

# Hydro power

SKF Solutions for hydroelectric industry



# Machined Seals

SKF is a leading supplier for standard and custom engineered sealing solutions. Based on many years of experience, especially in hydro power applications, SKF is able to support the hydro power industry with:

- on-site solution analysis,
- application engineering
- material development for increased wear resistance, reduced friction, high speed solutions, etc.,
- just-in-time availability of standard seals and customized sealing solutions.



The hydro power industry, in particular, has a high demand for special sealing solutions and large diameter seals produced in small to medium quantities. SKF can supply virtually any kind of seal for almost any application, in any dimension and design up to 4 000 mm in diameter as one piece. Larger seals with diameters up to 10 000 mm and above are assembled using a special welding technique.

# Application examples

## Rotor blades

- Compact seals
- Flexible lip seals
- Chevron sets
- Suitable for small housings
- Flexible sealing lip compensates for large misalignments
- Replacements for O-Ring, X-Ring or similar solutions



## Wicket gates

- Lip seals
- Compact seals
- Chevron sets
- Optimized for pivoting in low pressure range
- Flexible sealing lip compensates for large misalignments
- Low friction to avoid stick-slip tendency



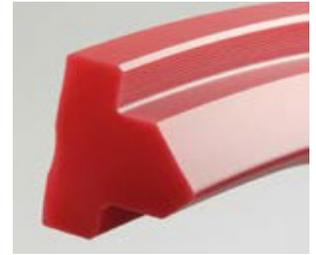
## Spherical valves

- Compact seals
- O-ring loaded cap seals
- Space saving designs to fit small housings
- High dimensional stability under pressure
- No twisting during installation or operation
- Flexible sealing lip compensates for deformation



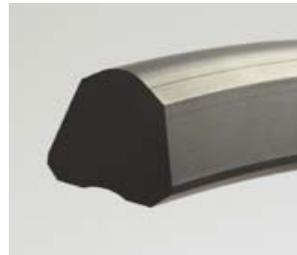
## Ring gates

- Flexible upper ring gate seals
- Compact lower ring gate seals
- Flexibility to adopt to different housing clamping ring designs
- Flexible upper ring gate seal lip design
- Flexible sealing lip compensates for tolerances and misalignments



## Butterfly valves

- Large variety of compact seals
- Geometry adjustments to any housing/clamping ring design possible
- High dimensional stability under pressure



## Capabilities

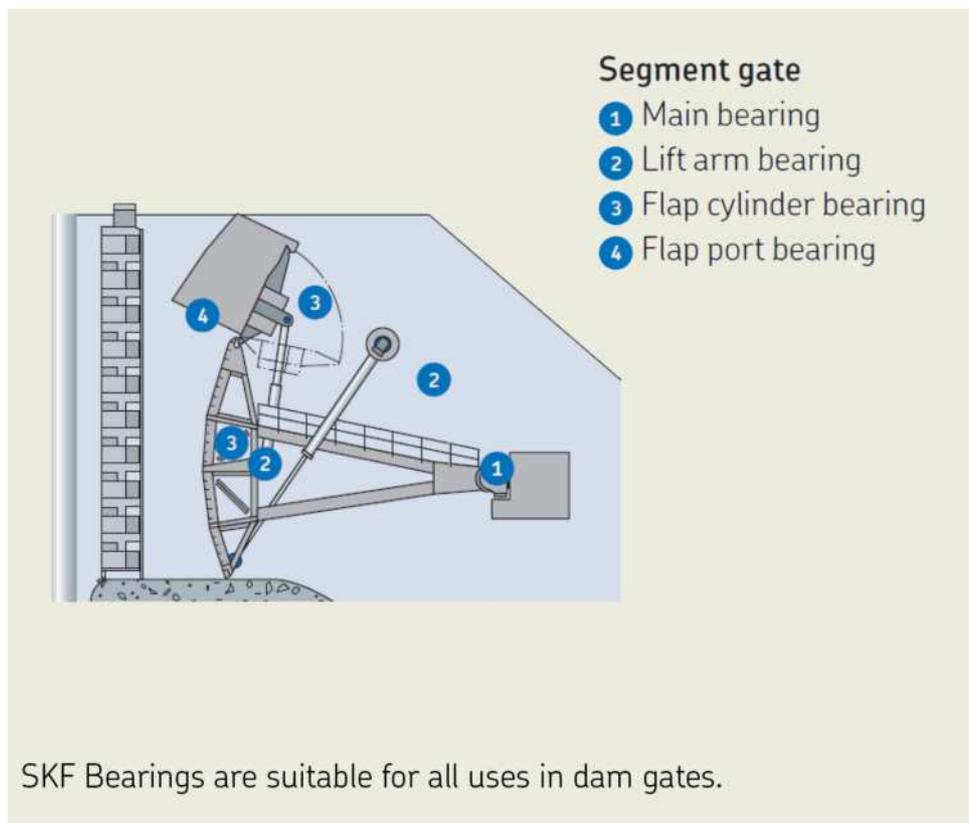
- High abrasion resistant materials
- Special self-lubricated polyurethanes
- Excellent resistance against sediments
- Endless, split and welded designs
- Easy installation depending on design
- Extremely large diameter capacity (10 000 mm and above)

## Overall benefits

- Increased seal service life
- Reduced downtime
- Easy and fast installation
- On-site welding and installation service

# Radial spherical plain bearings for dam gates

Throughout their long service life, dam gates handle high loads in humid environments and often get little maintenance; conditions that put strong demands on all parts, including bearings.



SKF radial spherical plain bearings for dam gates are robust, compact, easy-to-mount and corrosion-resistant. They accommodate both axial and radial loads, dampen vibration and shock loads and enable a long life of virtually maintenance-free low-friction dam gate operation.

SKF spherical plain bearings have the ability to:

- accommodate misalignment
- range of shaft diameter  $d=140 - 1\ 250$  mm
- virtually eliminate edge stresses and excessive stressing of adjacent components
- accommodate deformation of surrounding components in operation
- accommodate wide manufacturing tolerances and the use of cost-effective, welded assemblies.

These bearings cope with the heavy radial loads caused by water pressure as well as axial loads that arise from the inclined position of the support arms. In addition, SKF spherical plain bearings operate in the frequently used linkage attachments of the lifting and plunger cylinders as well as the flaps

For applications where contamination is a large problem, we offer sealed solutions with optimal performance in contaminated operating.



# OK Couplings

## SKF Hydraulic shaft couplings, OKC and OKF

When using the SKF OK coupling in shaft connections, you are exploiting potent oil injection technology. Preparation of the shaft is simple. No keyways to machine, no taper and no thrust rings. Ease of mounting and dismounting combined with high torque capacity are characteristics of the SKF OK couplings.



## SKF High-friction shaft couplings, OKCX and OKFX

SKF OKX and OKFX are strong couplings with a torque capacity that is around 50% higher. The couplings withstand heavy shock forces and rapid changes in rotational direction and are used in large heavily loaded shafts to optimize the design by reducing the diameter and coupling size. Furthermore, the pressure on the coupling is lower, thereby eliminating the need for reinforcement sleeves in hollow shafts.



OK couplings are used whenever you need to transmit high torque - on land and at sea. They create opportunities to save money and increase operational time, thanks to reduced mounting and dismounting times as compared with conventional couplings. With OK couplings, shaft design can also be simplified and the shaft diameter reduced. It is easy to see why more than 50 000 shafts all over the world have been connected with OK couplings. Shaft diameter  $d_a = 45 - 1\ 000$  mm

When using OK couplings for shaft connections, you are gaining from the advantages of our powerful oil injection method. Preparation of the shaft is simple There are no keyways to machine, no taper and no thrust ring.

Very large couplings, which previously could only be shrunk on after heating, can now be assembled cold with the OK method.

# SKF Supergrip Bolt

The SKF Supergrip Bolt offers a significantly better solution for connecting rotating flanges. Compared with traditional bolt systems, SKF Supergrip Bolts are easier to install and remove, taking much less time, holding the coupling halves together far more securely and they are fully reusable.

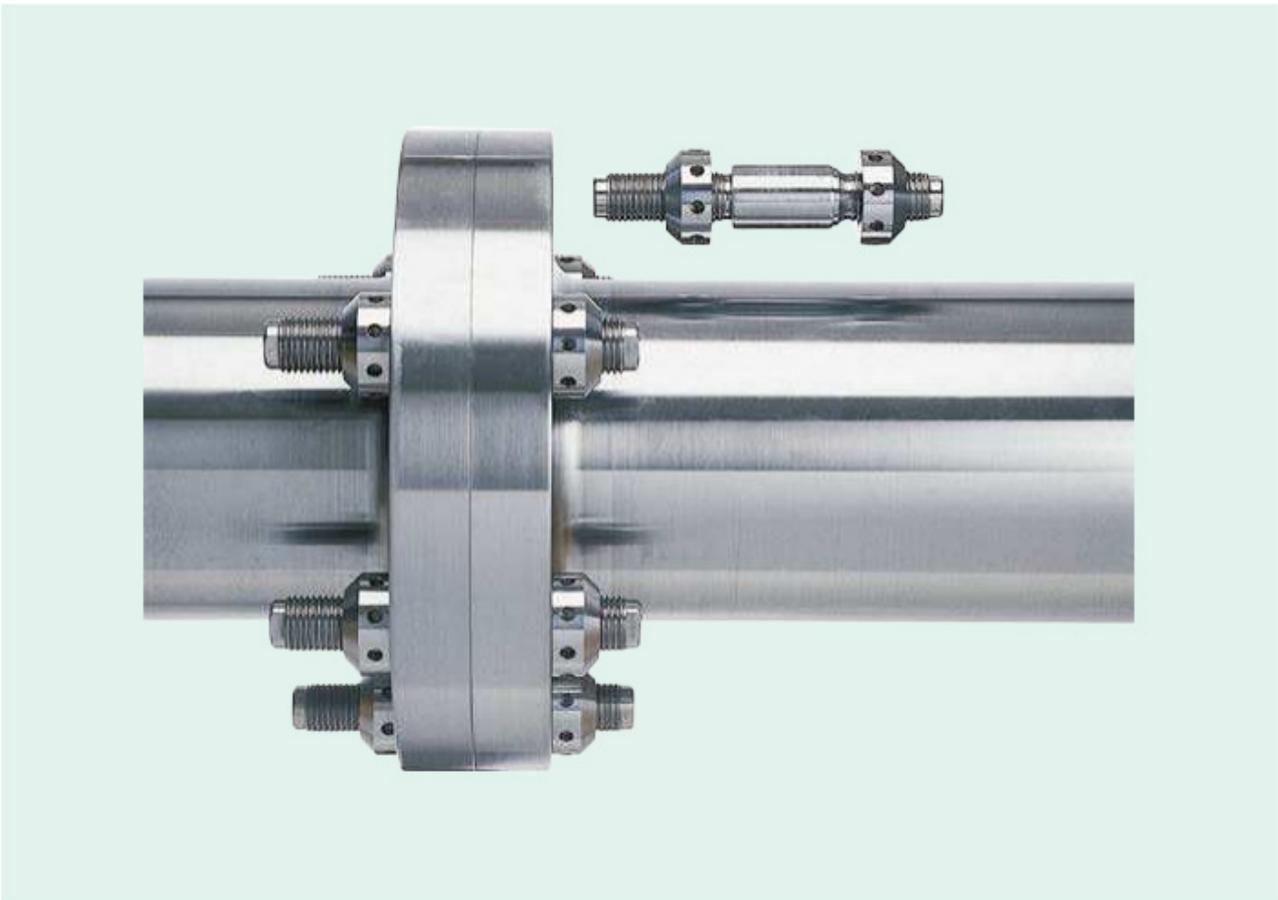


The torque in a coupling connected with a SKF Supergrip Bolt is transmitted in two ways: Mainly by the shear strength of the expanded bolt in the hole, and by the friction effect at the flange faces created by preloading the bolt. Both effects are controlled and measurable.

The standard SKF Supergrip Bolt is designed for a maximum shear stress of 280 N/mm<sup>2</sup> and a maximum axial stress of 350 N/mm<sup>2</sup>.

## SKF Hydraulic bolts, OKBS and OKBQ

SKF hydraulic bolt systems, Supergrip Bolts and Quickgrip Bolts offer a superior solution for connecting large couplings. Compared with traditional bolt systems, SKF Supergrip Bolts and SKF Quickgrip Bolts are much faster and easier to install and remove. It takes much less time to fasten the coupling halves together and the result is far more secure. The hydraulic bolt systems are designed specifically for high torque applications such as propeller shafts and rudder assemblies. Using them eliminates uncertainty regarding the downtime required for removing and installing the bolts.



# SKF Cooper

SKF Cooper split roller bearings' in-depth experience with OE turbine manufacturers in Austria, Italy, Spain, France and Canada heavily influenced the manufacturer's buying decision in this case. It was complemented by SKF Cooper's unique ability to tailor the largest bearings to the most exacting specifications, to precisely fit the needs of the installation.

SKF Cooper provides the widest assortment on the market. It includes four series' of cylindrical roller bearings and two types of split tapered roller bearings.

SKF Cooper bearings are available in the following design:

- Split Cylindrical Roller Bearings
- Split Tapered Roller Bearings
- Split Spherical Roller Bearings



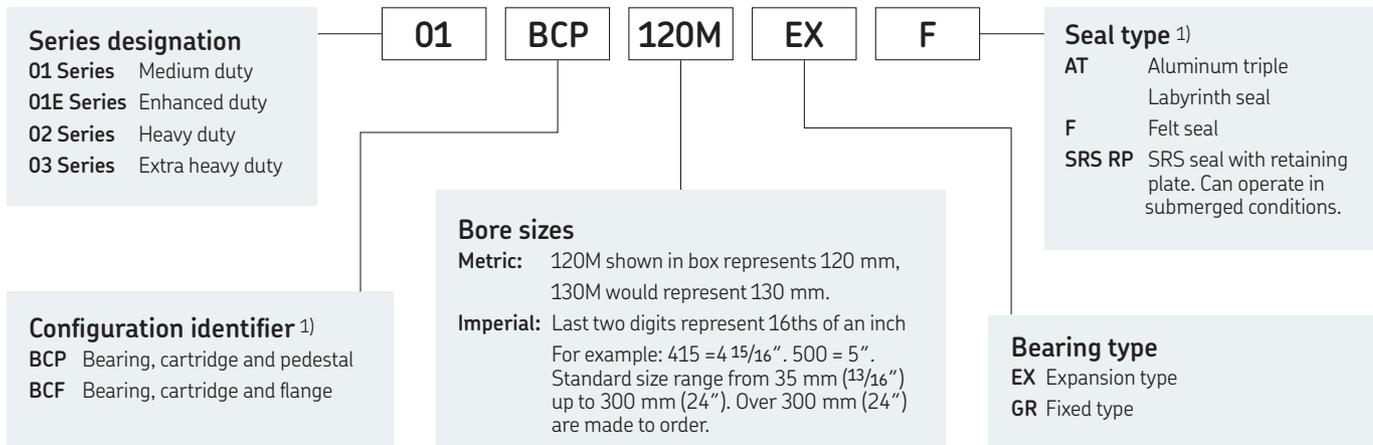
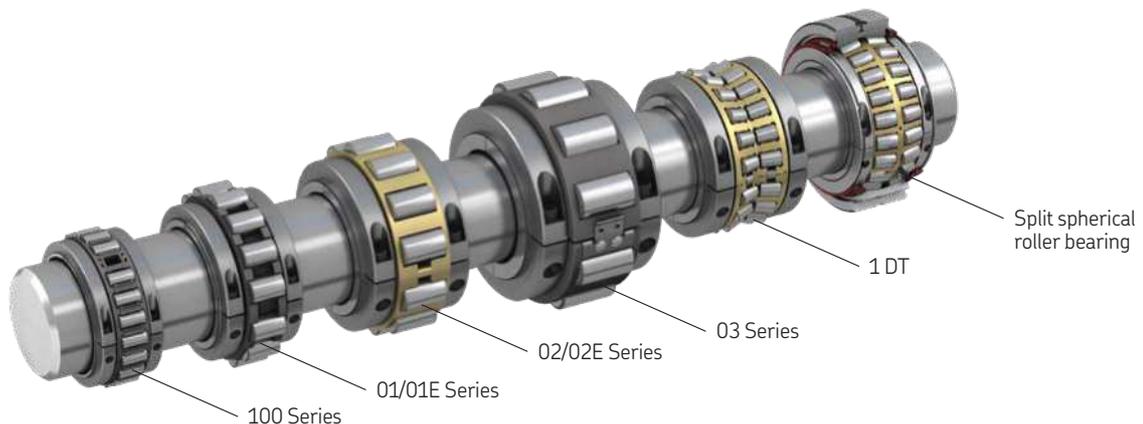
01 BCF 380 mm EX was selected in conjunction with the OEM on this 11 000 kW vertical shaft 'Kaplan' turbine. Our product was chosen because of the simplified installation, inspection and maintenance.

## Comparison of series

For most shaft sizes SKF offers a range of three standard series:

01 Series for medium duties, 02 Series for heavy duties and 03 Series for extra heavy duties. The use of more rollers, larger rollers or a combination of both, increases the load capacity of a roller bearing.

For a given shaft size, 02 Series offers more radial and axial capacity than the 01 Series. The 03 Series in turn offers more capacity than the 02. The choice of three Series enables SKF Cooper users to select bearings suitable for a wide variety of load and speed conditions. For more information please see the SKF Cooper split roller bearings product catalogue or visit our website at [skf.com](http://skf.com) or [cooperbearing.com](http://cooperbearing.com).



<sup>1)</sup> The full range of SKF Cooper mounting and sealing options are shown in our product catalogue and on our website: [cooperbearings.com](http://cooperbearings.com)

## Hydro turbine

01 Series complete bearing unit fitted to a water turbine in France. The customer required a special made-to-order shaft size solution, a custom four-part flange housing to support installation due to space and advanced bulk head sealing. Providing a significant improvement in bearing life and reduction in bearing operating temperature compared to the previous solution.

## Further turbine applications

SKF Cooper has considerable water turbine experience with applications in Canada, Italy, France and USA. Bearing specifications are from 01 BCP180 mm EX and GR on a horizontal turbine to four 01 BCF 380 mm EX in special flange housings on four turbines.



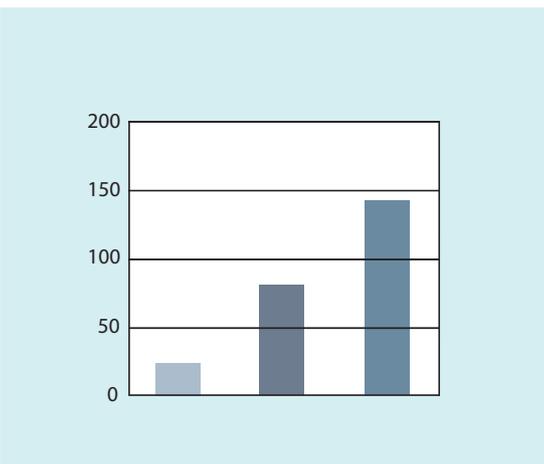
# SKF filament wound bushings

SKF filament wound bushings are maintenance-free, corrosion resistant, high performance bushings. The backing consists of high strength glass fibres and the sliding surface is made from PTFE and polymer fibres, an excellent solution for bearing arrangements that operate under heavy load conditions with low sliding speeds and/or in corrosive environments requiring a longer service life than other bushings due to the high wear-resistance of the sliding surface.

The SKF standard assortment ranges from a 20 to 200 mm bore diameter, each in three standard widths between 15 and 250 mm. Other dimensions are available on request. Custom dimensions available.

## Load carrying capacity

Comparison of the permissible specific dynamic loads for different SKF sliding materials (sliding speed less than 0,01 m/s)



# Condition monitoring

The SKF Connected Technologies division provides innovative, scalable, digital and IoT connected technology solutions.

SKF Multilog devices provide a complete system for early fault detection. Improve the reliability, availability, and performance of your rotating equipment with automatic advice for correcting existing or impending conditions. These compact devices offer 8 (16) analogue and 2 (4) digital channels, with connectivity to mobile devices and networks for easy configuration and monitoring.



Machine intelligence from IMx data will help you avoid unplanned downtime and schedule maintenance proactively, prolonging machine availability and minimizing maintenance and repair costs. The IMx-8 and IMx-16Plus integrate easily with other IMx units and can connect with the SKF Cloud for storing and sharing data, enabling SKF Remote Diagnostic Services for expert reporting and recommendations. They are DIN rail mounted or can be housed in an IP65 cabinet to provide additional protection in demanding industrial environments.

# Lubrication Solutions

Like any mechanical system, moving parts in a metal-producing plant need proper lubrication to function optimally. High mechanical loads, contamination, moisture, high temperatures and humidity are all threats to bearing and gear service life.

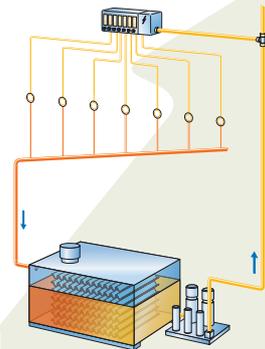
SKF automatic lubrication systems deliver the exact quantity of the appropriate lubricant to the right place at the right time while the equipment is running – without production downtime. In addition, our portfolio includes a broad variety of solutions to lubricate chains, regardless of the need for oil or grease.

Complete plant lubrication supply systems provide lubricant to an entire network of systems from a single source. In these lubrication networks, container or booster pumps supply secondary pump stations.

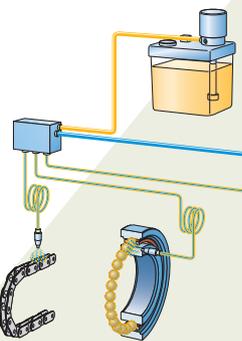
SKF also can assist you in optimizing lubrication settings and intervals and in developing a customized lubrication programme.



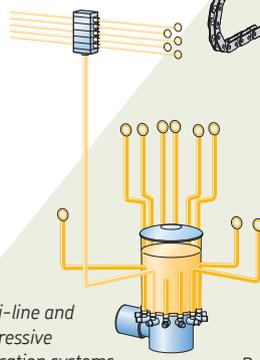
Proactive maintenance



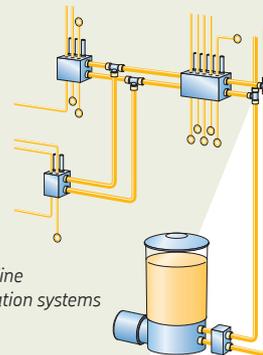
Circulating-oil lubrication systems



Oil+Air lubrication systems

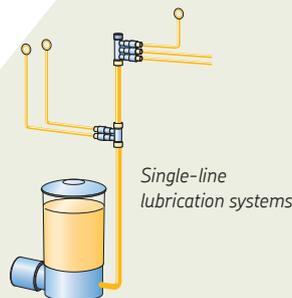


Multi-line and progressive lubrication systems



Dual-line lubrication systems

SKF offers a complete product portfolio of lubricants, manual lubrication tools and the industry's most advanced automatic lubrication systems.



Single-line lubrication systems



Chain lubrication systems



Hand-held lubrication tools



Lubricants

## Lubricants

By frequently delivering a precise, small volume of a high performance lubricant, you can reduce your lubricant consumption and increase the reliability of your system.



## Hand-held, battery-operated lubrication tools

SKF's offering of manual lubrication tools is designed with power and performance in mind. SKF's Power-Luber family provides the most extensive offering of battery-operated lubrication tools.

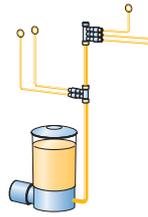
### Advantages:

- Provides easy, point-by-point lubrication
- Improves safety
- 14-, 18- and 20-volt options, also with Li-Ion batteries
- Wide range of pressure and volumes, better control of lubricant volume\*

### Applications:

- All applications where manual lubrication has to be utilized

\* Compared to traditional manual lubrication tools



## Single-line lubrication systems

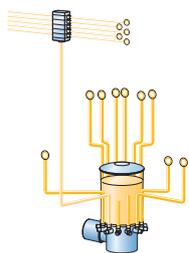
In SKF CentroMatic single-line lubrication systems, a pump feeds the lubricant via the main line to the lubricant metering devices, where it is metered and fed to the lubrication points. The individual lubricant requirements for each lubrication point can be adjusted.

### Advantages:

- Cost-effective
- Easy to understand, install and maintain
- Simple to adjust and expand
- Easy to monitor
- Lubricates small and large bearings at the same time; small local systems or scaled systems for a complete production line

### Applications:

- Transport bogies
- Cranes
- Bearings of roller tables (short line)
- Wire rope mills
- Blast furnaces (lower seal valve/lower material gates)
- Edger mills
- Roughing mills



## Progressive and multi-line lubrication systems

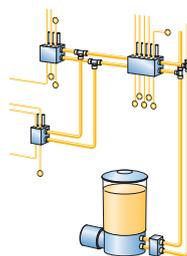
In SKF ProFlex and Multi-Flex or Lincoln Quicklub progressive automatic lubrication systems, a piston pump supplies a defined amount of lubricant through the main line to the metering device that serves each outlet.

### Advantages:

- Delivers frequent and measured amounts of grease to each lubrication point – preset lubrication volumes keep field adjustments to a minimum
- Cost effective for smaller lubrication systems
- Easy system monitoring and simple blockage control

### Applications:

- Owen fans
- Transport bogies
- Cranes, also overhead cranes and trolleys
- Ladle turrets of continuous casting systems
- Pivots and controls



## Dual-line lubrication systems

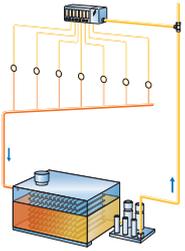
SKF dual-line systems, including SKF DuoFlex and Lincoln Helios, utilize two main lines that are supplied alternately with lubricant. These systems are ideal for applications with many lubrication points over long distances in harsh environmental conditions.

### Advantages:

- Very reliable when using high-viscosity greases
- Flexibility in adjusting metered quantity
- Parallel metering device setup enables simple system design
- Easy to monitor

### Applications:

- Coilers
- Cold rolling stands
- Skin passes
- Finishing lines
- Continuous casting plants
- Roller tables



## Oil circulating lubrication

SKF CircOil lubrication systems circulate oil to lubricate and cool bearings at the same time. They also efficiently remove dirt, water and air particles.

An oil supply system delivers the lubricant to the metering devices with individual settings, and the feed rates can be controlled visually or electronically.

SKF CircOil systems include a wide range of customized turnkey solutions. All are simple to service and feature a modular design that can be expanded easily.

### Advantages:

- Lubricates and cools bearings at the same time
- Patented air-removal design prolongs oil life
- Precise flow meter
- One-third the reservoir lubrication volume compared to conventional systems; provides cost savings for oil storage, filling and replacing

### Applications:

- Ideal for high-speed applications and applications with a temperature of more than 80 °C (176 °F) inside and outside the bearing
- Converter gears
- Rolling-stand drive gearboxes
- Pinions
- Back-up roll sleeve bearings



# SKF flanged housing units with rolling bearings

## SKF flanged housing units – AFC series

Developed as a cost-effective alternative to high cost sleeve bearing systems, SKF's AFC flanged housing unit shaft system carries and locates the shaft with two flanged housings, each equipped with a roller bearing.

The locating bearing is a spherical roller bearing whereas the non-locating bearing can be either a CARB toroidal roller bearing or another spherical roller bearing. The advantage of the CARB toroidal roller bearing is that it accommodates axial displacement like a cylindrical roller bearing within the bearing and misalignment like a spherical roller bearing.

This is particularly important in applications where thermal expansion of the shaft is a key operating parameter.



The SKF shaft system copes with reverse directions of rotation, low speeds and allows long rundown times of high inertia applications (e.g. generators in steam or water turbines). It bears radial and axial loads, accommodates thermal expansion of the shaft and shaft deflections.

There is no need for extra components like thrust bearings or hydrostatic jacking devices.

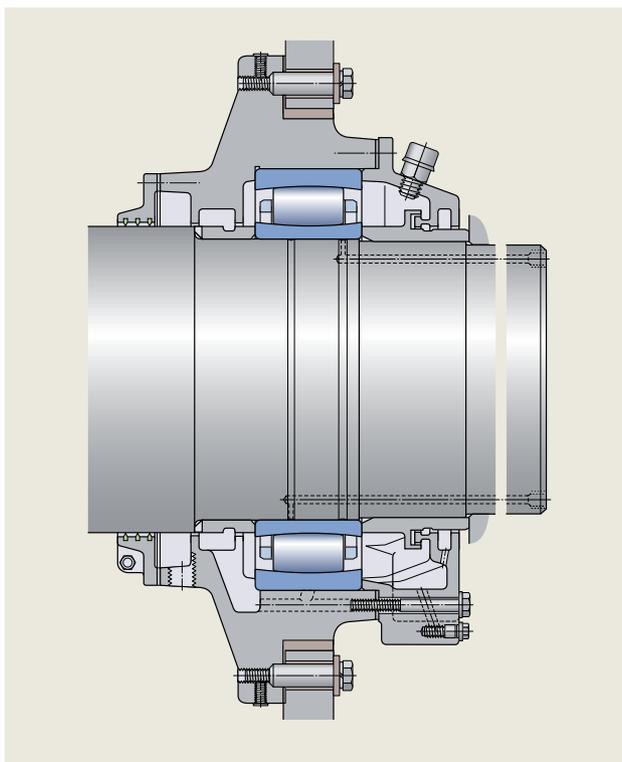
This can be particularly important for motors used in steel mills and marine propulsion units.

Designed for oil bath lubrication, the SKF shaft system does not need expensive oil circulation systems, which eliminates the need for pumps, pipes, oil sumps and coolers. Specially designed labyrinth seals are used to keep the lubricant in and contaminants out.

From a maintenance standpoint, regular oil changes are all that is necessary.

Compared to a sleeve bearing unit, the SKF shaft system is a more efficient, cost-effective solution that is simpler, has fewer components, and is easier to maintain. Variants using an oil reservoir with a smart oil level monitoring device, adjusting and replenishing the oil level during operation are also offered.

For further details, contact the SKF application engineering service.



#### Operating conditions

Bearings:	C 3036/HA3C4 + 23136 CC/W33
Bearing housing:	AFC 1001 BF
Speed range:	340–1 800 r/min
Axial load:	± 39 kN
Output:	1 160 kW
Bearing radial load:	54 kN
Lubrication:	Oil bath

#### CARB bearing advantages

- Optimum load distribution in both locating and non-locating bearings
- Improved reliability
- Increased bearing service life
- Increased machine availability
- Reduced maintenance costs

*Customer reference case: AFC housing + CARB bearing used on the large electric motor.*

# Relevant SKF publications



The publications listed on the next page are only a few of many issued by SKF.

If specific problems arise or if information not covered in these publications is needed, please contact SKF or your nearest SKF authorized distributor.

PUB SE/S2 13064/1 EN	Solutions for hydro power plants - Machined seals
PUB 11311/2 EN	Customized machined seals - Capabilities
PUB BU/P2 18795 EN	Radial spherical plain bearings for hydropower dam gates
PUB 43/P2 17372 EN	OK shaft couplings
PUB CS/P2 18212 EN	OKFX – friction-coated lange coupling from SKF
PUB 43/P2 17232 EN	SKF Supergrip Bolt for rotating langes
PUB 61/P2 17567 EN	Time saving solutions for turbine maintenance - SKF Supergrip bolt system
PUB 76/S7 11767 EN	SKF_Power360_SupergripBolt
PUB BU/S6 17741 EN	Cooper case study water turbine
PUB LS/P2 13651 EN P 205 / P 215	Lubrication pumps for multi-line systems
PUB LS/P1 16964 EN	Progressive automatic lubrication systems - Product catalogue 2021
PUB SE/P1 12393/2 EN	Hydraulic seals
PUB SE/P1 18729 EN	Industrial shaft seals
PUB 54/P7 13459 EN	Rolling bearings and seals in electric motors and generators
PUB SR/P7 10001/1 EN	SKF bearing maintenance handbook
PUB BU/P2 06104/1 EN	SKF spherical roller thrust bearings - For long lasting performance
PUB 73/I1 18342 EN SKF	Cooper split spherical roller bearings
PUB MP/P8 17660 EN	SKF Vibracon
PUB LS/P2 12852 EN	Centralized lubrication systems for water and wastewater treatment
6633/I EN	SKF SM-100 Oil Pumping Unit
PUB MP/P8 13238/2 EN	SKF lubricants
PUB LS/P2 17887 EN	Lubrication Remote Monitor LRM2
PUB LS/P2 10160 EN	Oil conditioning unit OCU
PUB LS/P2 15603 EN	Analog ultrasonic sensor
PUB MP/P2 13798/1 EN	Oil conditioning station
PUB MP/P8 12666/4 EN	SKF SYSTEM 24 - LAGD series
PUB MP/P8 14066/3 EN	SKF Automatic Lubricant Dispenser TLMR series
PUB LS/P2 17075 EN	SKF Flowline Monitor
PUB LS/P2 13094	Lincoln automatic lubrication systems



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