SKF

SKF angular contact ball bearings – Your key to longer service life

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Made by SKF® stands for excellence. It symbolises our consistent endeavour to achieve total quality in everything we do. For those who use our products, “Made by SKF” implies three main benefits.

Reliability – thanks to modern, efficient products, based on our worldwide application know-how, optimised materials, forward-looking designs and the most advanced production techniques.

Cost effectiveness – resulting from the favourable ratio between our product quality plus service facilities, and the purchase price of the product.

Market lead – which you can achieve by taking advantage of our products and services. Increased operating time and reduced down-time, as well as improved output and product quality are the key to a successful partnership.

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Diversity and quality

Why specify angular contact ball bearings?

High rotating speeds, combined radial and axial loads, a high degree of stiffness and running accuracy – these are the conditions where angular contact ball bearings are the preferred solution. The great variety of applications and operating conditions calls for customized bearing solutions made possible only by a wide range of angular contact ball bearings.

Why specify SKF angular contact ball bearings?

Because SKF is your reliable, expert source for angular contact ball bearings. Because SKF has a wide range of types and variants unmatched anywhere else. Because when you work with SKF you don't have to settle for any unfavourable compromises. Because since the introduction of our bearings of BE design in 1984, they have set the standard for single-row angular contact ball bearings. Since then, time certainly hasn't stood still, and neither has SKF.

The best example: our Explorer series single-row and double-row angular contact ball bearings offering a completely new level of performance. With SKF angular contact ball bearings, you benefit in a number of ways:

High performance
They have a high load carrying capacity and thus allow smaller bearings to be used while still providing long service life.

Quieter and cooler running
With their optimal inner geometry, they run quieter and cooler and can tolerate longer maintenance intervals.

Precise shaft guidance
Due to precision manufacturing processes, almost all SKF angular contacts exceed standard tolerances, to provide a smoother, truer running shaft with less heat and fewer vibrations.

High temperature capability
They can withstand relatively high operating temperatures without significant loss of dimensional stability.

Universal matching
At SKF, universally matchable single-row angular contact ball bearings are standard. These bearings simplify assembly and can also increase the quality of your products. Our selection of clearance and preload classes covers all possible requirements.

Integral sealing solutions
Double-row angular contact ball bearings are available with integral seals and shields. These bearings are supplied with grease and do not require maintenance.

Standard solutions
It will be hard to find an application for which there's no standard SKF bearing readily available from our vast selection and enormous variety.

Customer satisfaction
Now you can build additional value into your products with SKF Explorer bearings. Your customers will definitely be impressed by the low operating costs, reliability and long service life of your machines – no doubt in part to your use of SKF bearings.

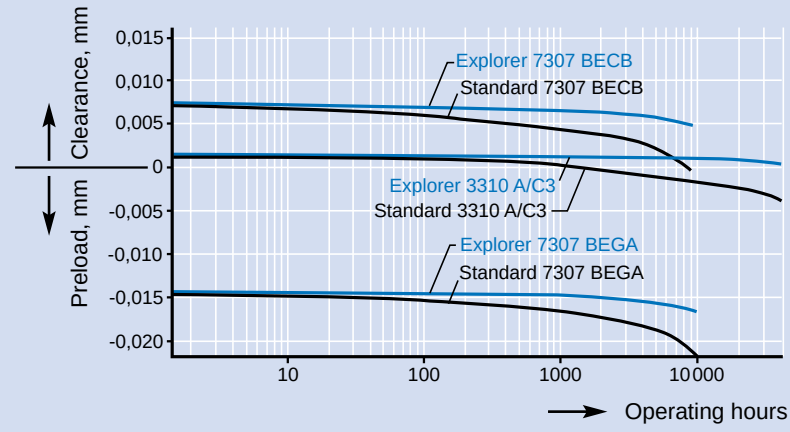
Advantages by design with SKF Explorer Bearings

At SKF we're continuously working to improve the performance and durability of our products. And with the new Explorer Series angular contact ball bearings, we think you'll notice the difference immediately. These bearings can provide:

- Even longer service life,
- Even higher reliability,
- Even more performance.

The following pages will describe the improvements we have made to our angular contact ball bearings in the 72 and 73 Series and in the 32 and 33 Series (52/53 Series US only).

Diagram 1



Examples: 7307 BE, F_a/F_r = 1.23, C/P = 29, operating temperature 110°C (230°F)
3310 A/C3, F_a/F_r = 1.23, C/P = 19, operating temperature 80°C (175°F)

Change of the residual bearing clearance/preload during operation

Technical improvements

Improved materials
Explorer angular contact ball bearings are manufactured from an extremely high quality bearing steel with a very low oxygen content and a minimum number of impurities. The rings are manufactured preferably from forged or cold rolled blanks.

All rings are heat treated to provide dimensional stability up to 150 °C (300 °F). The advantage of this: Bearing sets build with SKF single-row angular contact ball bearings hold their built-in clearances and preloads more exactly over their entire lifetime (→ **diagram 1**).

Improved inner geometry
Computer-aided design and manufacturing programs permit almost undetectable improvements in the bearing. These small but effective changes in the bearing's geometry lead to measurable improvements in performance and service life. One effect of this fine tuning: Explorer angular contact ball bearings are less sensitive to eventual axial overloading.

More precise shaft guidance
Explorer single-row bearings are manufactured to P5 running accuracy. Explorer double-row bearings are manufactured to P6 running accuracy.

Better ball quality
The balls used in Explorer angular contact ball bearings are one ISO grade better than before. The more uniform ball diameter helps to improve running accuracy even at high speeds, while reducing noise and operating temperature.

New cages
Explorer single-row bearings have solid cages made from polyamide or brass. Polyamide cages have been improved to better withstand high accelerations. Brass cages are manufactured to closer tole-

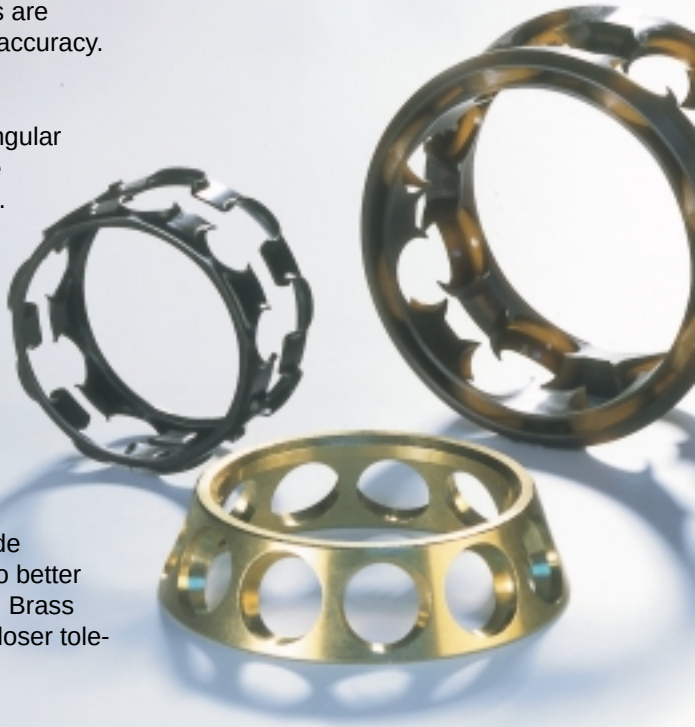
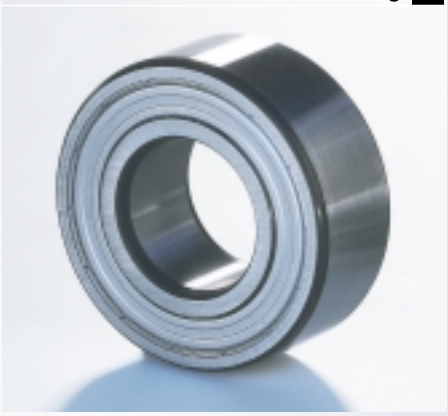


Fig 1



Shielded Explorer double-row angular contact ball bearing

rances and have been improved to provide better ball guidance and maximize the effects of the lubricant under all operating conditions.

Explorer double-row bearings are available as standard with a newly-developed crown cage made of sheet steel.

Effective seals

Double-row angular contact ball bearings are available with seals or shields. Explorer bearings use a new shield design (➔ **fig** 1). A new simple labyrinth keeps contaminants out and retains grease in the bearing cavity.

Explorer angular contact ball bearings

- Improved materials
- Optimised internal geometry
- Higher precision
- Higher ball quality
- Improved cages
- Single bearings which can be paired universally
- New shields for double-row bearings

Identification symbols

Explorer angular contact ball bearings are not an extension of the assortment. They replace final variants of the previous types. And because it is easier for inventory management, their part numbers remain the same. Nevertheless, Explorer bearings can be recognised easily.

Packaging

Explorer bearings come in a unique package, so that they can be recognised immediately as Explorer bearings.

Laser inscription

A new feature of the Explorer bearings is their laser inscription. It is not only more legible, but also more environmentally friendly because acids are no longer required for etching. It also permits individual markings. Depending on the requirements in Quality Assurance, the bearings can be traced precisely.

Availability

The introduction of the Explorer angular contact ball bearings has begun. The mayority of the single row bearings have already been converted and are now available only for delivery in the Explorer design, while Explorer double-row bearings will be introduced by the end of the third quarter of 2002. In this brochure, the bearings which are available in Explorer design as well as these where conversion is foreseen are marked as Explorer bearings.

Advantages for your design: higher performance with Explorer bearings

The technical improvements incorporated in Explorer angular contact ball bearings can provide one of four general design benefits. For existing designs, you can either increase service life or increase power output. For new designs, you can maintain power output or increase power density. The option you chose depends on the customer and application's requirements. Whichever option you chose, new Explorer angular contact ball bearings will provide increased service life and decreased maintenance costs for your application.

Longer service life

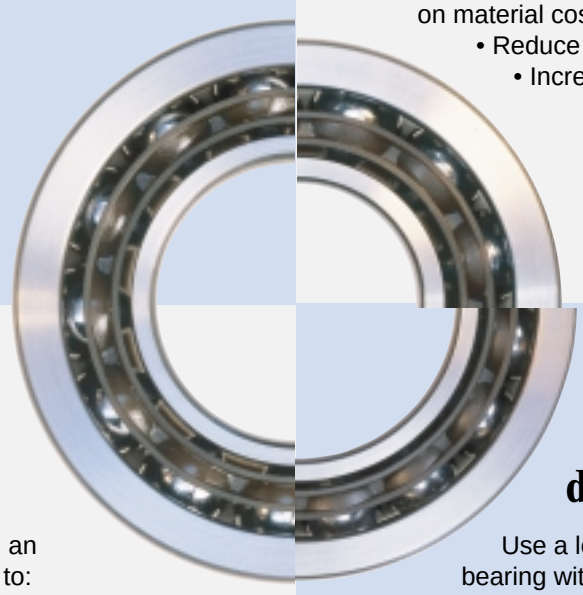
The extended life of Explorer angular contact ball bearings can be demonstrated best with the use of an example. The shafts of a twin screw compressor are supported radially with cylindrical roller bearings and axially with a matched set of angular contact ball bearings (→ **fig** 2). With the existing design, the axial bearing of the drive shaft is the critical point. The calculated life of this bearing arrangement, consisting of three 7308 BEGAP bearings amounts to 50 900 hours; calculated in accordance with the SKF Life Method. With new Explorer bearings, the calculated life amounts to 96 200 hours. This means a life 1.9 times longer under otherwise identical conditions and without any changes in the design.

Increase service life of existing designs

Don't need to increase power output? Use an Explorer bearing of equal size to:
- Increase the reliability
- Reduce vibration
- Reduce heat generation
- Increase service intervals
- Increase machine uptime

Maintain power output of new designs

Use a smaller Explorer bearing to:
- Reduce overall dimensions to save on material cost and weight
- Reduce heat generation
- Increase speeds



Increase power output of existing designs

Avoid costly redesign by using an Explorer bearing of equal size to:
- Increase power density (output)
- Increase speeds
- Increase loads

Increase power density of new designs

Use a lower cross section Explorer bearing with the same outside diameter to:
- Increase shaft size
- Achieve a stiffer design
- Operate at the same or higher speeds

New designs with smaller bearings

In many cases where 73 Series bearings are used, it will be possible to use 72 Series bearings in the future. Even with a smaller bearing, a longer bearing life will be possible. **Table 1** shows some suitable examples.

Without changes to the shaft, bearing arrangements can also be designed more compactly. Explorer bearings permit lighter structures with the same capacity.

New designs with higher power density

If the outside diameter of the bearing remains unchanged, the transition from 73 Series bearings to 72 Series bearings will permit the use of stronger shafts (→ **table** 1).

With otherwise unchanged parts, more rigid designs with higher power density are possible. And the service life of the bearing will be increased significantly.

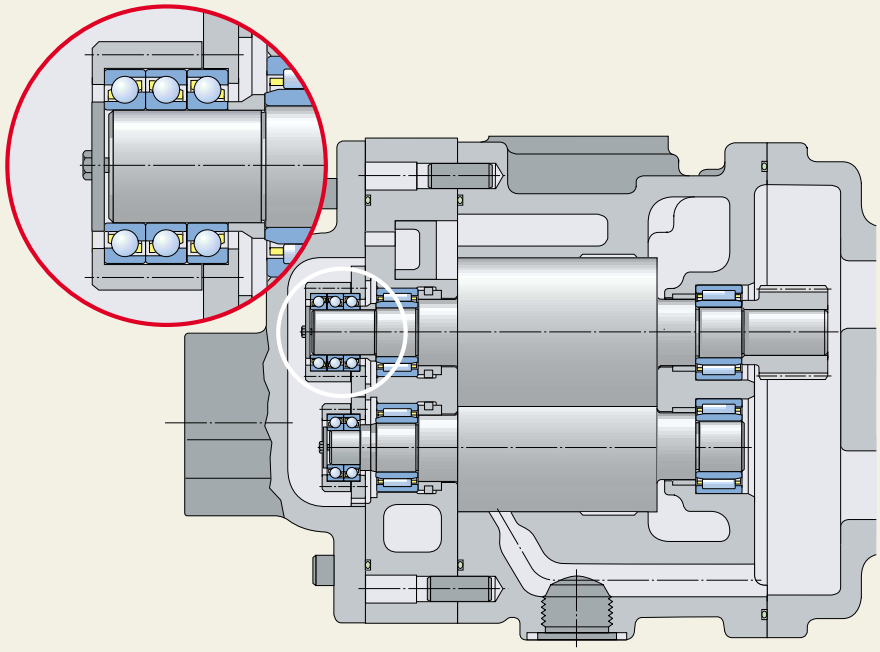
Table 1

	Previous bearing	Explorer bearing	Cross section $\frac{A_{Expl}}{A_{prev.}}$ x 100	Benefit life $\frac{L_{10m,Expl}}{L_{10m,prev.}}$
Same bore diameter	7306 BE	7206 BE	64 %	1,0
	7308 BE	7208 BE	63 %	1,2
	7319 BE	7219 BE	51 %	1,1
Same outer diameter	7304 BE	7205 BE	84 %	1,7
	7308 BE	7210 BE	70 %	1,6
	7313 BE	7216 BE	63 %	1,5

Comparison of Explorer and conventional bearings – possible downsizing

Twin-screw compressor bearing arrangement

Fig 2



Efficient in all industrial segments

Lower friction, quieter running and, above all, their reliability in complex applications with combined loads make SKF angular contact ball bearings indispensable in many areas. Long service life and reliable performance have earned SKF angular contact ball bearings an excellent reputation in a variety of industries ranging from gearboxes to turbines.

Nevertheless, the most common applications for SKF angular contact ball bearings are pumps and compressors. These applications are not just the most common, they are also the most demanding. For example, the bearings used in both pumps and compressors must be able to accommodate combined axial and radial loads, high speeds, poor lubrication and contaminated conditions.

The improvements made to the new Explorer bearings were aimed primarily at the demanding requirements of both pumps and compressors. For these applications a recommended product range is available. Additional information can be found in publication No. 4872: “Recommended Product Range: SKF angular contact ball bearings for pumps and compressors”.

Industrial segments

- Fluid machinery: Pumps, compressors, blowers, ventilators, turbines
- Automotive engineering: Drives, clutches, gearboxes, wheel bearings, components
- Industrial drives and drive motors
- Printing machines
- Textile machines
- Material handling

Requirements

- Long service life
- High load-carrying capacity and high speeds
- High degree of stiffness
- High degree of running accuracy
- Low heat generation
- Quiet running
- Technical support

Solution

Selection of bearing size

Bearing life

The life-extending improvements, embodied in SKF explorer bearings can best be understood using the SKF Life Method. This life calculation method constitutes an extension of the fatigue life theory developed by Lundberg and Palmgren and is better able to predict bearing life. The Life Method was first presented by SKF in 1989 and today standardised in ISO 281:1990/ Amd.2:2000. The modified rating life for angular contact ball bearings can be calculated from:

$$L_{10m} = a_1 \, a_{SKF} \, L_{10}$$

or

$$L_{10m} = a_1 \, a_{SKF} \left(\frac{C}{P}\right)^3$$

With a constant rotational speed, the life in operating hours can be calculated from the following formula:

$$L_{10mh} = a_1 \, a_{SKF} \, \frac{1\,000\,000}{60\,n} \left(\frac{C}{P}\right)^3$$

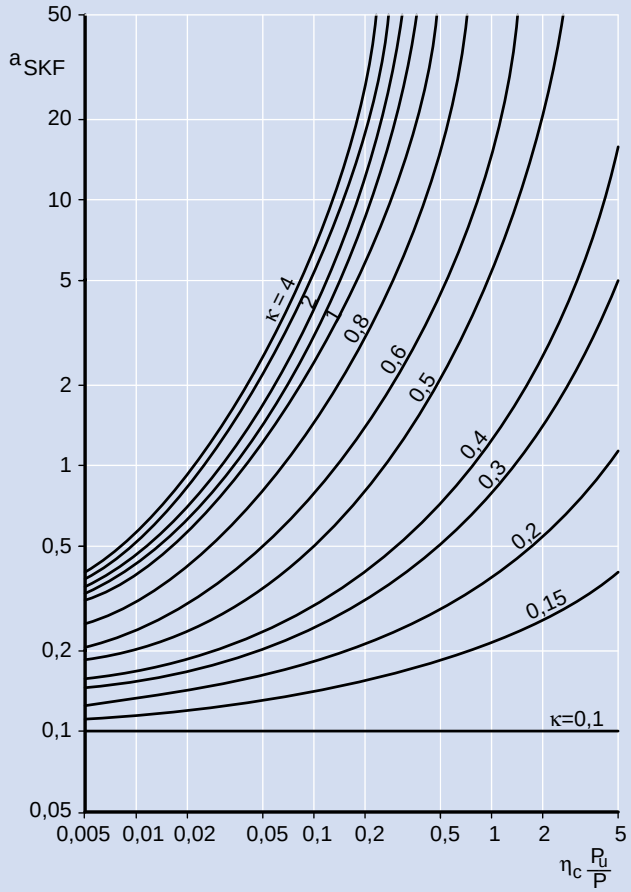
Where:

L_{10m} = modified rating life, millions of revolutions
L_{10mh} = modified rating life, operating hours
L_{10} = basic rating life, millions of revolutions
a_1 = life adjustment factor for reliability (for 90% reliability $a_1 = 1$, according to ISO 281)
a_{SKF} = life modification factor based on the SKF Life Method, (→ **Diagrams 1 and 2**)
C = basic dynamic load rating, N
P = equivalent dynamic bearing load, N
n = rotational speed, r/min

Bearing life can be calculated easily using the programs found in the “SKF Interactive Engineering Catalog.” Explorer bearing data will be added to the online version at www.skf.com.

Life modification factor a_{SKF} for conventional radial ball bearings

Diagram 1



If $\kappa > 4$, use $\kappa = 4$ curve
As the value of $\eta_c (P_u/P)$ tends to zero, a_{SKF} tends to 0,1 for all values of κ

Life modification factor a_{SKF}

The SKF Life Method takes into account the complex relationships between different factors influencing bearing life. These factors have been simplified so that they can be inserted into your calculations. Diagram 1 contains the life modification factor for standard SKF angular contact ball bearing designs. Diagram 2 contains the values for Explorer bearings. The values are given as a function of

- the viscosity ratio κ,
- the ratio of the fatigue load limit to the applied equivalent load (P_u/P),
- the cleanliness in the bearings (η_c).

Guideline values for the selection of η_c are given in **Table 1**.

Diagrams 1 and **2** are based on the general safety factors typically associated with the fatigue load limits for other mechanical components. The diagrams are valid for lubricants without EP additives. If lubricants with EP additives are used, see the information in the SKF General Catalogue or in the "SKF Interactive Engineering Catalogue" on CD-ROM or online at www.skf.com.

Load carrying capacity of paired single-row bearings

The values for the basic dynamic and static load ratings as well as for the fatigue load limit quoted in the bearing table on **pages 24 to 29** are for single bearings.

For pairs of universally matchable angular contact ball bearings the basic load ratings C obtained from the table should be multiplied by

- 1,62 for bearings in face-to-face or back-to-back arrangement,
- 2 for bearings in tandem arrangement.

The basic static load rating and the fatigue load limit of a pair of bearings can be obtained by multiplying the table value C_0 or P_u by 2.

Table 1

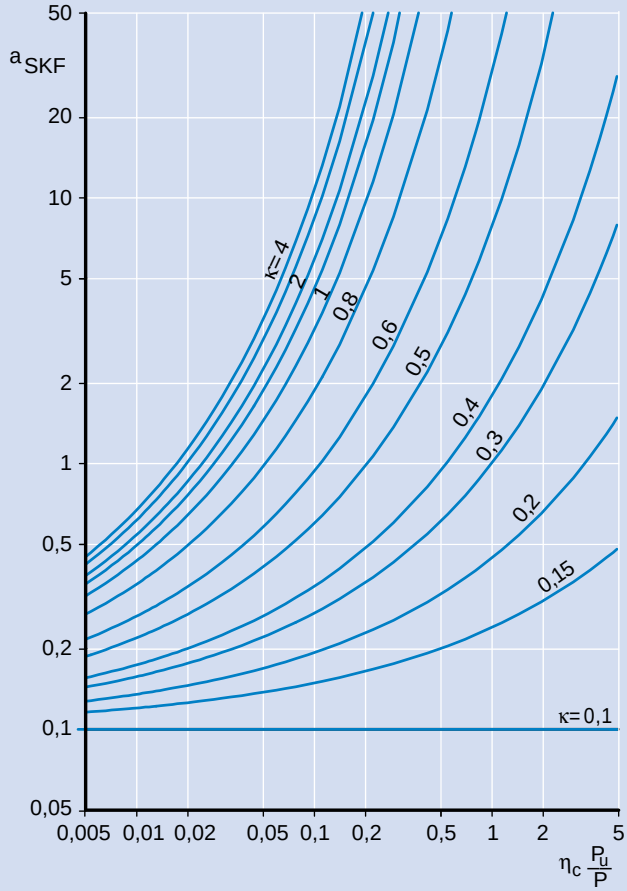
Condition	η_c [1]
Very clean Particle size of contamination of the order of the lubricant film thickness	**1**
Clean Conditions typical of bearings greased for life and sealed	**0,8**
Normal Conditions typical of bearings greased for life and shielded	**0,5**
Contaminated Conditions typical of bearings without integral seals; coarse lubricant filters and/or particle ingress from surroundings	**0,5 ... 0,1**
Heavily contaminated [2]	**0**

[1] The scale for η_c refers only to typical solid contaminants. Contamination by water or other fluids detrimental to bearing life is not included.
[2] Under extreme contamination, values of η_c can be outside the scale, resulting in a more severe reduction of life than predicted by the equation for L_{10m}.

Guide values for the factor η_c to describe the degree of cleanliness

Life modification factor a_{SKF} for Explorer angular contact ball bearings

Diagram 2



If $\kappa > 4$, use $\kappa = 4$ curve
As the value of η_c (P_u/P) tends to zero, a_{SKF} tends to 0,1 for all values of κ

Equivalent dynamic bearing load

Single row bearings
For single-row B and BE design angular contact ball bearings mounted as single bearings or paired in tandem:

$P = F_r$ when $F_a/F_r \leq 1,14$
$P = 0,35F_r + 0,57F_a$ when $F_a/F_r > 1,14$

When determining the axial load F_a, reference should be made to the chapter “Determining axial force for bearings mounted singly or paired in tandem”.

For pairs of bearings arranged back-to-back or face-to-face:

$P = F_r + 0,55F_a$ when $F_a/F_r \leq 1,14$
$P = 0,57F_r + 0,93F_a$ when $F_a/F_r > 1,14$

F_r and F_a are the forces acting on the pair of bearings.

Double-row bearings
For double-row angular contact ball bearings in the 32 A and 33 A Series:

$P = F_r + 0,78F_a$ when $F_a/F_r \leq 0,80$
$P = 0,63F_r + 1,24F_a$ when $F_a/F_r > 0,80$

and for double-row angular contact ball bearings in the 33 DNR Series:

$P = F_r + 0,55F_a$ when $F_a/F_r \leq 1,14$
$P = 0,57F_r + 0,93F_a$ when $F_a/F_r > 1,14$

and for double-row angular contact ball bearings in the 33 D Series:

$P = F_r + 0,47F_a$ when $F_a/F_r \leq 1,34$
$P = 0,54F_r + 0,81F_a$ when $F_a/F_r > 1,34$

Equivalent static bearing load

Single row bearings
For single-row B and BE design angular contact ball bearings mounted as single bearings or paired in tandem:

$P_0 = 0,5\ F_r + 0,26\ F_a$

If $P_0 < F_r$ then $P_0 = F_r$. When determining the axial load F_a, refer to the chapter “Determining axial force for bearings mounted singly or paired in tandem”.

For pairs of bearings arranged back-to-back or face-to-face:

$P_0 = F_r + 0,52F_a$

F_r and F_a are the forces acting on the pair of bearings.

Double-row bearings
For double-row angular contact ball bearings in the 32 A and 33 A Series:

$P_0 = F_r + 0,66F_a$

and for bearings in the 33 DNR Series:

$P_0 = F_r + 0,52F_a$

and for bearings in the 33 D Series:

$P_0 = F_r + 0,44F_a$

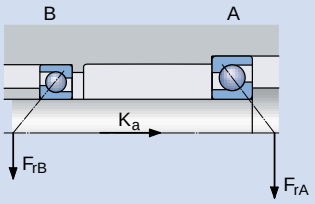
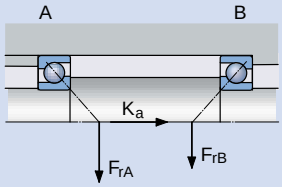
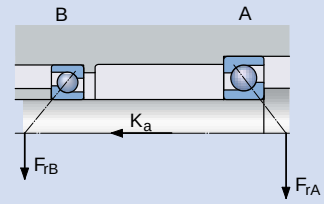
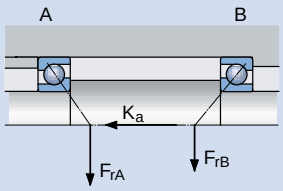
Determining axial force for bearings mounted singly or paired in tandem

As the load is transmitted from one raceway to the other at an angle to the bearing axis, an internal axial force will be induced in single row angular contact ball bearings when a radial load is applied to them. This must be considered when calculating the equivalent bearing loads for bearing arrangements consisting of two single bearings and/or bearing pairs arranged in tandem.

The necessary equations are given in **Table** 2 for the various bearing arrangements and load cases. The equations are only valid if the bearings are adjusted against each other to practically zero clearance, but without preload. In the arrangements shown, bearing A is subjected to a radial load F_{rA} and bearing B to radial load F_{rB}. Both F_{rA} and F_{rB} are always considered positive even when they act in the direction opposite to that shown in the figures. The radial loads act at the pressure centres of the bearings, see bearing dimension “a” in the product table, **pages 24** - **29**. In addition an external force K_a acts on the shaft (or on the housing).

Cases 1c and 2c are also valid when $K_a = 0$.

Table 2

Bearing arrangement	Load case	Axial forces	
Back-to-back  Face-to-face  	Case 1a $F_{rA} \geq F_{rB}$ $K_a \geq 0$	$F_{aA} = 0{,}88\ F_{rA}$	$F_{aB} = F_{aA} + K_a$
	Case 1b $F_{rA} < F_{rB}$ $K_a \geq 0{,}88\ (F_{rB} - F_{rA})$	$F_{aA} = 0{,}88\ F_{rA}$	$F_{aB} = F_{aA} + K_a$
	Case 1c $F_{rA} < F_{rB}$ $K_a < 0{,}88\ (F_{rB} - F_{rA})$	$F_{aA} = F_{aB} - K_a$	$F_{aB} = 0{,}88\ F_{rB}$
Back-to-back  Face-to-face  	Case 2a $F_{rA} \leq F_{rB}$ $K_a \geq 0$	$F_{aA} = F_{aB} + K_a$	$F_{aB} = 0{,}88\ F_{rB}$
	Case 2b $F_{rA} > F_{rB}$ $K_a \geq 0{,}88\ (F_{rA} - F_{rB})$	$F_{aA} = F_{aB} + K_a$	$F_{aB} = 0{,}88\ F_{rB}$
	Case 2c $F_{rA} > F_{rB}$ $K_a < 0{,}88\ (F_{rA} - F_{rB})$	$F_{aA} = 0{,}88\ F_{rA}$	$F_{aB} = F_{aA} - K_a$

Axial loading of bearing arrangements incorporating two single row B or BE design angular contact ball bearings and/or bearing pairs in tandem.

Design of bearing arrangements

Adjusting single-row angular contact ball bearings

Because of their internal design, angular contact ball bearings should not be used single and should always be used with a second bearing or as part of a bearing set (→ **fig** 1 and 2).

In cases where there are two individual single-row angular contact ball bearings, they should be adjusted against each other until the desired internal clearance or the necessary preload is obtained.

Adjusting clearance or preload correctly is one of the most important factors that affects bearing service life and the reliability of the bearing arrangement (→ **Diagram** 3). In the case of excessive clearance, the load carrying capacity of the bearings will not be exploited. This will cause excessive noise or skidding between the balls and raceways. In the case of excessive preload, higher friction and the resulting higher operating temperatures will reduce bearing service life.

Single-row angular contact ball bearings as bearing sets

Paired mounting is used when the load carrying capacity is inadequate (tandem arrangement) or when combined or axial loads act in both directions (back-to-back and face-to-face arrangements).

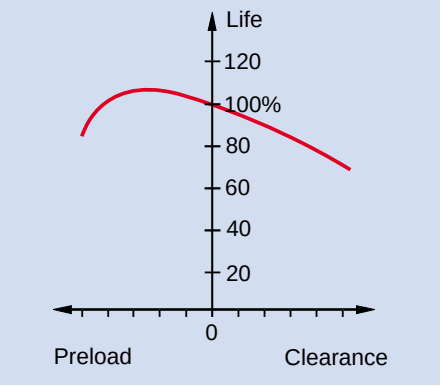
When arranged in tandem (→ **fig** 3a), the radial and axial loads are shared equally by the bearings. However the bearing set can only accommodate axial loads acting in one direction. Axial loads acting in both directions, as well as combined loads, require a third bearing adjusted against the tandem pair.

Bearings arranged back-to-back (→ **fig** 3b) can accommodate axial loads acting in both directions, but only by one bearing in each direction. Bearings mounted back-to-back provide a relatively stiff bearing arrangement, which can accommodate tilting moments.

Bearings mounted face-to-face (→ **fig** 3c) can accommodate axial loads acting in both directions, but only by one bearing in each direction. This arrangement is not as stiff as the back-to-back arrangement and is less able to accommodate tilting moments.

Bearing sets that use universal SKF bearings do not need special shims or final adjustments. These bearings are supplied with the correct preload or clearance manufactured into the bearing. To realize these predetermined values, the bearing seat in the housing and on the shaft must be manufactured to the correct tolerances.

Diagram 3



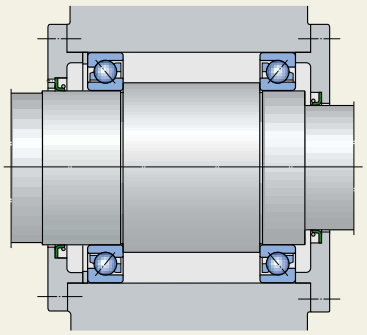
Life as a function of clearance or preload

Favourable load ratios for single-row angular contact ball bearings

For single-row angular contact ball bearings with a 40° contact angle (designation suffix B), the correct rolling conditions will only be achieved in the bearing when the load ratio $F_a/F_r \geq 1$.

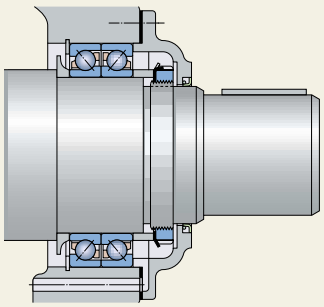
Bearing arrangement with two individual bearings

Fig 1



Bearing arrangement with a pair of bearings

Fig 2



Arrangement combinations of universal bearings

Fig 3

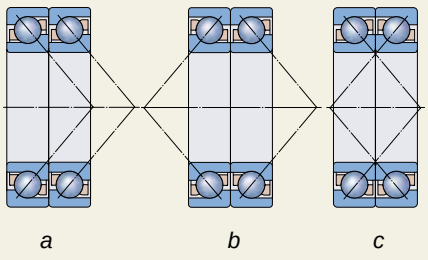


Table 3

Bearing series	Minimum load factors k_a	k_r
72 BE	1,4	95
72 B	1,2	80
73 BE	1,6	100
73 B	1,4	90
32 A	-	60
33 A	-	70
33 D	-	95
33 DNR	-	95

Minimum load factors

Axial loads acting in one direction

In applications where single row bearings are mounted back-to-back or face-to-face, axial loads acting predominantly in one direction can increase noise, cause the balls to skid, interrupt the lubricant film or increase cage loads.

To correct this condition, bearings with zero clearance or a light preload are typically used. For additional information, contact your local SKF application engineering service.

Minimum load

To obtain maximum performance, a minimum load must be applied to the bearing arrangement. This is particularly important in high-speed applications where inertial forces of the balls and the cage as well as the friction in the lubricant influence the rolling conditions in the bearing to cause sliding movements (skidding) between the balls and raceways.

For single-row individual bearings and pairs of bearings in a tandem arrangement, the requisite minimum load can be calculated as follows:

$$F_{am} = k_a \frac{C_0}{1000} \left(\frac{n\, d_m}{100\,000} \right)^2$$

For pairs of bearings arranged back-to-back or face-to-face as well as for double-row bearings, the following applies:

$$F_{rm} = k_r \left(\frac{\nu\, n}{1000} \right)^{2/3} x \left(\frac{d_m}{100} \right)^2$$

where:

F_{am} = minimum axial load, N
F_{rm} = minimum radial load, N
C_0 = basic static load rating of bearing or bearing pair respectively, N
k_a = minimum axial load factor according to **Table 3**
k_r = minimum radial load factor according to **Table 3**
ν = oil viscosity at operating temperature, mm^2/s
n = rotational speed, r/min
d_m = mean diameter of bearing = 0,5 (d + D), mm

As a rule, the load is already higher than the necessary minimum load through the weight of the parts supported and the external forces. If the calculated minimum load is not obtained, the bearing must be loaded additionally in other ways. In the case of individual bearings or pairs of bearings in a tandem arrangement, an additional axial load can be achieved by adjusting the inner and outer ring or with the use of springs. Double-row bearings as well as bearing sets arranged back-to-back or face-to-face can also be loaded radially.

Double-row bearings with shields or seals

Bearings with shields are typically used in applications where the inner ring rotates. In applications where the outer ring rotates, grease (at certain speeds) can exit between the shield and the outer ring.

Under extreme conditions, where there are high speeds or high operating temperatures, grease can escape between the inner ring and seal.

Cage selection criteria

Angular contact ball bearings are available with different cages. The characteristics of the cages and selection criteria are summarised in **Table 4**.

For more information on cages, which are typically used in bearings for high-speed applications, contact your local SKF representative.

Cage selection chart

Table 4

Characteristics	Cage design Inject. moulded polyamide	Pressed steel conventional	crowned	Machined steel	Pressed brass	Machined brass	
Suffixes **Cage guidance**	P or TN9 ball	J or non ball	J or non ball	F ball	Y ball	M ball	MA outer ring shoulder
Sliding properties							
of guiding surfaces	++	o	+	+	o	+	+
Lubricant access	++	o	++	+	o	+	- (grease) + (oil)
Weight	++	+	+	-	+	-	o
Elasticity	++	o	o	-	o	-	-
Strength	-	o	o	++	o	++	+
Suitable for							
high acceleration	o	-	o	-	-	+	++
high temperatures	o	+	+	++	+	++	++
vibration	o	-	o	+	-	+	++
high speed	o	-	o	o (grease) + (oil)	o	+	++

++ very favourable + favourable o average - unfavourable

Mounting and dismounting

Mounting

Angular contact ball bearings are usually mounted with an interference fit onto the shaft. Bearings up to a 50 mm diameter bore can usually be mounted mechanically. But it is not possible to mount larger bearings when they are “cold” as the force required to mount the bearing increases considerably with its size. Therefore, the bearings should be heated prior to mounting

When mounting, a clean work environment is essential since dirt introduced into the bearing will dramatically affect the bearing’s service life. In principle, all bearings should remain in the original packing until immediately before mounting.

Mechanical mounting

- Oil the bearing seating surface lightly with thin oil.
- Press the bearing on at right angles to the shaft axis.
- Apply force to the inner ring of the bearing (→ **fig** 4).

The SKF TMFT bearing fitting tools are designed for quick, precise and safe mounting of bearings.

Hot mounting

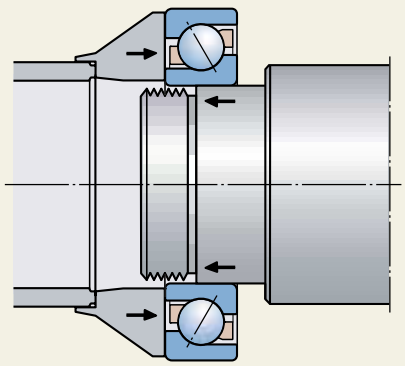
- Heat the bearing with an induction heater (→ **fig** 5) or a hotplate. SKF TIH Series induction heaters provide high quality heating power and control and provide excellent automatic demagnetisation.
- The required temperature difference between bearing inner ring and shaft seating depends on the magnitude of the interference fit and the bearing`s size. Normally a bearing temperature of 80 to 90 °C (175 to 195 °F) above that of the shaft is sufficient for mounting. Never heat a bearing to a temperature above 125 °C (255 °F).
- Wear clean protective gloves when mounting a hot bearing. Push the bearing along the shaft as far as the abutment and hold the bearing in position, pressing until a tight fit is obtained.
- Heat sealed bearings only by induction heaters, never heat them above 80 °C (175 °F) and never use a hotplate.

After mounting

- Check whether the outer ring can be turned without resistance.
- Secure the bearing onto the shaft or in the housing.
- Angular contact ball bearings usually operate at high speeds. Therefore, grease should fill only about 30% of the free space in the bearing´s cavity.

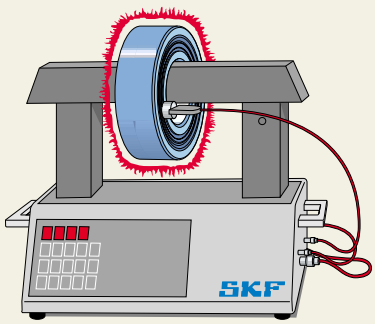
Pressing on at right-angle to the shaft axis

Fig 4



Induction heater for bearings

Fig 5



Dismounting

Dismounting is a potential source of internal bearing damage. Dirt may enter the bearing or errors may be made during remounting. Therefore avoid, if possible, dismounting an undamaged bearing.

When dismounting a bearing, arrange for a suitable stop or support for the shaft, otherwise the bearing might be damaged by dismounting forces.

Cleanliness is also important. It is easier to prevent bearings from becoming dirty than it is to clean them. Most angular contact ball bearings can not be separated and are therefore difficult to clean.

An undamaged bearing should be remounted in the same position in the housing. Mark the relative position of each bearing, i. e. which section of the bearing is up, which side is front etc.

Remove bearings from the shaft

- Always use the puller. SKF offers a comprehensive assortment of suitable pullers.
- Place the claws of the puller against the side face of the inner ring (→ **fig** 6)
- To avoid damage to the bearing seat, the puller should be accurately centred. The use of a self-centring puller eliminates the risk of damage and makes dismounting faster and easier.
- Only in cases, where it is impossible to engage the inner ring, should the claws of the puller be applied to the outer ring. Rotate the outer ring when dismounting so that no part of the bearing is damaged by the dismounting force. To do this lock the screw and rotate the puller continuously until the bearing comes free (→ **fig** 7).
  Note: It is not possible to engage the puller to the low shoulder of a single-row angular contact ball bearing (→ **fig** 8).

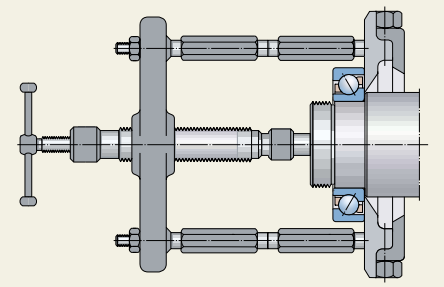
skf.com/mount

Detailed mounting instructions for almost all SKF rolling bearings are available online at **www.skf.com/mount**.

2

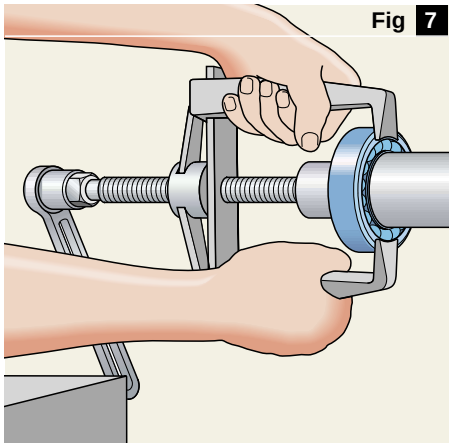
Always place the claws of the puller at the inner ring

Fig 6



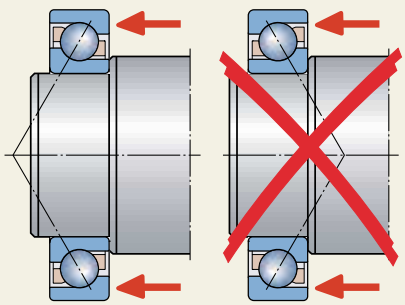
Only in exceptional cases apply the claws of the puller to the outer ring

Fig 7



Never engage the puller at the side of the low shoulder of the bearing outer ring

Fig 8



Service for a lasting partnership

Under the proper conditions, bearings can run for an almost unlimited time. For them to run at least as long as they should, operating conditions must be optimised. At SKF we know our bearings and you know your operating conditions. Together, as partners SKF can work with you during the design stage and continue to work with you right through to installation and maintenance to keep your machines in peak operating condition.

SKF concepts for creating customer value

Why not take advantage of SKF competencies for creating customer value?

Decades of troubleshooting experience in virtually every industrial sector enables SKF to provide solutions that improve machine performance and productivity. With our Total Shaft Solutions™ concept you can take full advantage of our in-depth competence comprising

- Root cause failure analysis and elimination
- Rotating equipment engineering
- Products, services and systems
- Machine monitoring

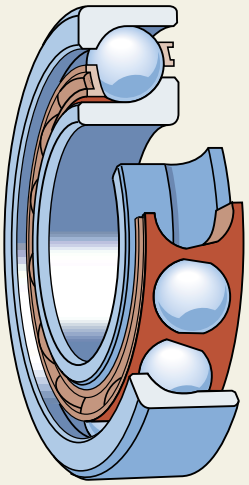
Another SKF concept that embraces a broader view of customer-focused technologies and competencies is called Asset Efficiency Optimization™, or AEO for short. As the name implies, AEO recognizes the importance of treating machinery and equipment as plant assets. SKF programs that take a system approach to optimizing these customer assets include

- Predictive Maintenance,
- Pro-active Reliability Maintenance
- Operator-driven Reliability, and
- Integrated Maintenance Solutions, an all-inclusive contractual program.

For more information about SKF competencies and services, contact your local SKF representative.

Single-row angular contact ball bearings

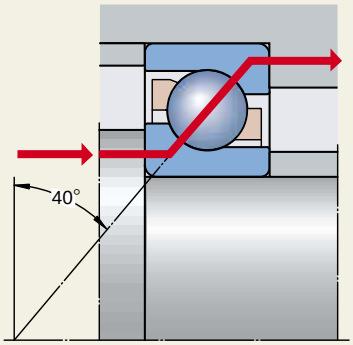
Fig 1



Single-row angular contact ball bearing

Contact angle α

Fig 2



General bearing data

Designs

Only bearings in the 72 B and 73 B Series (→ **fig** 1) are shown in this brochure. For information about other single-row angular contact ball bearings, please refer to the "SKF Interactive Engineering Catalogue" on CD-ROM or online at www.skf.com.

SKF bearings in the 72 B and 73 B Series have a 40° contact angle (→ **fig** 2) and are designed to be non-separable. Two versions are available:

- Standard design – These bearings are intended for arrangements where only one bearing is used at each bearing position.
- Universally matchable bearings – These bearings are designed for arrangements where two or more bearings are mounted immediately adjacent to each other in random order. In the following text these bearings are referred to as "universal bearings".

Universal bearings are precision manufactured so that a specific clearance or preload is “built into” the bearings when mounted immediately adjacent to each other. This precision manufacturing process also provides an even distribution of load, without the use of shims or similar devices.

Tables 3 and 4 on **pages 22** and **23** indicate which bearing versions are available as individual bearings or as universal bearings. All Explorer bearings are universally matchable and can be used as single bearings.

Dimensions

The boundary dimensions of single-row angular contact ball bearings conform to ISO 15:1998.

Tolerances

SKF single-row angular contact ball bearings of

- standard design for single mounting are manufactured to Normal tolerances,
- standard design for universally for paired mounting are manufactured to higher tolerances than Normal.
- Explorer design are manufactured to P6 dimensional accuracy, P5 running accuracy and are universally matchable.

The values of the tolerances correspond to ISO 492:1994.

Clearance, preload

In applications where individual bearings are used, the clearance or preload is determined by adjusting one bearing against another during installation.

Universal bearings mounted in a back-to-back or face-to-face arrangement, have the prescribed clearance or preload “built into” the bearings and do not require any adjustment during mounting.

Universal bearings are available in different internal clearance or preload classes. **Tables** 3 and 4 on **pages 22** and **23** show the available options. For additional information about special internal clearances or preloads, contact your local SKF representative.

Two or more universal bearings with axial internal clearance CA, CB and CC can be mounted immediately adjacent to each other in any order. However bearings with preload GA, GB and GC should only be arranged in pairs, as otherwise the preload will increase.

Values for the internal clearance classes CA, CB and CC are given in **Table** 1. They are valid for bearings arranged back-to-back face-to-face before mounting and under zero measuring load.

The values for the preload classes GA, GB and GC are given in **Table** 2 apply to bearing pairs in a back-to-back or face-to-face arrangement before mounting.

Table 1

Bore diameter d		Axial internal clearance Class CA		CB		CC	
over	incl.	min	max	min	max	min	max
mm		µm					
10	**18**	5	13	15	23	24	32
18	**30**	7	15	18	26	32	40
30	**50**	9	17	22	30	40	48
50	**80**	11	23	26	38	48	60
80	**110**	14	26	32	44	55	67
110	**180**	17	29	35	47	62	74
180	**250**	21	37	45	61	74	90

Axial internal clearance of sets of universal bearings arranged back-to-back or face-to-face (before mounting, zero measuring load)

Table 2

Bore diameter d		Preload class GA			GB				GC			
over	incl.	min	max	max	min	max	min	max	min	max	min	max
mm		µm		N	µm		N		µm		N	
10	**18**	+4	-4	80	-2	-10	30	330	-8	-16	230	660
18	**30**	+4	-4	120	-2	-10	40	480	-8	-16	340	970
30	**50**	+4	-4	160	-2	-10	60	630	-8	-16	450	1 280
50	**80**	+6	-6	380	-3	-15	140	1 500	-12	-24	1 080	3 050
80	**110**	+6	-6	410	-3	-15	150	1 600	-12	-24	1 150	3 250
110	**180**	+6	-6	540	-3	-15	200	2 150	-12	-24	1 500	4 300
180	**250**	+8	-8	940	-4	-20	330	3 700	-16	-32	2 650	7 500

Preload of bearing pairs consisting of universal bearings arranged back-to-back or face-to-face (before mounting, zero measuring load)

Speed ratings

Speed ratings are not speed limits. The values are based on thermal equilibrium between the bearing and its surroundings as described in the General Catalogue. With appropriate measures, maximum permissible speeds above the speed ratings are possible.

This is especially valid for SKF Explorer angular contact ball bearings, which run noticeably cooler than standard design bearings. This aspect of running cooler, which can have a direct affect on permissible speeds, has not been taken into account in the guideline values listed in the product table. For additional information contact your local SKF representative.

If multiple cages are available, the speed ratings given in the product table, **pages 24** - **29**, apply to bearings with a polyamide cage. The speed rating for a corresponding bearing with metal cage is approximately 7% lower than the published value.

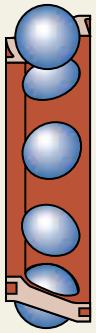
For bearings arranged in pairs, the speed ratings should be reduced. For bearings with normal internal clearance, the reduction amounts to approximately 20%. In case of smaller internal clearances or with preloading, larger reductions are necessary.

Misalignment

Single-row angular contact ball bearings have only limited ability to accommodate misalignment. The permissible misalignment of the shaft relative to the housing depends on the operating clearance in the bearing, bearing size, internal design and the forces and moments acting on the bearing. Because of the complex relationship between the influencing factors, it is not possible to quote any values which are universally valid. However, under normal operating conditions the value of the permissible misalignment for individual bearings lies between 2 and 6 minutes of arc.

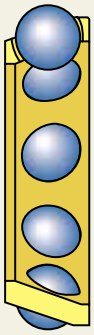
For bearings mounted in sets, particularly those with small axial internal clearance when mounted in a back-to-back arrangement, angular misalignments can only be accommodated between the balls and raceways by force. This leads to increased ball loads and cage stresses as well as a reduction in bearing service life. Any misalignment of the bearing rings will also lead to an increase in running noise.

Fig 3



Polyamide cage

Fig 4



Machined brass cage

Note
Single-row angular contact ball bearings with polyamide 6,6 cages can be used at temperatures up to +120 °C (250 °F). With the exception of a few oils and greases with a synthetic oil base, and lubricants containing a high proportion of EP additives when used at high temperatures, the lubricants generally used for rolling bearings do not have a detrimental effect on cage properties.

Cages
Depending on bearing series and size, SKF single-row angular contact ball bearings are equipped with one of the following cages:

- injection moulded cage of glass fibre reinforced polyamide 6,6, designation suffix P, (➔ **fig** 3)
- machined brass cage, designation suffix M,(➔ **fig** 4)

Bearings containing a polyamide cage may also be available with a machined brass cage. **Tables** 3 and 4 on **pages 22** and **23** show which cage designs are available for which bearing.

SKF single-row bearings are also available with sheet steel cage, sheet brass cage or other machined cages. Information "Cage selection" can be found on **page 15**. For additional information about cages, contact your local SKF representative.

Designation suffixes
The designation suffixes which occur most frequently with single-row angular contact ball bearings are listed and explained below.

B 40° contact angle
CA Universal bearing for paired mounting. When arranged back-to-back or face-to-face the bearing pair will have a smaller than Normal axial internal clearance before mounting.
CB Universal bearing for paired mounting. When arranged back-to-back or face-to-face the bearing pair will have a Normal axial internal clearance before mounting.
CC Universal bearing for paired mounting. When arranged back-to-back or face-to-face the bearing pair will have a larger than Normal axial internal clearance before mounting.
E Optimised internal design
F Machined steel cage
GA Universal bearing for paired mounting. When arranged back-to-back or face-to-face the bearing pair will have a light preload.
GB Universal bearing for paired mounting. When arranged back-to-back or face-to-face the bearing pair will have a moderate preload.
GC Universal bearing for paired mounting. When arranged back-to-back or face-to-face the bearing pair will have a heavy preload.
J Pressed steel cage, different designs or materials are identified by a figure, e.g. J1
M Machined brass cage, ball centred
MA Machined brass cage, outer ring centred
MB Machined brass cage, inner ring centred
P Injection moulded glass fibre reinforced polyamide 6,6 cage
P5 Dimensional and running accuracy to ISO tolerance class 5
P6 Dimensional and running accuracy to ISO tolerance class 6
Y Pressed brass cage

Assortment

SKF single-row angular contact ball bearings in the 72 B and 73 B Series are available in a number of variants. The assortment for bearings in

- 72 B Series is listed in **Table** 3 and
- 73 B Series is listed in **Table** 4.

The dimensions and performance data of all bearings can be found in the product table starting on **page 24**.

Additional variants with other internal clearance or preload values or different cage variations are available. For details, contact your local SKF Representative.

Bearing designations

Tables 3 and 4 also contain the bearing designations of the bearings available. The matrix headings show bearing designations without the size code. A darker coloured square indicates the position for the size where appropriate.

Example of an order designation

A universal bearing in the 73 BE Series

- for a 60 mm shaft diameter, the bearing size is 12
- for Normal axial internal clearance when arranged back-to-back or face-to-face as bearing pair, CB
- with a polyamide cage, P

has the order designation 7312 BECBP. The meanings of relevant designation suffixes are given on **page 21**.

When ordering universal bearings it is necessary to state the number of individual bearings required – not the number of pairs.

Table 3

	Single bearings			Universal matchable bearings										
Bearing size	BEP	BEM	BM	BECCP	BECBP	BECBM	BCBM	BECAP	BEGAP	BEGAM	BGAM	BEGBP	BEGCP	Bore diameter mm
	72	72	72	72	72	72	72	72	72	72	72	72	72	
00	■				■									10
01	■				■				■					12
02	■				■				■			■		15
03	■				■	■			■					17
04	■				■	■			■					20
05	■				■	■			■				■	25
06	■				■	■		■	■			■		30
07	■				■	■			■	■		■		35
08	■	■			■	■			■	■				40
09	■				■	■			■					45
10	■				■	■			■	■				50
11	■				■	■			■					55
12	■				■	■			■	■		■		60
13	■				■	■			■					65
14	■				■	■			■	■				70
15	■				■	■								75
16	■				■	■				■				80
17	■				■	■								85
18	■			■	■	■			■					90
19	■				■	■				■				95
20	■				■	■								100
21	■				■	■								105
22	■	■			■	■								110
24			■				■							120
26			■				■				■			130
28			■				■							140
30							■				■			150
32							■							160
34							■							170
36							■							180
38														190
40							■							200
44							■							220
48							■							240

■ *Standard bearings*
■ *Explorer bearings*

SKF standard assortment of single-row bearings in the 72 B Series

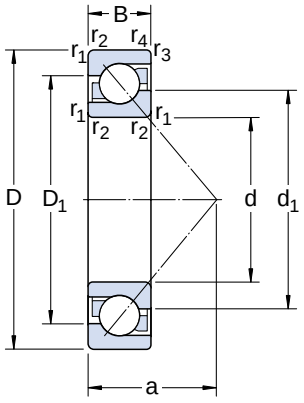
Table 4

Bearing size	Single bearings			Universal matchable bearings											Bore diameter mm
	BEP	BEM	BM	BECCM	BECBP	BECBM	BCBM	BECAP	BECAM	BEGAP	BEGAM	BEGBP	BEGBM	BGBM	
	73	73	73	73	73	73	73	73	73	73	73	73	73	73	
00															10
01	■														12
02	■				■										15
03	■				■					■					17
04	■				●	●				●					20
05	■				●	●				●					25
06	■				●	●				●	●	●	●		30
07	■				●	●				●		●			35
08	■				●	●		●		●	●	●	●		40
09	■				●	●		●		●		●			45
10	■				●	●				●	●	●			50
11	■			●	●	●				●	●		●		55
12	■	■		●	●	●		●		●	●	●	●		60
13	■			●	●	●				●	●	●	●		65
14	■				●	●				●	●				70
15	■				●	●				●	●				75
16	■	■		●	●	●				●	●				80
17	■	■		●	●	●				●	●				85
18	■	■			●	●				●					90
19	■	■			●	●					●				95
20	■	■		●	●	●				●	●				100
21	■				■	■			■		■				105
22	■	■		■	■	■					■		■		110
24							■							■	120
26			■				■								130
28							■								140
30							■								150
32							■								160
34							■								170
36							■								180
38							■								190
40							■								200
44															220
48															240

■ *Standard bearings*
● *Explorer bearings*

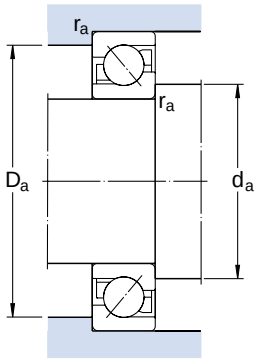
SKF standard assortment of single-row bearings in the 73 B Series

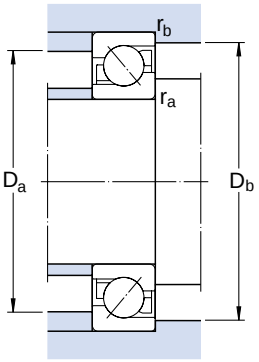
Single-row angular contact ball bearings
d **10 – 55** mm



Principal dimensions			Basic load ratings dynamic	static	Fatigue load limit	Speed ratings Lubrication grease	oil	Mass	Basic designation*
d	D	B	C	C_0	P_u				
mm			N		N	r/min		kg	-
10	30	9	7 020	3 350	140	19 000	28 000	0,030	**7200 BE**
12	32	10	7 610	3 800	160	18 000	26 000	0,036	**7201 BE**
	37	12	10 600	5 000	208	17 000	24 000	0,060	**7301 BE**
15	35	11	8 840	4 800	204	17 000	24 000	0,045	**7202 BE**
	42	13	13 000	6 700	280	15 000	20 000	0,080	**7302 BE**
17	40	12	11 100	6 100	260	15 000	20 000	0,065	**7203 BE**
	40	12	11 000	5 850	250	15 000	20 000	0,065	7203 BE
	47	14	15 900	8 300	355	13 000	18 000	0,11	**7303 BE**
20	47	14	14 000	8 300	355	12 000	17 000	0,11	**7204 BE**
	52	15	19 000	10 400	440	10 000	15 000	0,14	**7304 BE**
	52	15	19 000	10 000	425	10 000	15 000	0,14	7304 BE
25	52	15	14 800	9 300	400	10 000	15 000	0,13	**7205 BE**
	52	15	15 600	10 000	430	10 000	15 000	0,13	7205 BE
	62	17	26 000	15 600	655	9 000	13 000	0,23	**7305 BE**
	62	17	26 500	15 300	655	9 000	13 000	0,23	7305 BE
30	62	16	23 800	15 600	655	8 500	12 000	0,20	**7206 BE**
	62	16	24 000	15 600	655	8 500	12 000	0,20	7206 BE
	72	19	34 500	21 200	900	8 000	11 000	0,34	**7306 BE**
	72	19	35 500	21 200	900	8 000	11 000	0,34	7306 BE
35	72	17	30 700	20 800	880	8 000	11 000	0,28	**7207 BE**
	72	17	31 000	20 800	880	8 000	11 000	0,28	7207 BE
	80	21	39 000	24 500	1 040	7 500	10 000	0,45	**7307 BE**
	80	21	41 500	26 500	1 140	7 500	10 000	0,44	7307 BE
40	80	18	36 400	26 000	1 100	7 000	9 500	0,37	**7208 BE**
	80	18	36 500	26 000	1 100	7 000	9 500	0,35	7208 BE
	90	23	49 400	33 500	1 400	6 700	9 000	0,63	**7308 BE**
	90	23	50 000	32 500	1370	6 700	9 000	0,64	7308 BE
45	85	19	37 700	28 000	1 200	6 700	9 000	0,42	**7209 BE**
	85	19	38 000	28 500	1 220	6 700	9 000	0,42	7209 BE
	100	25	60 500	41 500	1 730	6 000	8 000	0,85	**7309 BE**
	100	25	61 000	40 500	1 730	6 000	8 000	0,83	7309 BE
50	90	20	39 000	30 500	1 290	6 000	8 000	0,47	**7210 BE**
	90	20	40 000	31 000	1 320	6 000	8 000	0,47	7210 BE
	110	27	74 100	51 000	2 200	5 300	7 000	1,10	**7310 BE**
	110	27	75 000	51 000	2 160	5 300	7 000	1,10	7310 BE
55	100	21	48 800	38 000	1 530	5 600	7 500	0,62	**7211 BE**
	120	29	85 200	60 000	2 550	4 800	6 300	1,40	**7311 BE**
	120	29	85 000	60 000	2 550	4 800	6 300	1,40	7311 BE

* The designations of bearings belonging to the Explorer range are printed blue. Information on available variants see pages 22 and 23.



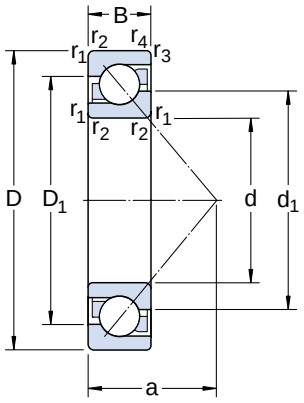


Conversion factors:

Length:	1 mm	=	0,0394 in.
	1 in.	=	25,4 mm
Force:	1 N	=	0,225 lbf
	1 lbf	=	4,4482 N
Mass:	1 kg	=	2,205 lb
	1 lb	=	0,454 kg

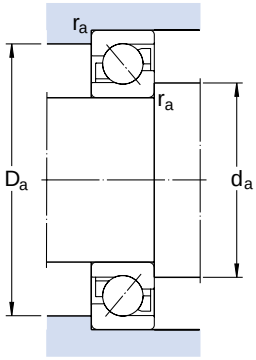
Dimensions						**Abutment and fillet dimensions**				
d	d_1 ~	D_1 ~	$r_{1,2}$ min	$r_{3,4}$ min	a	d_a min	D_a max	D_b max	r_a max	r_b max
mm						mm				
10	18,2	23,1	0,6	0,3	13	14,2	25,8	27,6	0,6	0,3
12	20,2	25,1	0,6	0,3	14	16,2	27,8	29,6	0,6	0,3
	21,7	28,3	1	0,6	16	17,6	31,4	32,6	1	0,6
15	22,7	28	0,6	0,3	16	19,2	30,8	32,6	0,6	0,3
	25,9	32,9	1	0,6	19	20,6	36,4	37,8	1	0,6
17	25,9	31,9	0,6	0,6	18	21,2	35,8	35,8	0,6	0,6
	26,2	31,2	0,6	0,6	18	21,2	35,8	35,8	0,6	0,6
	28,6	36,5	1	0,6	20	22,6	41,4	42,8	1	0,6
20	30,7	37,2	1	0,6	21	25,6	41,4	42,8	1	0,6
	32,9	41	1,1	0,6	23	27	45	47,8	1	0,6
	33,1	41	1,1	0,6	23	27	45	47,8	1	0,6
25	35,7	42,2	1	0,6	24	30,6	46	47,8	1	0,6
	36,1	41,5	1	0,6	24	30,6	46	47,8	1	0,6
	39,4	48,9	1,1	0,6	27	32	55	57,8	1	0,6
	39,6	48,3	1,1	0,6	27	32	55	57,8	1	0,6
30	42,3	50,8	1	0,6	27	35,6	56	57,8	1	0,6
	42,6	50,1	1	0,6	27	35,6	56	57,8	1	0,6
	46,2	57,3	1,1	0,6	31	37	65	67,8	1	0,6
	46,5	56,6	1,1	0,6	31	37	65	67,8	1	0,6
35	49,3	59	1,1	0,6	31	42	65	67,8	1	0,6
	49,6	58,3	1,1	0,6	31	42	65	67,8	1	0,6
	52,4	64,2	1,5	1	35	44	71	74,4	1,5	1
	52,7	63,5	1,5	1	35	44	71	74,4	1,5	1
40	55,9	66,3	1,1	0,6	34	47	73	75,8	1	0,6
	56,2	65,5	1,1	0,6	34	47	73	75,8	1	0,6
	59,4	72,4	1,5	1	39	49	81	84,4	1,5	1
	59,7	71,6	1,5	1	39	49	81	84,4	1,5	1
45	60,5	70,9	1,1	0,6	37	52	78	80,8	1	0,6
	60,7	70,3	1,1	0,6	37	52	78	80,8	1	0,6
	66,3	80,7	1,5	1	43	54	91	94,4	1,5	1
	66,5	79,9	1,5	1	43	54	91	94,4	1,5	1
50	65,5	75,9	1,1	0,6	39	57	83	85,8	1	0,6
	65,7	75,3	1,1	0,6	39	57	83	85,8	1	0,6
	73,5	89,7	2	1	47	61	99	104	2	1
	73,8	88,8	2	1	47	61	99	104	2	1
55	72,4	84,1	1,5	1	43	64	91	94,4	1,5	1
	80	97,6	2	1	51	66	109	114	2	1
	80,3	96,6	2	1	51	66	109	114	2	1

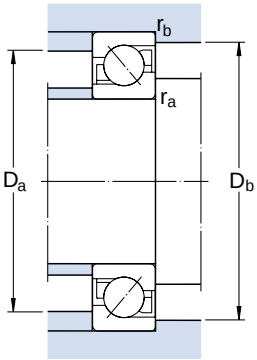
Single-row angular contact ball bearings
d **60 – 120** mm



Principal dimensions			Basic load ratings		Fatigue load limit	Speed ratings		Mass	Basic designation*
			dynamic	static		Lubrication			
						grease	oil		
d	D	B	C	C_0	P_u				
mm			N		N	r/min		kg	-
60	110	22	57 200	45 500	1 930	5 000	6 700	0,80	**7212 BE**
	110	22	61 000	50 000	2 120	5 000	6 700	0,77	**7212 BE**
	130	31	95 600	69 500	3 000	4 500	6 000	1,80	**7312 BE**
	130	31	104 000	76 500	3 200	4 500	6 000	1,80	**7312 BE**
65	120	23	66 300	54 000	2 280	4 500	6 000	1,00	**7213 BE**
	140	33	108 000	80 000	3 350	4 300	5 600	2,15	**7313 BE**
	140	33	116 000	86 500	3 650	4 300	5 600	2,15	**7313 BE**
70	125	24	71 500	60 000	2 500	4 300	5 600	1,10	**7214 BE**
	125	24	72 000	60 000	2 500	4 300	5 600	1,10	**7214 BE**
	150	35	119 000	90 000	3 650	3 800	5 000	2,65	**7314 BE**
	150	35	127 000	98 000	3 900	3 800	5 000	2,60	**7314 BE**
75	130	25	72 800	64 000	2 650	4 300	5 600	1,20	**7215 BE**
	160	37	133 000	106 000	4 150	3 600	4 800	3,20	**7315 BE**
	160	37	132 000	104 000	4 150	3 600	4 800	3,20	**7315 BE**
80	140	26	83 200	73 500	3 000	3 800	5 000	1,45	**7216 BE**
	140	26	85 000	75 000	3 050	3 800	5 000	1,50	**7216 BE**
	170	39	143 000	118 000	4 500	3 400	4 500	3,80	**7316 BE**
	170	39	143 000	118 000	4 500	3 400	4 500	3,70	**7316 BE**
85	150	28	95 600	83 000	3 250	3 600	4 800	1,80	**7217 BE**
	180	41	153 000	132 000	4 900	3 200	4 300	4,45	**7317 BE**
	180	41	156 000	132 000	4 900	3 200	4 300	4,40	**7317 BE**
90	160	30	108 000	96 500	3 650	3 400	4 500	2,30	**7218 BE**
	190	43	165 000	146 000	5 200	2 800	3 800	5,25	**7318 BE**
	190	43	166 000	146 000	5 300	2 800	3 800	5,10	**7318 BE**
95	170	32	124 000	108 000	4 000	3 200	4 300	2,70	**7219 BE**
	170	32	129 000	118 000	4 400	3 200	4 300	2,90	**7219 BE**
	200	45	178 000	163 000	5 600	2 800	3 800	6,05	**7319 BE**
	200	45	180 000	163 000	5 700	2 800	3 800	5,90	**7319 BE**
100	180	34	135 000	122 000	4 400	2 800	3 800	3,45	**7220 BE**
	215	47	203 000	190 000	6 400	2 600	3 600	7,50	**7320 BE**
	215	47	216 000	208 000	6 950	2 600	3 600	7,20	**7320 BE**
105	190	36	148 000	137 000	4 800	2 800	3 800	3,95	**7221 BE**
	225	49	203 000	193 000	6 400	2 400	3 400	8,45	**7321 BE**
110	200	38	163 000	153 000	5 200	2 600	3 600	4,60	**7222 BE**
	240	50	225 000	225 000	7 200	2 200	3 200	9,85	**7322 BE**
120	215	40	165 000	163 000	5 300	2 200	3 200	6,10	**7224 B**
	260	55	238 000	250 000	7 650	1 900	2 800	14,5	**7324 B**

* The designations of bearings belonging to the Explorer range are printed blue. Information on available variants see pages 22 and 23.





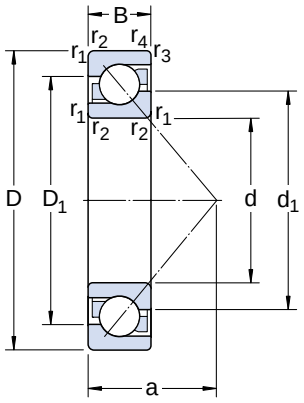
Conversion factors:

Length:	1 mm	=	0,0394 in.
	1 in.	=	25,4 mm
Force:	1 N	=	0,225 lbf
	1 lbf	=	4,4482 N
Mass:	1 kg	=	2,205 lb
	1 lb	=	0,454 kg

Dimensions						**Abutment and fillet dimensions**				
d	d_1 ~	D_1 ~	$r_{1,2}$ min	$r_{3,4}$ min	a	d_a min	D_a max	D_b max	r_a max	r_b max
mm						mm				
60	79,3	92,5	1,5	1	47	69	101	104	1,5	1
	79,6	91,7	1,5	1	47	69	101	104	1,5	1
	87	106	2,1	1,1	55	72	118	123	2	1
	87,2	105	2,1	1,1	55	72	118	123	2	1
65	86,3	101	1,5	1	50	74	111	114	1,5	1
	93,8	114	2,1	1,1	60	77	128	133	2	1
	94,1	113	2,1	1,1	60	77	128	133	2	1
70	91,3	106	1,5	1	53	79	116	119	1,5	1
	91,5	105	1,5	1	53	79	116	119	1,5	1
	100	123	2,1	1,1	64	82	138	143	2	1
	101	122	2,1	1,1	64	82	138	143	2	1
75	96,3	111	1,5	1	56	84	121	124	1,5	1
	108	130	2,1	1,1	68	87	148	153	2	1
	108	129	2,1	1,1	68	87	148	153	2	1
80	103	119	2	1	59	91	129	134	2	1
	103	118	2	1	59	91	129	134	2	1
	114	139	2,1	1,1	72	92	158	163	2	1
	115	137	2,1	1,1	72	92	158	163	2	1
85	110	128	2	1	63	96	139	144	2	1
	121	147	3	1,1	76	99	166	173	2,5	1
	122	146	3	1,1	76	99	166	173	2,5	1
90	117	136	2	1	67	101	149	154	2	1
	128	155	3	1,1	80	104	176	183	2,5	1
	129	154	3	1,1	80	104	176	183	2,5	1
95	124	144	2,1	1,1	72	107	158	163	2	1
	124	143	2,1	1,1	72	107	158	163	2	1
	135	163	3	1,1	84	109	186	193	2,5	1
	136	162	3	1,1	84	109	186	193	2,5	1
100	131	152	2,1	1,1	76	112	168	173	2	1
	144	176	3	1,1	90	114	201	208	2,5	1
	144	174	3	1,1	90	114	201	208	2,5	1
105	138	160	2,1	1,1	80	117	178	183	2	1
	151	183	3	1,1	94	119	211	218	2,5	1
110	145	169	2,1	1,1	84	122	188	193	2	1
	160	195	3	1,1	99	124	226	233	2,5	1
120	157	180	2,1	1,1	90	132	203	208	2	1
	175	210	3	1,1	107	134	246	253	2,5	1

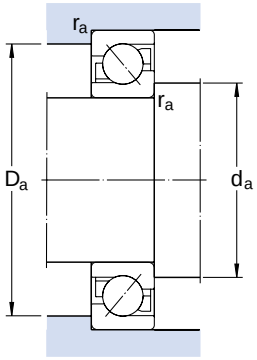
Page ..... 3 Page 10

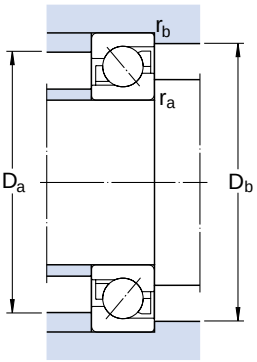
Single-row angular contact ball bearings
d **130 – 240** mm



Principal dimensions			Basic load ratings dynamic	static	Fatigue load limit	Speed ratings Lubrication grease	oil	Mass	Basic designation*
d	D	B	C	C_0	P_u				
mm			N		N	r/min		kg	-
130	230	40	186 000	193 000	6 100	1 900	2 800	6,95	**7226 B**
	280	58	251 000	270 000	8 000	1 800	2 600	17,5	**7326 B**
140	250	42	182 000	196 000	5 850	1 800	2 600	8,85	**7228 B**
	300	62	276 000	310 000	8 800	1 700	2 400	21,5	**7328 B**
150	270	45	195 000	224 000	6 550	1 700	2 400	11,5	**7230 B**
	320	65	302 000	365 000	10 200	1 600	2 200	26,0	**7330 B**
160	290	48	199 000	236 000	6 700	1 600	2 200	14,0	**7232 B**
170	310	52	221 000	270 000	7 350	1 600	2 200	17,5	**7234 B**
	360	72	358 000	455 000	12 000	1 400	1 900	36,0	**7334 B**
180	320	52	251 000	320 000	8 500	1 500	2 000	18,0	**7236 B**
	380	75	371 000	490 000	12 500	1 300	1 800	42,0	**7336 B**
190	400	78	410 000	560 000	13 700	1 200	1 700	48,5	**7338 B**
200	360	58	291 000	400 000	10 000	1 300	1 800	25,0	**7240 B**
	420	80	449 000	655 000	15 600	1 100	1 600	53,0	**7340 B**
220	400	65	319 000	465 000	11 200	1 100	1 600	37,0	**7244 B**
240	440	72	364 000	540 000	12 500	1 000	1 500	49,0	**7248 B**

* The designations of bearings belonging to the Explorer range are printed blue. Information on available variants see pages 22 and 23.





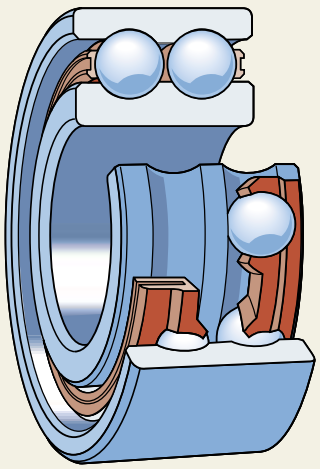
Conversion factors:

Length:	1 mm	=	0,0394 in.
	1 in.	=	25,4 mm
Force:	1 N	=	0,225 lbf
	1 lbf	=	4,4482 N
Mass:	1 kg	=	2,205 lb
	1 lb	=	0,454 kg

Dimensions						**Abutment and fillet dimensions**				
d	d_1 ~	D_1 ~	$r_{1,2}$ min	$r_{3,4}$ min	a	d_a min	D_a max	D_b max	r_a max	r_b max
mm						mm				
130	169	193	3	1,1	96	144	216	222	2,5	1
	189	227	4	1,5	115	147	263	271	3	1,5
140	184	208	3	1,1	103	154	236	243	2,5	1
	203	243	4	1,5	123	157	283	291	3	1,5
150	199	223	3	1,1	111	164	256	263	2,5	1
	218	258	4	1,5	131	167	303	311	3	1,5
160	211	241	3	1,1	118	174	276	283	2,5	1
170	224	258	4	1,5	127	187	293	301	3	1,5
	246	292	4	1,5	147	187	343	351	3	1,5
180	236	266	4	1,5	131	197	303	313	3	1,5
	260	308	4	2	156	197	363	369	3	2
190	275	323	5	2	164	210	380	389	4	2
200	265	297	4	1,5	146	217	343	351	3	1,5
	289	335	5	2	170	220	400	409	4	2
220	294	328	4	1,5	164	237	383	391	3	1,5
240	322	361	4	1,5	180	257	423	431	3	1,5

Double-row angular contact ball bearings

Fig 1



Double-row angular contact ball bearing

General bearing data

Designs

SKF double-row angular contact ball bearings correspond in design to two single-row angular contact ball bearings but take up less axial space (➔ **fig** 1).

Only bearings in the 32 and 33 Series are shown in this brochure. Bearings in the 52 and 53 Series (the designation used in the US market) have the same performance characteristics and dimensional features. However bearings in the 52 and 53 Series use a high temperature grease.

The SKF standard range of double-row angular contact ball bearings includes

- bearings of basic design, suffix designation A (➔ **fig** 2a and 2b)
- bearings with shields, suffix designation A–2Z (➔ **fig** 2c and 2d)
- bearings with seals, suffix designation A–2RS1 (➔ **fig** 2e)
- separable bearings with two-piece inner ring, suffix designation D (➔ **fig** 2f)
- non-separable bearings with two-piece inner ring and snap ring, suffix designation DNRCBM (➔ **fig** 2g)

The bearing range covers sizes from 10 to 110 mm bore diameter.

For information about other double-row angular contact ball bearings, please refer to the "SKF Interactive Engineering Catalogue" on CD-ROM or online at www.skf.com.

Basic design

Double-row angular contact ball bearings in the 32 A and 33 A Series have a 30 ° contact angle and are non-separable. These bearings do not contain filling slots and therefore can accommodate axial loads acting in both directions. Many of these bearings are manufactured in Explorer quality.

For manufacturing reasons, bearings of the basic design may have seal recesses on inner and outer rings, even if they are supplied without seals or shields (➔ **fig** 2b).

Bearings with shields or seals

SKF bearings in the 32 A and 33 A Series are available with

- shields (non-rubbing seals) or
- seals (rubbing seals)

at both sides. As standard, these bearings are filled with an NLGI Class 3 lithium base grease, which has good corrosion inhibiting properties and can be used at temperatures between -30 and +120 °C (-20 and + 250 °F). Bearings with this lithium base grease carry the suffix MT33.

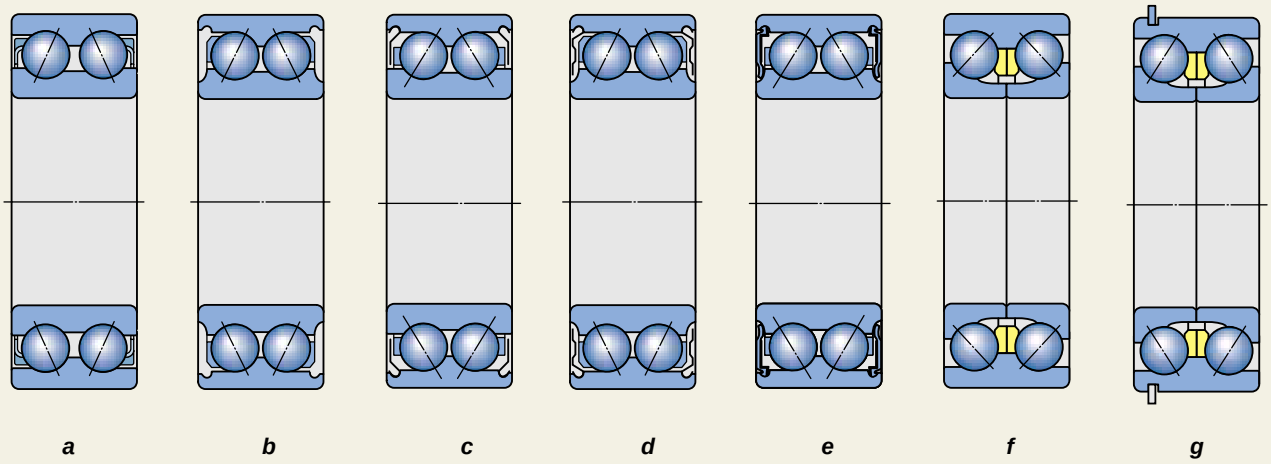
If sealed double-row bearings with a high-temperature grease are needed, bearings from the 52 or 53 Series should be ordered. These bearings are filled with an NGLI Class 2 mineral-oil based grease and polyurea thickener. This grease is resistant to ageing and has good corrosion inhibiting properties. Its operating temperature range is -30 to +175 °C (-20 to +345 °F). The temperature is nevertheless limited to 150 °C (300 °F) by the bearing rings or to 120 °C (250 °F) by the seals or in the eventuality of polyamide cages.

Sealed bearings are lubricated for life and are maintenance-free. They should therefore not be heated above 80 °C (175 °F) prior to mounting and should not be washed.

Bearings with shields

Bearings with shields made of sheet steel are supplied in two different designs depending on the bearing variant. Bearings of

Fig 2



Design alternatives of double-row angular contact ball bearings

- standard design have shields which form a long sealing gap with the land of the inner ring shoulder (➔ **fig** 3a).
- Explorer design are equipped with shields which overlap the recesses in the inner ring shoulder and form a highly efficient labyrinth seal (➔ **fig** 3b).

Bearings with seals
Bearings with seals, designation suffix 2RS1, have a nitrile butadiene rubber, sheet steel reinforced seal at both sides (➔ **fig** 3c). The seal material is resistant to ageing and wear. The temperature limits for the seals are -40 and +120 °C (-40 and +250 °F). The periphery of the seal engages in a recess in the outer ring without deforming the ring and provides good sealing at this position. The rubber lip seals against a recess in the inner ring shoulder, exerting a slight pressure on the ring.

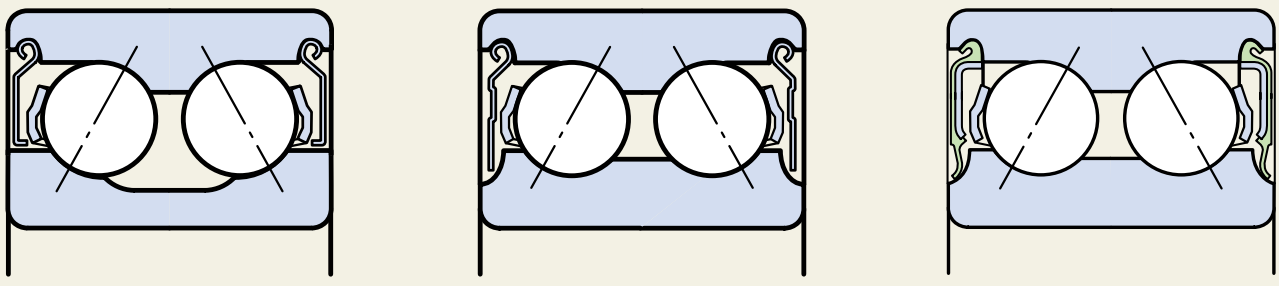
Bearings in the 33 D Series
SKF double-row angular contact ball bearings in the 33 D Series (➔ **fig** 2f) with two-piece inner ring incorporate a large number of large balls and have high load carrying capacity as a consequence. The bearings have a 45 ° contact angle and can support heavy axial loads in both directions. The bearings are separable.

Bearings in the 33 DNRCBM Series
Bearings in the 33 DNRCBM Series (➔ **fig** 2g) have been designed specifically to operate under the conditions pertaining in pumps, but can also be used in other applications. Their principal characteristics are

- a 40 ° contact angle,
- a splitt inner ring,
- machined brass cages, ball centered,
- higher running accuracy,
- a snap ring groove and a snap ring in the outer ring, enabling simple and space-saving axial location in the housing.

Shields and seals

Fig 3



Dimensions

With the exception of the width of bearing 3200 A the boundary dimensions of the double-row angular contact ball bearings listed in the product table conform to ISO 15:1998.

Tolerances

SKF double-row bearings of

- standard design are manufactured to Normal tolerances.
- Explorer design as well as the bearings in the 33 DNRCBM Series are manufactured to P6 dimensional and running accuracy.

The values for their tolerances correspond to ISO 492:1994.

Clearance

SKF double-row angular contact ball bearings in the 32 A and 33 A Series are available with Normal as well as with C3 axial internal clearance as standard; see **Tables** 2 and 3 on **pages 34** and **35**.

The bearings in the 33 D and 33 DNRCBM Series are only manufactured with the special axial internal clearance listed in **Table** 1.

The values for axial internal clearances given in **Table** 1 are valid for bearings before mounting and under zero measuring load.

Speed ratings

Speed ratings are not speed limits. The values are based on thermal equilibrium between the bearing and its surroundings as described in the General Catalogue. With appropriate measures, maximum permissible speeds above the speed ratings are possible.

This is especially valid for SKF Explorer angular contact ball bearings, which run noticeably cooler than standard design bearings. This aspect of running cooler, which can have a direct affect on permissible speeds, has not been taken into account in the guideline values shown in the product table. For additional information contact your local SKF representative.

Misalignment

Double-row angular contact ball bearings are limited in their ability to compensate shaft misalignment and axial deflections. Both conditions will increase noise, and decrease bearing service life.

Cages

SKF double-row angular contact ball bearings are fitted with one cage per ball row. The type of cage typically depends on bearing design and size. In some cases two different cages are available so that bearings with cages appropriate to the operating conditions can be chosen:

- Standard design bearings in the 32 A and 33 A Series:
  - snap type cage of glass fibre reinforced polyamide 6,6, designation suffix TN9 (→ **fig** 4) or
  - pressed steel, snap type cage, no designation suffix (→ **fig** 5)
- Explorer design bearings in the 32 A and 33 A Series:
  - pressed steel, crown type cage, no designation suffix (→ **fig** 6) or
  - snap type cage of glass fibre reinforced polyamide 6,6, designation suffix TN9 (→ **fig** 4)
- Bearings in the 33 D Series:
  - snap type cage of glass fibre reinforced polyamide 6,6, designation suffix TN9 (→ **fig** 4) or
  - pressed steel snap type cage, designation suffix J1 (→ **fig** 5) or
  - machined brass cage, outer ring centred, designation suffix MA (→ **fig** 7)
- Bearings in the 33 DNRCBM Series:
  - machined brass cage, ball centered, designation suffix M (→ **fig** 8)

Axial internal clearance of double-row angular contact ball bearings (before mounting, and zero measuring load)

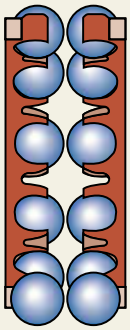
Table 1

Bore diameter		Axial internal clearance for bearings in the series									
		32 A and 33 A						33 D		33 DNRCBM	
d		C2		Normal		C3					
over	incl.	min	max	min	max	min	max	min	max	min	max
mm		µm									
–	10	1	11	5	21	12	28	-	-	-	-
10	18	1	12	6	23	13	31	-	-	-	-
18	24	2	14	7	25	16	34	-	-	-	-
24	30	2	15	8	27	18	37	-	-	-	-
30	40	2	16	9	29	21	40	40	60	10	30
40	50	2	18	11	33	23	44	40	60	10	30
50	65	3	22	13	36	26	48	45	65	18	38
65	80	3	24	15	40	30	54	45	65	18	38
80	100	3	26	18	46	35	63	45	65	-	-
100	110	4	30	22	53	42	73	45	65	-	-

Note

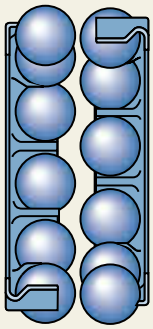
Double-row angular contact ball bearings with polyamide 6,6 cages can be used at temperatures up to +120 °C (250 °F). With the exception of a few oils and greases with a synthetic base oil, and lubricants containing a high proportion of EP additives when used at high temperatures, the lubricants generally used for rolling bearings do not have a detrimental effect on cage properties.

Fig 4



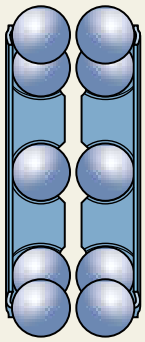
Polyamide cage

Fig 5



Snap cage of sheet steel

Fig 6



Crown cage made of sheet steel

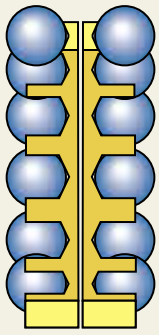
Tables 2 and 3 on **pages 34 - 35** show which cage designs are available for which bearing. Information on "Cage selection" can be found on **page 15**. For additional information about cages, contact your local SKF representative.

Designation suffixes

The designation suffixes which occur most frequently with double-row angular contact ball bearings, are listed and explained below.

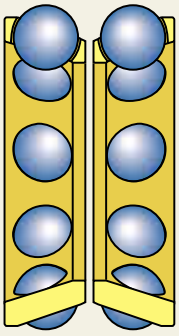
A Optimised internal design, no filling slots.
CB Special axial internal clearance
C2 Axial internal clearance smaller than Normal
C3 Axial internal clearance greater than Normal
D Two-piece inner ring
J1 Pressed steel snap type cage
M Machined brass cage, ball centred
MA Machined brass cage, outer ring centred
MT33 Lithium base grease for operating temperatures in the range of -30 to +120 °C (-20 to +250 °F)
NR Snap ring groove in the outside surface of the outer ring with snap ring
P5 Dimensional and running accuracy to ISO tolerance class 5
P6 Dimensional and running accuracy to ISO tolerance class 6
P62 P6 running accuracy and C2 clearance
P63 P6 running accuracy and C3 clearance
TN9 Snap type cage of glass fibre reinforced polyamide 6,6
2RS1 Rubbing seal of nitrile rubber with sheet steel reinforcement at both sides of the bearing
2Z Pressed steel shield at both sides of the bearing

Fig 7



Machined brass cage, outer ring centred

Fig 8



Machined brass cage

Assortment

SKF double-row angular contact ball bearings in the 32 and 33 Series (52/53 US only) are available in a large number of variants. The assortment for bearings in the

- 32 A Series is listed in **Table** 2
- 33 A Series is listed in **Table** 3.

The dimensions and performance data of all bearings can be found in the product table starting on **page 36**.

Additional variants with other internal clearance values or different cage variations are available. For details, contact your local SKF representative.

Bearing designations
Tables 2 and 3 also contain the bearing designations of the bearings available. The matrix headings show bearing designations without the size code. A darker coloured square indicates the position for the size where appropriate.

Example of an order designation
A double-row angular contact ball bearing in the 33 A Series

- for a 40 mm shaft diameter the bearing size is 08,
- with shields at both sides (-2Z),
- snap type cage of glass fibre rein forced polyamide 6,6 (TN9),
- clearance greater than Normal (C3)
- Lithium base grease (MT33)

has 3308 A-2ZTN9/C3MT33 as order designation. The meaning of all designation suffixes is explained on **page 33**.

Table 2

	Bearings of open design				Bearings with shields				Bearings with seals		
Bearing size	A	A/C3	ATN9	ATN9/C3	A-2Z/MT33	A-2Z/C3MT33	A-2ZTN9/MT33	A-2ZTN9/C3MT33	A-2RS1/MT33	A-2RS1TN9/MT33	Bore diameter mm
	32	32	32	32	32	32	32	32	32	32	
00			■	■			■			■	10
01			■				■			■	12
02			■	■			■			■	15
03			■	■			■			■	17
04	■	■	■	■	■	■	■	■	■	■	20
05	■	■	■	■	■	■	■	■	■	■	25
06	■	■	■	■	■	■	■	■	■	■	30
07	■	■	■	■	■	■	■	■	■	■	35
08	■	■	■	■	■	■	■	■	■	■	40
09	■	■	■	■	■	■	■		■	■	45
10	■	■	■	■	■	■	■		■	■	50
11	■	■	■		■	■			■		55
12	■	■	■		■	■			■		60
13	■	■				■			■		65
14	■	■			■						70
15	■	■				■					75
16	■	■									80
17	■	■									85
18	■	■									90
19	■	■									95
20	■	■									100
22	■	■									110

■ *Standard bearings*
■ *Explorer bearings*

SKF standard assortment of double-row bearings in the 32 A Series

Table 3

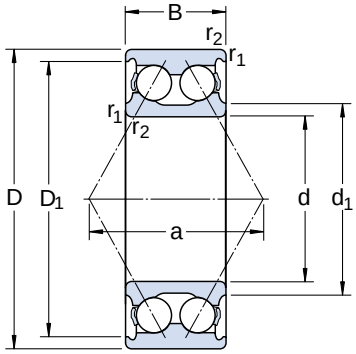
Bearing size	Bearings of open design				Bearings with shields				Bearings with seals		Bearings with two-piece inner ring				Bore diameter mm
	A	A/C3	ATN9	ATN9/C3	A-2Z/MT33	A-2Z/C3MT3	A-2ZTN9/MT33	A-2ZTN9/C3MT33	A-2RS1/MT33	A-2RS1TN9/MT33	DJ1	DTN9	DMA	DNRCBM	
	33	33	33	33	33	33	33	33	33	33	33	33	33	33	
00															10
01															12
02			■	■				■		■					15
03			■	■				■		■					17
04	●	●	●	●	●	●	●	●	●	●					20
05	●	●	●	●		●	●	●		●					25
06	●	●	●	●		●	●	●		●					30
07	●	●	●	●		●	●	●		●	■				35
08	●	●	●	●		●	●	●		●		■	■	■	40
09	●	●	●			●			●				■	■	45
10	●	●	●			●			●				■	■	50
11	●	●				●			●			■	■	■	55
12	●	●				●									60
13	●	●				●								■	65
14	■	■				■									70
15	●	●				●									75
16	■	■													80
17	■	■													85
18	■	■													90
19	■	■													95
20	■	■													100
22	■	■													110

■ *Standard bearings*
● *Explorer bearings*

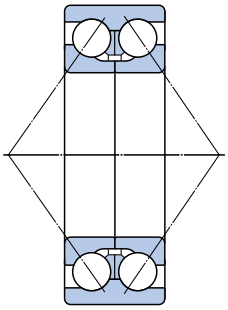
SKF standard assortment of double-row bearings in the 33 A Series

Double-row angular contact ball bearings

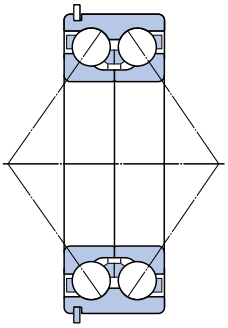
d **10 – 65** mm



A design



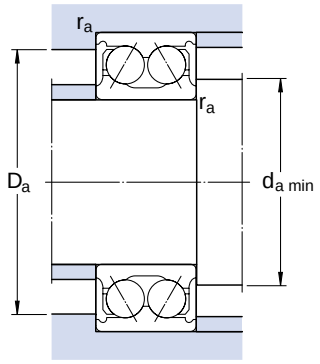
33 D

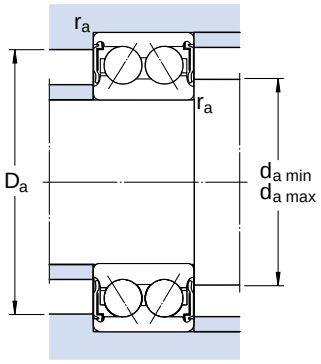


33 DNR

Principal dimensions			Basic load ratings dynamic	static	Fatigue load limit	Speed ratings Lubrication grease	oil	Mass	Basic designation*
d	D	B	C	C_0	P_u				
mm			N		N	r/min		kg	-
10	30	14	7 610	4 300	183	16 000	22 000	0,051	**3200 A**
12	32	15,9	10 100	5 600	240	15 000	20 000	0,058	**3201 A**
15	35	15,9	11 200	6 700	285	12 000	17 000	0,066	**3202 A**
	42	19	15 100	9 300	400	10 000	15 000	0,13	**3302 A**
17	40	17,5	14 300	8 800	365	10 000	15 000	0,096	**3203 A**
	47	22,2	21 600	12 700	540	9 500	14 000	0,18	**3303 A**
20	47	20,6	20 000	12 000	510	9 000	13 000	0,16	**3204 A**
	52	22,2	23 600	14 600	620	8 000	11 000	0,22	**3304 A**
25	52	20,6	21 600	14 300	600	8 000	11 000	0,18	**3205 A**
	62	25,4	32 000	20 400	865	7 500	10 000	0,35	**3305 A**
30	62	23,8	30 000	20 400	865	7 000	9 500	0,29	**3206 A**
	72	30,2	41 500	27 500	1 160	6 300	8 500	0,53	**3306 A**
35	72	27	40 000	28 000	1 180	6 000	8 000	0,44	**3207 A**
	80	34,9	52 000	35 500	1 500	5 600	7 500	0,73	**3307 A**
	80	34,9	52 700	41 500	1 760	5 600	7 500	0,82	**3307 D**
40	80	30,2	47 500	34 000	1 430	5 600	7 500	0,58	**3208 A**
	90	36,5	64 000	44 000	1 860	5 300	6 700	0,95	**3308 A**
	90	36,5	49 400	41 500	1 760	5 000	6 700	1,20	**3308 DNR**
	90	36,5	68 900	64 000	2 450	5 000	6 700	1,15	**3308 D**
45	85	30,2	51 000	39 000	1 630	5 000	6 700	0,63	**3209 A**
	100	39,7	75 000	53 000	2 240	4 800	6 300	1,40	**3309 A**
	100	39,7	61 800	52 000	2 200	4 500	6 000	1,40	**3309 DNR**
	100	39,7	79 300	69 500	3 000	4 500	6 000	1,60	**3309 D**
50	90	30,2	51 000	39 000	1 660	4 800	6 300	0,66	**3210 A**
	110	44,4	90 000	64 000	2 750	4 300	5 600	1,85	**3310 A**
	110	44,4	81 900	69 500	3 000	4 000	5 300	1,90	**3310 DNR**
	110	44,4	93 600	85 000	3 600	4 000	5 300	2,10	**3310 D**
55	100	33,3	60 000	47 500	2 000	4 300	5 600	1,05	**3211 A**
	120	49,2	112 000	81 500	3 450	3 800	5 000	2,55	**3311 A**
	120	49,2	95 600	83 000	3 550	3 800	5 000	2,50	**3311 DNR**
	120	49,2	111 000	100 000	4 300	3 600	4 800	2,75	**3311 D**
60	110	36,5	73 500	58 500	2 500	4 000	5 300	1,40	**3212 A**
	130	54	127 000	95 000	4 050	3 400	4 500	3,25	**3312 A**
65	120	38,1	80 600	73 500	3 100	3 400	4 500	1,75	**3213 A**
	140	58,7	146 000	110 000	4 550	3 200	4 300	4,10	**3313 A**
	140	58,7	138 000	122 000	5 100	3 200	4 300	4,00	**3313 DNR**

* The designations of bearings belonging to the Explorer range are printed blue. Information on available variants see pages 34 and 35.



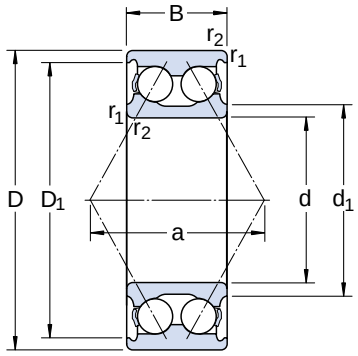


Conversion factors:

Length:	1 mm	=	0,0394 in.
	1 in.	=	25,4 mm
Force:	1 N	=	0,225 lbf
	1 lbf	=	4,4482 N
Mass:	1 kg	=	2,205 lb
	1 lb	=	0,454 kg

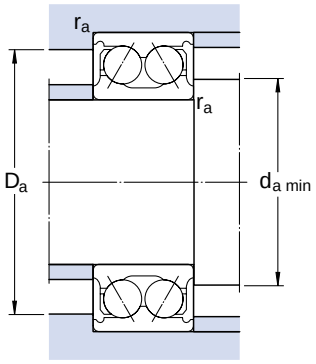
Dimensions					**Abutment and fillet dimensions**			
d	d_1 ~	D_1 ~	$r_{1,2}$ min	a	d_a min	d_a max	D_a max	r_a
mm					mm			
10	15,8	25	0,6	16	14,4	15,5	25,6	0,6
12	17,2	27,7	0,6	19	16,4	17	27,6	0,6
15	20,2	30,7	0,6	21	19,4	20	30,6	0,6
	23,7	35,7	1	24	20,6	23,5	36,4	1
17	23,3	35	0,6	23	21,4	23	35,6	0,6
	25,7	40,2	1	28	22,6	25,5	41,4	1
20	27,7	40,9	1	28	25,6	27,5	41,4	1
	29,9	44	1,1	30	27	29,5	45	1
25	32,7	45,9	1	30	30,6	32,5	46,4	1
	35,7	53,4	1,1	36	32	35,5	55	1
30	38,7	55,2	1	36	35,6	38,5	56,4	1
	39,8	64,1	1,1	42	37	39,5	65	1
35	45,4	63,9	1,1	42	42	45	65	1
	44,6	70,5	1,5	47	43,5	44,5	71	1,5
	52,8	71,5	1,5	76	44	-	71	1,5
40	47,8	72,1	1,1	46	47	47,5	73	1
	50,8	80,5	1,5	53	48,5	50,5	81	1,5
	60,1	79,5	1,5	71	49	-	81	1,5
	59,4	80,3	1,5	84	49	-	81	1,5
45	52,8	77,1	1,1	49	52	52,5	78	1
	55,6	90	1,5	58	54	55,5	91	1,5
	66,9	88,4	1,5	79	54	-	91	1,5
	66,6	88,6	1,5	93	54	-	91	1,5
50	57,8	82,1	1,1	52	56,5	57,5	83	1
	62	99,5	2	65	60,5	61,5	99	2
	73,5	98,3	2	88	61	-	99	2
	73	97,2	2	102	61	-	99	2
55	63,2	92,3	1,5	57	63	63	91	1,5
	68,4	109	2	73	66	68	109	2
	80,5	108	2	97	66	-	109	2
	81,3	108	2	114	66	-	109	2
60	68,8	101	1,5	63	69	68,5	101	1,5
	73,4	118	2,1	78	72	73	118	2
65	76,3	113	1,5	69	74	76	111	1,5
	78,5	130	2,1	84	77	78	128	2
	94	127	2,1	114	77	-	128	2

Double-row angular contact ball bearings
d **70 – 110** mm



Principal dimensions			Basic load ratings dynamic	static	Fatigue load limit	Speed ratings Lubrication grease	oil	Mass	Basic designation*
d	D	B	C	C_0	P_u				
mm			N		N	r/min		kg	-
70	125	39,7	88 400	80 000	3 400	3 200	4 300	1,90	**3214 A**
	150	63,5	153 000	125 000	5 000	3 000	4 000	5,05	**3314 A**
75	130	41,3	95 800	88 000	3 750	3 200	4 300	2,10	**3215 A**
	160	68,3	176 000	140 000	5 500	2 800	3 800	5,60	**3315 A**
80	140	44,4	106 000	95 000	3 900	3 000	4 000	2,65	**3216 A**
	170	68,3	182 000	156 000	6 000	2 400	3 400	6,80	**3316 A**
85	150	49,2	124 000	110 000	4 400	2 600	3 600	3,40	**3217 A**
	180	73	195 000	176 000	6 550	2 200	3 200	8,30	**3317 A**
90	160	52,4	130 000	120 000	4 550	2 400	3 400	4,15	**3218 A**
	190	73	195 000	180 000	6 400	2 000	3 000	9,00	**3318 A**
95	170	55,6	152 000	146 000	5 400	2 200	3 200	5.00	**3219 A**
	200	77,8	225 000	216 000	7 500	1 900	2 800	11,00	**3319 A**
100	180	60,3	178 000	166 000	6 000	2 000	3 000	6,10	**3220 A**
	215	82,6	255 000	255 000	8 650	1 800	2 600	13,50	**3320 A**
110	200	69,8	212 000	212 000	7 200	1 900	2 800	8,80	**3222 A**
	240	92,1	291 000	305 000	9 800	1 700	2 400	19,00	**3322 A**

* The designations of bearings belonging to the Explorer range are printed blue. Information on available variants see pages 34 and 35.



Conversion factors:

Length:	1 mm	=	0,0394 in.
	1 in.	=	25,4 mm
Force:	1 N	=	0,225 lbf
	1 lbf	=	4,4482 N
Mass:	1 kg	=	2,205 lb
	1 lb	=	0,454 kg

Dimensions					**Abutment and fillet dimensions**		
d	d_1 ~	D_1 ~	$r_{1,2}$ min	a	d_a min	D_a max	r_a
mm					mm		
70	82	118	1,5	74	79	116	1,5
	94,8	124	2,1	91	82	138	2
75	84,6	123	1,5	77	84	121	1,5
	103	135	2,1	96	87	148	2
80	97,7	120	2	82	91	129	2
	108	141	2,1	101	92	158	2
85	104	128	2	88	96	139	2
	115	153	3	110	99	166	2,5
90	111	139	2	94	101	149	2
	123	160	3	114	104	176	2,5
95	119	147	2,1	101	107	158	2
	127	168	3	118	109	186	2,5
100	126	155	2,1	107	112	168	2
	136	180	3	127	114	201	2,5
110	139	172	2,1	119	122	188	2
	153	200	3	142	124	226	2,5

Other SKF angular contact ball bearings

Precision angular contact ball bearings

SKF manufactures high-precision angular contact ball bearings for the machine tool industry. These radial angular contact ball bearings are available as series 719, 70 and 72 with two different contact angles. For additional information please ask for our catalogue “High-precision bearings“.

Four-point contact ball bearings

Four-point contact ball bearings are single row angular contact ball bearings having raceways that are so designed that the bearings can support axial loads acting in both directions. They take up less space axially than double-row bearings.

They are designed to accommodate loads, which are predominantly axial and in many applications they are used as thrust bearings together with cylindrical roller bearings that take the radial loads. For additional information on these bearings, consult the "SKF General Catalogue" or the "SKF Interactive Engineering Catalogue" on CD-ROM or online at www.skf.com.

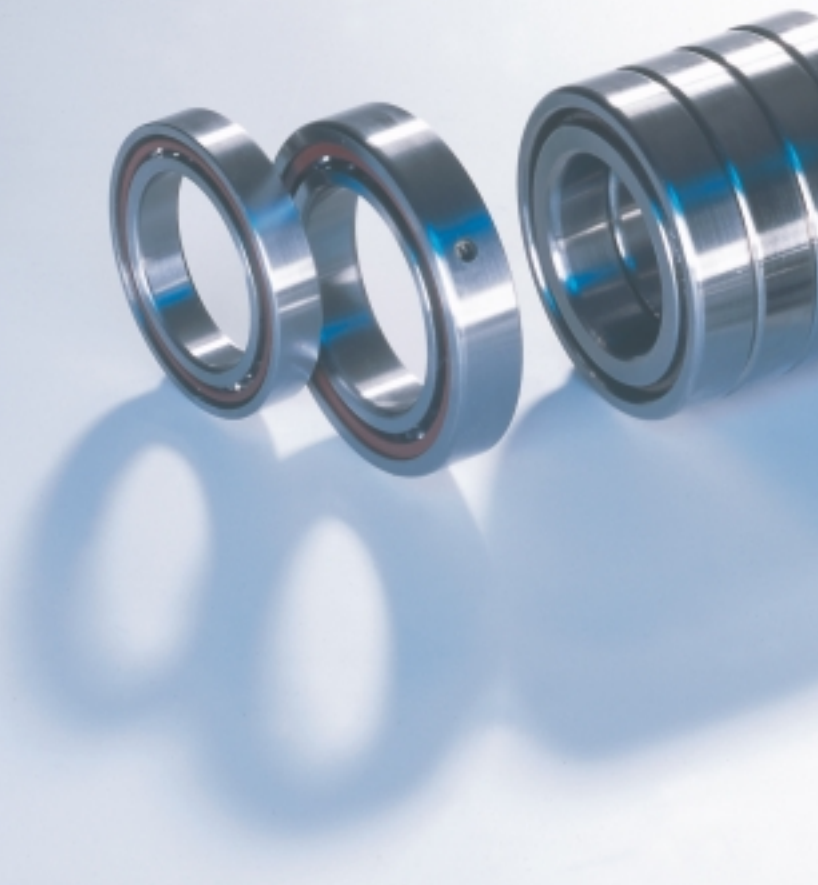
Hybrid bearings

Angular ball bearings are also manufactured as hybrid bearings. These bearings combine steel rings with ceramic balls. They are typically used in applications where there is inadequate lubrication, excessive amounts of contamination or stray electrical currents. Even under poor lubrication conditions there is no metal-to-metal contact between the raceways and balls because of the ceramic material.

Hybrid bearings can attain a service life 3 to 30 times longer than a comparable all-steel bearing.

Angular contact thrust ball bearings

High axial stability is important for bearings in roller or precision ball screws. The manufacturing quality of SKF angular contact thrust ball bearings, their running accuracy and low friction contribute to their outstanding positioning accuracy of machine tool spindles or ball screws. You can find additional information in the SKF catalogue "High-precision bearings".



Electrically-insulated bearings

To insulate bearings in electrical drives from stray currents, SKF INSOCOAT® bearings can be used. Available only from SKF, this ceramic coating is applied to the outer or inner ring of bearings used in electric applications. For additional information on SKF INSOCOAT® bearings, contact your local SKF representative. You can also find more information in our publication 5225.

NoWear® bearings

NoWear bearings consist of steel rings and rolling elements, but the rolling elements and, if necessary, the raceways are coated with a diamond-like carbon. NoWear bearings are typically used in applications where there are special operating conditions like high speeds with low loads, poor lubrication or high levels of contamination. For additional information about NoWear bearings, see publication 5047.

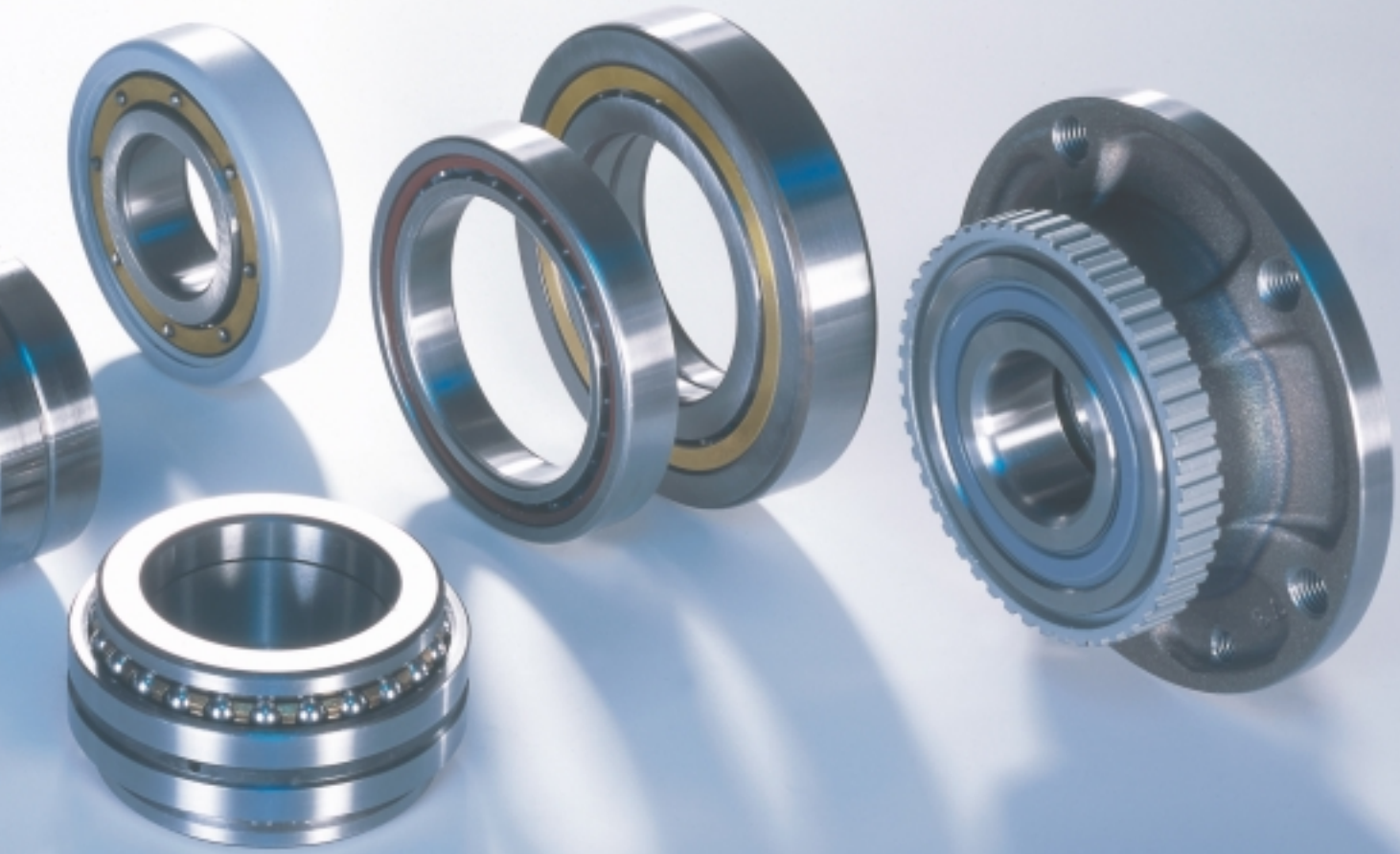
Application-specific bearing units

SKF manufactures optimised angular contact ball bearing units for special applications. They can be, for example, double-row units with different contact angles or units with flanges for quick installation, sealed and lubricated for life. For application-specific units, please contact your SKF representative.

Special designs for the automobile industry

Angular contact ball bearings can be adapted easily to new applications. The automobile industry uses this characteristic to its advantage in clutches, motors, drives, steering assemblies and hub units.

SKF manufactures complete hub units in a large variety of designs. Clutch release bearings and wire race ball bearings for steering columns also belong to our programme.



The SKF Group – a worldwide corporation

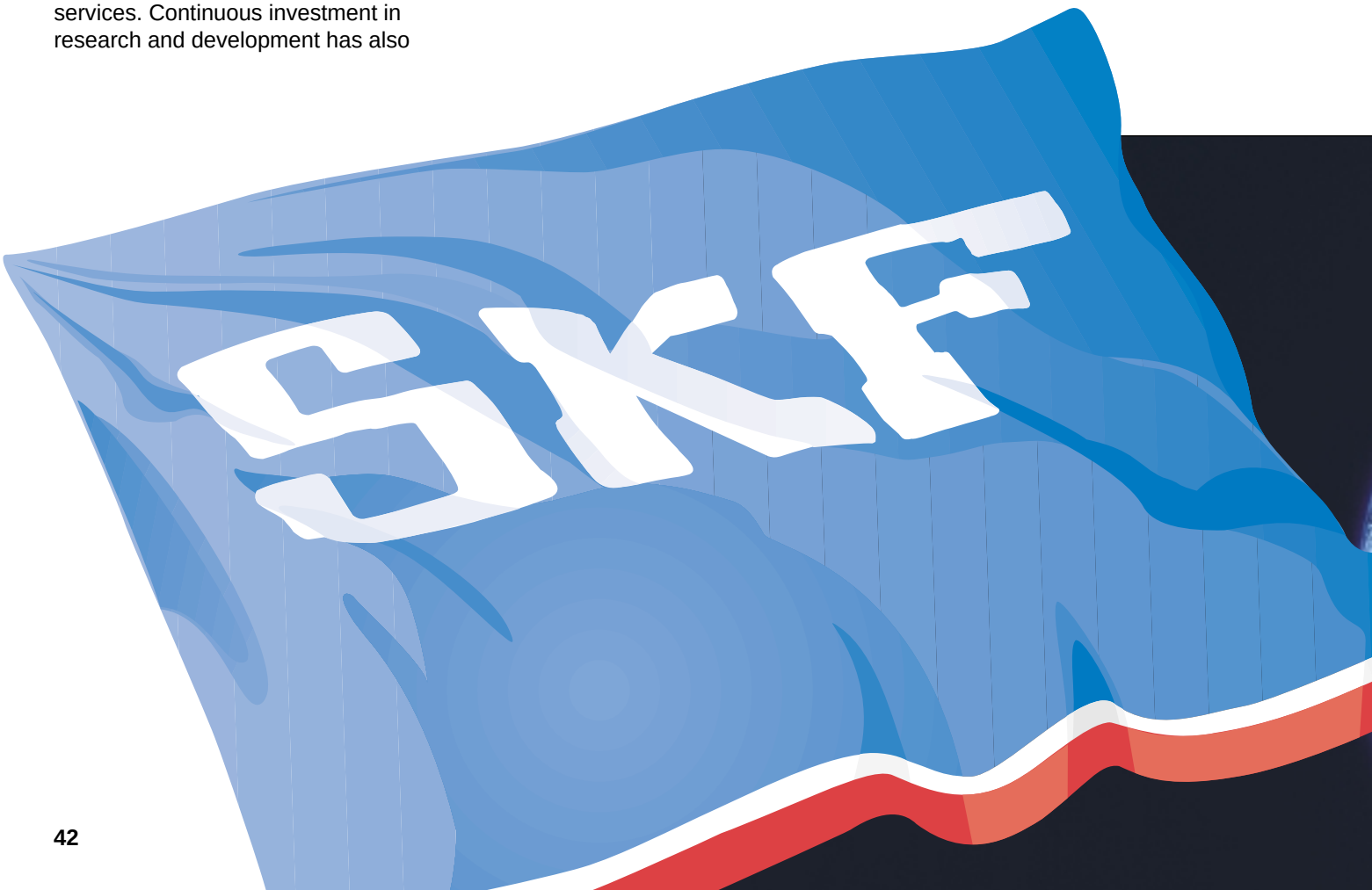
SKF is an international industrial Group operating in some 130 countries and is world leader in bearings.

The company was founded in 1907 following the invention of the self-aligning ball bearing by Sven Wingquist and, after only a few years, SKF began to expand all over the world.

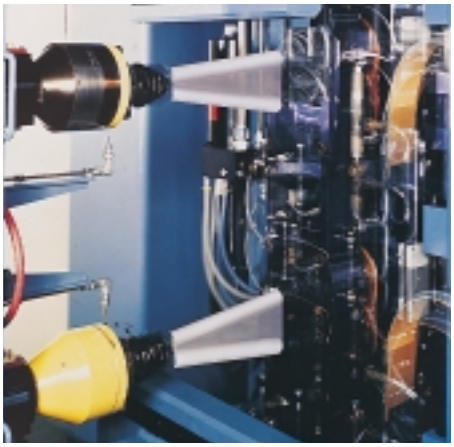
Today, SKF has some 40 000 employees and around 80 manufacturing facilities spread throughout the world. An international sales network includes a large number of sales companies and some 7 000 distributors and retailers. Worldwide availability of SKF products is supported by a comprehensive technical advisory service.

The key to success has been a consistent emphasis on maintaining the highest quality of its products and services. Continuous investment in research and development has also played a vital role, resulting in many examples of epoch-making innovations.

The business of the Group consists of bearings, seals, special steel and a comprehensive range of other high-tech industrial components. The experience gained in these various fields provides SKF with the essential knowledge and expertise required in order to provide the customers with the most advanced engineering products and efficient service.



The SKF Group is the first major bearing manufacturer to have been granted approval according to ISO 14001, the international standard for environmental management systems. The certificate is the most comprehensive of its kind and covers more than 60 SKF production units in 17 countries.



The SKF Engineering & Research Centre is situated just outside Utrecht in The Netherlands. In an area of 17,000 square metres (185,000 sq.ft) some 150 scientists, engineers and support staff are engaged in the further improvement of bearing performance. They are developing technologies aimed at achieving better materials, better designs, better lubricants and better seals – together leading to an even better understanding of the operation of a bearing in its application. This is also where the SKF Life Theory was evolved, enabling the design of bearings which are even more compact and offer even longer operational life.

SKF has developed the Channel concept in factories all over the world. This drastically reduces the lead-time from raw material to end product as well as work in progress and finished goods in stock. The concept enables faster and smoother information flow, eliminates bottlenecks and bypasses unnecessary steps in production. The Channel team members have the knowledge and commitment needed to share the responsibility for fulfilling objectives in areas such as quality, delivery time, production flow etc.

SKF manufactures ball bearings, roller bearings and plain bearings. The smallest are just a few millimetres (a fraction of an inch) in diameter, the largest several metres. SKF also manufactures oil and bearing seals which prevent dirt from entering and lubricant from leaking out. SKF's subsidiaries CR and RFT S.p.A. are among the world's largest producers of seals.

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Publication **5105 E**

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