



Machine tool optimization

SKF solutions for super-precision, productivity and sustainability



The Power of Knowledge Engineering



Run faster, longer,

Machine tools: whether you are designing them or using them, you face new challenges, from the need for greater speed and precision to reduced environmental impact.

As an engaged supplier to the machine tool industry for decades and a user of machine tools in over 130 of our own factories worldwide, SKF has a unique understanding of these challenges. We apply more than 100 years of experience and a broad set of competencies to:

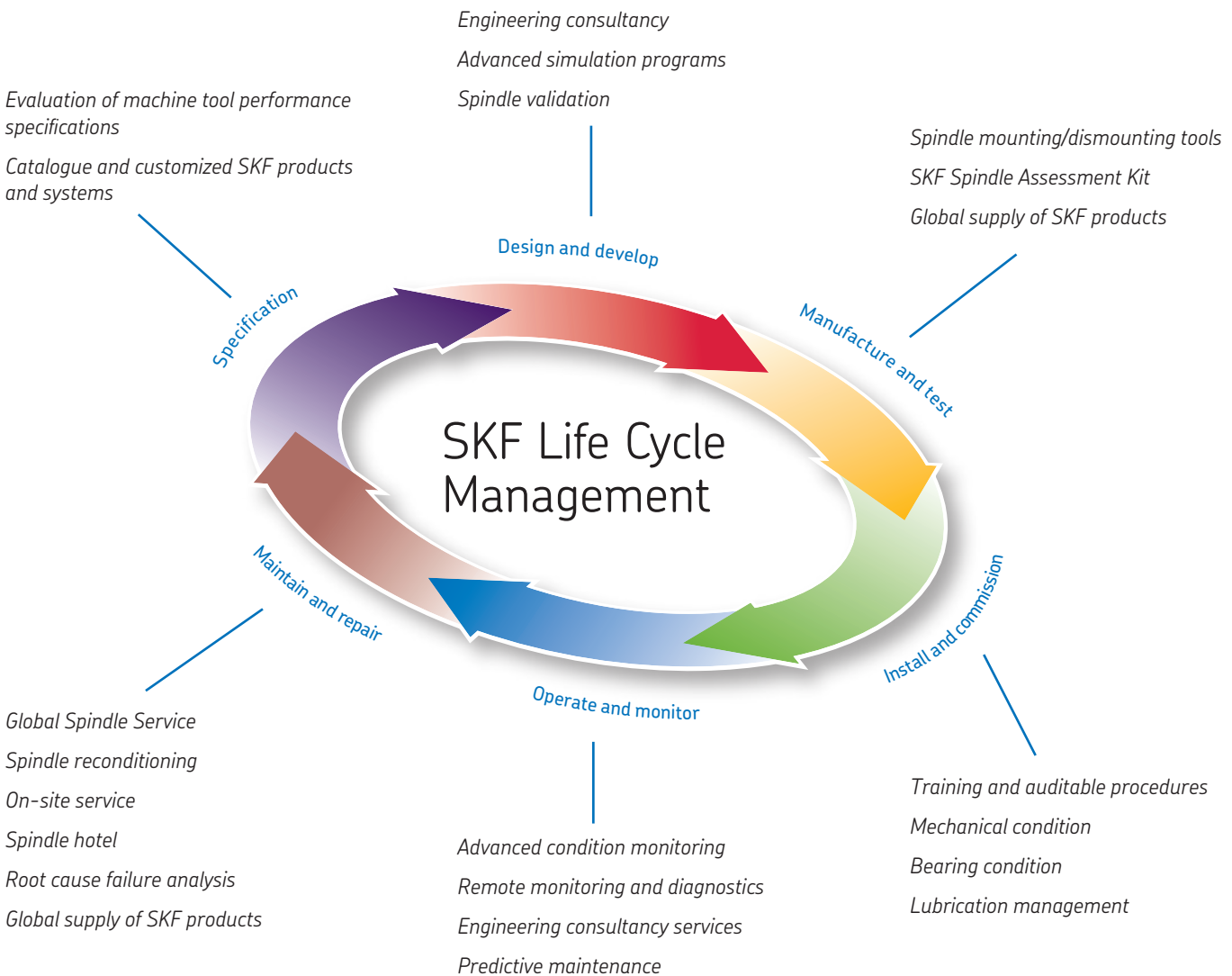
- **Support faster production by increasing machining speed and accuracy**
- **Improve machine availability by optimizing maintenance**
- **Add value throughout the machine tool life cycle**
- **Improve the environmental performance of machining operations**



and cleaner with SKF innovation

Optimizing the machine tool life cycle

SKF products, systems and application knowledge can help our customers – both machine tool manufacturers and machine tool operators – optimize machine tool performance, reliability and efficiency. The graphic below highlights the range of SKF solutions that can add value at each stage of the machine tool life cycle.



A global resource for high quality machine



Super-precision bearings

Extended speed capability, a high degree of running accuracy, high system rigidity, low heat generation, and low noise and vibration levels are just some of the many requirements for success in today's advanced machine tool applications.



The new generation of SKF super-precision bearings is able to meet these increasing performance requirements. As a result of new cage designs and cleaner steel for bearing rings, they enable higher speeds and higher load carrying capacity in machine tool applications. The SKF range also includes hybrid bearings (with high performance

ceramic rolling elements) that have high load capacity with low friction and heat characteristics suited to high speed operation.

On request we supply specific tolerances on bore and outside diameter, matched sets of bearings with different contact angles, special preloads, special axial clearance, individual filling grades, special greases, specific packaging requirements, measuring reports, and much more.

Precision lock nuts

When it comes to super-precision applications such as spindle units, ball screws and precision shafts, reliability is crucial. SKF precision lock nuts provide a strong joint with a precise angle and secure grip around shafts. Our KMT and compact KMTA designs offer high precision and simplicity and efficiency, reducing assembly time of super-precision bearing arrangements by up to 20%.

Lubrication systems

SKF provides a range of automatic lubrication technologies, each offering a number of important advantages, from improved production and reduced total cost of ownership (TCO) to a healthier, more environmentally friendly workplace. We can supply spindle lubrication systems that are suitable for most of the speed ranges. We also provide customized multi-point lubrication systems for linear guides, screw drives, bearings and auxiliary equipment as well as automated minimal quantity lubrication (MQL) systems for machining processes that reduce environmental impact and create healthier work environments.



Coolant pumps

SKF offers a full range of space-saving centrifugal and screw spindle pumps, each engineered to provide a reliable and efficient supply of cooling fluid in specific machine tool applications. In addition to systems supplying coolant directly to cutting tools and workpieces, SKF also offers centralized lubrication systems. Due to

immersed installation, most of these pumps operate without seals, reducing maintenance time and, ultimately, TCO. Available in numerous designs for various delivered media, flow rates and operating pressures, these pumps can be provided with assorted standard drive options and electrical connection ratings.



tool components and systems



Customized sealing solutions

Decades of experience with cutting and forming machines, combined with advanced materials expertise, has made SKF a leading supplier of standard and custom-engineered sealing solutions. These include integrated solutions consisting of seals and advanced engineered plastic parts, as well as moulded seals for higher volume orders and high-performance machined seals for hydraulic and pneumatic applications like press-cylinders, valves or clamping devices as well as for rotary applications like rotary distributors, joints or indexing tables.



Due to the flexible production process, customers benefit from short delivery times and just-in-time delivery for standard and special seals in customized dimensions and high performance one-piece sealing materials up to 4 000 mm in diameter as

one piece. Large seals with diameters up to 10 000 mm and above are assembled using a special welding technique.

A wide variety of high performance sealing materials – including hydrolysis-resistant and/or self-lubricated polyurethanes, fluoro-carbon-rubbers and different PTFE-compounds – provides high wear resistance, long service-life and chemical compatibility with various machine tool liquids. In addition, SKF supports customers with on-site solution analysis and application engineering. Located close to our customers, SKF's machined seals competence centers provide global availability with truly local service.



Linear motion technologies

By combining competencies in linear motion, bearings, sealing and lubrication with best practices, SKF offers a range of standard and customized solutions for advanced machine tool sub-assemblies.

We offer solutions for linear drive and for guiding systems, including profile rail guide, precision rail guide, dovetail slides, standard linear slides and linear ball bearings. All are designed for ease of maintenance and reliability.



Linear drives for many machine tool axes are equipped with ball screws or roller screws. SKF ball and roller screws provide a fast and precise linear movement, even under high load condition.

Roller screws fitted on machine axis provide the unique advantages of high acceleration, high linear speed and high loading capability combined with high axial stiffness. Satellite roller screws, which do not need recirculation systems and which do not exhibit friction between rolling elements, also provide higher accuracy when machine tool axis reverse direction. The screws are also available with the support bearings pre-assembled on the screw shaft – ready to bolt in place, speeding up and simplifying assembly and alignment procedures.

An OEM engineering partner for greater

As machine tools are pushed to new limits to maximize production output, exceptional demands are placed on main sub-assemblies such as drives, guides, lubrication, seals, monitoring and sensorics. Altogether, these systems significantly contribute to the machine's performance and reliability throughout its life cycle.

By combining advanced components and solutions that take full advantage of our competence in bearings, linear motion, seals and lubrication systems, SKF is able to support you in the development of a solution that meets your specific requirements and challenges.

SKF is a proven and resourceful partner to machine tool manufacturers worldwide, providing products, systems and knowledge that can help optimize designs for extreme accuracy and high speed production.

Collaborating with your engineering team to address performance at every step of the design, SKF experts support your goals of improved performance and reliability, differentiating your products and providing a competitive advantage in the marketplace.

Drives

Drive components have a vital function in a tooling machine. Quite simply, they must offer high reliability, easy maintenance and long service life. This puts high demands on the quality of the specific products and the way they interact with the machine.

For the motorized spindle, for example, SKF offers high-speed, sealed, super-precision bearings that can be combined with lifetime grease lubrication and separate re-greasing unit or permanent oil+air spindle lubrication.

Guiding

The performance of guiding products and solutions depends on qualities like high position accuracy and stiffness, low friction, non-stick-slip effect and ideal heat transfer.

SKF has a unique capability to offer advanced guiding solutions for optimal performance. A perfect example is precision rail guides with an integrated anti-creeping system, wipers and lubrication equipment. This combination provides reliable, precise, highly efficient and fast operation.



Lubrication and seals

Heat generation due to friction is a constant threat to production accuracy. The correct quantity of lubricant at all moving parts keeps heat development to a minimum and helps prevent wear and tear. Adequately selected seals keep the lubricant in the required contact areas and protect against contamination.

SKF offers a wide range of lubrication solutions with variable quantity allocation and different viscosity. Plastic and rubber seals complete the very specific technical requirements for highly productive systems.

Measurement and monitoring

Monitoring systems can often be the key to improved machine efficiency. A machine operator who has current information about machine performance can more quickly and easily take the proper actions.

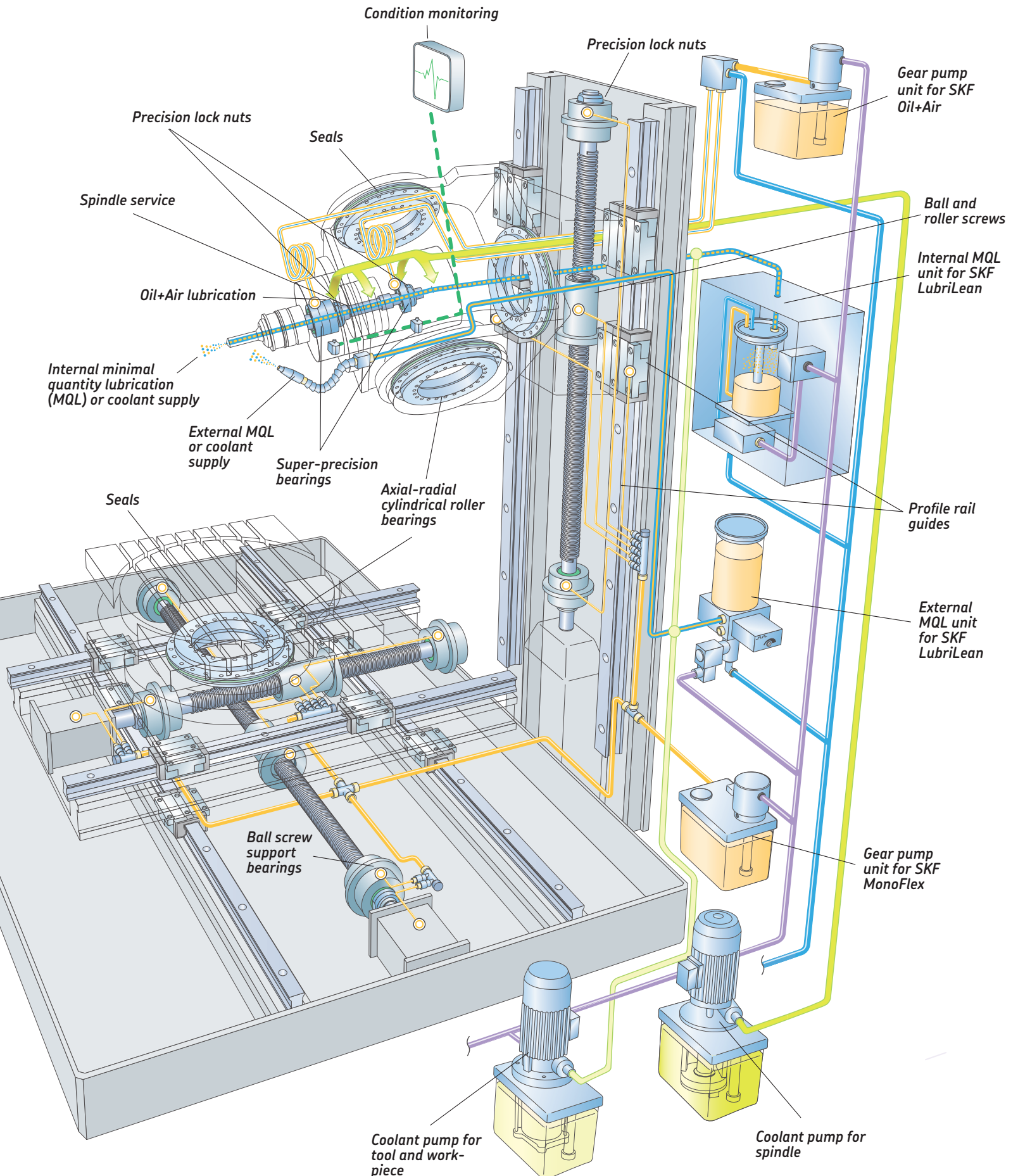
Valuable information about the operational health of the spindle can be collected using adapted sensor systems – opening up opportunities for cost effective process optimization.

Building on our experience with OEMs around the world, SKF is equipped to work with you to build in on-line condition monitoring and crash protection systems that provide advanced warning of developing machine tool spindle problems such as bearing damage, imbalance, and lubrication issues.

Advanced calculation tools

The SKF Spindle Simulator is an advanced simulation software for the analysis of spindle applications. It contains detailed models of the new harmonized SKF super-precision bearings.

reliability, accuracy and adaptability



Higher machine reliability through more

Assembly tools and measurement equipment

Incorrect mounting methods account for up to 16% of premature bearing failures. SKF offers a wide range of bearing assembly tools and measurement equipment that facilitates quick, easy and accurate mounting and dismounting of spindles. These include:

- Bearing heaters
- Hydraulic nuts
- Bearing pullers
- Gauges for bearing mounting



SKF bearing greases

SKF's vast experience in the development of rolling bearings forms the basis for the development of a wide range of lubricants adjusted to the respective field of application.



Spindle condition monitoring

The monitoring of spindle health is crucial to avoiding machining process disturbances and unplanned production stops. SKF provides a complete family of condition monitoring tools and technologies, from hand-held data collectors and analyzers to on-line surveillance and protection systems that provide reliable insight into machine condition including bearing, imbalance and lubrication issues.

These systems improve operational efficiency and reduce costs by eliminating unplanned downtime and enabling machine tool operations to schedule maintenance based on condition rather than time schedules. The data logging system is integratable with the machine's control system for aligned corrective actions.



For example, the SKF Spindle Assessment Kit is a complete solution for reliable, simplified, onboard condition monitoring. The kit includes an SKF Microlog Advisor Pro, acceleration sensor, laser tachometer, dial gauge with stand, belt tension gauge and a software package. SKF assists in the set up of measuring points on your machine tool spindles and also offers a consulting service as part of a service agreement.

efficient maintenance

Global spindle service network

The need for extreme accuracy and repeatability in machine tool applications demands that only highly skilled technicians with in-depth knowledge of the equipment or systems perform upgrades or repairs. Due to the intensive training and experience needed, many facilities choose to outsource service of their most critical equipment. SKF provides a wide range of highly specialized expert services – from engineering upgrades to spindle analysis, reconditioning, and replacement – for all spindle brands and designs used in a wide range of applications.



With experienced personnel and critical equipment such as balancing units, precision machining, special measuring tools and advanced vibration equipment, SKF Spindle Service Centres are able to recondition any kind of belt driven and motorized spindle for all spindle brands and designs used in a wide range of applications.

Our Spindle Service Centres worldwide are part of SKF Solution Factories, a unique concept that provides our customers with direct access to SKF's global capabilities, with specialized, one-stop support involving our core competencies: bearings and bearing units, seals, mechatronics, services, and lubrication systems.

At SKF Spindle Service Centres, spindles go through a total condition and function review following a thoroughly developed and mandatory reconditioning process. This includes analysis of breakdown cause, dynamic balancing of rotating parts and fine balancing of the complete spindle. Vital measurements and sensors are validated and components are replaced and refurbished when needed. When applicable, we provide proposals for modification and upgrading. Finally, the reconditioning is concluded by a comprehensive test before delivered together with verification documents.



Asset management services

SKF provides asset management services to optimize overall equipment effectiveness. In addition to integrated condition monitoring technologies, these include predictive and proactive maintenance programs, expert maintenance training, and web-enabled remote monitoring services that allow customers to benefit from the experience of SKF machine condition analysts. If corrective actions are needed, SKF reliability experts perform root cause failure analysis (RCFA) and recommend appropriate equipment upgrades.



Proven results worldwide



Increased spindle speed

SKF engineers helped a provider of CNC machining centres for the automotive industry increase spindle speed by 50%. The solution included a relubrication-free super-precision bearing with ceramic balls that enabled spindles to run with the highest precision at greatly increased speed without a significant rise in temperature.

Faster, more precise manufacturing

In the final manufacturing stages of aluminum shells for consumer electronic products such as smart phones, the high speed spindles of milling, grinding and tapping/drilling machines can spin at up to 60 000 r/min, 24 hours a day, 365 days a year.

Working closely with the customer, SKF improved the spindle design and assisted in selecting the right solutions: SKF high speed, super-precision angular contact ball bearings with ceramic balls for a high degree of stiffness and extended service life. These bearings reach their highest speeds at around 75 000 r/min with bore diameters of approximately 30 mm.



Cleaner production through reduced lubricant usage

By implementing SKF LubriLean minimal quantity lubrication, a leading automotive plant was able to increase tool life by as much as 50% in their engine block production stations. MQL systems not only extended the service life of the cutting tools but also reduced the coolant consumption needed in the process to nearly zero.



Longer spindle life, lower operating costs

SKF Spindle Services worked with an engine building facility in China to achieve longer spindle service life for more than 150 machines. This resulted in cost savings of 30% per year, compared

to costs with the previous spindle supplier. Additionally, the customer benefited from SKF's ability to repair almost any type of the many spindle types used in their operation. SKF has provided also training, enabling operators to reliably identify when spindle repairs were needed.



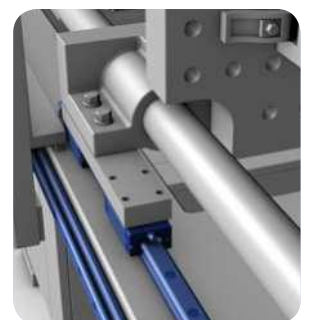
Longer seal life through reduced friction

A new SKF seal design with a larger groove radius for the housing increased the lifetime of index table seals from 100 000 clamping cycles to more than 1 000 000 cycles. The SKF solution provided lower friction, excellent wear and chemical resistance, outperforming PTFE designs and helping the customer avoid broken seals caused by dry friction.



A reliable resource for critical components

A leading machine tool producer required a reliable supplier of high quality profile rail guides. SKF supplied LLT profile rail guides, preloaded according to customer drawings. As the company was already sourcing SKF super-precision bearings, it also benefited from SKF supply chain efficiencies.



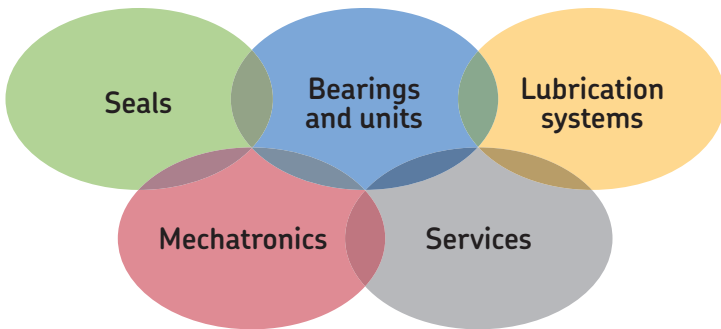
To learn more about SKF solutions for the machine tool industry, including more information about the success stories noted above, see your SKF representative or visit skf.com/machinetool



See inserts for more details about SKF solutions for the machine tool industry.

To learn more, scan the QR code ad left to link to the machine tool section at skf.com.

Or visit skf.com/machinetool



The Power of Knowledge Engineering

Drawing on five areas of competence and application-specific expertise amassed over more than 100 years, SKF brings innovative solutions to OEMs and production facilities in every major industry worldwide. These five competence areas include bearings and units, seals, lubrication systems, mechatronics (combining mechanics and electronics into intelligent systems), and a wide range of services, from 3-D computer modelling to advanced condition monitoring and reliability and asset management services. A global presence provides SKF customers uniform quality standards and worldwide product availability.

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