Increased uptime through reduced maintenance on bearings

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Abstract:

For many years SKF has focused on bulk handling machinery and has now developed a new range of sealed spherical roller bearings for harsh environments based on our findings. The new development has been done in close cooperation with SKF core knowledge teams resulting in the *SKF Three-barrier solution* with a sealed bearing, sealed housing and selected lubricant. In combination, these have proven to provide excellent protection and increased life. This has now led to increased productivity in tough and harsh environments.

The SKF Three-barrier solution

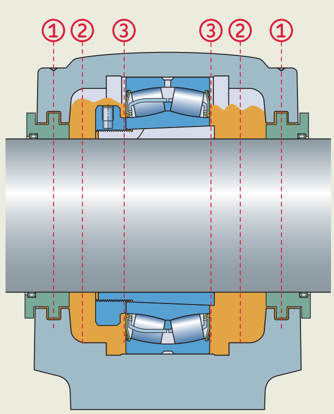
The effectiveness of the SKF Three-barrier solution (→ **fig 1**) lies in its simplicity. It protects the bearing during assembly and operation.

What is included:

1 SKF L-seals or S-seals – These housing seals are characterized by their ability to prevent the ingress of contaminants.
2 Housing grease – SKF recommends filling the housing with SKF LGGB2 biodegradable grease to act as a contamination barrier.
3 Integral bearing seals – These very effective seals keep the factory-filled bearing lubricant in and contaminants out of the bearing cavity.

The result is an environmentally friendly, cost-effective bundle of products that in many cases can extend bearing service life without complicated and expensive sealing arrangements.

Fig. 1



SKF Explorer sealed spherical roller bearings

Spherical roller bearings frequently operate in applications with high demands on load, misalignment, lubrication, temperature, resistance to contamination etc. SKF Explorer sealed spherical roller bearings can withstand these tough conditions. The bearings enable simplified maintenance, safer operation with fewer unscheduled stops and radically reduced grease consumption and grease disposal. This saves money and contributes to a cleaner environment.

Basic bearing designs

SKF sealed spherical roller bearings are basically made to E or CC designs.

Sealed E design bearings have the same internal geometry as corresponding open bearings, and accordingly, the same basic load ratings.

BS2-xxxx-2CS (E design)

To accommodate the seals, the width of sealed E design bearings is slightly larger than ISO standard. Apart from this, the principal dimensions are the same as for corresponding open bearings (→ **fig 2**)

Most abutment dimensions and all fillet dimensions are the same as for corresponding open bearings. Note that when choosing the abutment diameter d_a, the d_2 value for sealed bearings is smaller than for corresponding open bearings.

xxxxx-2CS (CC design)

All sealed bearings for the CC design have kept the principal dimensions of the corresponding open standard bearings (→ **fig 3**). The same applies to the abutment and fillet dimensions. Note that when choosing the abutment diameter d_a, the d_2 value for sealed bearings is smaller than for corresponding open bearings.

Fig. 2

Extended width sealed bearings for the 222 series, sizes 05-26 and for the 223 series, sizes 08-16.

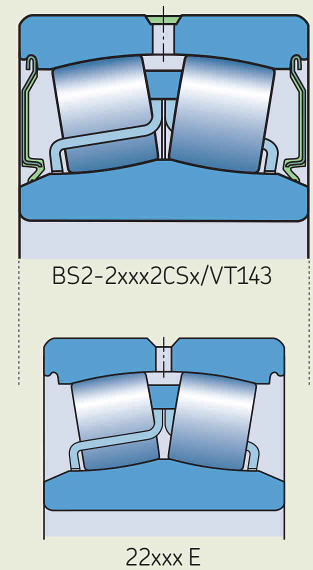
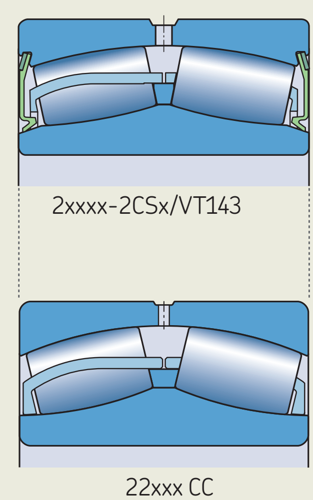


Fig. 3

Standard width sealed SRB (= ISO for open SRB). Marked with thick lines in the adjacent diagram.



Seals

Design

The seals are of a land-riding type and positioned inboard the bearing boundary dimensions. They are reinforced by a steel sheet plate resulting in robust designs. The seals do not have protruding parts.

Material

Two different seal materials are used depending on bearing size:

- Acrylonitrile-butadiene rubber (NBR) intended for normal operating temperatures. Bearings with NBR seals are identified by the suffice CS or LS.
  Example: BS2-2210-2LS/VT143
- Hydrogenated acrylonitrile-butadiene rubber (HNBR) is intended for both normal and high operating temperatures. Bearings with HNBR seals are identified by the suffix 2CS5 or 2LS5.
  Example: 24024-2CS5/VT143

Both variants of acrylonitrile-butadiene rubber are resistant to most lubricants and commonly used solvents, and they are both well-suited to the bulk handling industry.

Seal efficiency

The efficiency of the integral seals has been confirmed by many field tests and long-running, demanding lab tests in environments such as "Arizona dust" and moisture. The sealing efficiency in wet environments is even better than that of single-lip seals used for other bearings. Nevertheless, sealed spherical roller bearings should not be exposed to direct water spray, since the seal surface will corrode and reduce the sealing function.

The general SKF recommendation is that the integral seals are employed as secondary seals. In that way, the best use is made of the properties peculiar to these bearings. Labyrinth seals are the appropriate choice for use as primary seals.

Seal friction and power loss

Though the frictional losses arising from the seals are considerably smaller than those generated by the bearing, they have a significant impact on speed performance. Consequently, the SKF General Catalogue 1700 lists only limiting speeds for bearings with contact seals.

The average seal friction share (seal/total bearing friction) is 14%.

For large sizes the share can be as low as 5%. In the SKF model for calculating bearing friction, the total frictional moment, M, is derived from four sources:

$$M = M_{rr} + M_{sl} + M_{seal} + M_{drag}$$

where

M_{rr} = the rolling frictional moment, and includes effects of lubricant starvation and inlet shear heating [Nmm]

Msl = the sliding frictional moment, and includes the effects of the quality of lubrication conditions [Nmm]

M_{seal} = the frictional moment from integral seals [Nmm]

Where bearings are fitted with contact seals, the frictional losses from the seals may exceed those generated in the bearing.

M_{drag} = the frictional moment from drag losses, churning, splashing, etc., in an oil bath [Nmm]

Calculating values for these four sources of friction is complex. Therefore, we recommend using the SKF Bearing Calculator (skf.com/bearingcalculator).

For detailed information on the calculations, refer to The SKF model for calculating the frictional moment (skf.com/go/17000-B5).

When the total frictional moment, M, of the bearing is known, you can calculate the bearing frictional power loss using

$$P_{loss} = 1,05 \times 10–4\ M\ n$$

where

P_{loss} = bearing frictional power loss [W]

M = total frictional moment [Nmm]

n = rotational speed [r/min]

Greases and filling degree

All sealed spherical roller bearings are factory-lubricated with an appropriate quality grease.

General applications and bulk handling industry

For general applications bearings are filled to 25 - 45% of the free space in the bearing with SKF LGEP 2 grease, i.e. a high quality grease with EP additives suitable for operating temperatures up to 110 °C *(230 °F)*. This combination is identified by the designation suffix VT143.

Very low speed

For this operating condition the bearings can be filled to 70 - 100% with SKF LGEP 2 grease. This combination is identified by the designation suffix VT143C

Misalignment

The design of sealed SKF spherical roller bearings is such that they are inherently self-aligning, i.e. the bearings can accommodate angular misalignment of the shaft relative to the housing without any negative effect on bearing performance.

Under operating conditions where the misalignment is constant relative to the outer ring, sealed SKF spherical roller bearings can accommodate angular misalignment of the shaft relative to the housing of up to 0.5° with no detrimental effect on the efficiency of the seals.

When misalignment is not constant with respect to the bearing outer ring (→ **fig 5**), the bearing friction increases and therefore the misalignment of the inner ring relative to the outer ring should not exceed a few tenths of a degree.

Fig. 5

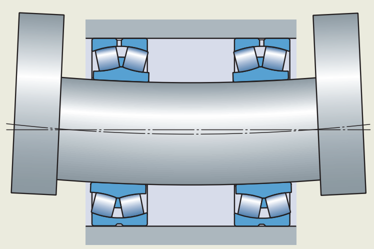
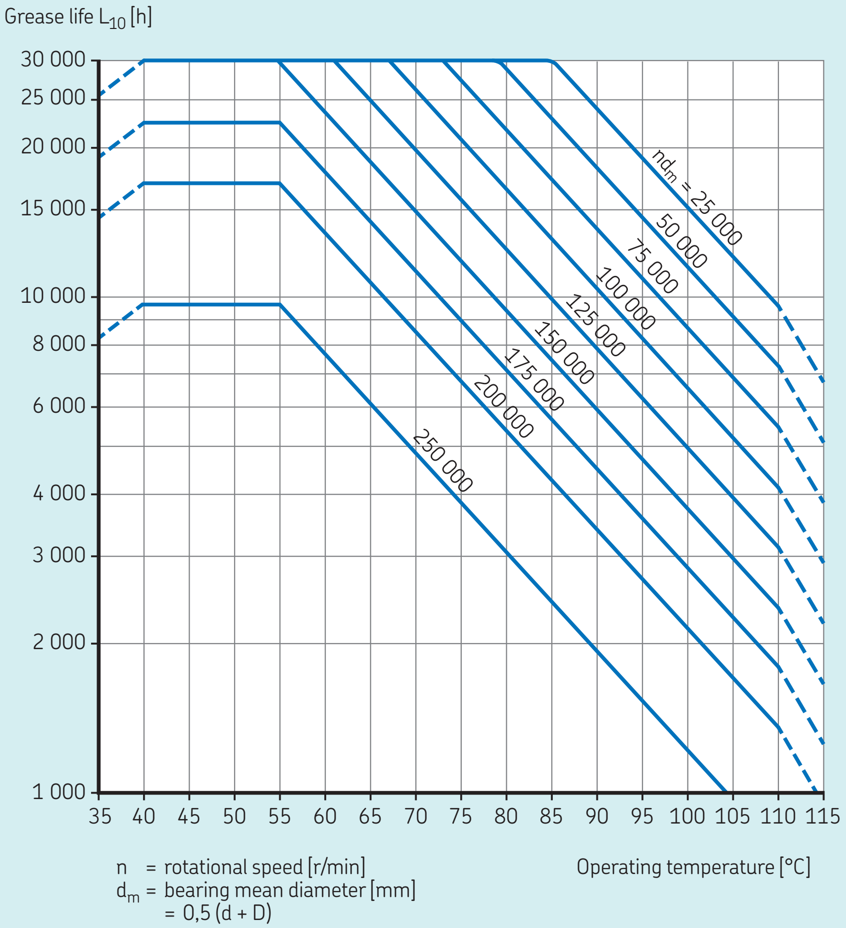


Diagram 1

Grease life for sealed spherical roller bearings with designation suffix VT143 where P ≤ 0,067 C



Grease life for sealed bearings

The grease life for sealed bearings is presented as L10, i.e. the time period at the end of which 90% of the bearings are still reliably lubricated, and depends on the load, operating temperature and speed value. It can be obtained for bearings with standard SKF LGEP 2 grease (designation suffix VT143) from:
→ **Diagram 1** for light load (P ≤ 0,067 C).

Relubrication of sealed bearings

When the required service life is longer than the grease life, the bearings may require relubrication. A suitable grease quantity to relubricate sealed bearings can be obtained using

$G_p = 0,0015\ D\ B$
where

G_p = grease quantity [g]
D = bearing outside diameter [mm]
B = bearing width [mm]

The grease should be applied slowly through the lubrication holes in the outer ring, preferably while the bearing is rotating to avoid damaging the seals. SKF recommends relubricating with the same grease as the initial fill.

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