has been substantially reinforced, while both the bearing and the label are now marked with a forgery-proof Data Matrix Code. The packaging boasts a fresh look, too!

RS and TR: Delivering Efficiency and High Performance

Cutting-edge bearings cut down on friction

With the RS (from the German "Robust und Schnell" – i.e., robust and fast) spindle bearing series and TR (thermally robust) cylindrical roller bearing series from FAG, Schaeffler offers a compelling combination of high load-carrying capacity and substantial power reserves that are designed to increase speed. Meanwhile, the bearings' internal design has been optimized to significantly reduce friction, which is especially apparent when the spindle runs at high speeds for extended periods of time. The ability to grease the bearing even at high speeds improves spindle reliability and reduces costs by eliminating the need for compressed air, which is usually required to supply the bearings with lubricant.

Robust and fast: RS bearings for the working side of the spindle

FAG's new RS-series features a friction-optimized internal design with large rolling elements and a 20° contact angle. It offers high load-carrying capacity and is

suitable for very high speeds. Consequently, the bearing support's frictional torque can be substantially reduced on the working side. Using either oil-air lubrication or grease lubrication, the frictional torque values of the RS-series' large-ball variants were able to be reduced to the same level as that of the small-ball bearings (HS, HC). Meanwhile, large-ball bearings have a significantly higher load-carrying capacity than their small-ball counterparts.



FAG's TR-series cylindrical roller bearing



FAG's RS-series spindle bearing

Thermally robust: TR bearings for the non-locating bearing side of the spindle

TR-series cylindrical roller bearings from FAG have a flexible outer ring that significantly reduces the increase in preload during operation. This means that the bearing is unaffected by temperature fluctuations and exhibits significantly lower friction loss. The friction-optimized internal design, which features a PEEK cage that is guided on one side of the outer ring, optimizes lubricant distribution and is suitable for high speeds.

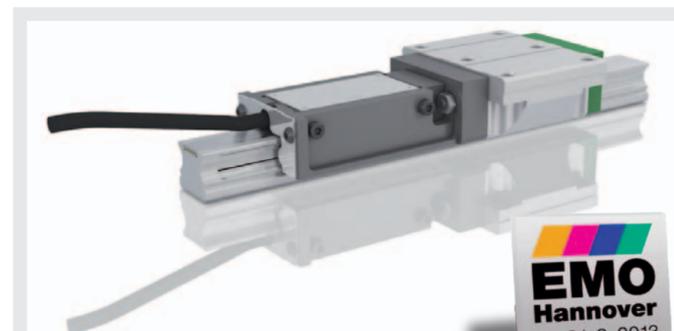
In addition, by using of ceramic rollers instead of steel rollers, the weight of the rolling elements is reduced. Consequent-

ly, the resulting reduction in centrifugal forces cuts down on friction. Moreover, the ceramic material's lower thermal expansion coefficient also reduces the rise in radial preload during operation, further lowering bearing friction. Because ceramic material tends to not adhere to steel, the pairing of steel rings with ceramic rolling elements inside hybrid bearings is tribologically more advantageous than bearings with steel rolling elements. The resulting decrease in rolling-contact temperatures and reduced strain on the lubricant therefore makes these bearings more suitable for high speeds. The grease's service life is extended, too.

Hybrid cylindrical roller bearings can also benefit from flexible outer rings in order to reduce the preload that occurs during operation. Cutting the number of rollers in half can also decrease friction in cylindrical roller bearings.

Raising the Bar for Performance:

A new generation of linear products from Schaeffler



LMSA-series (Length Measurement System Analog) measurement system

Integrated inductive travel-measurement system LMSA

Schaeffler proudly presents its LMSA-series travel measurement system for integrated travel measurement in main axes. LMSA (which stands for Length Measurement System Analog) is based on an inductive analog measurement principle that is accurate to $\pm 3\mu\text{m/m}$. LMSA is exceptionally robust, impervious to magnetic interference fields and operates without hysteresis. A sensor head, which is connected directly to the guiding carriage's steel saddle plate and installed inside a metal housing, uses a high-frequency alternating field to scan an incremental dimensional scale inside the head of the rail, generating two sensor signals that are phase-offset by 90°. The dimensional scale is generated using a high-grade steel strip with a photolithographically etched high-precision graduation. Although the exact distance between the measuring head and the measuring strip is preset at the factory, this can be reset as needed using four adjusting screws. The movement between the sensor head and the measuring strip produces mutual inductance in the individual coils which, consequently, generates sine wave signals. The LMSA measurement system has an analog output of 1 Vss with a subdivided signal period of up to 10 μm . It has an intuitive design and is easily connected to existing control systems.

Linear recirculating roller bearing and guideway assembly RUE25-E with enhanced technical features

With the addition of a new size, the RUE25-E, Schaeffler has filled out its portfolio of linear recirculating roller

2nd-generation hydrostatic compact guide HLE

Along with the adaptive damping offered by our RUDS damping carriage, machine tools can benefit from Schaeffler's fully hydrostatic HLE linear guidance system. Now in its second generation, this ready-to-install and sealed system with integrated pressure control combines guidance and damping functions in a single package that fits inside a monorail guidance system.

In order to prevent crash situations, the saddle plate's pressure pockets are filled with a sliding material which, in the latest HLE 45 generation, has been replaced by a special bronze coating that offers the highest geometrical accuracy and durability. The emergency running characteristics ensure that the system is not damaged - even if it is overloaded or operated without pressure.

By expanding our comprehensive lineup of linear solutions with this hydrostatic compact guidance system, machine tool manufacturers will be able to achieve a variety of machine-tool performance classes while retaining their machine's overall design. With its excellent damping characteristics and high dynamic rigidity, HLE delivers faster cutting speeds, improved surface quality and longer tool life.

Ready-to-fit complete solutions

Beyond mere individual components, Schaeffler offers machine tool manufacturers a range of complete solutions that are standardized and ready to install. Typically, these consist of proven Schaeffler guidance systems and corresponding drive systems which are combined with motors and sensors. Of course, Schaeffler can also manufacture assemblies and complete machine components tailored to the customer's specific application.

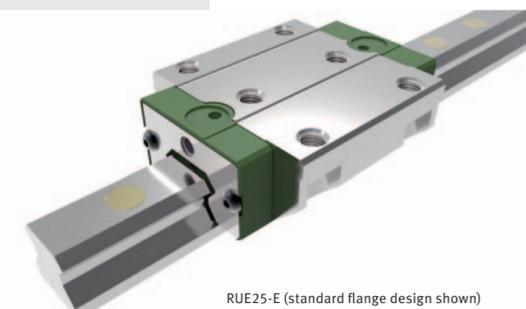


System solutions from our Linear Technology division can consist of multi-axis systems that have been designed using standard actuators, as well as bespoke multi-axis systems that are specially tailored to the particular application (image shows a standard multi-axis positioning unit designed as a ready-to-install system solution).

An example of a standard axis is the development of the MKUVS32-KGT compact linear actuator. This series offers high power density in a compact 80 mm x 48 mm design. By using the KUVS linear recirculating ball bearing unit as a guidance unit, it was possible to locate the high-precision ball screw drive on this actuator in a central position. Integrated into an aluminum housing, the guide unit can therefore transmit high forces and moments, despite its low overall weight and flat design. The MKUVS32-KGT-series is available in 16 variants, allowing customers to choose from different ball-screw drive pitches, single or double carriages as well as a variety of cover options.

Another example is a so-called heavy-duty module from the MDKUSE...3ZR-series, which consists of an inherently rigid aluminum support rail with two KUSE six-row ball bearing and guideway assemblies that are arranged parallel to each other. The actuator can be up to 12,000 mm long, while the unit's height is 200 mm and the driven carriage is 500 mm wide and 700 mm long. The comparatively compact tandem linear actuator's mass is only about 800 kg. Despite its diminutive size, the carriage can be repeatedly precisely positioned to within ± 0.01 mm at a travel speed of up to 2m/s and an acceleration of up to 5m/s².

Of course, our expansive selection of standard actuators can be customized into multi-axis systems, resulting in system solutions that are specially tailored to each particular application.



RUE25-E (standard flange design shown)

FAG SmartCheck for Monitoring the Condition of Machine Tool Components

Diagnostic systems from Schaeffler: ensuring quality and process reliability



just the right bearing diagnosis system. When it comes to an innovative online system for monitoring main spindles in machine tools, FAG SmartCheck is a top choice. Of course, Schaeffler offers other options, including FAG Detector III, FAG DTECT X1 s and FAG ProCheck.

FAG SmartCheck: the condition-monitoring tool for machinery that works!

The remarkably flexible FAG SmartCheck offers three expandable levels of monitoring capabilities for machine tools. In Stage I, individual components are monitored on a decentralized basis. Easy to install and connect means that FAG SmartCheck is ready for immediate use, while data is accessible directly on the device. Based on the measured data, FAG SmartCheck automatically determines the correct alarm thresholds. The available SmartCheck app provides convenient data access on a smartphone. If the user opts for Stage II, FAG SmartCheck is intelligently integrated into the machine's control system. Process integration can be achieved through a variety of communication options via interfaces. Stage III offers expanded



CTX beta 800 turning machines from DMG/MORI SEIKI use FAG SmartCheck from Schaeffler to monitor the main spindle bearing supports (Source: DMG/MORI SEIKI, www.dmgmoriseiki.com).

service activities, ranging from internet-based remote access capabilities as well as consultation services and other options. In addition, Schaeffler offers a variety of additional monitoring systems that can be employed depending on customer needs.

Leading machine tool manufacturers are already enjoying the benefits of FAG SmartCheck to successfully monitor the main spindle while interfacing with the machine's control system.



FAG SmartCheck: The new online monitoring system for analyzing vibrations and other operating condition parameters of main spindles in communication with the machine's control system.

Condition-based replacement of components during planned downtime, consistently high machining quality, minimizing costs incurred due to lost production – absolute imperatives for today's operators and manufacturers of modern machine tools. As a manufacturer of components and condition monitoring systems offering a complete range of proven products and superior consulting expertise, Schaeffler Industrial Aftermarket is a dependable partner to the machine tool industry. Whatever the customer's requirements and condition monitoring strategy, Schaeffler has

Spindle Bearings in Practice (SLP)

This Schaeffler compendium has been the subject of considerable demand leading up to its publication. This nearly 170-page handbook for engineers and students covers the process of selecting and designing spindle bearings. It offers design tips for the space in which the spindle is located and conveys basic and in-depth knowledge with regard to the arrangement, lubrication and mounting of spindle bearings. Also included is valuable information on how to analyze and prevent damage to bearings in main spindles located inside machine tools. English- and German-language versions of Spindle Bearings in Practice (SLP) will be



available for order beginning in the spring of 2014.

Bearing Supports for Food Processing and Packaging Machines (PVP)

The process of producing food is becoming increasingly automated, usually taking place under extreme operating conditions and stringent cleanliness requirements. Because this requires extremely reliable processes, high-quality machine components that are designed for continuous operation have become indispensable. This 24-page brochure presents durable, corrosion-resistant rotary and linear bearing solutions for round-the-clock



operation, and covers topics such as application-specific technical information on materials and coatings as well as tribology and calculation principles. Available in English, German and Chinese since June 2013.

Spindle Bearing Catalog SP1

The Schaeffler Spindle Bearing Catalog SP1 is an ideal complement to the above compendium. A revised edition will be published in English and German by the end of the year.



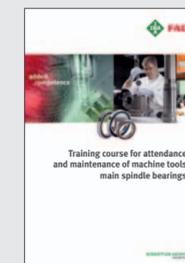
Mounting Training

The next spindle bearing training session in Schweinfurt will take place on September 26, 2013.

This training is offered at regular intervals. Further sessions can be scheduled upon request.

Your contact:
Karin Morgenroth

Phone: +49 (0) 9522 71 503
Email: Schulungszentrum@schaeffler.com



Tip
Register now!
These training sessions fill up quickly!

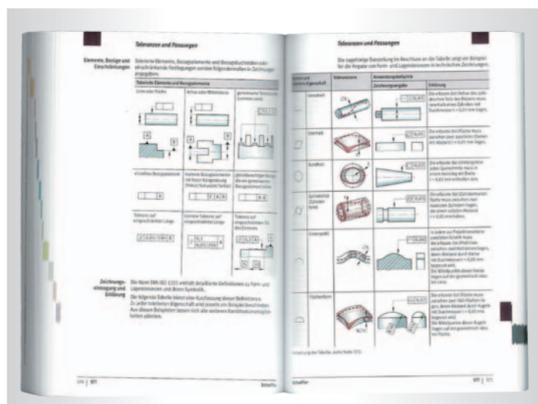


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An efficient tool for 25 years now – Schaeffler's Technical Pocket Guide.

Schaeffler Technical Pocket Guide (STT)

For over 25 years, Schaeffler's Technical Pocket Guide has served as a popular standard reference work for professionals in numerous technical disciplines. To date, 750,000 copies have been distributed

since its initial publication – a veritable success story. Now, a completely revised edition of this classic reference work is available. The accompanying smartphone app, which has been available for both iOS and Android platforms since 2011, has also been treated to a comprehensive update. Available since April 2013, the

new version of the app can be downloaded for free at <http://apps.schaeffler.com/>. To order the German print version, go to <http://www.schaeffler.de/> → Mediathek → Publikationen. The English-language print version is scheduled for release at the end of December 2013/January 2014. Spanning almost 640 pages, the

Technical Pocket Guide covers a broad range of topics, including mathematics, physics and technical statistics as well as technical disciplines such as mechanics & acoustics, hydraulics and pneumatics. Also included are sections on construction materials and elements as well as – for the first time ever – mechatronics.

Encyclopedia of Rolling Bearings

The Basics of Failure Analysis

Wear – Part 3: “Adhesive Wear – Smearing”

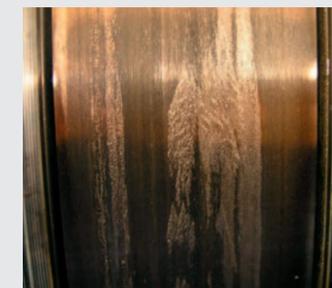
As part of our feature “The Basics of Failure Analysis,” we would like to familiarize you with the concept of “damage mechanisms.”

The third part of our series concludes the chapter on wear. In our next issue, we will turn our attention to the topic of corrosion.

While abrasive wear still requires that foreign particles infiltrate the bearing, adhesive wear occurs at the interface of the contacting surfaces that are typically found inside a rolling bearing. This phenomenon is called “two-body wear,” colloquially also referred to as “smearing.”

This type of damage is caused by cold welding that occurs as a result of extreme slippage between the parts that are in rolling contact. While this slippage results from high acceleration forces, it does not matter whether the slippage is caused by actual angular acceleration or by the bearing's kine-

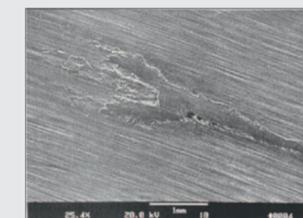
matics. The latter can be observed in large bearings that have massive rolling elements. Such rolling elements have a high mass moment of inertia and require relatively high drive torque to reach



their kinematic nominal speed. This is typically achieved inside the bearing's load zone while in a “clamped” state between the bearing's rings that are under load. Upon exiting the load zone, the rolling elements are then decelerated due to internal bearing friction (cage, lubricant friction); this can even cause the

rolling elements to come to a complete standstill. As they reenter the load zone, the rolling elements must once again be accelerated to their nominal speed as quickly as possible. This is comparable to the acceleration of the wheels in an airplane's landing gear as the approaching aircraft touches down on the runway. In an airplane, the resulting slippage leads to smoking tires. When it comes to large bearings, however, the result is cold welding in the contact zone. The damage to the bearing results from the splitting of the weld as the rolling elements continue to run. When this happens, particles are torn from the parts that are in rolling contact. This debris then sticks to the surface of the opposite part.

Continued operation causes these particles to become dislodged again where they then accumulate in the lubricant inside the bearing. Depending on the lubrication method, they are either washed out with the lubricant, or they get mixed in with the grease where they lead to



abrasive wear as secondary damage. “Smearing” typically manifests itself in the form of arrow-shaped surface defects.

To prevent this type of damage, consider switching to bearings with several rows of smaller rolling elements as the inertia of more diminutive rolling elements is lower. In addition, black oxidizing the parts that are in rolling contact has proved to be an effective remedy, as has the use of so-called tube rollers in applications such as wind turbines.