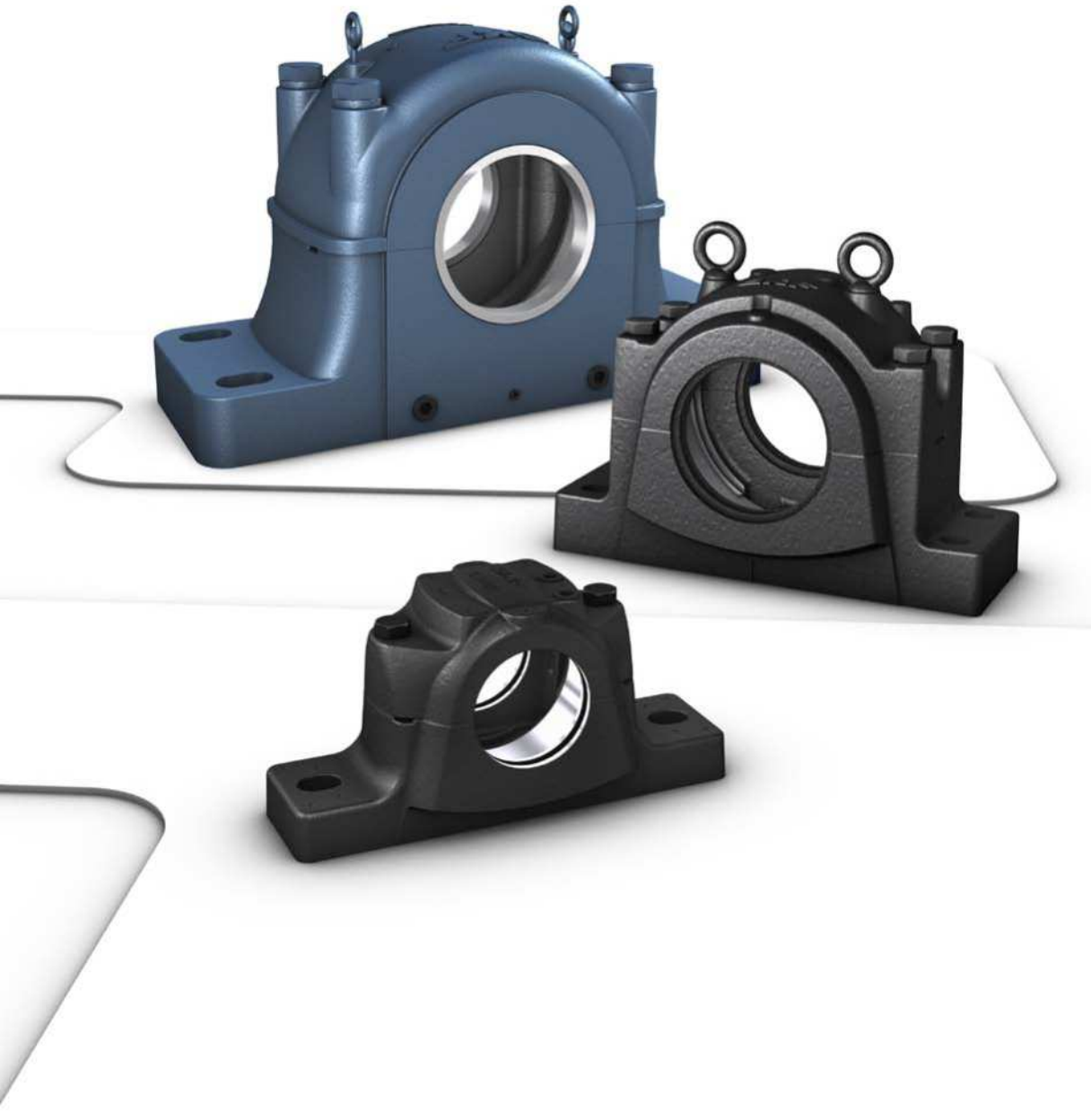


SKF bearing housings – overview, selection and application recommendations

Basics

The purpose of a bearing housing is to:

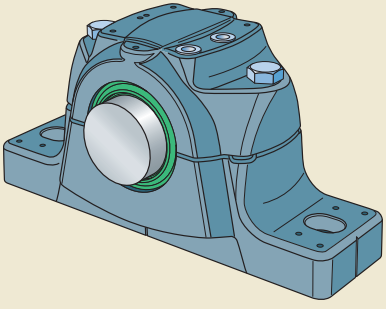
- support the bearing and transmit operating static and dynamic loads
- protect the bearing and lubricant from contaminants
- contain the lubricant and accommodate lubrication system components
- accommodate monitoring system components
- maximize the performance and service life of the incorporated bearings

Terminology

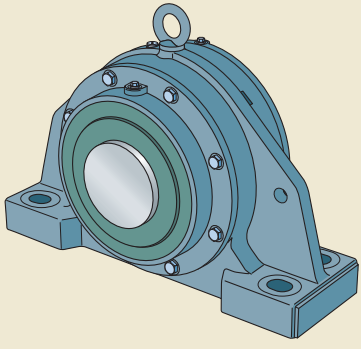
An overview of the terminology used in this catalogue is provided in **figs. 1** to **4**:

- types of bearing housings and bearing units (→ **fig. 1**)
- split plummer (pillow) block housings (→ **fig. 2**)
- housing and shaft arrangements (→ **figs. 3 and 4**)

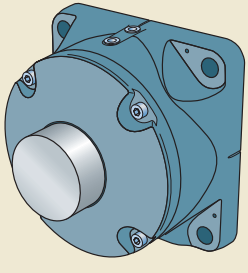
Fig. 1



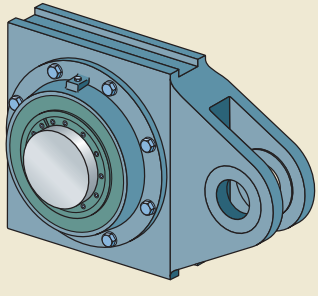
Split plummer (pillow) block housing



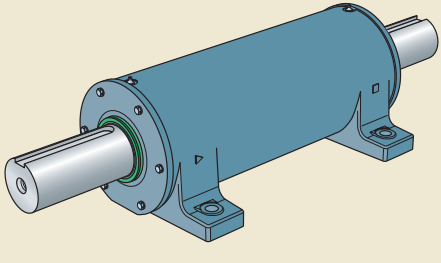
Non-split plummer (pillow) block housing



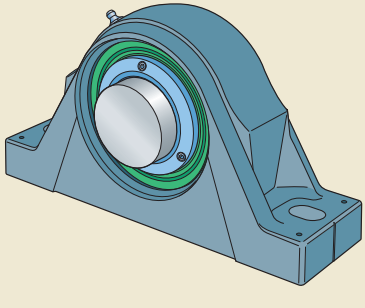
Flanged housing



Take-up housing



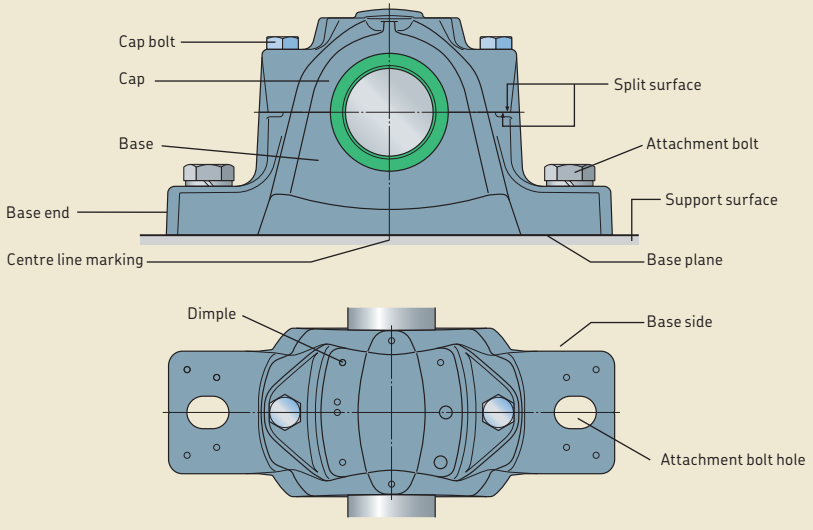
Two-bearing housing



Roller bearing unit

Fig. 2

SE plummer (pillow) block housing



SONL plummer (pillow) block housing

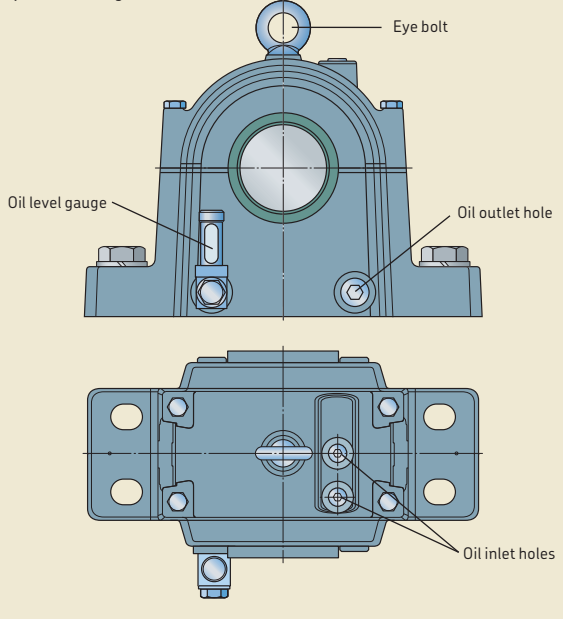
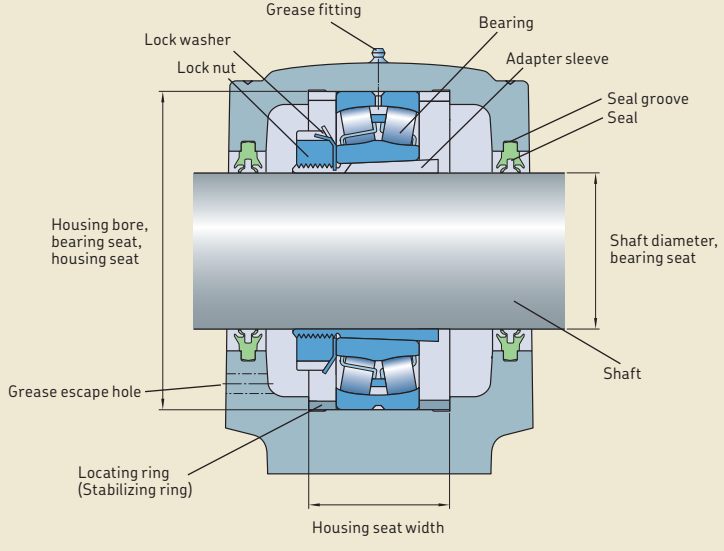


Fig. 3

SE plummer (pillow) block housing



FNL flanged housing

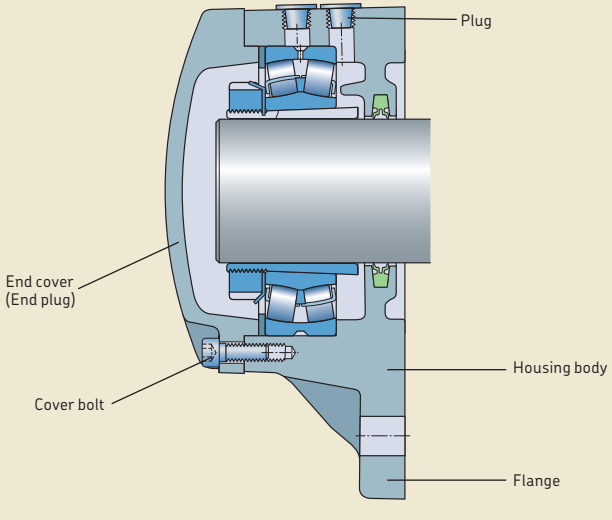
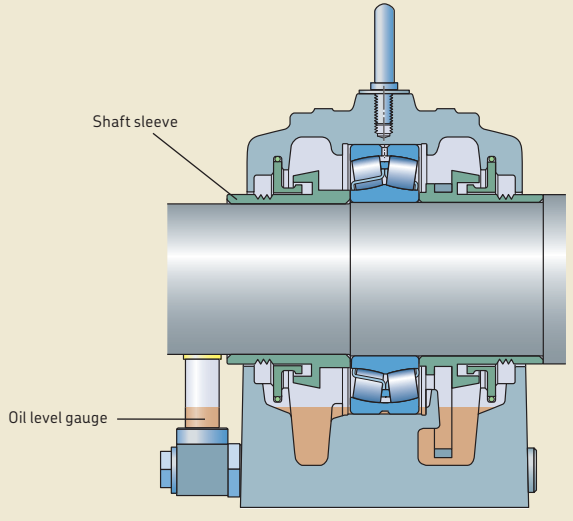
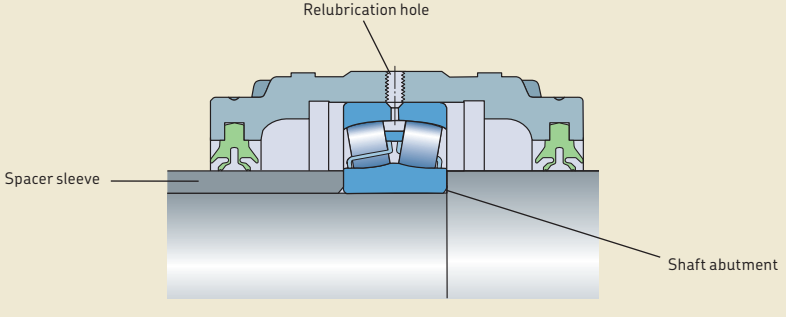


Fig. 4


Shaft sleeve
Oil level gauge


Relubrication hole
Spacer sleeve
Shaft abutment

Overview of SKF bearing housings

Assortment

The comprehensive assortment of SKF bearing housings is provided in **tables 1** to **4**, starting on **page 30**. SKF can also supply custom housings for specific applications and requirements. For additional information, contact the SKF application engineering service.

Split plummer (pillow) block housings

The main benefit of split plummer (pillow) block housings (→ **fig. 5**) is that they can accommodate preassembled shafts. Also, these housings simplify bearing inspections and maintenance because the shaft does not need to be disassembled.

The assortment of split plummer block housings is provided in **table 1** on **page 30**. Application-specific housings are provided in **table 4** on **page 34**.

Non-split plummer (pillow) block housings

Non-split plummer (pillow) block housings (→ **fig. 6**) are preferred when there are heavy loads acting in directions other than toward the support surface. They are also used when the housing has to be mounted from the end of the shaft.

The assortment of non-split plummer block housings is provided in **table 2** on **page 32**. Application-specific housings are provided in **table 4** on **page 34**.

Flanged housings

Flanged housings (→ **fig. 7**) provide a solution for applications that do not have a frame parallel to the shaft. The assortment of flanged housings is provided in **table 2** on **page 32**.

Fig. 5

Fig. 6

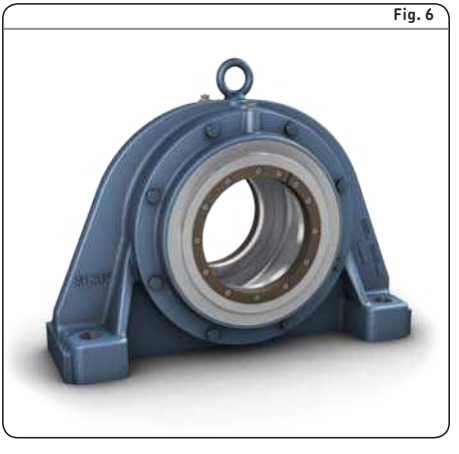


Fig. 7

Take-up housings

Take-up housings (→ **fig. 8**) are typically used to maintain the tension in conveyor belt applications and are mounted onto a guide frame.

The assortment of take-up housings is provided in **table 2** on **page 32**.

Two-bearing housings

Two-bearing housings (→ **fig. 9**) have intrinsically aligned bearing seats. As a result, they can accommodate rigid bearings, such as deep groove ball bearings, angular contact ball bearings and cylindrical roller bearings. Two-bearing housings are typically used in applications with an overhanging load.

The assortment of two-bearing housings is provided in **table 2** on **page 32**.

Roller bearing units

Roller bearing units consist of a bearing, housing, lubricant and seals as well as a mechanism to lock the bearing inner ring onto the shaft (→ **fig. 10**). These ready-to-mount units are assembled, lubricated and sealed at the factory for maximum service life. Bearing units require very little maintenance. They are also easy to install and replace. Once a unit is bolted to its support surface, only the grub (set) screws in the collar need to be tightened.

The assortment of roller bearing units is provided in **table 3** on **page 33**.

Application-specific housings

Application-specific housings have features that enable them to be used in special operating conditions. The assortment of application-specific housings is provided in **table 4** on **page 34**.

Fig. 8

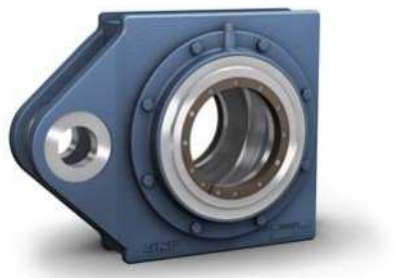


Fig. 9

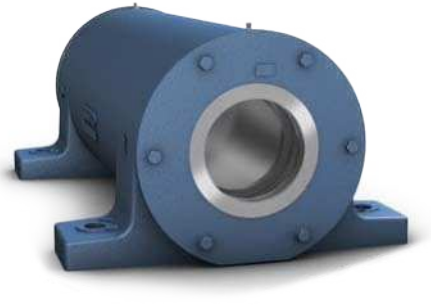


Fig. 10

Housing materials

SKF housings are typically made of either grey cast iron or spheroidal graphite cast iron. For information about the material options available for a particular housing type, refer to **tables 1** to **4**, starting on **page 30**, or the relevant product chapter.

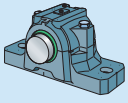
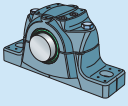
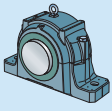
Grey cast iron

Grey cast iron is the standard material for most SKF housings and is sufficient for the majority of applications. It is characterized by high strength, good damping capability and good thermal conductivity.

Spheroidal graphite cast iron

Spheroidal graphite cast iron contains graphite nodules, making it ductile. It therefore provides a higher degree of strength and toughness than grey cast iron. On average, housings made of spheroidal graphite cast iron can withstand 1,8 times heavier loads compared to housings made of grey cast iron.

Split plummer (pillow) block housings

Series	 SNL 2, 3, 5 and 6	 SE 2, 3, 5 and 6	 SNLN 30
Chapter	2	3	4
Bearing types			
Self-aligning ball bearing	✓	✓	–
Spherical roller bearing	✓	✓	✓
CARB bearing	✓	✓	✓
Shaft diameter range			
from [mm]	20 and 60	30	110
to [mm]	30 160	75	280
from [*in.*]	*3/4* and *2 3/16*	*15/16*	–
to [*in.*]	*1* *5 1/2*	*2 1/2*	–
Shaft-bearing combination			
Bearing on an adapter sleeve	✓	✓	✓
Bearing on a withdrawal sleeve	✓	✓	✓
Bearing on a cylindrical seat	✓	✓	✓
Sealing solutions			
Lip seal	✓	✓	✓[1]
Radial shaft seal	–	–	–
V-ring seal	✓	✓	✓[1]
Felt seal	✓	✓	✓[1]
Labyrinth seal	✓	✓	✓
Taconite heavy-duty seal	✓	✓	✓
Multi-seal	–	–	–
Lubrication			
Grease	✓	✓	✓
Oil	optional	optional[2]	–
Materials			
Grey cast iron	standard	standard	standard
Spheroidal graphite cast iron	optional	optional	optional
Cast steel	–	–	–
Mounting			
No attachment bolts	✓	✓	✓
Two-bolt mounting	✓	✓	✓
Four-bolt mounting	✓	✓	✓
Eight-bolt mounting	–	–	–
Supersedes (SKF)	SNH, SNA, SN	SNL 2,3,5 and 6, SNH, SNA, SN	SN 30
Replacement for (non-SKF)	ISO 113 standard housing	ISO 113 standard housing	ISO 113 standard housing

[1] Not available for sizes 34 and above.
[2] For sizes 518 to 532 circulating oil only.

Table 1

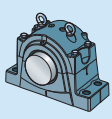
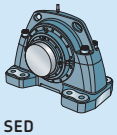
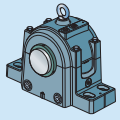
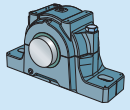
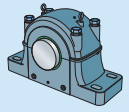
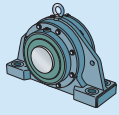
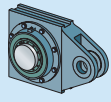
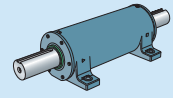
				
SNL 30, 31 and 32	**SED**	**SONL**	**SAF, SAW**	**SDAF**
5	6	7	8	9
–	–	✓	✓	–
✓	✓	✓	✓	✓
✓	✓	✓	✓	✓
115	430	75	40	85
530	900	240	220	530
4 7/16	–	*2 15/16*	*1 3/16*	2 15/16
19 1/2	–	*8 15/16*	*10 1/2*	20
✓	✓	✓	✓	✓
✓	–	–	–	–
✓	✓	✓	✓	✓
–	–	–	–	–
–	–	–	✓	✓
–	–	–	–	–
–	–	–	–	✓
✓	–	✓	✓	✓
✓	–	–	✓	✓
–	✓	–	–	–
✓	✓	–	✓	✓
✓	✓	✓	✓	✓
standard	–	standard	standard	standard
optional	standard	optional	optional	optional
–	–	–	optional	optional
–	–	–	–	–
–	–	–	✓	–
✓	–	✓	✓	✓
–	✓	–	–	–
SD, SDD	–	SOFN 2, 5	–	–
ISO 113	–	–	–	–
standard housing				

Table 2

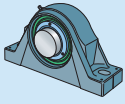
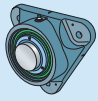
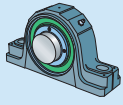
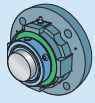
Non-split housings

				
Series	**SBD**	**THD**	**FNL**	**PD**
Chapter	10	10	11	12
Bearing types				
Self-aligning ball bearing	–	–	✓	–
Spherical roller bearing	✓	✓	✓	✓
CARB bearing	✓	✓	✓	–
Other	–	–	–	✓[1]
Shaft diameter range				
from [mm]	60	50	20	25
to [mm]	420	400	100	120
from [*in.*]	–	–	–	–
to [*in.*]	–	–	–	–
Shaft-bearing combination				
Bearing on an adapter sleeve	✓	✓	✓	–
Bearing on a withdrawal sleeve	–	–	–	–
Bearing on a cylindrical seat	✓	✓	–	✓
Sealing solutions				
Lip seal	–	–	✓	–
V-ring seal	–	–	–	✓
Felt seal	–	–	–	✓
Labyrinth seal	✓	✓	–	–
Lubrication				
Grease	✓	✓	✓	✓
Oil	–	–	–	optional
Materials				
Grey cast iron	optional	optional	standard	standard
Spheroidal graphite cast iron	standard	standard	–	–
Cast steel	optional	optional	–	–
Mounting				
No attachment bolts	–	n/a	–	–
Two-bolt mounting	–	n/a	–	–
Four-bolt mounting	✓	n/a	✓[2]	✓
Supersedes (SKF)	–	–	7225(00)	–

[1] Typical bearings include deep groove ball bearings, angular contact ball bearings, and cylindrical roller bearings.
[2] Housings with a triangular flange have three attachment bolts.

Table 3

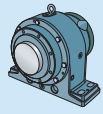
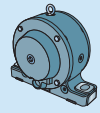
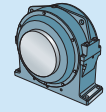
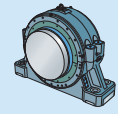
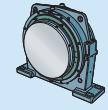
Roller bearing units

				
Series	**SYNT**	**FYNT**	**SYE .. N, SYR .. N, FSYE**	**FYE, FYR, FYRP**
Chapter	16	16	17	17
Bearing types				
Self-aligning ball bearing	–	–	–	–
Spherical roller bearing	✓	✓	✓	✓
CARB bearing	–	–	–	–
Shaft diameter range				
from [mm]	35	35	–	–
to [mm]	100	100	–	–
from [*in.*]	–	–	*1 7/16*	*1 7/16*
to [*in.*]	–	–	*4 15/16*	*4*
Locking method				
SKF ConCentra	✓	✓	✓	✓
Locking collar	–	–	✓	✓
Sealing solutions				
Lip seal	✓	✓	✓	✓
Radial shaft seal	✓	–	✓	✓
Labyrinth seal	✓	–	✓	✓
Lubrication				
Grease	✓	✓	✓	✓
Oil	–	–	–	–
Materials				
Grey cast iron	✓	✓	✓	✓
Mounting				
No attachment bolts	–	–	–	–
Two-bolt mounting	✓	–	✓	–
Four-bolt mounting	–	✓[1)]	✓	✓
Supersedes (SKF)	SYT	–	–	–

[1)] Housings with a triangular flange have three attachment bolts.

Table 4

Application-specific housings

Series	SBPN	SBFN	SDM	SKND	FSDR
					
Chapter	13	13	13	14	15
Application	Drying cylinder	Felt roll	Yankee cylinder	Converter trunnion	Mill trunnion
Bearing types					
Self-aligning ball bearing	–	–	–	–	–
Spherical roller bearing	✓	✓	✓	✓	✓
CARB bearing	✓	✓	✓	✓	–
Shaft diameter range					
from [mm]	180	60	340	530	825
to [mm]	320	180	670	1 180	1 460
from [*in.*]	1)	1)	1)	1)	1)
to [*in.*]	1)	1)	1)	1)	1)
Shaft-bearing combination					
Bearing on an unthreaded sleeve	–	–	–	–	✓2)
Bearing on a cylindrical seat	–	optional	–	✓	–
Bearing on a tapered seat	✓	✓	✓	–	–
Sealing solutions					
Lip seal	–	–	–	✓	–
V-ring seal	–	–	–	–	✓
Labyrinth seal	✓	✓	–	–	✓
Gap-type seal	–	–	✓	–	–
Lubrication					
Grease	–	–	–	✓	✓
Oil	✓	✓	✓	–	–
Materials					
Grey cast iron	✓	✓	✓	–	✓
Spheroidal graphite cast iron	–	–	–	✓	optional
Mounting					
No attachment bolts	–	–	–	–	–
Two-bolt mounting	–	✓	–	–	–
Four-bolt mounting	✓	optional	✓	✓	✓
Supersedes (SKF)	SBP	SBF2)	–	SDKD	–

1) Contact SKF.
2) Housings are still available.

Selecting a housing

When selecting a housing, many factors should be considered. The selection process depends not only on the bearing type and size but also on the ability of the housing to safely accommodate the magnitude and characteristics of all applied loads. Beside this, important considerations are mounting, maintenance, sealing options and bearing lubricant requirements.

Search for a housing

To identify housings that are suitable for a specific bearing type, size and shaft-bearing combination, use the *Bearing index*, starting on **page 742**, or the online application *SKF Housing Select*, available at skf.com/housings. Also keep in mind that a roller bearing unit may be the preferred solution (→ **table 5**). An online search facility for bearing units is also available at skf.com/housings.

Adjust the bearing selection

If there is no suitable housing for the selected bearing type or size, consider switching to a bearing that can be accommodated in a standard housing. The result will be a more cost-effective bearing/housing solution.

Select the final housing variant

Once a housing has been selected, be sure that the housing and available sealing solutions will accommodate the loads, shaft-bearing combination, lubrication method and operating conditions, e.g. type and level of contaminants. Consider all housing variants, including those with a non-standard seat tolerance or special seals. For unique requirements, contact the SKF application engineering service.

Table 5

Housing equivalents

Housing series	Roller bearing unit
SNL 5 series	SKF ConCentra roller bearing units in the SYNT series
FNL series	SKF ConCentra roller bearing units in the FYNT series

Environmental conditions

SKF housings are intended for both interior and exterior applications. The following corrosivity categories, in accordance with ISO 12944-2, are applicable for SKF housings:

- C2 for all housings except SE and SED plummer (pillow) block housings
- C3 for SE and SED plummer (pillow) block housings

Additional information about corrosivity categories is provided in **table 6**.

Custom painting / corrosivity category

The standard colour and corrosivity category of an SKF housing is indicated in the relevant product chapter. SKF housings can also be supplied in other colours and/or corrosivity categories (→ **table 6**) or according to customer specifications. Housings that have a non-standard painting requirement are identified by the designation suffix P followed by a unique two- or three-digit number e.g. SNL 510-608/P76.

If a housing is going to be repainted, SKF recommends taking the following precautions prior to painting:

- Cover all housing openings. For housings with seal grooves, place discs cut from cardboard or plastic in the seal grooves. This is particularly important because residual chemicals or abrasives from the preparation process can lead to premature bearing and seal damage.
- Remove all grease fittings and protect all threaded holes with plugs.
- To avoid any chemical attack of the surface when washing painted castings, follow the instructions from the supplier of the washing chemicals regarding concentration, temperature, and time. The paint is resistant to commonly used low alkalescent washing chemicals.

Sealing solutions

The performance of a sealing arrangement is vital to the cleanliness of the lubricant and the service life of the bearings. The type of seal should be selected based on the lubricant type and operating speed but levels of contamination and misalignment should also be considered.

There is a wide assortment of SKF housing seals. Some housings can accommodate different types of seals, while other housings are designed for one specific sealing solution. For information about the sealing solutions available for a particular housing or roller bearing unit, refer to **tables 1** to **4**, starting on **page 30**, or the relevant product chapter. The properties, application conditions and suitability of each sealing solution are also provided in the relevant product chapter.

Converting circumferential to rotational speeds

To convert the circumferential speed limit of a sealing solution to the equivalent rotational speed, refer to **table 7**.

Table 6

Corrosivity categories[1]

Corrosivity category	Examples of typical environments in a temperate climate Exterior	Interior
C1 (very low)	–	Heated buildings with clean atmospheres, e.g. offices, shops, schools, hotels.
C2 (low)	Atmospheres with low levels of pollution. Typically inland rural areas.	Unheated buildings where condensation may occur, e.g. depots, sport halls.
C3 (medium)	Urban and industrial atmospheres with moderate levels of sulphur dioxide. Coastal areas with low salinity.	Production rooms with high humidity and some air pollution, e.g. food-processing plants, laundries, breweries, dairies.
C4 (high)	Industrial and coastal areas with moderate salinity.	Chemical plants, swimming pools, coastal ship- and boatyards.
C5-I (very high, industrial)	Industrial areas with high humidity and aggressive atmosphere.	Buildings or areas with almost permanent condensation and with high pollution.
C5-M (very high, marine)	Coastal and offshore areas with high salinity.[2]	Buildings or areas with almost permanent condensation and with high pollution.

[1] In accordance with ISO 12944-2.
[2] In hot, humid coastal areas, the mass loss or thickness loss can exceed the limits of category C5-M and special precautions should be taken when selecting protective paint systems.

Table 7

Converting circumferential speed limits to rotational speeds

Shaft diameter at the seal lip	Rotational speed for circumferential speed limits					
	2 m/s	4 m/s	7 m/s	8 m/s	12 m/s	13 m/s
mm	r/min					
20	1 910	3 820	6 680	7 640	11 460	12 410
25	1 530	3 060	5 350	6 110	9 170	9 930
30	1 270	2 550	4 460	5 090	7 640	8 280
35	1 090	2 180	3 820	4 370	6 550	7 090
40	950	1 910	3 340	3 820	5 730	6 210
45	850	1 700	2 970	3 400	5 090	5 520
50	760	1 530	2 670	3 060	4 580	4 970
55	690	1 390	2 430	2 780	4 170	4 510
60	640	1 270	2 230	2 550	3 820	4 140
65	590	1 180	2 060	2 350	3 530	3 820
70	550	1 090	1 910	2 180	3 270	3 550
75	510	1 020	1 780	2 040	3 060	3 310

continues on next page

cont. Table 7

Converting circumferential speed limits to rotational speeds

Shaft diameter at the seal lip	Rotational speed for circumferential speed limits					
	2 m/s	4 m/s	7 m/s	8 m/s	12 m/s	13 m/s
mm	r/min					
80	480	950	1 670	1 910	2 860	3 100
85	450	900	1 570	1 800	2 700	2 920
90	420	850	1 490	1 700	2 550	2 760
95	400	800	1 410	1 610	2 410	2 610
100	380	760	1 340	1 530	2 290	2 480
110	350	690	1 220	1 390	2 080	2 260
115	330	660	1 160	1 330	1 990	2 160
120	320	640	1 110	1 270	1 910	2 070
125	310	610	1 070	1 220	1 830	1 990
130	290	590	1 030	1 180	1 760	1 910
135	280	570	990	1 130	1 700	1 840
140	270	550	950	1 090	1 640	1 770
145	260	530	920	1 050	1 580	1 710
150	250	510	890	1 020	1 530	1 660
155	250	490	860	990	1 480	1 600
160	240	480	840	950	1 430	1 550
165	230	460	810	930	1 390	1 500
170	220	450	790	900	1 350	1 460
175	220	440	760	870	1 310	1 420
180	210	420	740	850	1 270	1 380
185	210	410	720	830	1 240	1 340
195	200	390	690	780	1 180	1 270
200	190	380	670	760	1 150	1 240
205	190	370	650	750	1 120	1 210
215	180	360	620	710	1 070	1 150
220	170	350	610	690	1 040	1 130
240	160	320	560	640	950	1 030
255	150	300	520	600	900	970
260	150	290	510	590	880	950
275	140	280	490	560	830	900
280	140	270	480	550	820	890
295	130	260	450	520	780	840
300	130	250	450	510	760	830
320	120	240	420	480	720	780
340	110	220	390	450	670	730
360	110	210	370	420	640	690
380	100	200	350	400	600	650
400	100	190	330	380	570	620
410	90	190	330	370	560	610
430	90	180	310	360	530	580
450	80	170	300	340	510	550
470	80	160	280	330	490	530
500	80	150	270	310	460	500

The SKF three-barrier solution

For highly contaminated environments, SKF recommends the three-barrier solution. This cost-effective sealing solution can have a significant impact on bearing service life as contaminants have to pass through three barriers to reach the bearing (→ **fig. 11**):

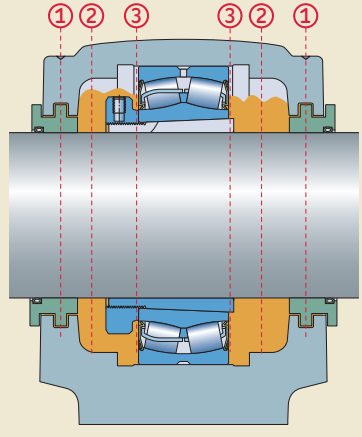
- 1st barrier – external housing seal
- 2nd barrier – housing grease
- 3rd barrier – integral bearing seal

The SKF three-barrier solution consists of a sealed SKF bearing, a housing with a 70 to 90% grease fill, and labyrinth housing seals.

Sealed bearings have integral contact seals that keep the lubricant in and contaminants out of the bearing cavity during operation. The seals also protect the bearing from the ingress of contaminants during installation. Using a sealed bearing also means that the grease used to fill the housing and labyrinth seals is independent of the lubrication requirements for the bearing. Therefore, environmentally friendly, biodegradable greases, such as SKF LGGB 2, can be used to fill the housing (→ skf.com/lubrication).

When the SKF self-aligning bearing system is used (→ **page 41**), the labyrinth seal for the CARB toroidal roller bearing should be replaced with a taconite seal.

Fig. 11



Design considerations

SKF housings are typically designed for self-aligning ball bearings, spherical roller bearings and CARB toroidal roller bearings. These bearings are chosen because they are insensitive to initial misalignment, which normally occurs when the housings are spaced far apart.

Two-bearing housings have inherently aligned bearing seats and therefore can accommodate rigid bearings such as deep groove ball bearings, angular contact ball bearings and cylindrical roller bearings.

Bearing arrangements

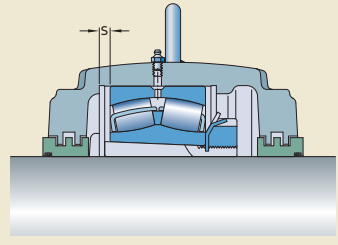
Locating/non-locating bearing arrangements

Conventional locating/non-locating bearing arrangements (→ **fig. 15**) are designed to accommodate thermal elongation of the shaft. In these systems, the non-locating bearing must be able to move axially on its seat in the housing.

SKF housings can accommodate bearings in both the locating and non-locating positions. Most standard housings have a bearing seat that is sufficiently wide to enable axial displacement of the non-locating bearing (→ **fig. 12**, "s"). When these housings are used in the locating position, locating (stabilizing) ring(s) should be used to secure the bearing axially in the housing (→ **fig. 13**).

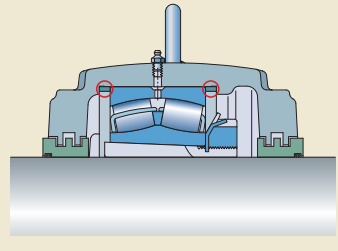
Some SKF housing series are available with a wide bearing seat for axial displacement, designation suffix L, and a bearing seat that matches the width of the bearing to locate it axially, designation suffix F (→ **fig. 14**).

Fig. 12



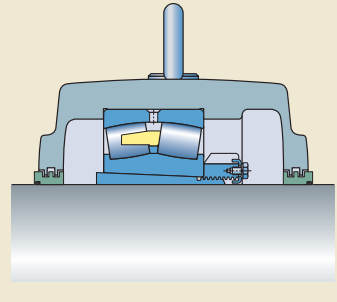
Wide bearing seat for the non-locating bearing position

Fig. 13



Locating bearing held axially by locating rings

Fig. 14



Locating bearing held axially by a matched bearing seat

The SKF self-aligning bearing system

To accommodate misalignment and shaft deflections, conventional self-aligning bearing arrangements use spherical roller or self-aligning ball bearings in both the locating and non-locating bearing positions (→ **fig. 15**). To accommodate thermal elongation of the shaft in these arrangements, the non-locating bearing must be able to move axially on its seat in the housing. Any wear or damage to the housing seat results in a "stick-slip" condition that induces axial loads, friction, and heat into the bearing arrangement.

A better solution is to use a CARB toroidal roller bearing in the non-locating position (→ **fig. 15**). CARB bearings accommodate misalignment and shaft deflections. They also accommodate thermal elongation of the shaft within the bearing, with virtually no friction, to avoid induced axial loads.

Because CARB bearings do not accommodate axial loads, these bearings must always be secured axially in the housing, with either locating (stabilizing) rings or by using a housing variant with an F (or RA for some housings) in its designation suffix.

Compared to conventional self-aligning bearing arrangements, replacing the non-locating bearing with a CARB bearing increases the load carrying capacity of the bearing arrangement, enabling a more compact, and therefore lighter, bearing arrangement to be used. By virtually eliminating induced axial loads, vibration levels and temperatures are reduced and less grease is consumed, resulting in less maintenance. The solution contributes to improved reliability and extended bearing service life.

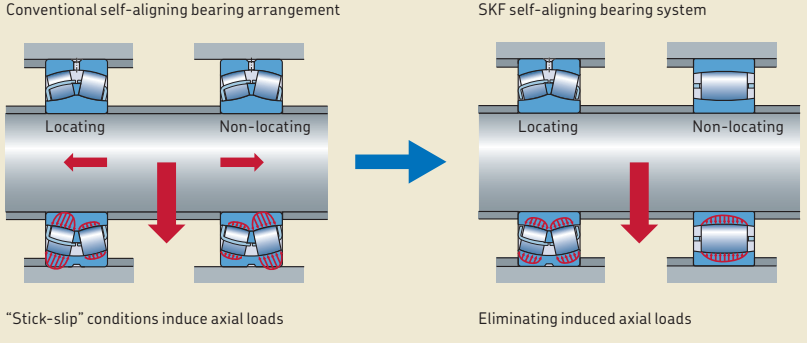
Typical shaft-bearing combinations

Bearings in SKF housings can be mounted either directly on a shaft or on a sleeve on the shaft. There are four typical combinations (→ **table 8**, **pages 42–43**):

- plain shaft with bearing on an adapter sleeve
- stepped shaft with bearing on an adapter sleeve
- stepped shaft with bearing on a withdrawal sleeve
- stepped shaft with bearing on a cylindrical seat

For information about the shaft-bearing combination alternatives for a particular housing type, refer to **tables 1** to **4**, starting on **page 30**, or the relevant product chapter.

Fig. 15



Comparison of typical shaft-bearing combinations

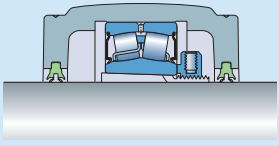
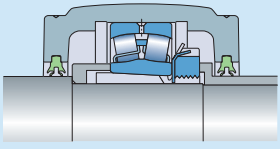
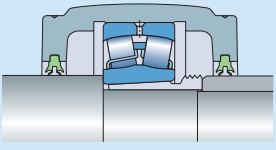
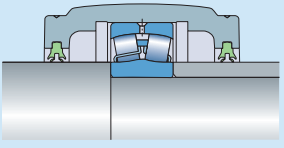
	 **Plain shaft with bearing on an adapter sleeve**	 **Stepped shaft with bearing on an adapter sleeve**
Shaft	• Machining not required, drawn round bars (h9 or better) can be used • Maximum shaft strength (no shoulders or undercuts)	• Machining required, typically two steps • Shaft strength weakened by shoulders
Bearing	• Bearing can be mounted at any position on the shaft • Internal clearance changes during mounting (proper drive-up required) • Axial load carrying capacity limited by the adapter sleeve	• Bearing position determined accurately by the stepped ring • Internal clearance changes during mounting (proper drive-up required) • Axial load carrying capacity limited by the shaft sleeve or adapter sleeve in one direction and by the bearing and housing in the other direction
Mounting and dismounting	• 40% less mounting force required compared to other sleeve mounted arrangements as friction only occurs between two mating surfaces	• Other components on the shaft can be located axially against the bearing on its sleeve via spacer sleeves • Easy dismounting as the bearing inner ring is in contact with the stepped ring
Applications	• Long shafts where more than two bearings are required for support • When the final position of the bearing cannot be accurately determined prior to mounting • When machine components are mounted using clamping or tensioning devices so that the shaft does not need to be machined	• Support of shaft ends • Frequent mounting and dismounting

Table 8

	Stepped shaft with bearing on a withdrawal sleeve	Stepped shaft with bearing on a cylindrical seat
		
Shaft	• Machining required, typically two steps • Shaft strength weakened by shoulders	• Machining required, typically two steps • Shaft strength weakened by shoulders • Largest shaft diameter for a given bearing size
Bearing	• Bearing position determined accurately by the shaft shoulder • Internal clearance changes during mounting (proper drive-up required) • Axial load carrying capacity limited by the shaft sleeve or withdrawal sleeve in one direction and by the bearing and housing in the other direction	• Bearing position determined accurately by the shaft shoulder • Internal clearance determined by the shaft seat tolerance • Axial load carrying capacity limited by the bearing and housing
Other components	• Other components on the shaft can be located axially against the bearing on its sleeve via spacer sleeves • Easy dismounting with a withdrawal sleeve and hydraulic nut	• Other components can be located axially against the bearing via spacer sleeves • Suitable when large numbers of bearings have to be mounted • Simple axial locating by shaft nut
Application	• Support of shaft ends • Frequent mounting and dismounting	• Support of shaft ends • Frequent mounting and dismounting • Suitable for shock loads or where higher speeds or higher precision are required

Load carrying capacity

The load carrying capacity of a housing depends on many factors:

- the housing material and design and, where applicable, cap bolt strength
- the direction of the load
- the strength of the attachment bolts and support structure
- the condition of the support surface

SKF provides static housing load limits, either in the form of breaking loads or safe loads, for most housings. Where values are not provided, the load carrying capacity is higher for the housing than for the bearing.

Breaking loads can be used to calculate a permissible load, based on a selected safety factor. Safe loads already include a safety factor.

Special attention is required for split housings subjected to cyclic loads or dynamic imbalance. Under these conditions, cap bolt and housing cap strength ($P_{180°}$) should be analyzed carefully. For additional information, contact the SKF application engineering service.

Breaking loads

For most SKF housings, guideline values for the breaking loads P are provided in the relevant product chapter. To obtain the permissible load for a housing, the guideline value should be divided by a factor based on the safety requirements and operating conditions of the application. In general engineering, a safety factor of 6 is typical. The permissible load can only be exploited if the housing is mounted properly and all bolts are tightened to the specified torque values. For split housings, the strength of the cap bolts should also be considered. A minimum safety factor of 2 against cap bolt yield should be used.

The load P_a is the axial breaking load of the housing. If the incorporated bearing is mounted on a sleeve, check the permissible axial load for the sleeve (→ *Axial load carrying capacity for bearings on a sleeve*).

Safe loads

In some regions, safe loads are used instead of breaking loads. These guideline values have been established using accepted engineering practices, taking safety and ultimate tensile strength of the materials into account. They reflect a safety factor of 5 against housing fracture, and where applicable, a minimum factor of 2 against cap bolt yield. The safe loads can only be fully exploited if the housing is mounted properly and all bolts are tightened to the correct torque values.

Axial load carrying capacity for bearings on a sleeve

When using a bearing on a sleeve on a plain shaft, the axial load carrying capacity is limited either by the bearing, sleeve or housing.

For the axial load carrying capacity of the bearing, refer to the product information available online at skf.com/bearings. For the sleeve, the permissible axial load to safely prevent slippage on the shaft is determined by the friction between the shaft and sleeve. Provided the bearing is mounted correctly (→ skf/mount.com), the permissible axial load can be calculated from

$$F_{ap} = 0{,}003\ B\ d$$

where
F_{ap} = maximum permissible axial load [kN]
B = bearing width [mm]
d = bearing bore diameter [mm]

Information about the axial load carrying capacity of the housing is provided in the relevant product chapter.

Specifications for shafts and housing support surfaces

Shaft

Bearing seat

Recommended fits for bearings on solid steel shafts in cast iron housings are provided in the SKF catalogue *Rolling bearings* and are available online at skf.com/bearings.

If adapter or withdrawal sleeves are used, the sleeve seat on the shaft should be machined to tolerance class h9Ⓔ or better. The total radial runnout should be IT5/2 for tolerance class h9Ⓔ.

If bearings are to be mounted directly onto the shaft, the cylindricity tolerance and total runout tolerance of the bearing seat should, depending on the requirements, be one to two IT tolerance grades better than the prescribed dimensional tolerance. Abutments for bearing rings should have a perpendicularity tolerance and total axial runout tolerance that is at least one IT tolerance grade better than the diameter tolerance of the associated cylindrical seat.

Seal seat or counterface

Recommendations are provided in the relevant product chapter. Generally, seal counterfaces should be machined to tolerance class h9Ⓔ or better and the cylindricity should be to tolerance grade IT5.

Surface roughness

At the sleeve and seal positions, the shaft surface should have a surface roughness $R_a \leq 3{,}2$ µm *(125 µin.)*. Recommendations for the surface roughness of cylindrical bearing seats are provided in the SKF catalogue *Rolling bearings* and are available online at skf.com/bearings.

Housing support surface

To maximize bearing service life and prevent deformation of the housing bore, SKF recommends that the flatness of the housing support surface is to tolerance grade IT7 in accordance with ISO 1101. The surface should be finished to a surface roughness $R_a \leq 12{,}5$ µm *(500 µin.)*.

Lubrication

Grease selection

Grease selection is typically driven by the bearing and its operating conditions. The same grease can be used to fill the housing and lubricate the seal.

For information about SKF greases, refer to the product information available online at skf.com/lubrication. The SKF grease selection program *LubeSelect*, also available online at skf.com/lubrication, can be used to select an appropriate grease.

Biodegradable grease for housings with sealed bearings

If sealed bearings are used, the grease used to fill the housing and lubricate the housing seals does not need to be compatible with the grease inside the bearing. This is a good opportunity to use environmentally friendly grease such as SKF LGGB 2. It is a biodegradable, low toxicity grease. For additional information about this grease, refer to the product information available online at skf.com/lubrication.

Initial grease fill

If no other requirements exist, the free space in the bearing should be completely filled with grease and the free space in the housing should be filled to 20 to 40% of its volume. A 40% grease fill is required when bearings have to be relubricated from the side, while a 20% grease fill is used when bearings are lubricated via the outer ring.

For highly contaminated environments and slow speeds, fill the housing to 70 to 80%. For the best protection against contaminants, use the SKF three-barrier solution (→ **page 39**).

Higher speeds can require a reduced grease fill. For additional information, contact the SKF application engineering service. Quantities for the initial grease fill are provided in the individual product chapters.

Relubrication

Grease escape holes

Bearing arrangements in housings that have contact seals, e.g. double-lip or four-lip seals, can be equipped with a grease escape hole to allow used, excess grease to be purged from the housing. The escape hole should be positioned on the side opposite the grease inlet and if applicable, on the same side as the lock nut. For long relubrication intervals, it is often sufficient to remove the housing cap or cover and remove the old grease.

Relubrication via the outer ring

CAUTION: Care should be taken when relubricating spherical roller bearings in the non-locating position via their lubrication feature in the outer ring. There is a risk that the lubrication groove of the bearing will not be aligned with the hole in the centre of the housing cap and the lubricant will not reach the bearing. This can be the case when narrow bearings are mounted in housings with a wide housing seat, e.g. spherical roller bearings in the 222 series mounted in SNL 5(00) series housings, and the application is subjected to large axial movements. Under these circumstances, the bearings should be relubricated from the side.

Fig. 16

SKF tools and products

SKF has a wide assortment of lubrication tools and products for SKF bearing housings. A brief overview is provided here. For additional information, refer to the product information available online at mapro.skf.com and skf.com/lubrication.

Grease meter

The SKF grease meter LAGM 1000E (→ **fig. 16**) accurately measures grease discharge in volume or weight, and in both metric (cm^3 or g) and imperial (fl.oz. or oz.) units. It is suitable for all SKF bearing greases with a consistency class of up to 3 on the NLGI scale.

Automatic lubricators

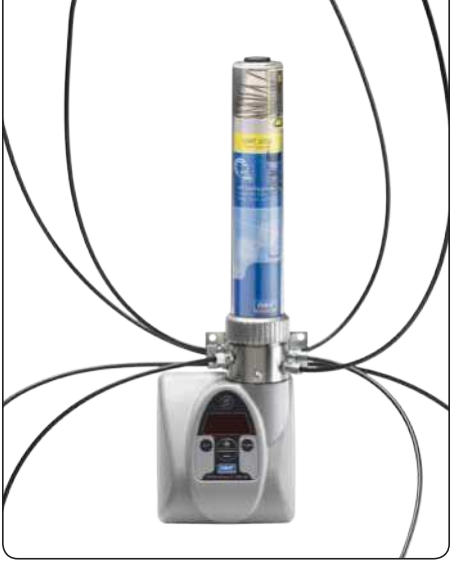
Automatic lubricators can prevent both over and under-greasing.

SKF SYSTEM 24 lubricators (→ **fig. 17**) are automatic single point lubricators suitable for a wide range of applications and operating conditions. They are compact, easy to install and have a transparent container to check the amount of lubricant that is available. There are two series of lubricators: Gas driven lubricators include LAGD 60 (60 ml) and LAGD 125 (125 ml); Electro-mechanical driven lubricators include LAGE 125 (122 ml) and LAGE 250 (250 ml).

The SKF MultiPoint lubricator LAGD 400 (→ **fig. 18**) is a centralized automatic lubricator that simultaneously lubricates up to eight points. It is compact, easy to install and has a transparent container to check the amount of lubricant that is available.

Fig. 17

Fig. 18



Oil levellers

SKF oil levellers LAHD 500 (→ **fig. 19**) and LAGH 1000 are designed to automatically adjust the oil level in a bearing housing. The levellers allow the oil level to be adjusted during operation, optimizing machine performance and increasing the service life of the bearings. The transparent container enables the oil level to be inspected.

Adapters to change connection threads

The assortment of adapters in the LAPN series (→ **fig. 20**) are available, to convert, for example, from a 1/8 – 27 NPSF thread to a G 1/4 thread.

Caps and tags for grease fittings

TLAC 50 caps and tags provide a space to properly identify the lubrication point(s) on a bearing housing as well as protect the grease fittings from the ingress of contaminants (→ **fig. 21**). The labels can also be used in conjunction with the SKF Lubrication Planner.

Centralized lubrication systems

The SKF Multilube pumping unit (→ **fig. 22**) is a compact, all-in-one unit for lubricating individual machines and equipment. Designed for indoor and outdoor use, the unit is suitable for all pumpable oils and greases and can be used in single line, dual line and progressive lubrication systems.

Circulating oil lubrication concept

Oil circulation lubrication is needed in applications where the lubrication point (bearing) must be cooled while lubricated. An oil circulation system consists of a pumping station with a large oil reservoir and oil flow meters.

SKF Flowline reservoir (→ **fig. 23**) is round in shape and the plate construction inside improves the oil movement so much, that the efficiency is over 90%. This means, the reservoir size can be reduced even down to 1/3 of the traditional reservoir and still the real retention time of the oil is the same or better. Plate construction makes water and air separation very effective and the oil remains in very good condition, which means longer bearing life.

Fig. 19

Fig. 20

Savings in the oil purchase and handling costs are significant and the entire pumping station can be installed in the space taken by the old reservoir only.

Oil flow meters are always needed as a part of an oil circulation system to regulate and monitor oil flow. SKF Flowline Monitor is a digital oil flow meter, where the measurement is viscosity compensated and the reading by clear numbers is always correct, independent of temperature. On-line monitoring and setting parameters can also be done remotely.

Fig. 22

Fig. 21

Fig. 23

Mounting

Mounting instructions are supplied with most SKF bearing housings, or with the corresponding seal kit. For additional information about mounting, refer to the *SKF bearing maintenance handbook* or the information available online at skf.com/mount.

Preparations prior to mounting

Mounting housings (and bearings) requires care, accuracy and the appropriate tools. Prior to mounting, do the following:

- Make sure that the work area is clean.
- Study any drawings or instructions to determine the correct order in which to assemble the various components.
- Make sure that all the necessary components and tools are at hand.
- Clean the support surface.
- Check that the support surface meets the requirements for flatness (→ *Specifications for shafts and housing support surfaces*, **page 45**).
- Check that the shaft seats and seal counterfaces meet the requirements for dimensional and form accuracy, roughness and hardness (→ *Specifications for shafts and housing support surfaces*, **page 45**).
- Chamfer or round any shaft edges over which a seal lip will pass.

SKF tools and products

The SKF assortment of mounting tools and products includes mechanical tools, hydraulic tools, heating equipment and gloves. For additional information, refer to the product information available online at mapro.skf.com.

Lifting housings

Many SKF bearing housings are supplied with eye bolts for safe and easy handling. The eye bolts are designed to support the weight of the housing only, and not the incorporated bearing or shaft.

When lifting, make sure that the eye bolts are only subjected to load in the direction of the shank axis. The load should be evenly distributed across the number of eye bolts.

Attachment bolt tightening

Applying the specified torque to a bolt during installation is extremely important. Improper torque values can lead to machinery movement during operation. This can cause misalignment between machine parts, which will eventually lead to premature damage to bearings and other components.

Recommended tightening torque values are provided in the product chapters and are based on bolt manufacturers' recommendations.

All bolts should be tightened with an accurate torque wrench (in at least two stages) or a hydraulic bolt tensioner. SKF recommends using a HYDROCAM hydraulic bolt tensioner in applications where the attachment bolt has an end protruding above the tightening nut. These tensioners reduce the risk of over tightening and enable bolts to be installed accurately without the need of a torque wrench. The tensioners also provide uniform assembly preload or uniform bolt elongation.

Using shims

Shims can be used to raise the centre height of a housing. SKF recommends using shims made of stainless sheet steel with sufficient strength and the ability to withstand corrosion from several media. Shims made from soft metals like copper or brass typically compress over time, causing looseness, which can eventually lead to misalignment. Whenever possible, use only one shim and never stack more than three shims.

CAUTION: Make sure that the shim covers the complete contact surface between the housing base and the support surface (→ **fig. 23**). If shims are placed under the housing feet only, the bearing seat can distort.

Using locating (stabilizing) rings

A bearing in the locating position must be secured axially in the housing. If the bearing seat in the housing and the bearing width do not match, locating (stabilizing) rings (→ **fig. 24**) are required. Typically, two locating rings are required per housing. One ring should be placed on each side of the bearing. If only one locating ring is required, it should be installed on the same side as the lock nut. When placing

a locating ring in position, make sure that the open end of the locating ring is facing up.

CARB toroidal roller bearings, which are used exclusively in the non-locating position, require locating rings when the bearing seat in the housing and the bearing width do not match. For information about which locating rings are required for a bearing in a particular housing, refer to the relevant product chapter.

Installing seals

The seal counterface should meet the specifications for surface roughness and roundness (→ *Specifications for shafts and housing support surfaces*, **page 45**), and should be clean. If the counterface shows any signs of wear, repair it. This can be done easily with an SKF SPEEDI-SLEEVE or a large diameter wear sleeve (LDSLV). If repair is not possible, replace the shaft.

In general, the seal and counterface should be coated lightly with the lubricant used in the application.

When installing seals, make sure that the seal is oriented correctly. Many seals are not symmetrical and can be installed to either exclude contaminants or retain the lubricant.

Split seals consist of two halves, which can be installed around the shaft. They are easier to replace and can ease mounting.

Felt seals should be soaked in hot oil prior to installation.

Fig. 23

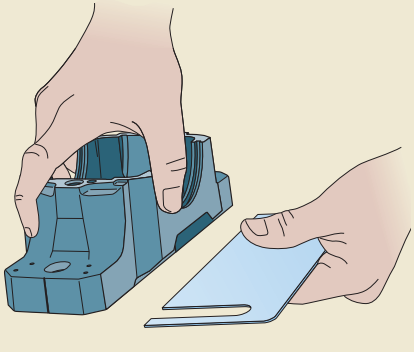
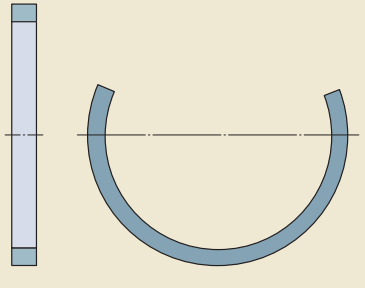


Fig. 24



Inspection and condition monitoring

SKF housings and roller bearing units should be inspected regularly for damage and lubricant leaks. SKF also recommends a visual inspection of the seals, plugs, bolts and housing joints. The frequency of these inspections depends on the operating conditions and potential downtime consequences but should be done as part of a regularly scheduled maintenance program.

Where oil bath lubrication is used, the oil level should be monitored regularly. During operation, the oil level may drop below the minimum level. If that should happen, and oil needs to be added while the machine is running, keep the oil level well below the maximum oil level on the indicator or overfilling can result.

For additional information about inspection techniques and corrective maintenance actions, refer to the *SKF bearing maintenance handbook*.

SKF also recommends monitoring the condition of all bearings on a regular or continuous basis to detect early signs of bearing damage. Trending the condition of the bearing makes it possible to analyze the root cause of an impending failure, and plan for corrective action. Trending can also eliminate unplanned downtime. The most reliable way to do condition monitoring is through vibration analysis.

Vibration analysis

Many SKF housings are prepared for condition monitoring and are supplied with drilled and tapped holes to accommodate sensors. For other housings, dimples indicate the position where sensors can be located. For information about the condition monitoring possibilities for a particular housing type, refer to the relevant product chapter.

SKF has a comprehensive assortment of vibration detection, analysis and diagnostic products, from light hand-held instruments to fully integrated monitoring systems. For additional information, refer to the product information available online at skf.com/cm.

Storage

SKF housings, roller bearing units and associated components, including the seals, should be stored under controlled temperature and humidity conditions in a clean, dry environment. Variations in temperature and humidity should be avoided but gradual, seasonal variations of a gradual nature are acceptable. As a general rule, SKF recommends the following storage conditions:

- temperature: < 30 °C *(< 85 °F)* for long-term storage
- relative humidity: < 60%
- If peaks above 65% occur regularly, a dehumidifier is required.
- temperature fluctuation: max. 3 °C / 48 hours

Under these conditions, housings can be stored for up to 10 years. Roller bearing units should not be subjected to vibration during storage as this could cause false brinelling damage to the bearing. Depending on the actual storage conditions, the lubricating properties of the initial grease fill might deteriorate. Generally SKF roller bearing units should not be stored for more than 3 years.