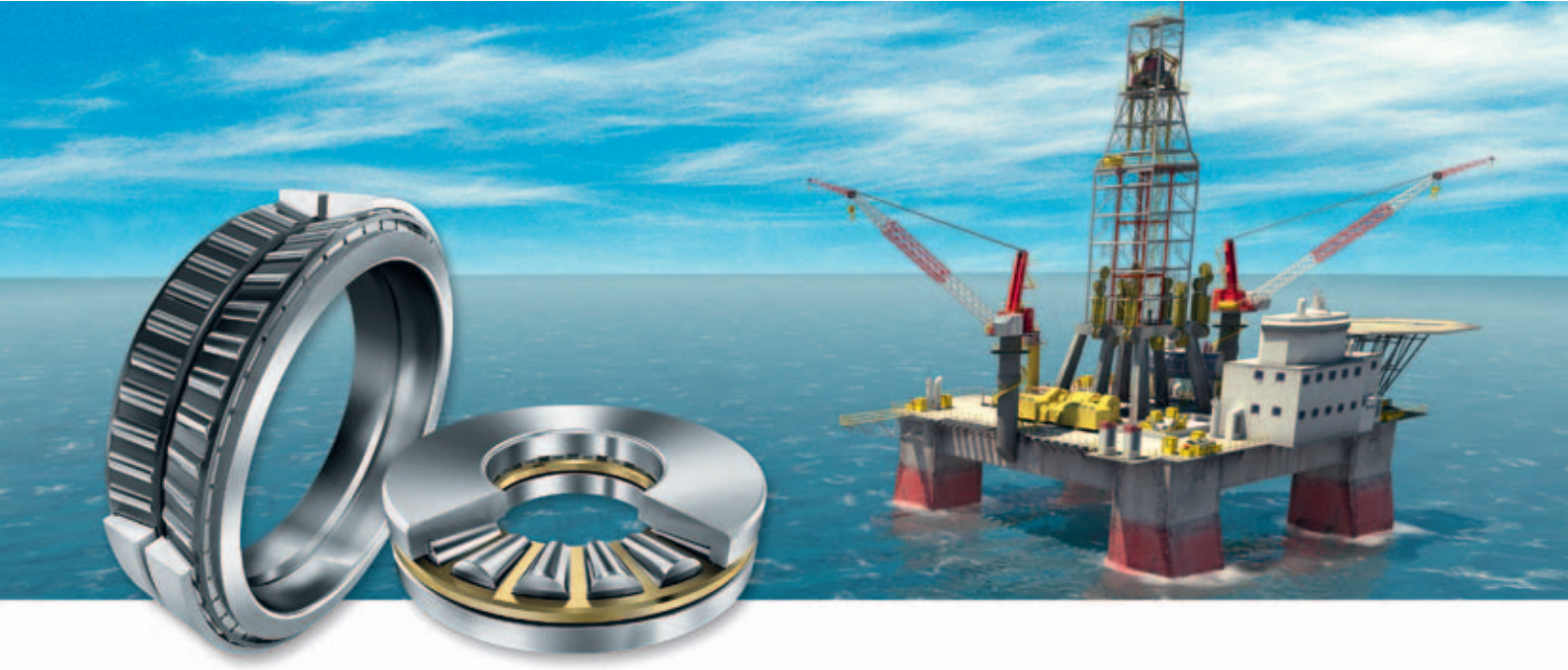




FAG



Bearing Solutions and Services for Drilling Rigs

The Schaeffler Group – your development partner



With the wide array of premium-quality products from our FAG and INA brands, Schaeffler Group Industrial has a product range that, in terms of its scope, is unique throughout the world. Our comprehensive product portfolio encompasses approximately 40,000 catalog products, making it one of the most expansive product lineups in the rolling bearings sector. Broad enough, in fact, to cover applications for approximately 60 different industrial sectors! Condition monitoring systems, bearing mounting and dismounting services as well as maintenance tools round off our product range. Together with the products and services offered by our Industrial Aftermarket division, we can find solutions for virtually every application in the oil and gas industry.

Rolling bearings utilized in the drilling sector have to operate under some of the harshest conditions on (and under)

the earth. Because this unforgiving operating environment subjects the drilling equipment to so much stress, extremely robust and reliable bearings are required for this industry.

Our research and development work with manufacturers and operators of drilling equipment has resulted in a continuous increase in the operational safety and operating life of INA and FAG bearings. In terms of Total Cost of Ownership (TCO), we take the machines' entire life cycle into consideration, which leads to longer operating life and fewer unplanned downtimes. Our solutions help operators increase machine availability, achieve verifiable savings, and reduce overall costs.

We offer bearing solutions for the entire drilling rig – from the crown block down to the drill string. As your development partner, we do far more than just supply all of your bearing needs: we are with

you every step of the way – from the inception of the product idea to volume production.

We also offer:

- Expert technical advice from highly experienced engineers
- Effective product support and product-refinement services
- Lower operating costs and improved reliability, thanks to our premium-quality X-life products
- Optimally matched bearing material and seal combinations
- Product customization to handle the wide range of operating conditions
- General as well as customer-specific training programs
- Globally enforced quality-control and environmental standards (ISO 9000/QS 9000, ISO/TS 16949: 2002, ISO 14001)
- Our proprietary bearing calculation software BEARINX® to ensure the best-possible product selection.



In a nutshell: the right bearing for every application

Our product portfolio ranges from basic, application-specific bearings to complete, ready-to-install systems to customized solutions that are designed to handle complex bearing-related challenges – reliably and economically.

- **Tapered Roller Bearings** – e.g., sheave bearings, double-row in an O-arrangement: the paired arrangement allows the bearing to support axial loads in both directions as well as tilting moments

- **Axial Tapered Roller Bearings** – very high axial load capacity, with a solid brass cage or pin-type cages

- **Cylindrical Roller Bearings** –
 - a) Single-row design: very rigid, able to handle high radial loads, simple disassembly allows for easy installation and removal, can be used as a locating or floating bearing
 - b) Multi-row design with solid brass cage: high accuracy, high radial load capacity, long service life

- **Needle Bearings** – high load capacity with minimal radial space requirements, ideal for designs that provide limited radial installation space

- **Spherical Roller Bearings** – compensate for misalignments while providing high radial load capacity, also available in an X-life-version;



- **Ball Bearings** – e.g., axial angular contact ball bearings, able to handle high axial loads due to the large contact

- **Special Bearings** – e.g., a mud motor bearing: multi-row bearing for which we expressly developed a special type of steel that was able to withstand the turbodrill's harsh operating environment.

angle, can also be employed as a high-precision bearing due to its high rigidity;

- **Special Bearings** – e.g., a mud motor bearing: multi-row bearing for which we expressly developed a special type of steel that was able to withstand the turbodrill's harsh operating environment.



X-life.
More cost-effective.
More reliable operation.

X-life denotes the premium product line from INA and FAG. It provides design engineers with unprecedented design opportunities.

State-of-the-art manufacturing techniques have made it possible to create a higher-quality, smoother surface throughout the entire contact

area between the rolling elements and raceway. This allows for a significant reduction in the stress conditions present on the rolling elements and mating track under identical loads. The result:

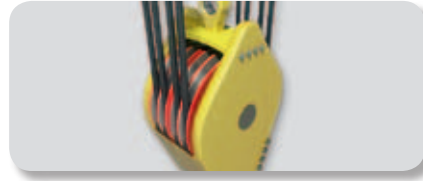
- Less friction and lower bearing temperatures
- Less strain on the lubricant
- Higher dynamic load rating
- Higher basic rating life

Consequently, the operating life of X-life bearings is considerably longer when the operating

conditions remain unchanged. Conversely, if the rating life values remain unchanged, significantly higher loads can be applied.

With their optimized features, X-life bearings open up completely new application possibilities, such as smaller bearing supports. Moreover, the improved price/performance ratio ultimately increases the bearing support's overall value proposition.

Sheave Applications

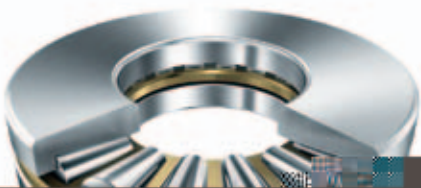


Sheaves are used in crown and traveling blocks as well as in heave compensation systems. Reliability under high static and dynamic loads is required to ensure maximum uptime under the extreme range of drilling conditions.

The solution: The Schaeffler group provides traditional, high capacity, double

row taper designs in the common oilfield sizes meeting API 8C. Banitic hardened components provide for a soft core with lower retained austenite levels to provide thermal stability under the extreme range of conditions. A complete range of full complement cylindrical bearings can be specified as well. Seals are available on both cylindrical and tapered roller designs. These seals are designed specifically for the extreme conditions found in the industry.

Swivel, Top Drive



The Topdrive/Swivel supports the weight of the drill string, while simultaneously acting as a rotating passageway to permit drilling mud to flow into the drill string. The top drive, additionally, provides the torsional force needed to turn the drill string. This

application requires high reliability and resistance shock loads generated during the drilling process.

The solution: Schaeffler provides high capacity solutions resistant to potential spike loads possible with this difficult application. We can also work to better understand the stresses developed during periods of high load. These stresses can be minimized by carefully analyzing both the bearing design and structural components.

Rotary Table



The rotary table is the traditional solution for providing the rotational force to turn the drill string. When drilling is interrupted, the rotary table can also function as a supporting device and carry the entire weight of the drill string. The

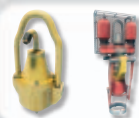
bearing locations are exposed to high radial as well as axial loads.

The solution: Due to the above requirements, axial angular contact ball bearings are the preferred choice for the main bearing in rotary tables either as single row designs or as three race assemblies. They are distinguished by their high axial load-carrying capacity. Schaeffler also provides the pinion bearings providing trouble free operation on the input shaft.



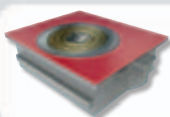
Sheave Applications

Sheave Applications
Sheave bearings (double-row tapered roller bearings) for sheaves in crown blocks, traveling blocks, drill string compensators, wireline tensioners and block hooks



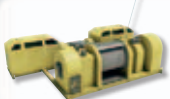
Swivel, Top Drive

Swivel
Main bearing: axial tapered roller bearing; counter bearing, upper bearing: tapered roller bearing; radial guidance bearing, lower bearing: cylindrical roller bearing
Top Drive
Intermediate shaft: cylindrical roller bearing or tapered roller bearing; input and output shaft: tapered roller bearing; main axial bearing: axial tapered roller bearing



Rotary Table

Rotary Table
Main bearing: axial angular contact ball bearing (upper and lower bearing or complete units)
Drive shaft: spherical roller bearing (outer bearing), tapered roller bearing (inner bearing)



Drawworks, Winches

Drawworks, Winches
Spherical roller bearings, ball bearings, tapered roller bearings and cylindrical roller bearings in the drum, gearbox and drive motor



Mud Pump

Mud Pump
Drive shaft: cylindrical roller bearings or spherical roller bearings
Crank shaft: spherical roller bearings or tapered roller bearings
Connection rod: cylindrical roller bearing
Cross head: needle roller bearing



Mud Motor

Mud Motor
Mud motor bearings: multi-row bearings made from special steel



Other Rig Equipment

Other Rig Equipment
Various bearings in downhole drilling tools (mud turbines, rotary steerable drilling tools), cranes, thrusters, jack-up rigs, shaker screens, cementing units, fans and blowers, gearboxes and power-generation equipment



The right solution for every application

Drawworks, Winches



The primary function of the drawworks is to raise or lower the drill string and provide proper weight on bit. Modern drawworks and winches also can operate Active Heave Compensation (AHC), designed to compensate for the wave motions on floating rigs. The resulting

rapid load cycles require an extremely rigid system.

The solution: Schaeffler provides a range on bearing products including Spherical roller bearings for the main bearing on hoisting drum. These bearings can compensate for misalignments while providing high load capacity. Additional bearing positions can be found in the drive motor and gearboxes used to operate the hoisting drum. All work together as a system to ensure reliable operation.



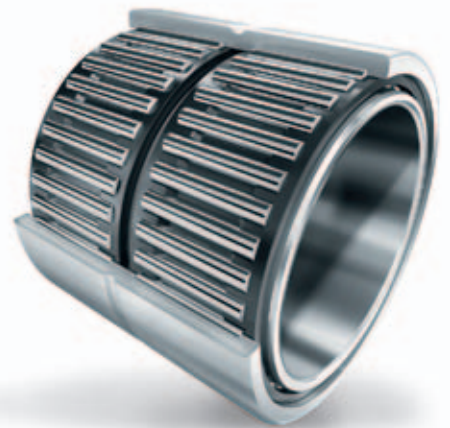
Mud Pump



The mud pump supplies the drilling rig with a constant flow of high-pressure mud (drilling fluid). These positive displacement pumps operate up to 10,000 psi resulting in high radial loads at the typical bearing positions including the

crosshead bearings, eccentric bearings, crankshaft main bearings and driveshaft bearings.

The solution: Schaeffler provides complete Mudpump bearing sets for some of the most technically advanced pump designs in the industry. These bearing arrangements provide high capacity systems ideally suited for the increasing demands with increasing drilling depths.



Mud Motor



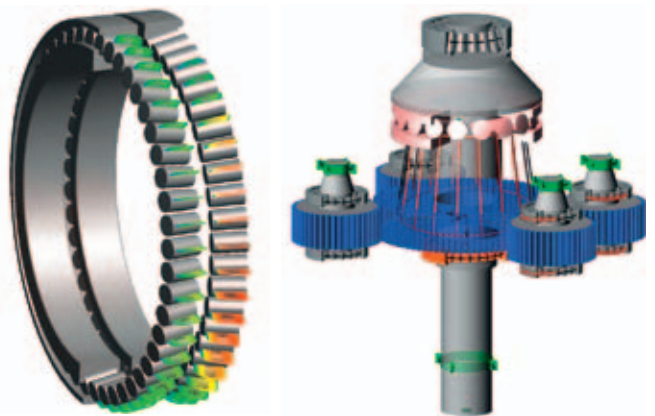
The mud motor applications are perhaps the most demanding in the industry. Operating at the end of the drillstring, mud motor bearings see high temperatures, high loads, impact

conditions, as well as the direct contact with the contaminated drilling fluid.

The solution: Schaeffler's solution for the mud motor applications utilizes specialized multi-row geometries created from specialty steels. These products are designed with the leading downhole tool manufacturers to maximize operation in wide range of drilling conditions.



Expert advice and software designed for real-world applications



With over 30 years' experience as a development partner for the oil & gas industry, we invite you to take advantage of our expertise: our engineers are ready to develop cost-effective solutions tailored to your specific requirements.

Our portfolio of available services encompasses detailed instructions for mounting and removing bearings as well as lubricant recommendations and inspection of used bearings. Where applicable, all of our products are designed according to the applicable industry-specific standards (e.g. API, ABMA, SO). Companies throughout the world place their trust in our expertise and count on us as their development and engineering partner.

BEARINX® – powerful, high-performance software for analytical bearing calculations

BEARINX® enables us to analyze our bearings in minute detail with regard to their suitability for each particular installation. Even for the most complex machine systems, it is possible to precisely calculate, display and document the load acting on each individual

bearing location, while taking into account a wide variety of environmental conditions. In this manner, we work in concert with you to design the optimal solution for your application - with the goal of providing maximum service life, minimum space requirements and extremely reliable operation.

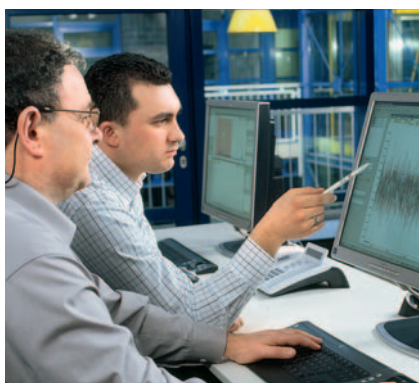
Our newest module BEARINX®-online Easy Friction now makes it possible, for the first time ever, to calculate the friction values for rolling bearings using a highly sophisticated methodology. It allows the user to quickly compare friction values for a variety of bearing designs.

medias® – far more than an electronic product catalog

Our electronic product selection and information system *medias® professional* provides detailed information on over 40,000 standard products for approximately 60 industry sectors. It enables the user to calculate the adjusted life according to DIN/ISO 281 for every bearing. In addition, a comprehensive database makes it easy to select the right lubricant. Remarkably, it takes just a few mouse clicks to open up Schaeffler Group Industrial's entire array of services.

medias® is available on the internet at: <http://medias.schaeffler.com>

Products and services designed for your success



Online condition monitoring ensures safety on offshore drilling rigs

Optimal equipment availability is critical to the cost-effective operation of drilling rigs. So what can Schaeffler offer you in this area? Quality. Process reliability. Efficiency. Our global network of production facilities and technical service centers, combined with the rigorous application of the Total Cost of Ownership (TCO) philosophy, are the cornerstones of our shared business success. Here are some examples:

Condition monitoring – to help you avoid unplanned downtime

We offer condition monitoring services and systems throughout the world. Depending on your requirements, our experts can employ not only vibration-analysis procedures as part of their tests, but also force- and torque measurements, multi-channel systems for modal analysis, thermal-imaging cameras and endoscopes. We also offer explosion-proof condition monitoring systems (up to

Class 1/Div 1 resp. ATEX II 1G IIC T4) for use in hazardous areas.

Lubrication – essential for bearing performance and operating life

Improper lubrication is the most common cause of rolling bearing failure. By using ARCANOL products that are tested in our in-house laboratories for the initial greasing of our bearings, we provide the foundation for long bearing life with minimal maintenance requirements.

The ARCANOL product line also includes greases for bearings that operate under extremely high loads, along with environmentally friendly lubricants. We also offer customized, permanent lubrication systems for automatic lubrication applications.

Expert bearing installation – a prerequisite for precision and performance

Using the correct tools at installation and removal is an important prerequisite for ensuring long bearing life. To that end, we offer professional tools for bearing mounting and bearing removal, as well as training programs for proper bearing mounting techniques. We can even install the bearings for you! In this case, a team of specially trained Schaeffler technicians can be on site to provide expert assistance when you need it.

Bearing reconditioning – a cost-effective alternative to buying new

Schaeffler has the capability to recondition rolling bearings with an outer diameter

of up to 4,250 mm. This is often a more economical option than investing in a brand new rolling bearing. Lead times are typically shorter, too.

Customer training programs – benefit from our expertise!

We can provide training programs at any of our proprietary Schaeffler training centers or, if desired, on-site at our customers' facilities. Whether you wish to learn about the fundamentals of bearing technology, industry-specific bearing know-how, or general service-related topics – talk to us!



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