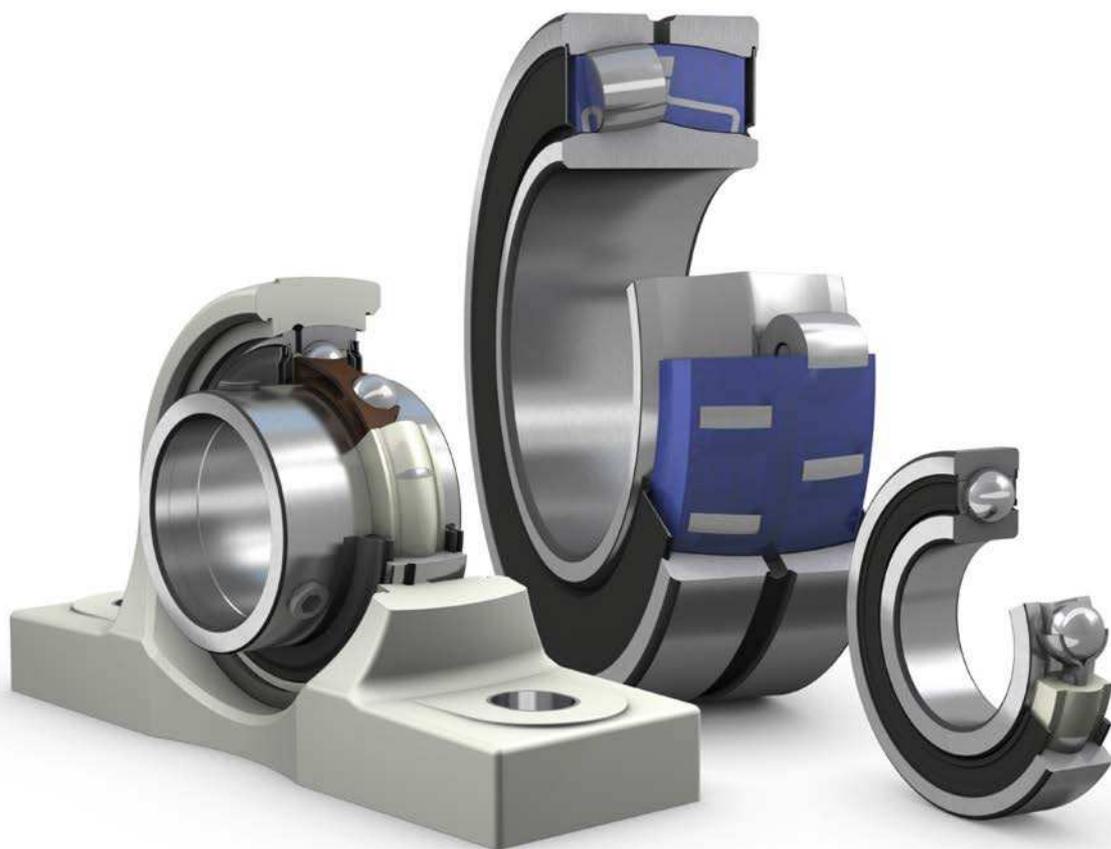


# SKF bearings with Solid Oil

Relubrication-free solutions for wet environments





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# Reduce downtime and maintenance costs in wet and contaminated environments

Bearings operating in wet and contaminated environments can suffer from unreliability and very short service life, resulting in costly maintenance and downtime. This is particularly true for applications exposed to the elements and those that must undergo frequent washdowns. Attempts to extend service life in these conditions by frequent relubrication tend to be relatively unsuccessful and there is a risk of contamination of the product by the ejected used grease (→ fig. 1)



## The challenge: wet conditions

The presence of high moisture levels and water poses a unique set of challenges for bearings. When moisture or water enters the free space in a bearing, it decreases the effectiveness of the lubricant, which accelerates wear, increases frictional heat and corrodes the rolling elements and raceways.

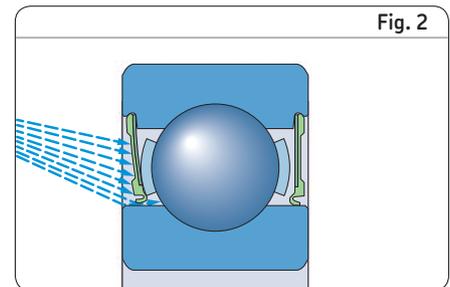
Applications in the food, beverage and pharmaceutical processing industries face additional challenges that result from frequent high pressure washdowns. During washdown, integral bearing seals can deflect inward, allowing water to enter, and grease to be washed out of the bearing. Grease washout risks contaminating the product and decreasing the effectiveness of any lubricant that remains in the bearing, leading to early failure.



Water contamination of bearings can degrade lubrication causing wear and corrosion damage



High pressure washdowns can deflect and open seals, contaminating and washing out the lubricating grease



Seals deflected by high pressure washing

# sts in wet

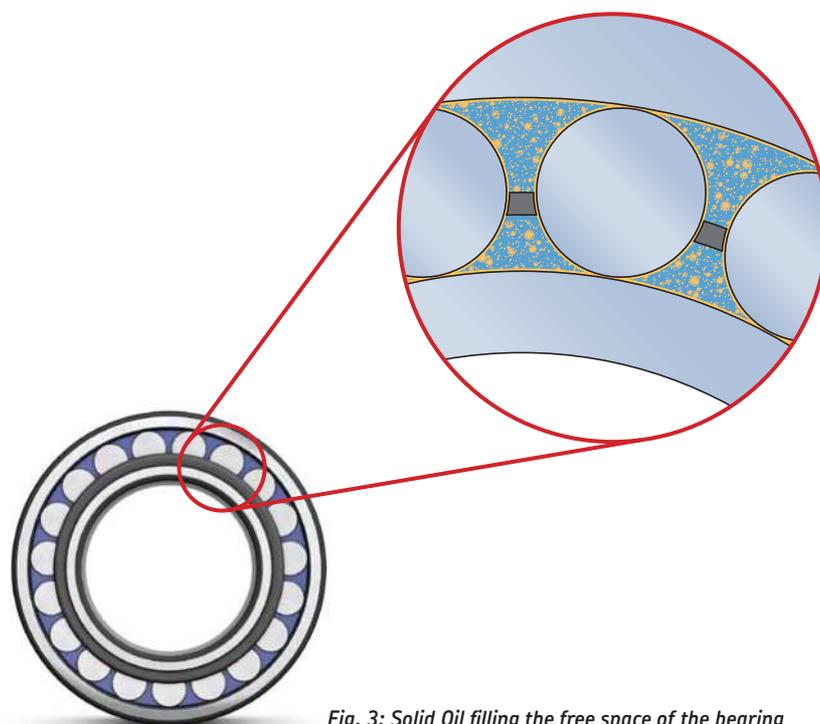


Fig. 3: Solid Oil filling the free space of the bearing

## About Solid Oil

Solid Oil is an oil saturated, polymer material that virtually fills all of the free space in the bearing (→ fig. 3). The polymer material is moulded into the bearing forming very narrow gaps around the rolling elements and raceways, enabling the bearing to rotate freely. The polymer material has a porous structure, with millions of micro-pores, that hold the lubricating oil retained by surface tension. In service, oil is released from the material into the narrow gaps between it and the bearing components, thus providing effective minimum quantity lubrication.

## Consistent lubricant supply

Solid Oil enables bearing lubrication with an even and consistent film of oil. An increase in operating temperature pushes oil toward the surface of the polymer material. This “flow” of oil within the polymer material occurs because the oil has a higher coefficient of thermal expansion than the polymer material and because the viscosity of the oil decreases with increasing temperature. During shutdown, any excess oil is reabsorbed back into the polymer material.

## Benefits of Solid Oil

SKF bearings with Solid Oil are designed for use in applications where high levels of moisture and incidental contact with water and other contaminants are real issues.

These bearings are also an excellent choice for applications where relubrication is impractical or dangerous.

- **Longer lubricant life**

A bearing with Solid Oil contains two to four times more oil than bearings lubricated with a conventional grease fill. The high quality synthetic oil resists oxidation and the solid structure of the polymer material means that it cannot be over-rolled or churned further extending lubricant life. Bearings with Solid Oil are lubricated for the life of the bearing and cannot be relubricated.

- **Improves performance in wet environments**

Solid Oil is beneficial where a bearing is exposed to wet environments since:

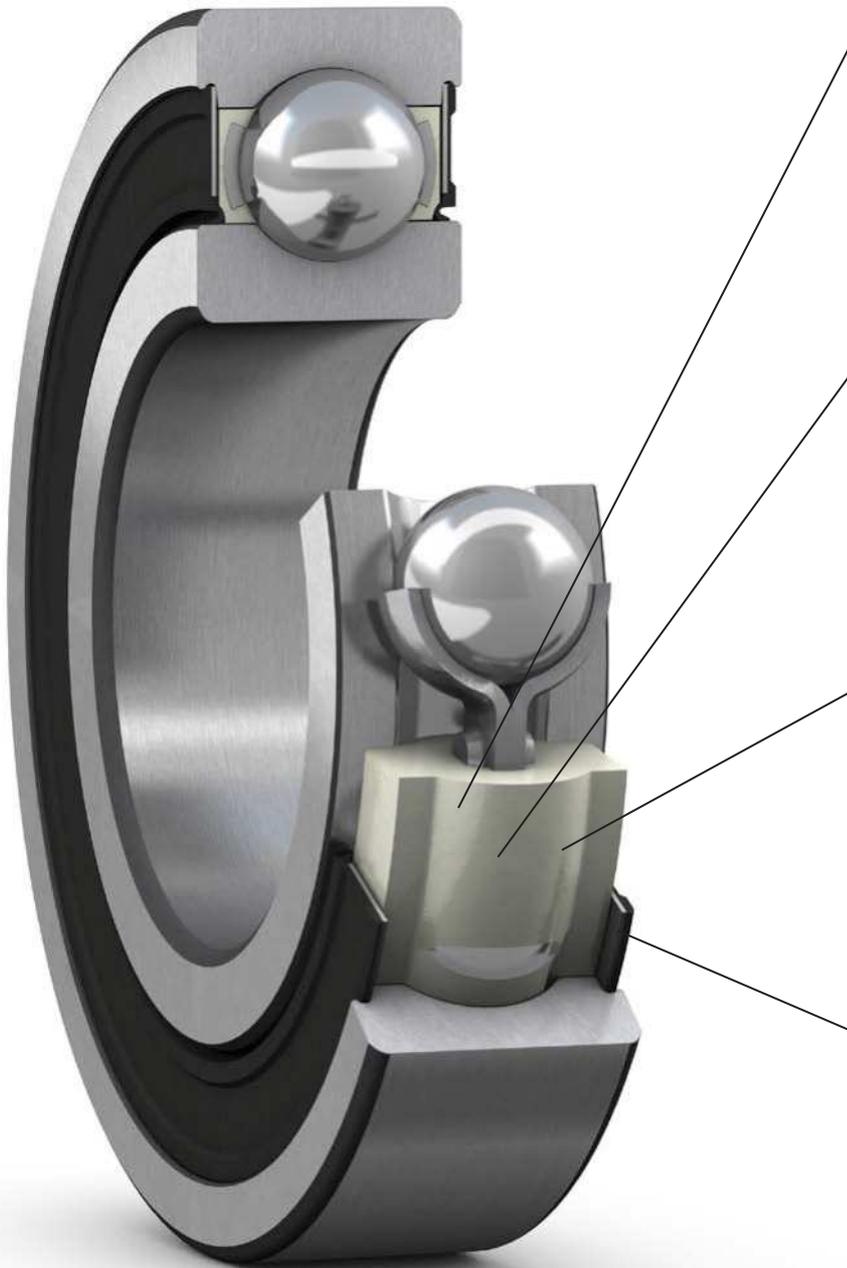
- It cannot be washed out and virtually fills all free space limiting the amount of wet contamination that can enter the bearing
- It helps to maintain good lubrication by retaining the oil, distributing it over the bearing surfaces and resisting emulsification
- It physically supports integral seals, reinforcing their effectiveness under washdown conditions

**NOTE:** Particularly where carbon steel bearings are exposed to wet environments, external seals are recommended to protect the bearing’s external surfaces from corrosion.

- **Reduce cost of ownership and environmental impact**

Bearings with Solid Oil can last significantly longer than grease lubricated bearings in wet environments, thus reducing total cost of ownership and environmental impact.

## Features and benefits of bearings with Solid Oil



### Longer lubricant life

- Large amount of oil available
- Eliminates lubricant churning
- High quality, synthetic oil resists oxidation

### Resists washout

- Solid Oil cannot be washed out of the bearing
- Water cannot mix with the oil or Solid Oil polymer

### Virtually eliminates lubricant leakage

- Solid Oil retains oil in the bearing
- Integral bearing seals increase the oil retention even further

### Protects against the ingress of contaminants

- Close osculation between Solid Oil and the rollers and raceways significantly reduces the ingress of contaminants
- Provides additional support for integral bearing seals

# Applications

## Food and beverage, pharmaceutical

In the food, beverage and pharmaceutical processing industries, extremely clean and sanitary conditions are a basic requirement. To maintain these conditions, machinery frequently undergoes high pressure wash-downs with aggressive detergents.

Any risk that the product might be contaminated, for example from grease or oil leakage, must be minimised and all materials used must be considered acceptable for incidental contact with the product and detectable if contamination should occur.

### Bottle filling station

In conventional bottle filling stations, bottles are usually cleaned, filled and sealed in a single process line. To enhance product hygiene and food safety, the environment needs to remain clean and is often wet due to the cleaning regime.

### Customer issue

A customer using sealed, greased for life, stainless steel deep groove ball bearings faced problems.

Under high pressure washdowns, the integral bearing seals were deflecting, allowing washdown fluid to penetrate, washing out most of the grease and contaminating what was left. Compromised lubrication resulted in unacceptably short bearing life and washed out grease presented a serious contamination risk. Maintenance and unplanned shutdowns were time consuming and expensive, affecting productivity and profitability.



*Bottle filling station*

### SKF solution

Sealed SKF stainless steel deep groove ball bearings with food grade Solid Oil.

- Significantly increased bearing service life from 12 weeks to 2 years
- Virtually eliminates lubricant leakage and resists washout
- Designed for easy cleaning and is virtually maintenance-free
- Significantly reduced maintenance costs
- Enhanced robust and reliable operation
- Improved food safety
- Reduced environmental impact



*Sealed SKF stainless steel deep groove ball bearings filled with Solid Oil W6204-2RS1/W64F*

# Marine

In the marine industry, deck machinery is impacted by harsh environments and continual salt water spray. Maintaining deck machinery offshore can be dangerous and time consuming, making it important that critical components such as bearings be weather resistant and designed for reliable operation. Because the operational and financial consequences of downtime are severe, bearing related failures are not an option.

## Deck machinery

An example of deck machinery is heave compensation systems. They are used on marine vessels to reduce the effect of waves on equipment operation. Within this system, large rope sheaves compensate for the vessel motion, so operation can continue even during exposure to large waves. System failure can result in the destruction of sensitive and expensive drilling equipment.



## Customer issue

A customer using standard spherical roller bearings with grease lubrication and external seals in the rope sheaves of a heave compensation system experienced the following problems:

- Lubricating grease was being washed out of the bearings
- Salt water was causing contamination and corrosion in the bearings
- Bearing service life was insufficient
- Additional equipment costs were incurred

## SKF solution

Sealed SKF spherical roller bearings with Solid Oil incorporated into an SKF Three-Barrier Solution provided a robust and relubrication-free solution. The solution resulted in:

- Increased reliability and longer bearing service life
- Eliminated offshore relubrication and its health and safety risks
- Significantly reduced maintenance costs



Heave compensation system

# Material handling

Cranes used in material handling operations must withstand severe mechanical and physical demands. Bearings must meet heavy lifting requirements and be weather resistant and reliable. Crane failure can result in serious financial and operational consequences, and, in some cases, can be life threatening.

## Port cranes

In port and deck cranes, salt water spray can impact bearings in critical components including wheels, drums and rope sheaves. Water ingress into these components can result in lubrication failure, wear and corrosion. To reduce the related risk of premature bearing failure, very frequent relubrication is often employed to purge the bearing of water and contaminated grease, and to replace grease that has been washed out. Manual relubrication can be difficult and poses a safety risk for maintenance personnel.

## Customer issue

In the wheels of a trolley crane, a customer was using standard spherical roller bearings lubricated with grease and sealed with external seals. The following problems were experienced:

- Water ingress caused lubrication failure, wear and corrosion of the bearings
- Bearing service life was unacceptably short resulting in crane unreliability and high maintenance costs
- The need for frequent manual relubrication created safety and cost issues

## SKF solution

Replacement of the open bearings with sealed SKF spherical roller bearings with Solid Oil, keeping the existing sealing arrangement, resulted in:

- Increased reliability and longer bearing service life
- Bearings lubricated for life, eliminating need for relubrication
- Robust weather resistance
- Contributed to ease of maintenance



Sealed SKF spherical roller bearing with standard Solid Oil 23052-2CS/W64



Port cranes

# Product information

## Assortment

The SKF standard assortment of bearings with Solid Oil includes:

- Deep groove ball bearings
- Spherical roller bearings
- Y-bearings
- Tapered roller bearings
- Cylindrical roller bearings
- Self-aligning ball bearings

The assortment includes a standard variant containing a high quality synthetic oil which meets the needs of most applications (designation suffix W64) and a food grade variant containing an oil registered by NSF as a category H1 (designation suffix W64F).

On request, SKF can supply other bearing types with Solid Oil to meet the needs of a particular application, except for CARB toroidal roller bearings which are unsuitable for use with Solid Oil. Bearings fitted with a large-volume cage are not suitable for Solid Oil because there is too little free space inside the bearing. For information about these engineered products, contact the SKF application engineering service.

## Sealing solutions

For optimal performance in wet environments, it is strongly recommended that bearings with Solid Oil with integral contact seals be used, wherever possible. When combining Solid Oil and contacting seals, the sealing capacity is improved as the Solid Oil acts as an axial support preventing the seals from deflecting and opening under pressure (→ fig. 2, page 4).

For more information regarding sealing options, see *SKF Rolling bearings* catalogue or contact SKF application engineering service.

**Table 1**

Technical specifications for bearings and units with Solid Oil		
Characteristic	Standard variant	Food grade variant
<b>Designation suffix</b>	W64	W64F
<b>Base oil viscosity</b> at 40 °C (105 °F) at 100 °C (210 °F)	mm <sup>2</sup> /s 150 20	220 25
<b>NSF H1 food grade</b>	no	yes
<b>Operating temperature</b> Maximum continuous Minimum start-up temperatures Maximum intermittent	°C (°F) 85 (185) -50 (-60) 95 (205)	85 (185) -25 (-15) 95 (205)
<b>Relubrication-free</b>	yes	yes

## Bearing data

Dimensions, tolerances and internal clearances of bearings or units with Solid Oil are the same as for the corresponding standard products. **Table 1** lists characteristics of both general purpose (W64) and food grade (W64F) versions of bearings with Solid Oil.

## Friction characteristics

The friction characteristics of a bearing with Solid Oil correspond to the relevant standard bearing except that the Solid Oil polymer filling adds a fixed friction.

## Load carrying capacity

The basic dynamic and static load ratings for bearings with Solid Oil are the same as for corresponding SKF standard bearings.

## Mounting

If a bearing with Solid Oil is to be hot mounted, it should be heated using an induction heater when mounting temperatures up to 120 °C (248 °F) are permissible. Heating plates or heated oil baths should not be used to heat bearings with Solid Oil.

## Speed limits

The recommended maximum speed limits for bearings and bearing units with Solid Oil is limited by the maximum continuous operating temperature of 85 °C (185 °F). **Table 2** provides the recommended speed limits for bearings with Solid Oil operating in an ambient temperature of 20 °C (70 °F).

Ambient temperature is the temperature closest to the bearing position, not necessarily room temperature. For bearing types or variants not listed in **table 2**, contact the SKF application engineering service.

For bearings with Solid Oil operating at the recommended speed limits, an increase in the operating temperature of approximately 65 °C (115 °F) above ambient is to be expected.

For ambient temperatures above 20 °C (70 °F), the speed limit should be reduced. The applicable reduction factor is set forth in **diagram 1**.

### Calculation example

A deep groove ball bearing 6208/W64 is to operate at an ambient temperature of 50 °C (120 °F). What is the reduced speed limit?

#### 1 Recommended maximum speed for 20 °C ambient temperature

Speed limit for 20 °C ambient temperature from **table 2**: 300 000 /  $d_m$ , single row deep groove ball bearing with stamped metal cage dimensions  $d = 40$  mm,  $D = 80$  mm

$$n = \frac{300\,000}{0,5(40 + 80)} = 5\,000 \text{ r/min}$$

#### 2 Reduction for 50 °C ambient temperature

Speed reduction factor  $f_T \approx 0,53$  from **diagram 1**

$$n_{\text{reduced}} = 5\,000 f_T = 5\,000 \times 0,53 = 2\,650 \text{ r/min}$$

Table 2

Recommended maximum speed limits for bearings and bearing units with Solid Oil for ambient temperature 20 °C

Bearing type	Recommended maximum speed limit n
–	r/min
<b>Deep groove ball bearings</b>	
single row with a stamped metal cage	300 000 / $d_m$
single row with a polymer cage	40 000 / $d_m$
double row	40 000 / $d_m$
<b>Single row angular contact ball bearings</b>	
with a stamped metal cage	150 000 / $d_m$
with a polymer cage	40 000 / $d_m$
<b>Self-aligning ball bearings</b>	
with a stamped metal cage	150 000 / $d_m$
with a polymer cage	40 000 / $d_m$
<b>Cylindrical roller bearings</b>	
with a stamped metal cage	150 000 / $d_m$
with a polymer cage	40 000 / $d_m$
<b>Tapered roller bearings</b>	45 000 / $d_m$
<b>Spherical roller bearings</b>	
E design	42 500 / $d_m$
CC design	85 000 / $d_m$
<b>Y-bearings, Y-bearing units</b>	40 000 / $d_m$

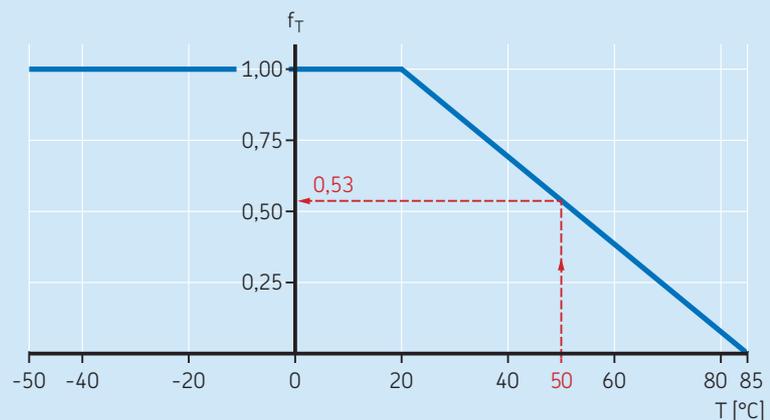
Where

$$d_m = 0,5(d+D)$$

For bearings with integral seals, use 80% of the quoted speed limits.

Diagram 1

Speed reduction factor  $f_T$  for ambient temperature above 20 °C



## 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.



For more information  
about bearings and  
bearing units with  
Solid Oil

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