

WHAT'S NEW

X-life Cylindrical Roller Bearings

Even higher speeds, even greater load-carrying capacity, Page 5



New: Smart Aktor PWG

Innovative planetary screw drive for electromechanical linear actuators Page 8



Expo and EMO in Milan

Feeding the planet, energy for life Page 11



Passion 4.0 Machine Tools

added competence for Production Machinery



Added value through digitalization – innovation project "Machine Tool 4.0"

In cooperation with other industry partners, Schaeffler has developed and financed the "Machine Tool 4.0" concept. This approach – which networks existing technology, ranging from the sensor to the cloud, with new, digitalized components – represents a real step toward digitalized production. To that end, as part of a specific Schaeffler investment project, two prototypes were constructed on the basis of 4th-generation DMG MORI DMC 80 FD duoBLOCK® machines. One of these units is already being used in volume production at a Schaeffler plant in Germany, so a live video feed of this prototype in action will be shown at the Schaeffler booth during the EMO trade show.

As a leading supplier and development partner for drive components used in machine tools, Schaeffler is pursuing a defined digitalization strategy aimed at making the collected data available for a wide range of processes through the use of sensors, networking and analysis. The ultimate goal is to provide significant added value for customers.

Bearings as data sources – direct integration of sensors

The prototypes used as part of the innovation project feature additional sensors – which measure vibrations, forces, temperatures and pressures – that have been directly integrated into virtually all of the bearing positions that pertain to the machining process. However, making a machine "4.0 ready" for production goes beyond merely capturing data. This information must also be evaluated, stored and, ultimately, used as the basis for taking appropriate measures. To accomplish this, a network that is linked to all of the applicable sensors, actuators as well as evaluation units must be established inside the machine. A gateway is used to connect to the cloud. To ensure that data is exchanged with the machine control system, a Profibus is linked to the PLC for time-critical and process-related data, while the OPC UA protocol to the Human-Machine-Interface (HMI) is used for any additional information. Data from the machine is stored locally on the gateway and mirrored to the Schaeffler cloud. This ensures that the data history is accessible at the machine even without a network connection. Calculations in the cloud can be initiated via web services or apps.



Concept demonstrator Machine Tool 4.0

Continued on page 2

Editorial

Passion 4.0 Machine Tools – added competence for Production Machinery!



The term “passion” neatly encompasses the enthusiasm and strong personal commitment that is the hallmark of people who get things done. Which is why I believe that our slogan for this year’s EMO trade show aptly describes our approach: at Schaeffler, “passion” is truly a way of life for us – day in and day out, and especially when it comes to machine tools. At the same time, “passion” also represents a declaration and a requirement – a message that we continually hear from you, our customers, as well. Consequently, the subtitle “added competence for production machinery” applies to us both and unites us in our respective passions.

Nestled between “passion” and “machine tools,” the reader’s eye is drawn to “4.0,” which is intended to make reference to the “Industry 4.0” concept. When it comes to the various issues pertaining to digitalization, such as optimizing systems using integrated sensors as well as analyzing and interpreting data, our guiding principle must always be to consistently focus on generating value for the user. At this year’s EMO trade fair in Milan, we hope to show you that Schaeffler – as a leading, innovative manufacturer with a portfolio of high-performance components, direct drives and service tools – definitely has some compelling new innovations “in store” for your company. But at the same time, we are also a global player and a major user

of machines, as we utilize thousands of machine tools in our factories throughout the world. Accordingly, we share your desire for increased efficiency, reduced “time to market” and greater machine flexibility.

As a result, issues such as “big data”, “networked production” and “self-organization along the value chain” affect us as both a user and a manufacturer. This is why we took the initiative, well in advance of EMO, to invest in a technology demonstrator that – using the “added competence” of our industry partners – provides a visual record of the added value of digitalization, specifically as it pertains to Industry 4.0. You can see it for yourself at our booth in Milan - with a live feed to our own production line – where it is in action in the form of the innovation project “Machine Tool 4.0.”

This year’s newsletter is intended to introduce you to Schaeffler’s highlights from EMO 2015 – along with the principle that guides us yesterday, today and tomorrow: Passion 4.0 the Machine Tool!

Please enjoy.

Best regards,

Martin Schreiber
President – Business Unit Production Machinery / Linear Technology

Continued from page 1

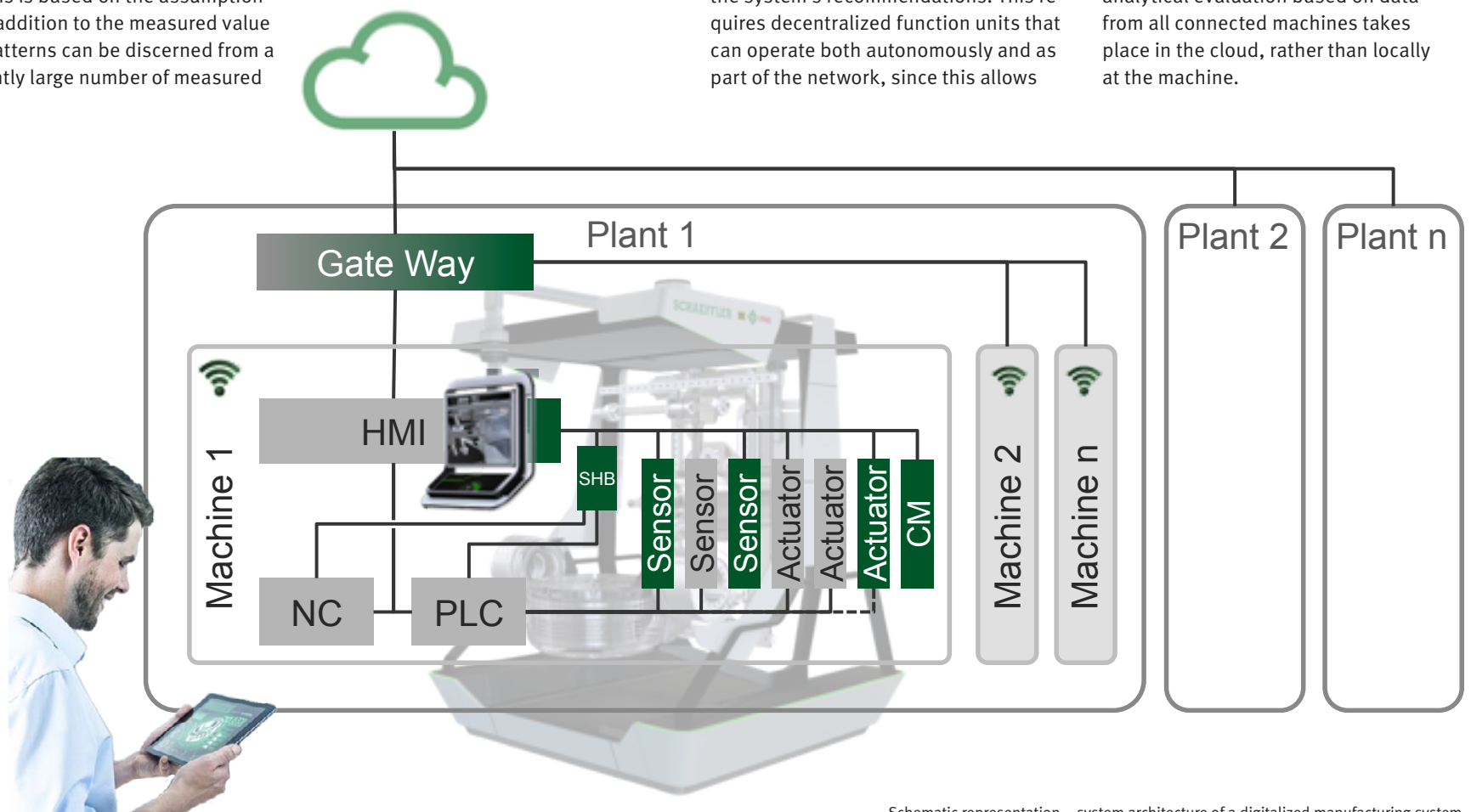
Big data and data analysis

Beyond the existing data analysis, which typically has a 1:1 relationship to the output, a new emphasis is being placed on analyzing large amounts of data. This is based on the assumption that, in addition to the measured value itself, patterns can be discerned from a sufficiently large number of measured

values/data points (big data) that have been correlated with other data. The information provided by these patterns offers a new level of quality, for example, with respect to the condition of the

bearing and, by extension, the machine itself (data-based added value). With the right algorithms, it is possible to automatically identify these patterns and take the appropriate action based on the system’s recommendations. This requires decentralized function units that can operate both autonomously and as part of the network, since this allows

the local processor to analyze the data locally. More comprehensive data analysis that requires greater computing power can be accessed via the cloud connection. Similarly, an analytical evaluation based on data from all connected machines takes place in the cloud, rather than locally at the machine.



Schematic representation – system architecture of a digitalized manufacturing system

Integration in the production line

Opportunities for digitalization are not limited to the production machine. The manufacturing environment can also benefit from an integrated flow of data, as this avoids isolated solutions that may require manual intervention. In addition, vertical integration is necessary in order to connect to the ERP system to facilitate automatic job processing.

Production

An important aspect within the context of “big data” involves ensuring that the individual components are clearly identified. This is accomplished by a built-in marking machine that gives each part a unique identity using data matrix code. This ID accompanies the component throughout the manufacturing process, until it is absorbed into the ID of the assembly during production. This provides traceability, allowing the component’s history to be analyzed.

Process

By measuring the forces at the tool center point (TCP), it is possible to further optimize machine load as well as the actual process itself: A mathematical model is used to identify any shifts that take place at the TCP due to the occurring loads, so that potential correction values can be supplied to the control unit in real time. Using machining simulations, the likely resulting machining forces can be determined in advance. Consequently, these forces form a target

value that cannot deviate from a pre-defined tolerance range, as this would indicate an unstable condition.

Energy

In addition to measuring the actual consumption values that can be assigned to each machining step, it is possible to determine future energy requirements by means of process simulation. Using empirical data, energy consumption can now be more accurately forecast; this benefits both demand-based energy purchases as well as production planning strategies that are designed to minimize company-wide energy spikes.

Machine condition

The condition of the machine is captured using standard vibration monitoring methods. In addition, the lubrication conditions of various bearings are measured and analyzed. While also making sure that resources are being used sparingly, a demand-based lubrication system ensures that the machine is functioning properly without impeding performance. As a further benefit, it is also possible to obtain a projection about how the bearing is expected to wear over time.

Maintenance

By classifying the machining processes, the machine’s duty cycles can be clearly understood. For example, it is currently possible to selectively perform online calculations of the bearing positions’



Information delivered intuitively via WLAN to mobile electronic devices

nominal residual operating life, using the Schaeffler bearing calculation program BEARINX®. The aim is to control production based on the simulation of the pending processing jobs and the resulting expected life of the individual components. This would allow the necessary maintenance measures to be planned in advance, so that machine availability is kept as high as possible.

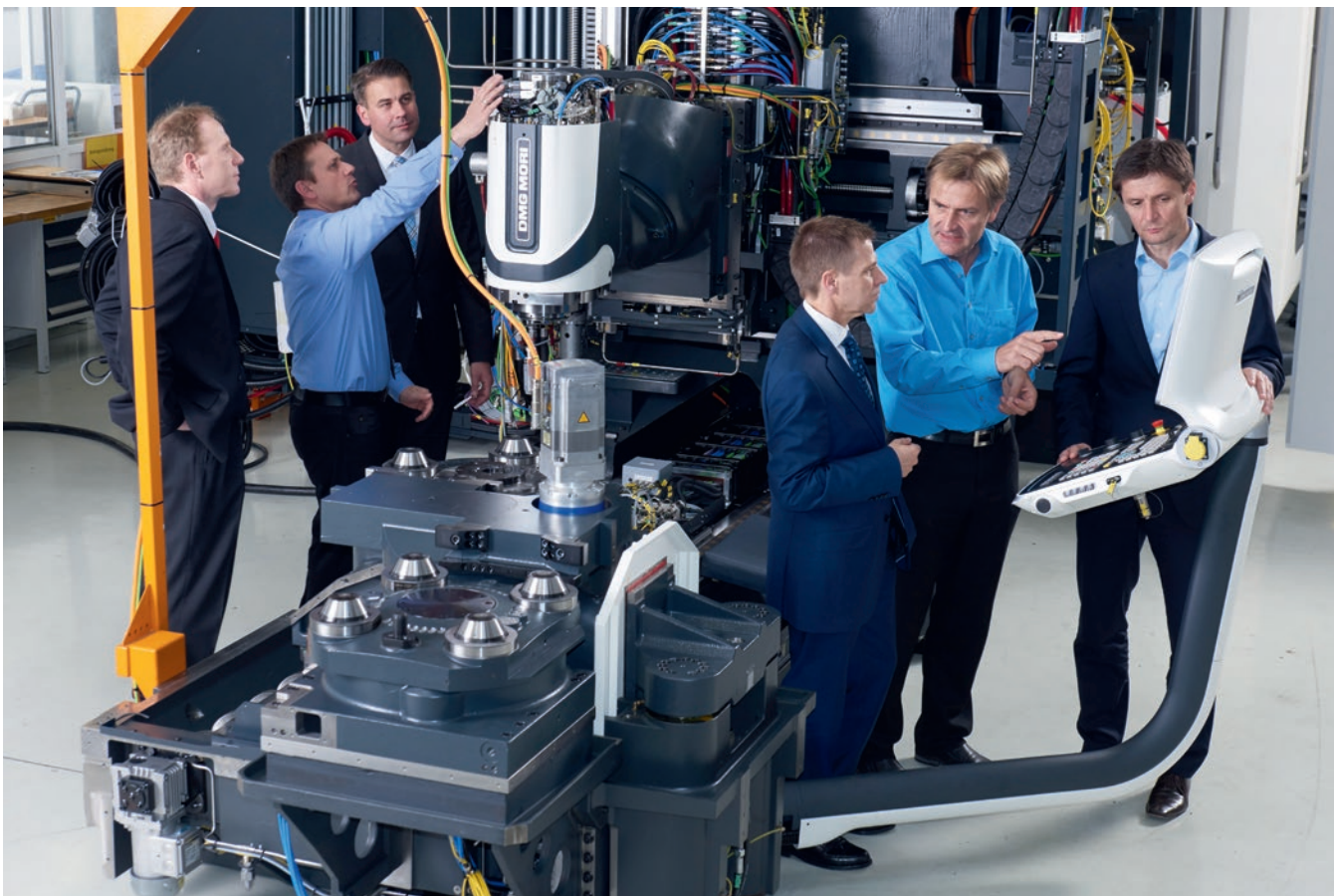
All of this means that Schaeffler is not just developing the required hardware (i.e., integrating sensors directly into the components). Rather, together with its system partners, Schaeffler is also actively shaping both the horizontal networking along the value chain as well as the vertical integration from the sensor to the cloud itself. As we have seen, it takes added competence and passion to learn and, at the same time, help pave

the way for our industry to enter into the age of 4.0.

When it comes to the future of the machine tool, Schaeffler is the right partner – both as a leading supplier and development partner for drive components, and as a significant user of machine tools in its own right. Together with its partners, Schaeffler is adding value to production machinery by proactively driving its digitalization.



“added competence” up close – experts from Schaeffler and DMG MORI Pfronten at one of the two “Machine Tool 4.0” concept demonstrators



New Materials and Improved Processes

For maximum main spindle performance

X-life cylindrical roller bearings with plastic cage – Higher speeds, increased load ratings, reduced running noise and more design options

With its new X-life generation, Schaeffler has further increased the basic dynamic load ratings of its proven N10- and NN30-series of high-precision cylindrical roller bearings, featuring bore diameters ranging between 30 mm and 120 mm, by as much as 19%. These bearings are equipped with a window-type cage made of PPA (polyphthalamide) high-performance plastic. When compared to bearings with brass cages, tests have shown significantly improved speed capability, especially with regard to double-row versions. These same tests revealed that bearings with the new polyamide cage run at up to 12 K lower operating temperatures, which also enables them to attain up to 25% higher speeds in the limit speed test.

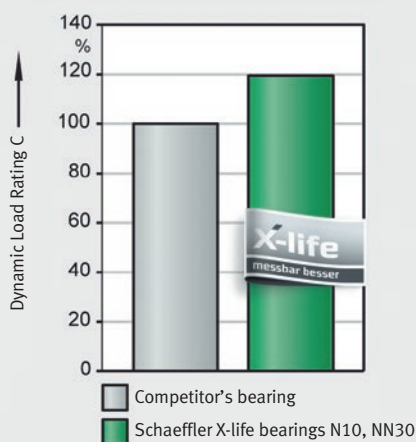


X-life cylindrical roller bearing with plastic cage



Another advantage of the polyamide cage's lower running temperature, as compared to a brass cage, is its longer grease operating life. Utilizing a lightweight plastic cage that offers better damping characteristics also has a positive effect on noise levels – the bearings run more quietly. Thanks to their increased limit speeds, Schaeffler's new X-life cylindrical roller bearings make it possible to significantly raise the performance of design applications. This is especially true in conjunction with Schaeffler's BAX-series of high-speed axial bearings. With minimal oil lubrication, speeds of almost one million mm/min are now possible.

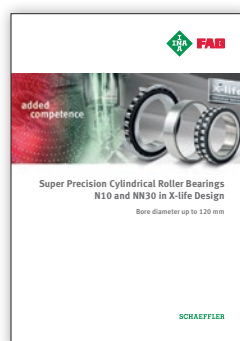
19% higher dynamic load rating – up to 65% longer life!



Longer service life thanks to X-life technology



X-life cylindrical roller bearing shown on top of the new telescope-style box



Download the brochure!

Bearings made from Vacrodur – peak performance for the future

One way to increase the load-carrying capacity of a bearing while maintaining its speed capability is by utilizing superior materials for the bearing's ring. For many years now, Schaeffler rolling bearings with rings made from Cronidur have represented the pinnacle of superior load-carrying capacity and grease life. Now, comparison tests have shown that the new Vacrodur high-performance steel provides even higher static and dynamic load-carrying capacity, along with superior wear behavior. Vacrodur is a powder metallurgically produced high-performance steel whose fine, homogenous microstructure provides an excellent combination of hardness and strength. It has demonstrated exceptional wear behavior – even under conditions of lubricant starvation and contamination – because the material is harder than most dirt particles.

Schaeffler offers spindle bearings made from Vacrodur as a special solution for extremely high-stress bearing positions. Additional fields of application for this high-performance steel include bearings that are vulnerable to mixed friction and contamination as well as high static loads.



Milling spindle in action

In addition, the material's exceptional surface hardness also makes it less sensitive to brinelling. Bearings made from Vacrodur can support higher loads without any resulting plastic deformation in the raceway. Compared to a bearing made from 100Cr6 steel with the same internal design, the basic dynamic load rating increases by 65%.



New FAG spindle bearing with P4 running accuracy

Spindle bearings with P4 accuracy

Schaeffler now offers a range of spindle bearings with P4 running accuracy that are perfect for simple, belt-driven milling spindles or even high-speed electric motors. These open single bearings are equipped with a rolling-element-guided plastic cage and large steel balls in the B70 diameter range. Featuring 15° and 25° contact angles and UL-class standard preload, mechanically speaking (with the exception of their accuracy), the bearings correspond to the well-known P4S B70-series of high-precision spindle bearings. Available bore diameters range from 25 mm to 100 mm. In addition, FAG P4 spindle bearings are pre-marked with a data matrix code that, in conjunction with the new PrecisionDesk app (see page 12), already now makes it possible to verify the bearing's authenticity. Additional functions to be offered in the future include the ability to access data on performance capacity and mounting information.



Grease or Oil Relubrication

FAG CONCEPT PRECISION ensures accurate and efficient spindle bearing lubrication

With its newly developed compact lubrication systems FAG CONCEPT PRECISION GREASE and FAG CONCEPT PRECISION OIL, Schaeffler delivers maximum precision and efficiency when supplying lubricant to spindle bearings. For these high-speed rolling bearings, proper lubricant supply and removal, lubricant quantity, heat dissipation as well as the lubricants themselves were the primary areas of focus during the product development process.

FAG CONCEPT PRECISION GREASE – Relubrication system designed specifically for the main spindle

With the FAG CONCEPT PRECISION GREASE, Schaeffler presents a lubrication system that was designed specifically for the demands of the main spindle with regard to delivery volume per stroke. Grease-filled tubes, which make up the actual lubricant reservoir for the relubrication process, are connected to the discharge outlets. The cartridge only contains pressurized oil, which gets pumped into the hoses during the delivery process. Meanwhile, the grease and pressurizing medium are separated by a ball located inside the tube. The feed rate per stroke and supply line is 0.025 cc.

Grease is only pressurized during the relubrication process in order to prevent it from separating inside the relubrication device.

Other compact small lubrication systems from Schaeffler include the FAG CONCEPT2. Available with one or two discharge outlets, it is particularly suitable

FAG CONCEPT PRECISION OIL – Specifically designed for direct oil lubrication of high-speed spindles, this innovative solution eliminates the need for compressed air.



FAG CONCEPT PRECISION GREASE – automatic grease relubrication system



for applications such as relubricating rotary table bearings. With up to eight outlets, FAG CONCEPT8 is an excellent solution for tasks such as relubricating machine tools' linear axes.

FAG CONCEPT PRECISION OIL – Direct oil lubrication without compressed air

If an application calls for very high speeds (> 1.6 million mm/min), the current technological standard involves the use of oil-air lubrication. The disadvantage to this approach, however, is that it requires compressed air, which is both resource-intensive and expensive. For a single motor spindle in a three-shift operation, one can spend approximately € 700 on compressed air – just to lubricate the bearings. Moreover, inadequately filtered air or condensation resulting from insufficient drying can also lead to sudden spindle failure.

The solution: FAG CONCEPT PRECISION OIL, which enables direct oil lubrication in minute quantities without the use of compressed air as a carrier medium. The

device's innovative approach consists of replacing the compressed air with a damper throttle element as a means to feed the lubricant into the bearing. This element makes it possible to achieve an almost continuous transmission rate to



the bearing. The concept was tested, in collaboration with Weiss Spindeltechnologie GmbH, on a motor spindle test unit; it has since proven its practical application under real operating conditions. A speed-dependent control device for the direct oil lubrication system offers additional optimization opportunities.

Newly Updated Spindle Bearing Catalog

Just in time for the 2015 EMO trade show, Schaeffler will be publishing a new edition of the FAG "SP1" spindle bearing catalog.

Reflecting the many product improvements that have been introduced over the past three years, the new SP1 catalog contains the latest performance specifications for FAG super precision bearings used in main spindles. Included are high-performance angular contact ball bearings, high-precision cylindrical roller bearings, double-direction axial angular ball bearings and, for the first time ever, the new BAX-series axial bearings for high-speed main spindles from FAG.

Special-purpose solutions are explained as well. The catalog's extensive engineering section offers particular benefits to the user, as it provides a comprehensive and in-depth analysis of the technical fundamentals of:

- Components and materials
 - Tolerances
 - Speeds
 - Rigidity
 - Load-carrying capacity and operating life
 - Lubrication
 - Design examples
 - Mounting
 - Bearing condition monitoring
- Also included are detailed mounting tips

as well as practical application examples. Checklists, worldwide contact information and a keyword index complete this reference work. The catalog has been designed to be more user-friendly and application-oriented than ever.

The latest edition of the SP1 goes far beyond a typical catalog and, just as the much sought-after previous version, is likely to serve as the definitive foundation for teaching purposes at venues ranging from universities to training programs for mounting bearings.

As a companion to the new SP1 spindle bearing catalog, Schaeffler offers the textbook "Spindle Bearings in Practice"



(SLP), which will be available – for the first time ever – in an English version at this year's EMO trade show.

For more information about ordering and downloads, please visit:



Bearing and Drive Solutions for the Rotary Axis

The benchmark for the machine tool

Schaeffler does not just offer a single series of bearings for a specific performance class; rather, we have several bearing lines that are optimized to the particular feature that is being prioritized. In addition, we also develop customer-specific solutions.

Rotary table bearing series – Peak performance for all applications

YRTC axial-radial cylindrical roller bearings are at the forefront of technology when it comes to resistance to tilting. These bearings are synonymous with maximum machining precision and cutting capacity.

Thanks to their patented raceway geometry, **YRTS** axial-radial cylindrical roller bearings offer friction levels that are so low, they are unmatched in the industry when it comes to preloaded roller bearings. For example, where a standard rotary table bearing with a 325 mm bore diameter produces a frictional torque of approximately 90 Nm at 100 rpm, a YRTS bearing in the same application reduces the frictional torque to just 10 Nm! As a result, motor power consumption is lowered by approximately 800 W, which corresponds to savings of approximately 1,000 € per year (assuming S1 operation, 24/7). The benefit to customers: superior manufacturing quality due to lower thermal expansion and, at the same time, substantial savings in operating costs. Consequently, when it comes to operating reliability, optimum cutting parameters and achievable speeds, YRTS bearings are the benchmark for rotary tables that include a turning option.

ZKLDF.B axial angular contact ball bearings, which are also designed for direct flange-mounting, are the market leaders for rotary tables that operate at extremely high speeds. When used in combination with IDAM **RKI** torque motors, these bearings make it possible to significantly increase the speeds at which rotary tables are able to run. If maximizing speeds is not a priority, then the customer is still able to benefit from extremely low bearing friction and the accompanying reduction in heat dissipation throughout the machine's structure. This improves machining accuracy.

State-of-the-art angular measuring systems – YRTMA absolute angular measuring system now ready for series production

To achieve the highest possible positioning accuracy with rotary tables, there is no getting around integrating a measuring system into the bearing support. That's because this is where the system's "zero point" is situated, i.e. the location

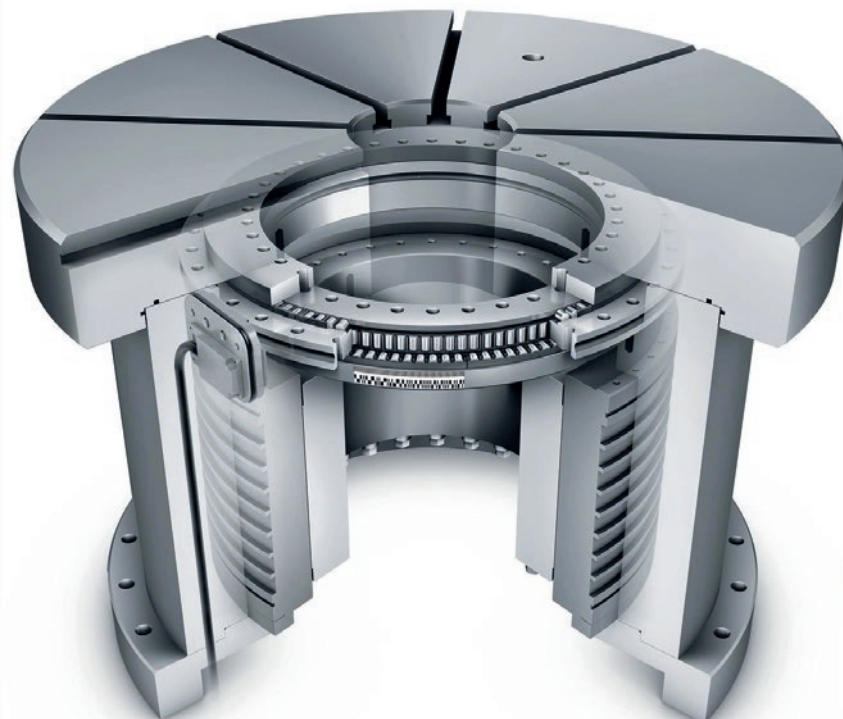
where deformations and offsets due to machining forces are the smallest, where the diameter for the measuring scale is large, and where the measurement can be executed with raceway accuracy. By integrating a highly resistant measuring system into the relatively large bearing diameter, the indexing of the measurement system can be optimally utilized. Schaeffler's product portfolio includes both magnetoresistive measuring systems with pitch-coded reference marks as well as absolute systems that function inductively.

Systems with reference marks have the advantage that the 1Vss electrical interface is compatible with almost all control systems that are typically used in ma-

chine tools - a benefit that is particularly appreciated by machine tool manufacturers who have to equip their machines with a variety of different controls. With absolute measuring systems, there is no need for a reference run after the machine is switched on. This also allows the control system to immediately recognize the pole position of the torque motors. Consequently, in the event of a power failure, any tools that may be engaged in a workpiece can be retracted in a controlled manner.

First presented at EMO 2013, Schaeffler's YRTMA inductive absolute angular measuring system with single-head technology is now ready for series production. Under real-life operating conditions, positioning accuracies measuring just 2 arc seconds were obtained using the new single-head system – a value that, until now, had never been achieved. In fact, the

result even exceeded Schaeffler's own expectations. This remarkable performance was validated in practical rotary table and milling head applications, which thoroughly convinced the industry's leading users of such equipment. The measuring head, for which a patent has already been applied, is designed so that the measurement gap adjusts itself automatically when the head is screwed onto the bearing. No additional adjustments are necessary. An especially user-friendly feature: the measuring head is always easily accessible from the outside. The system is offered with the common interfaces SSI+ 1Vss, Siemens Drive-CliQ, Fanuc alpha and Heidenhain EnDat2.2 (pending).



Schaeffler rotary table bearing featuring the YRTMA integrated absolute angular measuring system

tioning, synchronizing and swiveling. (For more details, please see the separately issued press release on RIB motors.)

The RKI-series of torque motors, introduced at EMO 2013, is the technology leader when it comes to combining extremely high torques and speeds with low power loss. Ideal applications include rotary tables that have a turning option, e.g., for combined machining operations (milling/turning/hard-turning or grinding). This product is already proving to be a great commercial success, as it is being featured in leading manufacturers' top-of-the-line machines.

When it comes to highest speeds and smooth, consistent performance, the HSRV/SRV-series of torque motors are the best in the industry. These drives are ideal for rotary tables with very high speeds (> 2,000 min⁻¹) as well as tool- or work-piece spindles. They are also perfectly suited as a direct drive for ball screws in feed axes.

Preferred application areas for the RMF/RMK-series of torque motors include rotary axes for ultra-precision machining operations, such as in gear grinders, measuring machines, optical lens machining and ultra-precision machining <1µm. They are installed in the world's most accurate machines, including OptoTech's UPG2000 8-axis ultra-precision grinding and polishing center.



YRTC – The market leader with the industry's best tilting rigidity

Four new series of torque motors First-ever presentation of the RIB-series of direct-drives

The new RIB-series of torque motors is being presented - for the first time ever – at EMO 2015. In the category of "highest torques with minimal power loss", this direct drive represents the absolute pinnacle of performance throughout the world. It is perfect for applications such as rotary tables, swiveling axes for rotary table swing arms, and milling heads for highly dynamic and powerful milling, posi-



RIB: The new generation of IDAM torque motors – highest torques with minimal power loss



Download publications
SSD 27, SSD 30 here!

Partnership for Peak Performance

International customers rely on Schaeffler rotary table bearings

Thanks to their outstanding performance capabilities and unique technical features, Schaeffler's bearing designs continue to gain ground in growth markets, too. YRT-series products offer excellent load-carrying capacity, rigidity and, in particular, high accuracy – features that are highly prized by international machinery and systems manufacturers. For example, a YRT325 bearing delivers standard axial and radial runouts that are less than 6 µm; in versions with restricted tolerances they are even below 3 µm. Moreover, the YRTS (Speed) versions achieve even higher speeds in continuous operation - all while offering the same accuracy and higher tilting resistance, which enables these bearings to meet the requirements for use in turning and milling operations. The new rotary table bearing generation known as YRTC – especially with its large bearing diameters – makes a particularly strong case for itself, thanks to improved tilting rigidity and significantly reduced frictional torque. Meanwhile, for applications requiring ex-

rotary acceleration runs with particularly exacting demands for accuracy and load-carrying capacity. Combined with direct-drive motors, to whose specifications they are also specifically calibrated, ZKLDF bearings meet the manufacturing industry's highly complex standards that will become even more stringent in the future. Thanks to uniform mounting dimensions that are employed across the various types of rotary tables, a single



Parkson rotary table

mechanical basic design can be used to switch between either high-speed/low friction torque or low-speed/maximum tilting rigidity settings, depending on the customer's requirements.

The new "High-Precision Horizontal CNC Rotary Table" was on display at several high-profile machine tool shows in Asia, including the 2014 JIMTOF in Japan, the 2015 TIMTOS in Taiwan and the 2015 CIMT in Beijing. The show audiences, comprised of industry experts from all over the world, responded with great enthusiasm to this machine. Schaeffler proposed a so-called "E&M (Electro & Machinery)-in-one program," which is focused on trends in machine tool development.

Tanshing Accurate Industrial, meanwhile, established and built a new manufacturing facility known as TANSHING by HOSEA in 2008.

TANSHING by HOSEA primarily manufactures 5-axis rotary tables, of which over 300 are exported to overseas customers each year. These machines have enabled the manufacturer to lead Taiwan in machine productivity by a wide margin. To ensure the extremely high accuracy of its machines - and guided by an understanding of how important it is to monitor the precision of individual components - TANSHING by HOSEA manufactures up to 90% of the parts inside its machines. For over seven years, Tanshing rotary table products have been widely used throughout Europe.



Parkson manufacturing plant



ZKLDF for rotary tables operating at extreme speeds

tremely high speeds, ZKLDF double-row axial angular contact ball bearings are an excellent choice.

Parkson Wu Industrial Co., Ltd and Tanshing Accurate Industrial Co., Ltd are Taiwan's two largest manufacturers of high-precision rotary tables. Established in 1990, Parkson Wu Industrial was a pioneer among Taiwan's developers and volume manufacturers of automatic pallet-exchange systems and CNC indexing units. Today, its main product lines include modern subassemblies for 5-axis milling machines, such as high-end single-axis and 2-axis CNC rotary axis subassemblies, as well as automatic pallet changers for workbenches.

Parkson Wu Industrial has been cooperating with Schaeffler in the production of high-precision horizontal CNC rotary tables since 2014. The double-direction INA ZKLDF axial angular contact ball bearing is used in these tables, which are intended for applications in the aerospace, automobile, and electronic consumer goods industries, as well as for high-speed turning-milling operations. These bearings are perfect for applications requiring high

The customer-supplier partnership that has since developed between TANSHING by HOSEA and Schaeffler has created a bond of trust between the two companies. For 2015, there are plans to install the C-version of the YRT-series in the rotary tables of 5-axis CNC machining centers and horizontal machine tools. Thanks to the "SCHAEFFLER INSIDE" quality and precision initiative, we expect to provide our customers with extremely reliable premium products, creating a satisfying win-win situation for us as partners as well as for end users and machine operators.



Tanshing manufacturing plant

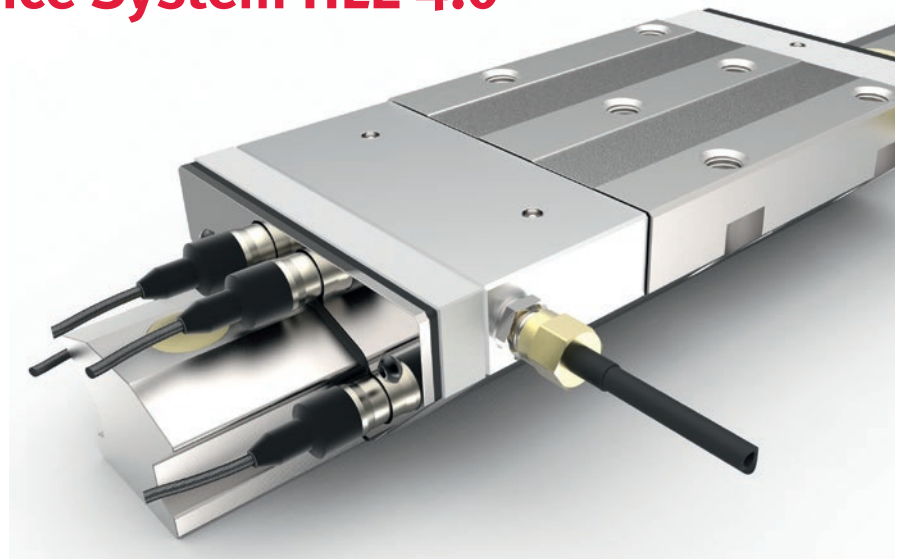
Hydrostatic Compact Linear Guidance System HLE 4.0

For optimum active axis control

Now available in its second generation and in X-life quality, the fully hydrostatic compact linear guidance system HLE has been equipped – for the first time ever – with integrated pressure sensors – the result of an R&D project. This 4.0 function enables workpiece machining to be actively controlled, which significantly improves the quality and efficiency of the machining process. To avoid crash situations, the pressure pockets of the saddle plate are filled with a sliding material. In the latest generation of

the HLE-A-XL, this sliding material is replaced by a special bronze coating to ensure very good emergency running properties. It enables machine tool manufacturers to achieve a variety of performance classes in machine tools while still retaining the machine's original design.

The HLE-A-XL offers excellent damping characteristics along with high dynamic rigidity, which results in higher cutting rates, better surface quality and longer tool life.



Hydrostatic compact linear guidance system HLE-A-XL with integrated pressure sensors

Smart Actuator for Maximum Load-Carrying Capacity

Innovative screw drive for electromechanical linear actuators

Schaeffler is expanding its range of spindles with the addition of a screw drive that features a new design and operating principle. The PWG planetary screw drive – also known as a differential roller screw – bridges the gap between the roller screw drive (RGT) and ball screw drive (KGT). Initially, the PWG series will be available for spindle diameters ranging from 5 mm to 25 mm. The PWG is distinguished by very high load-carrying capacities and the smallest-possible overall pitches. The PWG's high power density even allows it to be used as a replacement for hydraulic drives.

The PWG features planetary gears with v-shaped parallel grooves that roll up and down the spindle. The rotation of these planetary gears and their attendant drive is ensured by the two-piece spindle nut, which also has grooves at the ends that engage with the ends of the planetary gears. The very high number of rolling contacts enables the PWG to achieve the highest load-carrying capacity and rigidity



The PWG achieves the highest power density for spindle diameters ranging between 5 mm and 25 mm.

as compared to both of the other screw drive designs. Friction levels remain low, thanks to the excellent internal load distribution and the optimized osculation between the spindle thread flanks and the planetary gear grooves' crowned flanks.

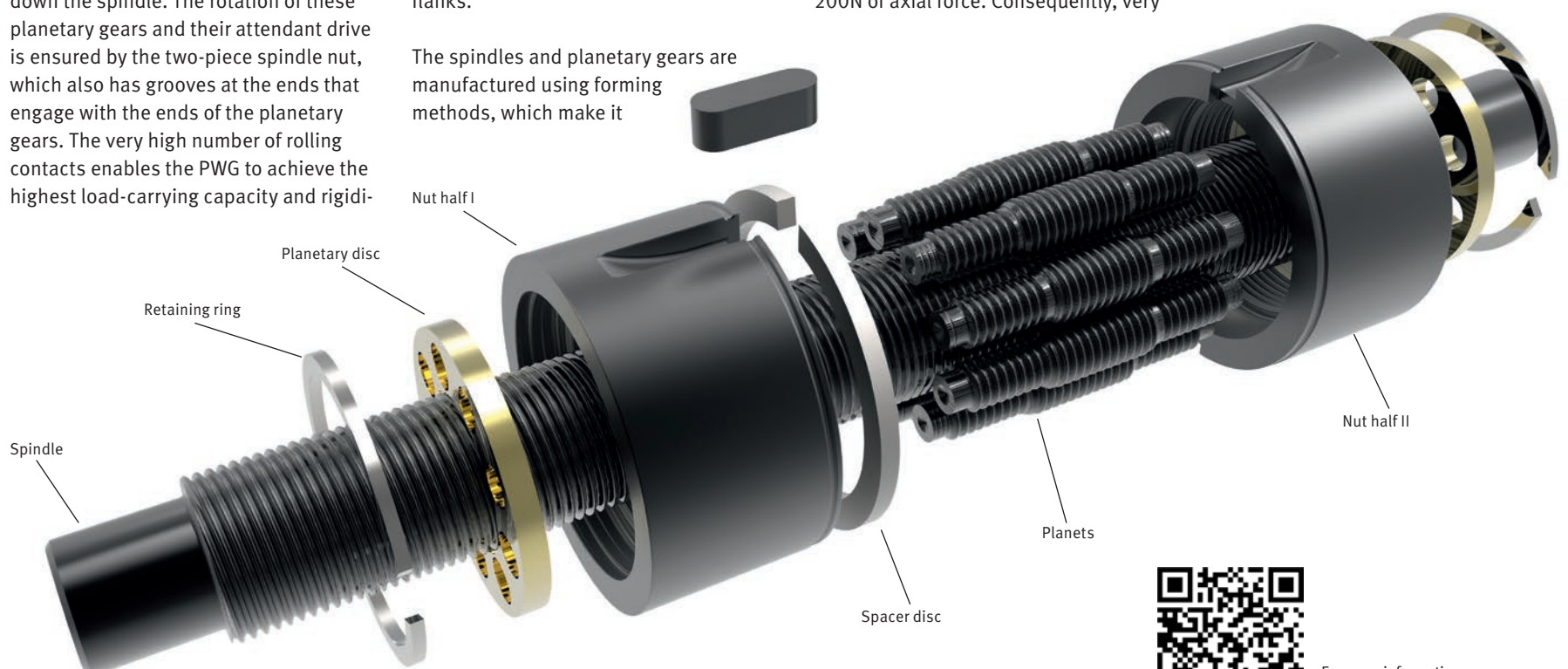
The spindles and planetary gears are manufactured using forming methods, which make it

possible to achieve good material compression along with optimum grain flow, highest-possible rigidity, and, consequently, a further 15 percent increase in load rating compared to conventional technologies. This manufacturing method also lowers costs to a level comparable with that of ball screw drives manufactured using forming methods. Clearance-free preloaded units are easily produced by adding a spacer washer between the two halves of the spindle nut.

Saves space, increases power density, lowers costs

Case in point: with an overall pitch of, for example, 0.75 mm from only 40 Ncm, the PWG is able to generate an impressive 200N of axial force. Consequently, very

high axial forces can be achieved even with small, cost-effective motors. The electric drive can be easily integrated using a feather key connection on the outside diameter of the spindle nut. Areas of application and potential projects include mirror tracking systems in the solar power sector; tool clamping and release units in machine tools; feed units for sheet metal forming in the mechanical engineering sector; in sheet-metal bending machines as well as in locking cylinders for plastic injection molding machines; in riveting and cutting devices; and in adhesive metering systems. The PWG has already gone into volume production for clutch actuators used in the automotive industry.



Exploded view of the planetary screw drive (PWG): spindle and planetary gears are manufactured using forming methods.



For more information,
see publication PDB 35

Economical Plug-and-Play Solutions

Linear guidance systems for machine tools and special machinery

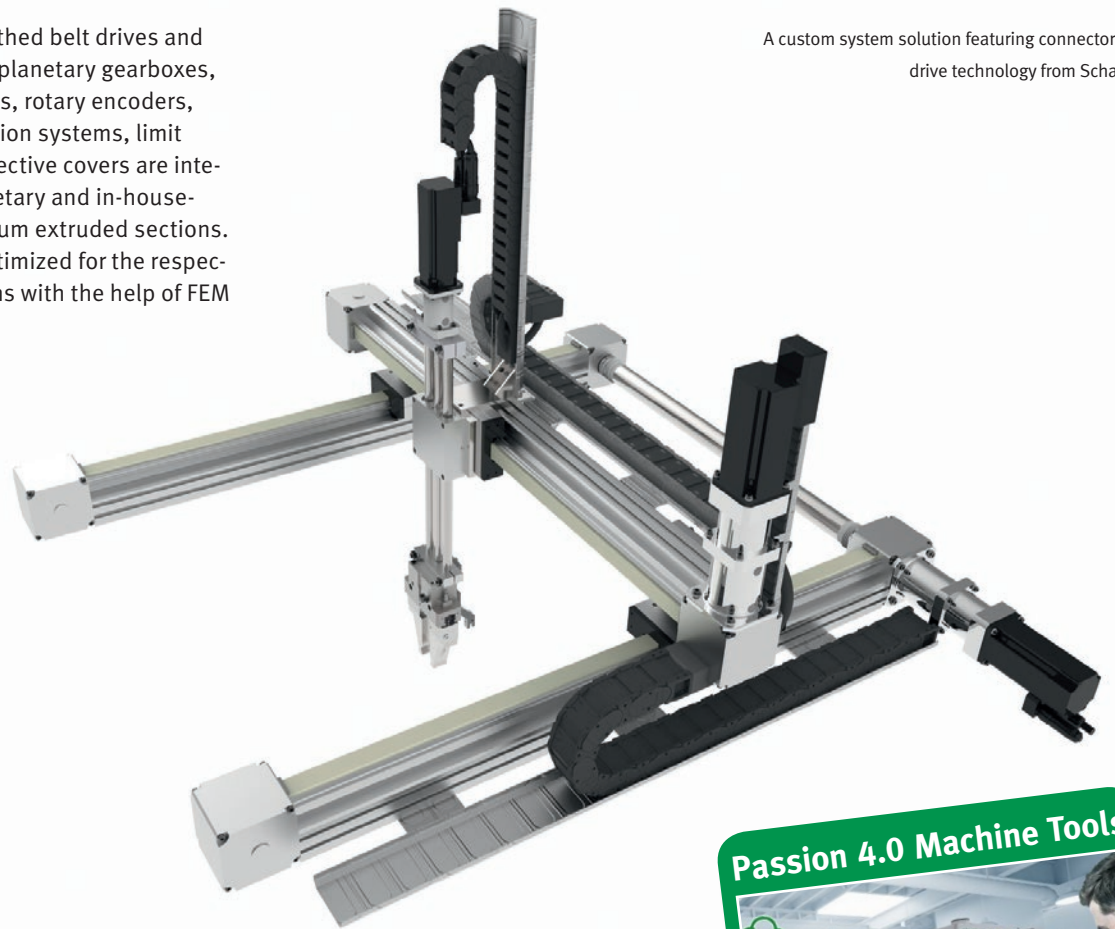
Many functions with just a few components – this is the Schaeffler way of developing economic linear guidance systems. These assemblies are designed and manufactured both as standard products and as customer-specific versions. Schaeffler provides plug-and-play subsystems that include engineering and drive technology as well as additional services such as final assembly, wiring, parameterization of the control system and even initial startup.

Linear guides, toothed belt drives and ball screw drives, planetary gearboxes, measuring systems, rotary encoders, carriages, lubrication systems, limit switches and protective covers are integrated into proprietary and in-house-developed aluminum extruded sections. These are then optimized for the respective load conditions with the help of FEM analysis.

A custom system solution featuring connectors and drive technology from Schaeffler



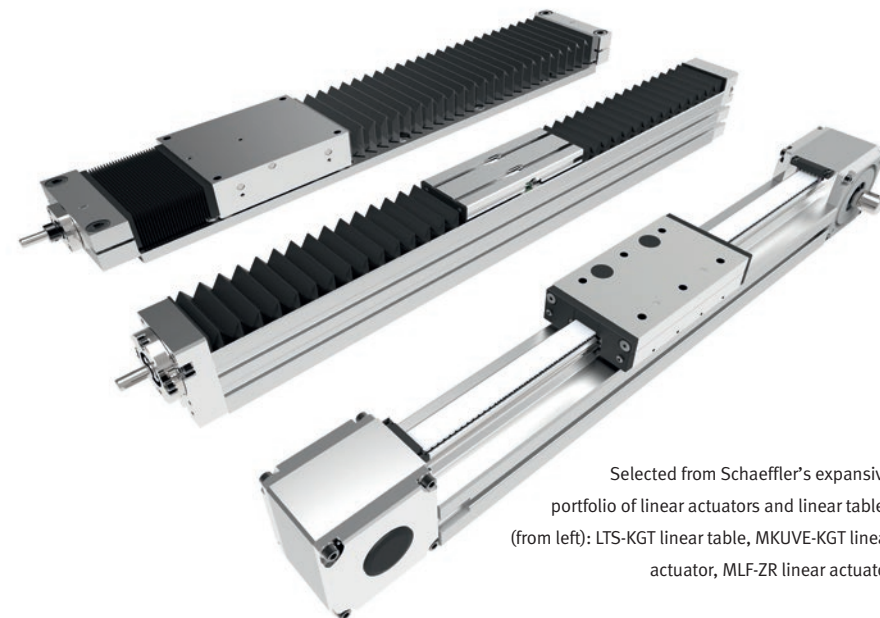
An MTKUSE telescopic actuator combined with an MDKUVE25-KGT linear actuator



Telescopic actuator MTKUSE: Extra space for machine tools

Telescopic axes do not extend across the entire travel distance and, therefore, free up more work space for other machines and operations. This enables the machine to be designed more flexibly, or possibly even moved behind safety panels or separate work areas.

The telescopic actuator MTKUSE has been specifically designed for secondary axes, such as in pick-and-place applications or in tool-transfer devices. MTKUSE includes three high-precision linear ball bearing and guideway assemblies that are arranged one above the other. Consequently, the available travel distance is more than twice as long as the base actuator itself. The linear unit can be telescoped in both directions, while a geared servomotor is externally flanged to the aluminum profile rail and drives the actuator via a rack-and-pinion drive. Upon customer request, servomotors from a wide range of manufacturers as well as appropriately prepared low-clearance, high-precision planetary gearboxes can be installed. Alternatively, limit switches and linear encoders can be integrated as well. By using current detection and by monitoring tracking errors, the servo controller makes it possible to indirectly evaluate frictional



Selected from Schaeffler's expansive portfolio of linear actuators and linear tables (from left): LTS-KGT linear table, MKUVE-KGT linear actuator, MLF-ZR linear actuator

torque and, therefore, the condition of the bearing.

High-precision linear table LTP: Extremely accurate positioning and repeatability

High-precision LTP linear tables are used whenever tools need to be moved precisely and with extremely accurate repeatability during machining or monitoring operations. The linear carriage is supported by a precision-manufactured aluminum plate on high-precision linear ball bearing and guideway assemblies

that ensure smooth and quiet operation with minimal sliding resistance.

The unit is typically powered by a servomotor and a ball screw drive. Alternatively, a direct-drive version is possible, too. Linear encoders and position switches are applied according to the customer's specifications.

High-precision LTP linear tables come in three sizes. A vibration-damping gray cast iron version is also available as an option. In addition, the LTP can be



equipped with bellows or with a metal telescopic cover to protect against foreign particles and liquids. To ensure that servomotors from various manufacturers can be installed according to customer requirements, Schaeffler developed the KGEH coupling housing as an open interface. Here, too, the servo controller makes it possible to indirectly evaluate frictional torque and, therefore, the condition of the bearing.

These high-precision linear tables are used as auxiliary axes in machine tools, such as in tool-transfer devices or as a drive for laser delivery in tool-marking and coding applications.

Monorail Guidance Systems 4.0

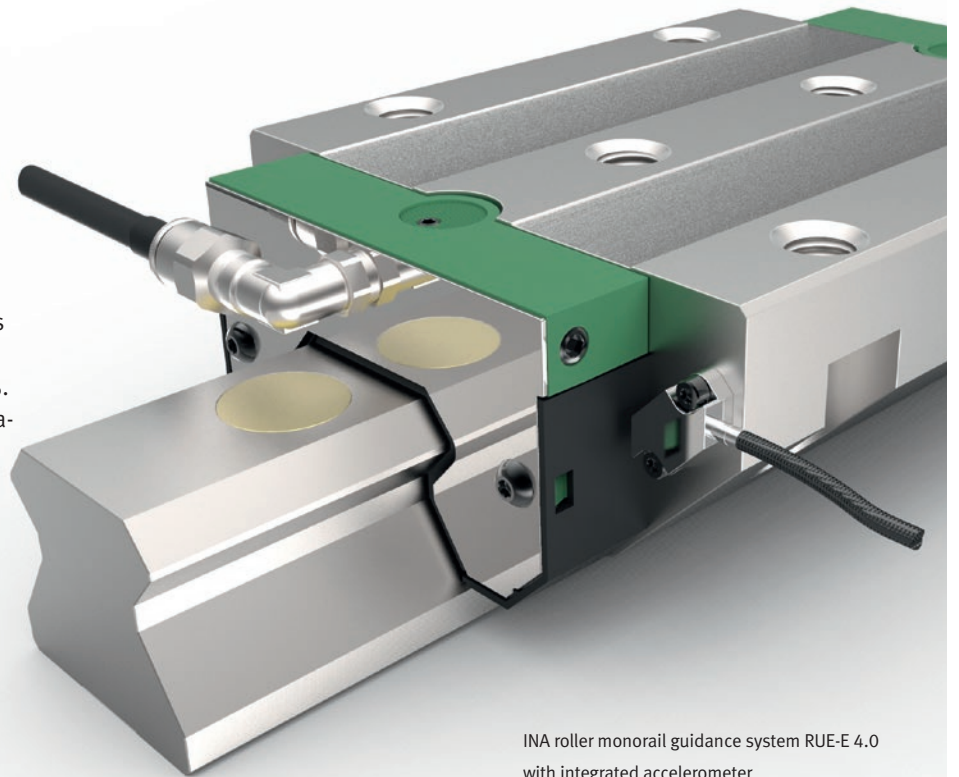
Intelligent components for feed axes

For the first time ever, the RUE-E linear recirculating roller bearing and guideway assembly – now in its 5th generation – includes integrated sensor units that ensure just the right amount of lubrication while facilitating bearing condition monitoring.

The sensor system for monitoring the condition of the lubricant provides feedback to the machine control, and – via the innovative FAG CONCEPT8 multi-point lubricator, for example – initiates automatic relubrication. Meanwhile, a piezoelectric accelerometer mounted on the carriage's steel saddle plate is used to monitor the condition of the bearing. It supplies information on vibration speed, vibration acceleration and rolling bearing parameters to the connected signal transducer with built-in limit value monitoring.

With this concept for the new RUE-E, Schaeffler has developed a system that offers the user instant feedback and communication with the machine's control unit, an automated lubrication system that delivers just the right amount of lubricant, and the ability to automatically initiate maintenance measures.

As a result, manual lubrication intervals are eliminated, and lubricant consumption can be reduced by as much as 30%. The automated condition monitoring feature allows for predictive maintenance, which results in increased equipment availability, higher quality and a lower total cost of ownership.



INA roller monorail guidance system RUE-E 4.0 with integrated accelerometer

X-life Screw Drive Bearings

Longer life and increased productivity, thanks to higher limiting speeds

In order to be able to take advantage of the full performance potential of screw drives used in feed axes, it is crucial that the bearings in these applications deliver commensurate performance, load-carrying capacity and dynamics. This is where the benefits of INA's ZKLN- and ZKLF-series of double row, preloaded angular contact ball bearings are particularly apparent. And after years of being used to great success, these series of bearings now come standard with the X-life seal of quality.



The modified X-life manufacturing processes have made it possible to increase the bearings' basic dynamic load ratings by an additional 10%, which corresponds to a 30% increase in their basic rating life. In addition, tests have confirmed that the bearings' limiting speeds have been boosted by as much as 60%.

Users also benefit from reduced friction, which allows the bearings to run cooler. This, in turn, leads to higher accuracy, in-



New X-life standard INA ZKLF (for flange mounting) and ZKLN

creased dynamics and, ultimately, better machining results.

At the same time, the machine tool can now be operated at higher speeds during rapid traverse, which increases efficiency. Not to be overlooked, of course, is how capably these bearings perform when there is a change in the rotational direction, which happens constantly in machine tools during precise positioning operations. Here it is critically important that the moment of friction is consistent throughout the entire positioning process. Benchmark tests have shown that INA's new ZKLN and ZKLF bearings deliver a constant frictional torque, even when changes in the tool's rotational direction are made at slow speeds, which allows for far more precise positioning maneuvers.



Download
the brochure!



Expo and EMO in Milan

Feeding the Planet, Energy for Life



In a serendipitous coincidence for visitors to this year's EMO, the world's leading trade show for machine tools happens to be sharing the fairgrounds with this year's world's fair, EXPO 2015 in Milan, Italy. After all, ideas, products and concepts from related or even entirely different disciplines often provide inspiration for solutions that can be applied to one's own work.

The slogan for this year's EXPO combines technology, innovation, culture, tradition and creativity with the themes of resources and life.

Similar to Machine Tools 4.0, the slogan invites a networked and forward-looking look at the overall system – which, in this case, happens to be “Planet Earth,” thereby offering us the wonderful opportunity to broaden our own horizons. This means that at this year's EMO, we are not merely walking by ourselves from one booth to the next. Rather, we can also wander from country to country – together, with you – as citizens of the world.

By the way, this year's slogan for the German Pavilion is “be active” – and here we come full circle with EMO, because this slogan certainly applies to all of us at that venue as well.



German pavilion: “be active”



Passion 4.0 Milano: an icon of culture as well as commerce. The city's cathedral alone is well worth a visit!



The stylish pavilion from host country Italy at EXPO 2015



This is where you'll find us at EMO: Hall 3, Booth L07/H08





PrecisionDesk

New: Schaeffler app for super-precision bearings

At your fingertips – reliable – time-saving

Available now and securely stored on your smartphone or on your mounting station's PC!

The new PrecisionDesk app from Schaeffler – offered free of charge! – provides services for super-precision rotary and linear bearings. Activated for the first time to coincide with EMO 2015, this ingenious app helps installers and engineers select and mount bearing components for machine tools, textile machines and printing presses, food & packaging machines as well as all other applications that rely on high-precision bearings.

Users of the PrecisionDesk app can take advantage of the many software features listed below - immediately at hand, where it can't get lost.

Data is accessible from any smartphone, tablet device or mounting station's PC. This means that, going forward, it will be possible to perform tasks such as directly calling up bearing-specific inspection sheets for spindle and rotary table bearings, and – with the help of the app – saving or forwarding them on for documentation purposes. For spindle bearings, it will be possible to generate electronic bearing-related data sets (.csv) and use them, for example, for a logistics system. Schaeffler customers can use the app to monitor their inventory and improve the quality of their assembly operations. Schaeffler is pleased to be first to market with this type of a service tool.

All the user needs to do is to scan the data matrix code on the bearing or the bearing packaging to access the app's features:

Counterfeit protection

- DMC verification

Bearing inspection sheets (spindle bearings)

- Bearing ID
- Designation
- Time of manufacture
- Actual value codes
- Width deviation
- Contact angle
- Offset

Mounting recommendations

- Proper grease amount
- Grease distribution run
- Universal bearing sets
- Permissible heating temperatures
- Designation and marking

Performance data

- Catalog information
- Additional product information
- Direct access to Schaeffler's media library

Service

- Distributor network
- Hotline



PrecisionDesk app for super-precision bearings (in rotary axes, linear axes, main spindles, feed spindles)

The app is initially available in English and German; other languages are planned as well. In cooperation with Schaeffler IT specialists and its business partners, work is already underway on a generation plan for PrecisionDesk.

The application can be used on Android, iOS and Windows-based operating systems. It is available for download in the respective app stores. Using the QR code below, you can learn more about the app and jump straight to your preferred app store via the embedded link.

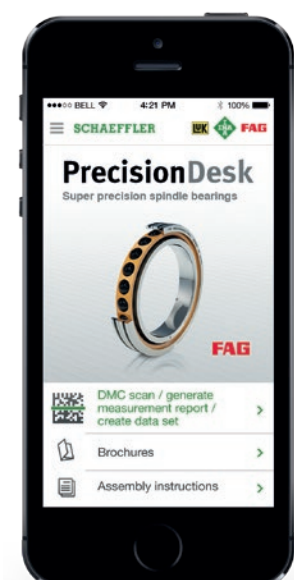


Messprotokoll / bearing inspection sheet **FAG**
Spindle bearings

Titel / title	Scan2 Lager WAN	
Lagertyp / bearing type	B7014-E-TVP-P4-UL	
Produktionsdatum / date of production	35K	
Seriennummer / serial number	2DS.UB/9769534611F.7	
Istwertkennzahl Außendurchmesser diameter code OR (iDimp ; iDs)	-4	Istwertkennzahl Bohrung diameter code IR (iDimp ; iDs) -3
Breitenabweichung width deviation (ABs ; iCs)	-58	axialer Überstand offset (a) -1,1
Druckwinkel bearing angle (α)	15	

Bemerkungen / notes:

Erstelldatum / date of creation 15.11.2014 **SCHAEFFLER**



Inspection sheet for spindle bearing B7014, available directly via the PrecisionDesk app!

Protection against counterfeit bearings: scan the data matrix code on the packaging or the bearing itself

BEARINX®

High-performance bearing calculation tool for even the most demanding applications

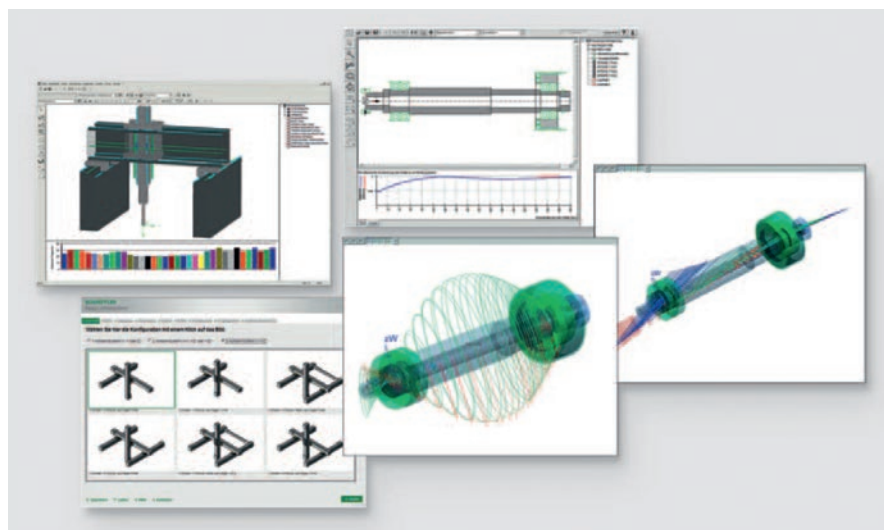
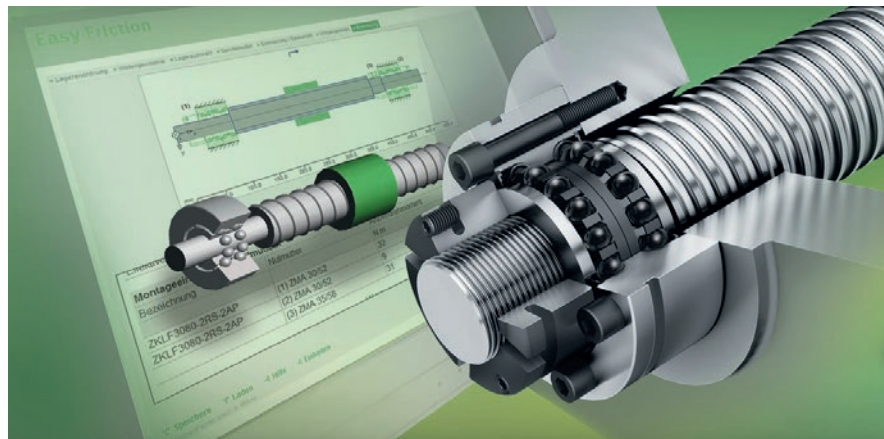
With BEARINX®, Schaeffler has developed a powerful tool for designing and calculating bearing supports in complex systems. It helps find solutions wherever something rotates or is moved in a straight line. BEARINX® makes it possible to analyze bearings in detail: from the individual bearing component to complex shaft systems and all the way to simulating operating conditions. To varying degrees, calculation modules from the full BEARINX version have been made available for the customer version.

BEARINX® customer versions are able to access a bearing database that contains all the catalog bearings from the various Schaeffler brands. Special bearings are also available upon request. Internal assembly data, which is stored in a location that is not visible to the user, are also factored into the operating life calculation. Consequently, the quality of the calculation results is much higher than what would be achieved with a bearing approximation, since the profile data of both the raceways and the rolling elements are taken into consideration.

BEARINX® customer versions are also extremely interesting from a cost perspective. Usage is contractually agreed upon and includes an initial training as well as reimbursement for expenses. There are no maintenance or license fees. Universities receive access free of charge. Nothing needs to be installed by the customer.

Calculations are performed online using the following modules:

- BEARINX® shaft calculation for designing rolling bearings in elastic shaft systems
- BEARINX® spindle calculation for designing spindle bearings in machine tools
- BEARINX® calculation for designing linear guidance systems



Lightning-quick and free of charge: calculations with BEARINX®-online Easy modules

Available exclusively online, Schaeffler's BEARINX®-online Easy modules are available to anyone, at any time and at no charge. After completing an initial registration, which takes almost no time, you can get started with your calculations right away:

- BEARINX®-online Easy Linear
- BEARINX®-online Easy Friction
- BEARINX®-online Easy Linearsystem
- BEARINX®-online Easy Ballscrew
- BEARINX®-online Easy RopeSheave
- BEARINX®-online Easy EMachine



Your direct access to BEARINX®:
www.schaeffler.com/calculation

BEARINX® calculation expertise for machine tools – available anywhere, anytime!

ENTER FOR A CHANCE TO WIN!

Win a Canon EOS 750D SLR camera!



Image shown is similar to actual prize

QUESTION:

What is the Schaeffler Group's slogan for this year's EMO trade show?

Please enter the correct answer on the coupon shown on the right. Complete the form and return it to: Schaeffler Technologies AG & Co. KG GB Produktionsmaschinen & Linear-technik IEBSWE-SM Georg-Schaefer-Strasse 30 D-97421 Schweinfurt

Fax: +49 (0) 9721 911 435
Closing date: September 30, 2016

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 Canon EOS 750D SLR camera!

ANSWER:

4.0

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?

Mounting Training

The next training sessions on spindle bearing mounting will take place in Schweinfurt on:

- November 26, 2015
- April 21, 2016
- September 22, 2016
- December 01, 2016

Training sessions are offered on a regular basis. Additional dates available upon request.

Your contact person:
Karin Morgenroth
Phone: +49 (0) 9522 71 503
E-mail: Schulungszentrum@schaeffler.com



Training course for attendance and maintenance of machine tools main spindle bearings



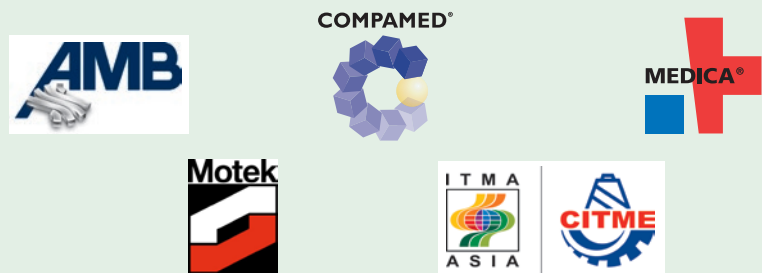
The winner of our contest from added competence, issue 2014/15

Dr. Alexander Seitz (photo, right) from Schuler Automation GmbH & Co.KG in Heßdorf is the winner of the quiz in our last issue of "added competence." He was thrilled to receive a new iPad Air, presented to him by Schaeffler Sales Representative Michael Martinkovich.



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The Schaeffler Group will be exhibiting at **AMB** (Stuttgart, Sept. 13-17, 2016), at **Compamed + MEDICA** (Düsseldorf, Nov. 14-17, 2016), at **MOTEK** (Stuttgart, Oct. 10-13, 2016) and at **ITMA Asia + CITME** (Shanghai, June 2016)



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