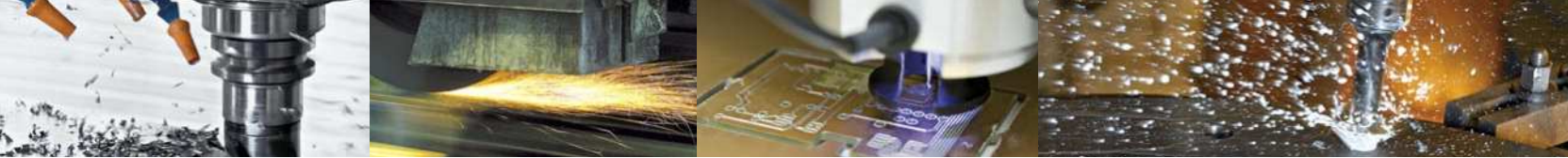


Bearing solutions for super-precision performance

Meeting the challenges of the machine tool industry





Committed to precision and performance

In the machine tool industry, success relies on top performance. 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. The new generation of SKF super-precision bearings is able to meet the ever-increasing performance requirements of precision applications. In addition to our highly innovative solutions, we offer continuous sales and application engineering support from our specialists. Nothing is overlooked in our promise of super-precision performance.

Customised solutions

Our customisation capability is one of our key strengths. On request, we can 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.

Improved performance

Machine tool design is becoming increasingly complex. In order to meet the exceptional demands that are placed on the main sub-assemblies, we have further developed our super-precision bearings to improve performance, machine uptime, speed and precision. These improvements include:

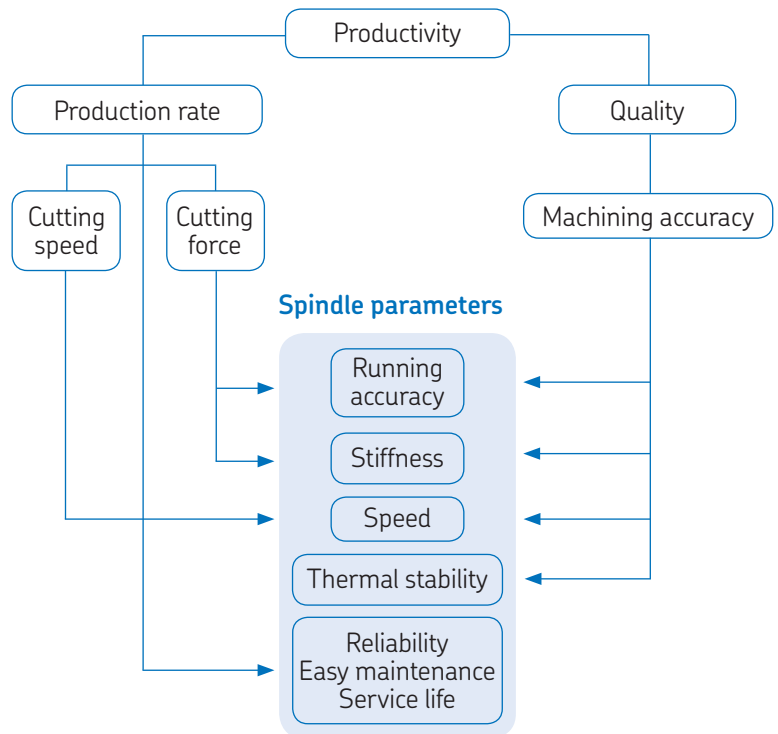




for your success

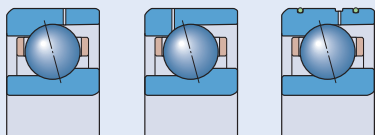
- More sizes and series are available as sealed bearings to keep the grease in and contaminants out of the bearings, without compromising speed capability
- More preload classes to support virtually all possible needs in terms of speed and rigidity
- Optimised chamfers on inner and outer rings for improved mounting accuracy
- Optimised guiding clearance between the cage and outer ring for improved behaviour at high speeds
- Additional features such as two lubrication holes in the outer ring of open bearings to accommodate direct oil lubrication, enabling higher speeds while reducing operating temperatures
- Optimised internal geometry and a redesigned PEEK cage for N10 series cylindrical roller bearings, enables them to accommodate a speed increase of up to 30% when lubricated with grease
- Optimised BTW series design (double direction angular contact thrust ball bearings) for higher speed capability, reduced friction, noise and vibration levels, lower weight, easier handling, more accurate preload control and improved system rigidity

Experience the positive results with our new generation of SKF super-precision bearings

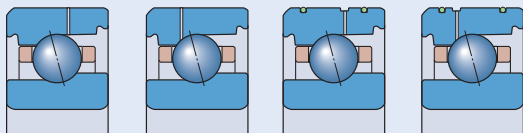


Variants for direct oil lubrication for open bearings in the series:

719 .. E (VEB)



70 .. E (VEX)



An application partner that simply offers

Specialised application knowledge

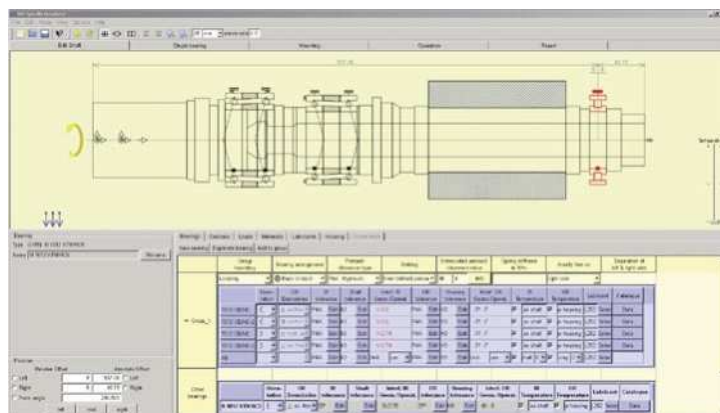
A deep understanding of how spindle bearings respond under different operating conditions is important when developing reliable solutions. At SKF, we use high-precision machine tools as an integral part of our manufacturing processes. The experience and know-how we have put into our products and services is available to all our customers.

Global Spindle Service Centres

Our competence centres are dedicated to the machine tool industry in different parts of the world, with teams of specialists in bearings, lubrication, seals, condition monitoring and more. With strategically located Service Centres in more than 15 countries, our SKF Spindle Service is one of the largest networks for reconditioning and upgrading machine tool spindles in the world.

The SKF Spindle Simulator

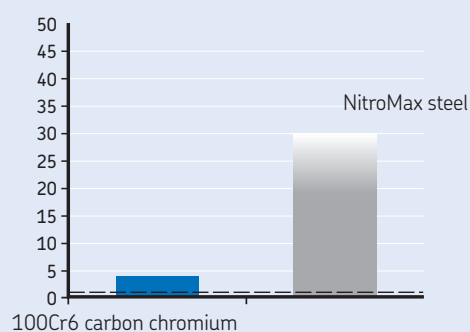
The SKF Spindle Simulator is an advanced simulation software program for the analysis of spindle applications. It supports the analysis of spindles and contains detailed models of the new harmonised SKF super-precision bearings. Based on the SKF Simulator platform and using the same advanced technology, it has been designed to be exceptionally user friendly. The software makes allowance for the effect of the operating speed and temperature on the bearing shaft and housing fits and also the bearing preload. In addition, at each point in the spindle's duty cycle, it analyses the effect of the external loads on the shaft and the bearings and delivers highly accurate information about each contact for each rolling element on every bearing.



more value

Diagram 1

Observed L_{10h} (relative performance)



— — — basic rating life L_{10}

Steel used for bearing rings

Note: Life test results depend on the lubrication conditions i.e. the values for the viscosity ratio κ and the film thickness to surface roughness ratio λ .

Fatigue life tests under full-film lubrication condition conducted on open hybrid bearings made from conventional bearing steel (100Cr6 carbon chromium) and NitroMax steel. Depending on the bearing arrangement and operating conditions, the bearings lasted at least three times longer than bearings made from conventional bearing steel.

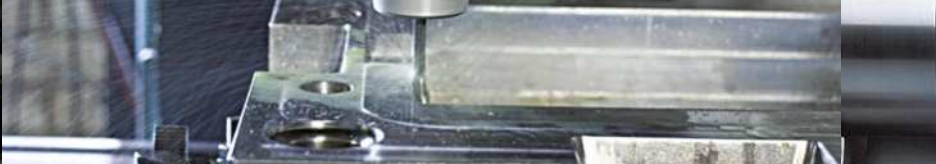
Superior bearing material for superior performance

Super-precision bearings can be supplied with rings made from NitroMax bearing steel. NitroMax is a new generation high-nitrogen stainless steel with superior corrosion resistance, enhanced fatigue strength and a high degree of impact toughness. This ultra-clean steel can extend bearing service life in applications under good (full-film) as well as critical (thin-film) lubrication conditions (see diagram 1).



Longer service life with hybrid bearings

The use of hybrid bearings is another innovative advancement that SKF has extensively tested in its manufacturing facilities located in the USA, Germany, Brazil and India. As silicon nitride balls are considerably lighter and harder than steel balls, hybrid bearings can provide a higher degree of rigidity and run considerably faster than a comparable all-steel bearing. The lower weight of the ceramic balls reduces the centrifugal forces as well as the heat generated in the bearing, thereby significantly extending the service life of the lubricant and markedly extending the maintenance intervals.



Our comprehensive product range for

Different machines have different challenges. SKF now offers a wider product range than ever for all product series and different requirements. By working closely with our customers, we are able to find suitable and practical solutions for even the most specific of conditions.

For high-speed applications

Angular contact ball bearings in the 719 and 70 E series are specially designed to meet the ever-increasing performance requirements of high-speed precision applications. They provide high reliability, superior accuracy and system rigidity for applications such as high-speed machining centres, milling machines, internal grinding machines and woodworking machines.

High-speed cylindrical roller bearings in the N 10 series, offers high system rigidity and load carrying capacity, together with minimal friction and heat generation during high-speed operation. Their optimised internal geometry, a redesigned cage made in PEEK, and a flangeless outer ring allow a speed increase of up to 30 percent with grease lubrication compared to previous high-speed design. Hybrid variants are also available for even higher speeds.

For a longer service life

The new S719 .. B (*HB .. /S*) and S70 .. B (*HX .. /S*) angular contact ball bearings are equipped with seals made of acrylonitrile-butadiene rubber (NBR), to keep lubricant in and contaminants out of the bearing. These series are particularly suitable for metal cutting and woodworking machines. Bearings without seals for grease or oil lubrication are also available. For extreme high-speed applications, to facilitate direct oil lubrication, the outer ring of open bearings can also be manufactured with an annular groove and two lubrication holes as well as two annular grooves to accommodate O-rings.

For confined spaces

718 (*SEA*) series angular contact bearings are the optimal solution for applications where space is very limited. They combine a slim cross-section with high precision and rigidity and are ideal for machine tool applications, multi-spindle drilling heads, robotic arms, measuring devices, racing car wheels and other precision applications.

For exceptional system rigidity

Angular contact ball bearings in the 719 .. D (*SEB*), 70 .. D (*EX*) and 72 .. D (*E200*) series are designed for applications where a high load carrying capacity and a high degree of stiffness are key operational requirements. They provide greater reliability, superior accuracy and extended bearing service life for applications such as lathe spindles, grinding and boring machines and parallel kinematics machines.





demanding applications

For improved performance

The BTW series high-speed angular contact thrust ball bearings represent a radical departure from the former 2344 (00) series bearing design. BTW series bearings consist of two separate angular contact thrust ball bearings that are arranged back-to-back to accommodate thrust loads in both directions. The new design without a spacer sleeve makes mounting faster, easier and more accurate. This new series of bearings is designed to better meet the load, speed and stiffness requirements of modern machine tools.

For screw drives

Single direction angular contact thrust ball bearings in the BSA and BSD (*BS*) series are characterized by superior axial stiffness and high axial load carrying capacity. Double direction angular contact thrust ball bearings in the BEAS series have been developed for machine tool applications where space is tight and easy mounting is required. Bearings in the BEAM series can be bolt-mounted to an associated component. Cartridge units are another solution for simple and quick mounting. Units in the FBSA (*BSDU* and *BSQU*) series incorporate SKF single direction angular contact thrust ball bearings.

For heavy radial loads

High-precision double row cylindrical roller bearings are available in the NN and NNU designs. These bearings feature a low cross sectional height, high load carrying capacity, high rigidity and high-speed capability. They are therefore particularly well suited for machine tool spindles where the bearing arrangement must accommodate heavy radial loads and high speeds, while providing a high degree of stiffness.

For precise positioning

To support our full line of precision bearing products, we also provide axial/radial cylindrical roller bearings (NRT series). These bearings are typically used to support rotating tables, indexing tables and milling heads. Their internal design, together with their high degree of running accuracy (better than P4), enables very precise positioning of the workpiece or the working head.



Different industries, different challenges:

SKF super-precision solutions help machine tool manufacturers and end-users all over the world to increase their productivity and meet the high demands of different industries such as automotive, medical, aerospace, consumer electronics and more.



Specific knowledge and support for the automotive industry

In the automotive industry, the most important challenges on machines are reducing set-up cost as a result of frequent tool changes and working piece translation as well as minimising required maintenance. As an automotive industry supplier, you need a partner that can provide high flexibility and productivity for your machine tools and help you provide the highest precision and quality end-products. Where crankshaft, camshafts, connecting rods, engine cylinder blocks and cylinder heads, transmission housings and assemblies, car body and so on are concerned, nothing less than perfection will do.

Our specific application knowledge and more than half a century of experience in the automotive industry enables us to offer you high-capacity and high-speed super-precision bearings, lubrication systems, seals and services.



Customised solutions for the aerospace industry

The aerospace industry requires the highest standards. After all, every single component is vital to ensure reliability and safety. For suppliers in the aerospace industry, managing cost versus performance is a continuous challenge. Performance cannot be compromised, so the suppliers must manufacture the highest quality workpieces despite the complexity of the materials and elements such as engine and landing gear devices or structural components.

As machine tool manufacturers, you provide technologies that allow aerospace suppliers to fulfil every specification meticulously. An increase in spindle service life as well as higher rigidity are the keys to a flawless performance. Machine tool manufacturers trust the knowledge of our engineers and have worked with SKF to make the spindles in their machine tools run with the highest precision.

face them with precision solutions



Produce high-end electronics faster with high-speed bearings

All over the world, the demand for advanced consumer electronics, computers and communication devices is rapidly growing. Today's innovations will be shortly outdated by even smarter devices. Manufacturers have to produce high-quality products and deliver higher volumes within tighter and tighter time frames.

High-speed spindles are key components in these fast manufacturing processes. By working closely with our machine tool customers, we have applied our engineering knowledge to improve spindle design. Spinning at 20 000 to 60 000 r/min, 24 hours a day, 365 days a year, these machines are used, for instance, to machine the components of high-end electronic devices. Our customised solutions help to improve productivity and bring even smarter products to market faster than ever.



Helping medical technology by providing safety and reliability

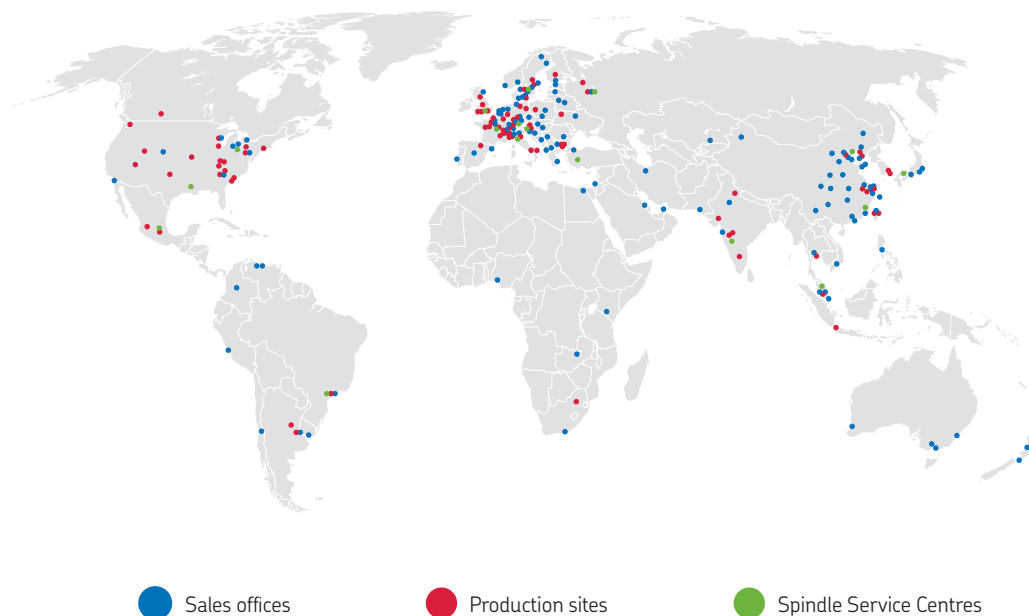
Machine tools play an important role in manufacturing components that will improve the lives of patients such as knee joints, bone screws, dental implants and complete prostheses, to name just a few. The demands are high. Your machine tools have to work with special materials, from titanium to advanced ceramics, under extreme conditions and still try to achieve a perfect surface quality and precision.

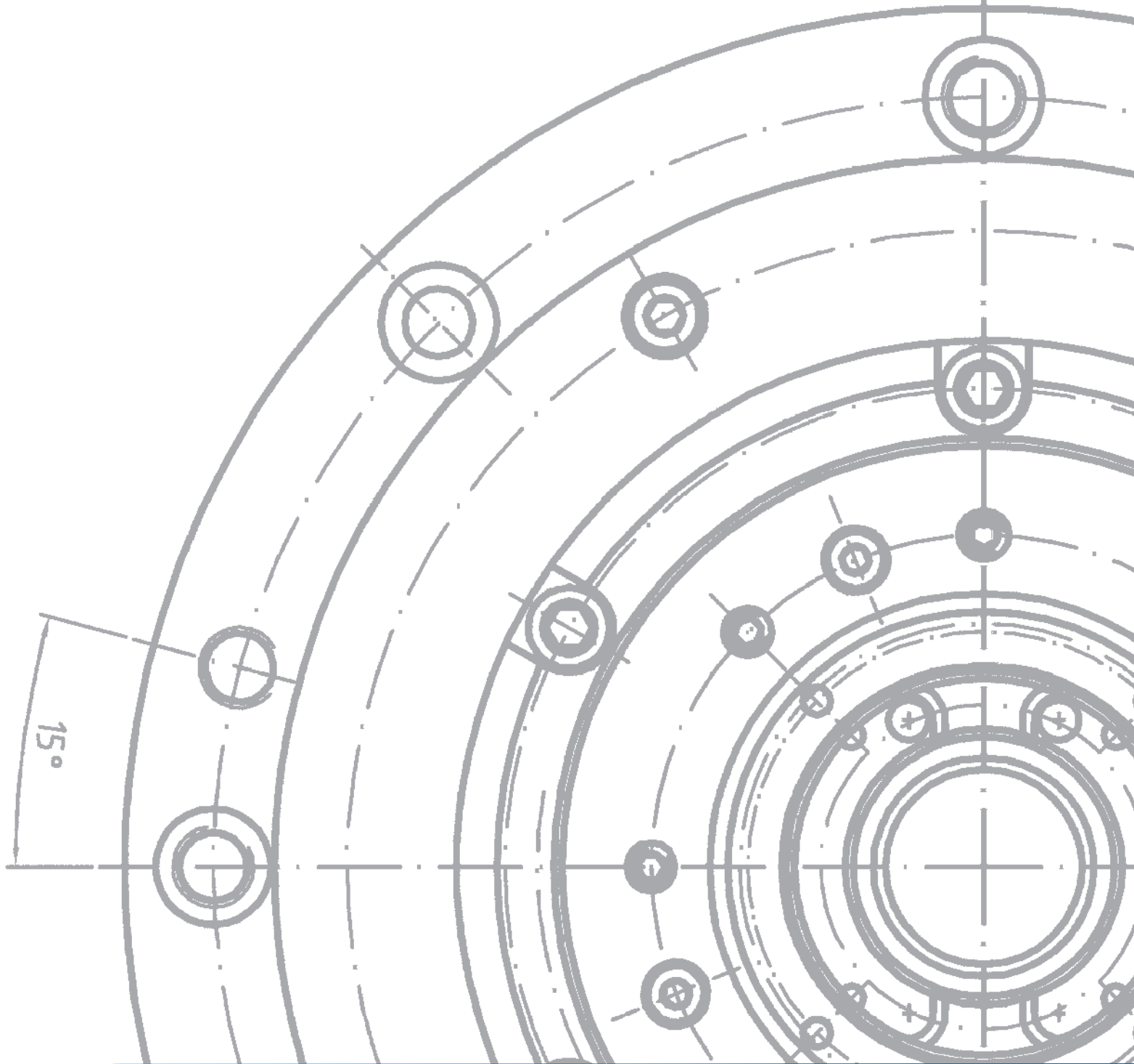
Being able to meet these unique requirements is critical to success and staying competitive. We apply our knowledge, experience and global capability to equip your machine tools with suitable bearings and help with extensive engineering support to increase machine precision, productivity and efficiency for the demanding medical technology industry.

Global services for the machine tool industry

In addition to the most comprehensive assortment of super-precision bearings, we offer our customers global availability of our products and services.

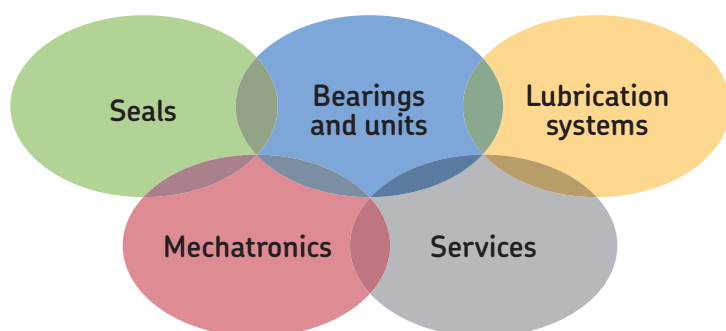
Every spindle is a unique project that requires knowledge from different experts and disciplines. The more you share your problems and challenges with us, the greater the opportunities become to get the most out of your machines. Use of our advanced modelling and virtual testing services enables super-precision bearing customers to take the next step and look at all aspects of their application.





See inserts for more details about SKF solutions.





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.

® SKF is a registered trademark of the SKF Group.

™ NITROMAX is a trademark of the SKF Group.

© SKF Group 2011

The contents of this publication are the copyright of the publisher and may not be reproduced (even extracts) unless prior written permission is granted. Every care has been taken to ensure the accuracy of the information contained in this publication but no liability can be accepted for any loss or damage whether direct, indirect or consequential arising out of the use of the information contained herein.

PUB BU/S2 11494/1 EN • December 2011

Certain image(s) used under license from Shutterstock.com and Corbisimages.com