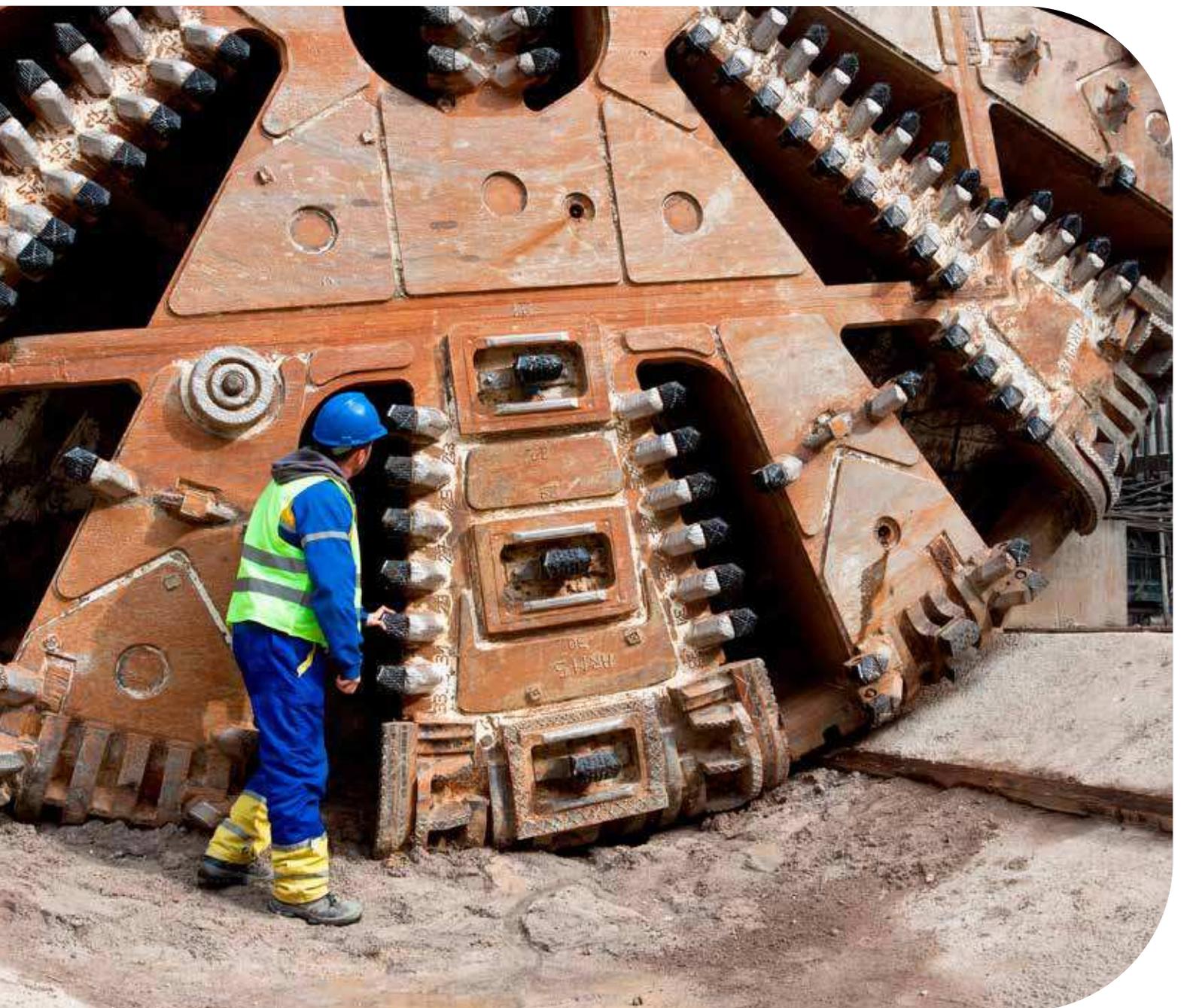


# Tunnel boring machine solutions from SKF

Driving reliability to cut tunnel completion times



Once the tunneling starts



# there's no turning back

## Preventing equipment failures is crucial

Once a tunnel boring machine begins its descent, its inability to backtrack becomes a big liability. If a major breakdown occurs while the machine is tunneling, the resulting downtime and repairs can delay construction for many months and send costs soaring. Cutter heads that fail in operation, for example, can result in costly repairs.

During tunnel boring machine development projects, breakdowns can be equally damaging. A main bearing failure can stop a project for as long as two years, negatively impacting the manufacturer's bottom line and quite possibly, customer relationships.

Clearly, tunnel boring machines require the most reliable components and systems available. To help ensure machine uptime and control project costs, fully field and lab-tested solutions are essential. Application of sophisticated modeling tools and expert design calculation skills are key to reliability as well. At SKF, we've been meeting these and other requirements for more than 20 years.

## Keep the project moving forward with SKF

Since the early 1990s, SKF has been working with leading tunnel boring machine original equipment manufacturers (OEMs) to develop robust bearing, sealing and lubrication solutions.

As shield diameters have increased, we've gained a depth of knowledge about the application challenges facing the industry. This expertise also informs a range of SKF support services, from engineering and testing to installation and refurbishment. Our standardisation of parts, fast design verification processes and expert involvement throughout the machine lifecycle are helping manufacturers get their machines on the market more quickly and cost-effectively than ever.

Today, proven SKF tunnel boring machine solutions are helping OEMs:

- **Improve machine reliability**
- **Reduce time to market**
- **Reduce maintenance**
- **Extend machine lifecycles**
- **Cut tunnel project times**
- **Lower total cost of ownership**

# Tunnel boring machine solutions from SKF

## 1 Cutter bearings



Supporting cutter head wheels as they carve through rock and soil is punishing work. SKF cutter bearings are specifically application-engineered to handle it. High quality profile rollers help these taper roller bearings deliver high shock resistance and high load carrying capacity for maximum uptime.

### Benefits

- Application-optimized bearing design
- Longer service life
- Robust bearing design
- Reduced cutter costs by avoiding major rebuild
- Prevent cutter wipeout

## 2 Main bearings



Built to withstand huge loads as cutter heads bore into solid rock, SKF slewing bearings are heavy-duty, roller-based bearings designed to carry all cutter head loads and transfer them to the rear.

SKF slewing bearings include gear and bolting, and are specifically application-engineered and optimized to meet application-specific demands. The internal bearing design is critical and has been designed and manufactured to achieve the

high level of accuracy and performance required. Although bearing designs sizes vary, SKF produces 8 m and larger for the world's largest tunnel boring machines.

### Benefits

- Application-optimized solution
- Fully integrated seal
- Robust bearing design

## 3 Main bearing seal



Designed to keep earth out of the main bearing and lubricants in it, SKF main bearing seals are part of a fully integrated large slewing bearing solution. Custom engineered from G-ECOPUR material – a hydrolysis-resistant, self-lubricating proprietary material – these seals are available in many designs, including multi-lip configurations. SKF seals also provide high pressure resistance (up to 10 bar) and can help compensate for misalignments.

### Benefits

- Application-specific seal designs
- Excellent wear and chemical resistance
- Proven designs for TBM head applications

## Additional SKF solutions

- Erector bearings
- Drive pinion bearings
- Screw conveyor bearings
- Hydraulic cylinder seals
- Hydraulic cylinder bearings
- On-line condition monitoring

## 4 Grease lubrication systems



Safe, reliable tunneling demands effective lubrication. SKF grease lubrication systems provide it automatically for shields, joint bearings and grippers – without interrupting boring operations. These individually configurable systems allow adjustment of grease volume and frequency even after installation. ATEX compliant variants are available.

### Benefits

- Reduced risk of bearing contamination
- Maximized safety
- Reduced maintenance
- Minimized wear
- Reliable system monitoring

## 5 Oil lubrication systems

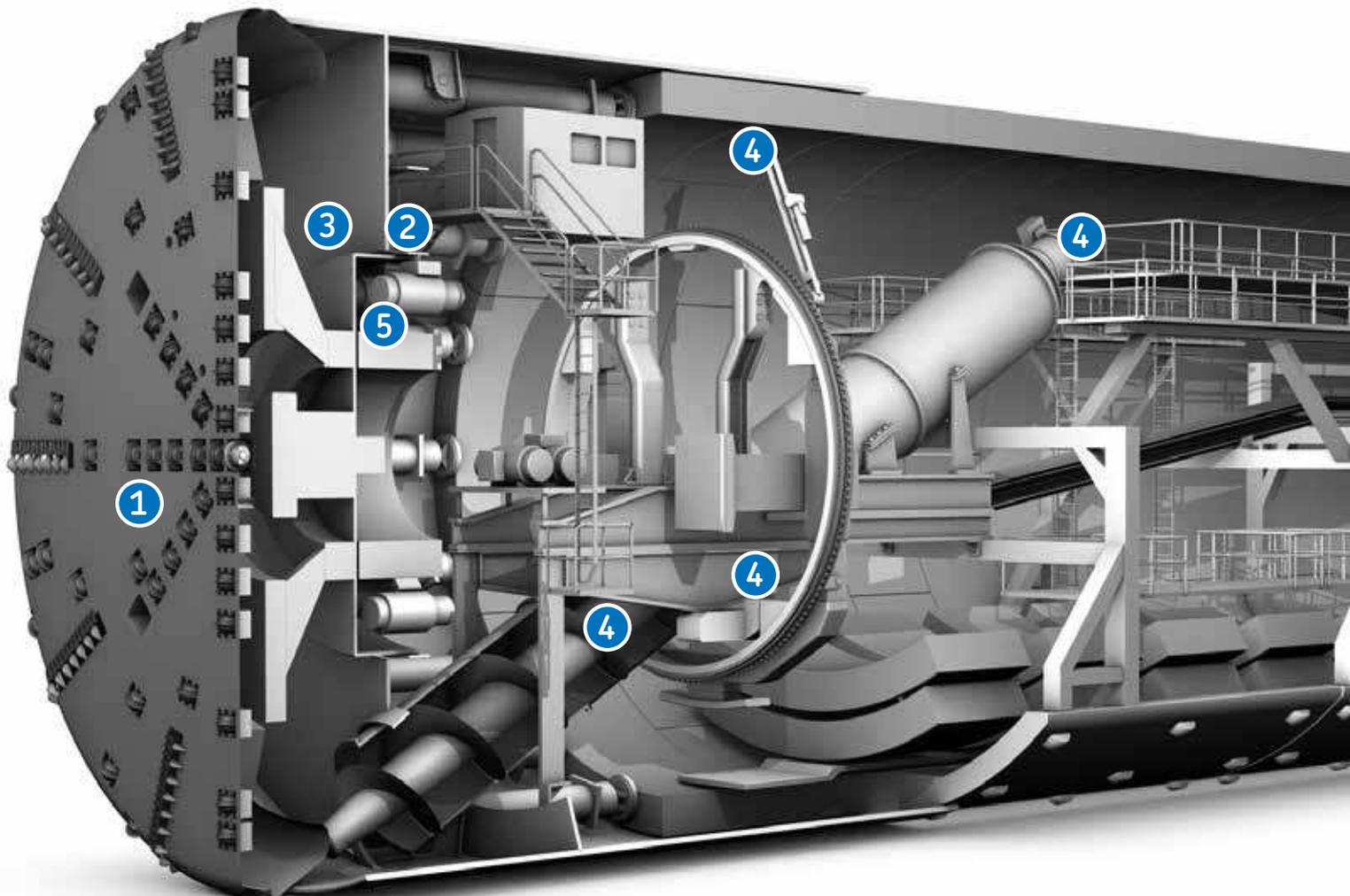


By delivering a continuous, circulating oil supply to main bearings and drives, SKF oil lubrication systems help optimize both boring safety and reliability. Self-regulating metering helps ensure constant oil quantities, keeping seal running surfaces lubricated even under temperature or pressure changes. SKF

circulating oil systems can also be integrated with bus-based condition monitoring systems; ATEX-compliant variants are also available.

### Benefits

- Maximized safety
- Increased reliability
- Reduced maintenance
- Minimized wear



# Supporting asset efficiency throughout the machine life cycle

SKF offers a broad spectrum of expert services and related technologies that can help OEMs optimize machine performance throughout the life cycle, from design to maintenance. These services range from engineering and asset reliability consulting to asset diagnostics and mechanical services. SKF services and related products are made available to customers worldwide through SKF Solution Factory, a global network of facilities staffed by experts from every SKF discipline.



## SKF Engineering Consultancy Services

Backed by decades of tunnel boring machine application engineering knowledge, SKF Engineering Consultancy Services can help OEMs optimize new or existing equipment designs.

SKF helps OEMs develop validation strategies to verify designs, and we can conduct component performance trials in prototypes. We also model components, bearings, lubrication systems and more with our proprietary software. This virtual testing can mean fewer, less complex field tests and faster project development times.



## Remanufacturing services

A bearing with only 30% left of its calculated service life can be well worth remanufacturing. Available worldwide, SKF remanufacturing services offer a standardized remanufacturing process that extends the service life of critical equipment with resulting cost savings and shorter lead times.

### Benefits:

- **Reduced total life cycle cost**
- **Extended bearing service life**
- **Reduced machine downtime**
- **Reduced environmental impact**

Other remanufacturing services include bearing remanufacturing, gearbox repair and upgrade, and hydraulic cylinder repair.



## Mechanical and inspection services

Rotating machinery problems – misalignment, imbalance, looseness and friction – can all be telegraphed through the bearing. SKF mechanical services can help diagnose, prevent and correct these issues. These services include:

- **Precision alignment**
- **Precision balancing**
- **Lubrication services**
- **Bearing failure analysis**
- **Mounting /dismounting**
- **Inspection services**
- **Bearing installation**



## Condition monitoring and diagnostic analysis services

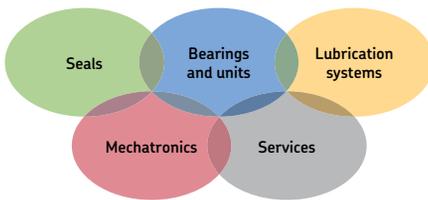
To help extend service life and reduce costly unscheduled downtime, SKF can provide a variety of condition monitoring solutions – including the technology to monitor or the diagnostic services to understand the current condition of your machine. This can range from the detection of impending faults in rotating parts, to enabling automated additional lubrication as and when required.

### Benefits:

- **Minimize the risk of unplanned downtime**
- **Improve operational efficiency**
- **Reduce maintenance costs**
- **Optimize manpower resources**

*See inserts for more details  
about SKF solutions for the  
tunnel boring industry*





### The Power of Knowledge Engineering

Combining products, people, and application-specific knowledge, SKF delivers innovative solutions to equipment manufacturers and production facilities in every major industry worldwide. Having expertise in multiple competence areas supports SKF Life Cycle Management, a proven approach to improving equipment reliability, optimizing operational and energy efficiency and reducing total cost of ownership.

These competence areas include bearings and units, seals, lubrication systems, mechatronics, and a wide range of services, from 3-D computer modelling to cloud-based condition monitoring and asset management services.

SKF's global footprint provides SKF customers with uniform quality standards and worldwide product availability. Our local presence provides direct access to the experience, knowledge and ingenuity of SKF people.

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PUB 45/P2 14405 EN · January 2014

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