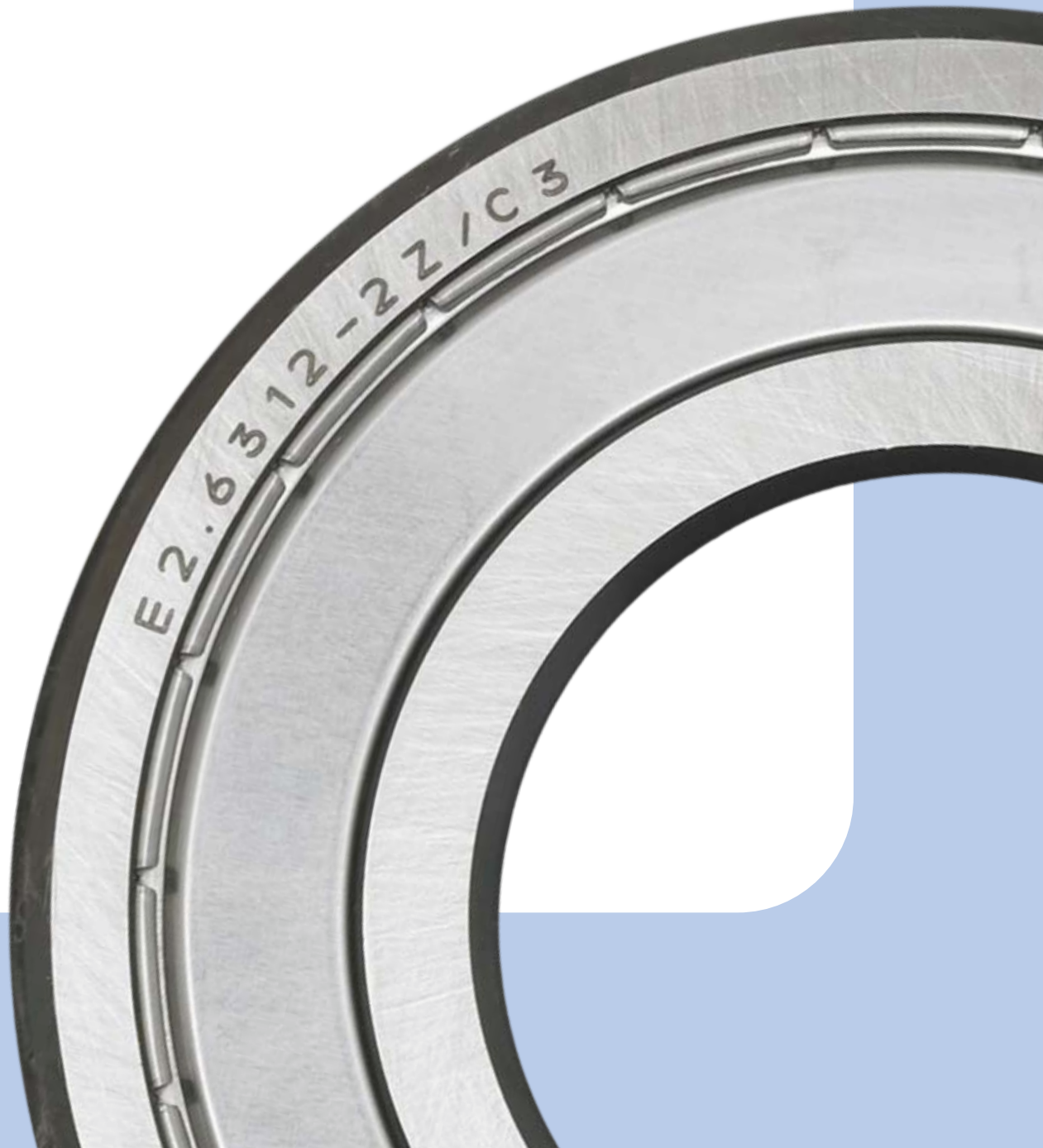


SKF Energy Efficient deep groove ball bearings



Reduced friction for reduced energy use



E2.6312-2Z/C3

SKF Energy Efficient bearings

Engineered to promote sustainability

As the need to conserve energy grows more apparent every day, the technology that enables even a small reduction in energy consumption is big news.

Drawing on over 100 years of engineering knowledge and unmatched expertise in the field of tribology and related sciences, SKF has created a new, low-friction deep groove ball bearing. The SKF Energy Efficient (E2) deep groove ball bearing is the first bearing type, in the SKF family of bearings, to represent the new SKF E2 performance class.

While SKF bearings have continually evolved toward ever greater efficiency and reliability, this new performance class represents a significant breakthrough. SKF E2 deep groove ball bearings reduce frictional losses in a bearing by 30% or more when compared to a comparably sized standard SKF bearing. This means that when compared to other manufacturers' bearings, the reduction can be even more dramatic.

Designed for grease lubricated, light-to-normal load applications, SKF E2 deep groove ball bearings also consume less lubricant than comparable SKF Explorer bearings and enable longer bearing service life.

With all their special features, this new performance class of bearings is designed to improve machine efficiency and advance everyone's goal of a sustainable planet.

Reduce friction – reduce energy consumption

Frictional losses waste energy – energy that could have been used to run machinery. But more importantly, it represents energy that will not be available to future generations. Therefore, reducing the amount of friction generated by the bearing by at least 30% is an achievement with far-reaching implications. The potential for energy savings on a global scale is huge.

Longer service life lowers cost of ownership

Optimized to reduce frictional losses in the bearing and provide longer service life, shielded SKF Energy Efficient deep groove ball bearings can last twice as long as comparably sized shielded standard SKF bearings in light-to-normal load applications. This means that the number of bearings needed to run an application over its lifetime can be halved. In instances where an application is run-to-failure, these E2 bearings can conceivably outlast other components in the application.



The distinctive mark for SKF Energy Efficient products

SKF E2 deep groove ball bearings

For light to normal load applications

The operating conditions for deep groove ball bearings typically are characterized by light to normal loads at relatively high speeds. Typical examples include electric motors, pumps, conveyors and fans. SKF Energy Efficient deep groove ball bearings are designed specifically for these applications.

Reduced frictional moment

Diagram 1 illustrates the effectiveness of SKF Energy Efficient deep groove ball bearings in a 3 kW electric motor. In this example, the motor was equipped with standard SKF deep groove ball bearings and later with SKF E2 bearings. The free running time after the power was switched off was measured. With SKF E2 bearings, the free running time was about 50% longer.

Extended grease life means longer bearing service life

In light to normal load applications, metal fatigue is rarely an issue, but grease life is a limiting factor when determining the life of a sealed bearing.

Compared to standard SKF shielded deep groove ball bearings, SKF Energy Efficient deep groove ball bearings can more than double the mean time between failure (→ **diagram 2**) due to reduced heat generated by the bearings and the specially formulated SKF low-friction grease.

Recommended operating conditions for SKF Energy Efficient deep groove ball bearings:

- $P \leq 0,125 C$
- Speeds greater than 1 000 r/min

Diagram 1

Speed-time curves after switching off an electrical motor

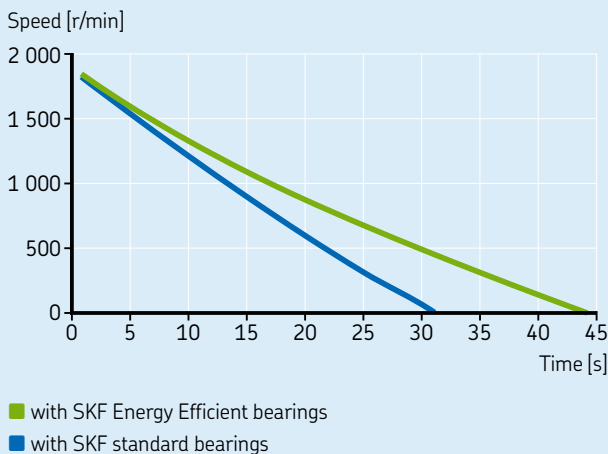
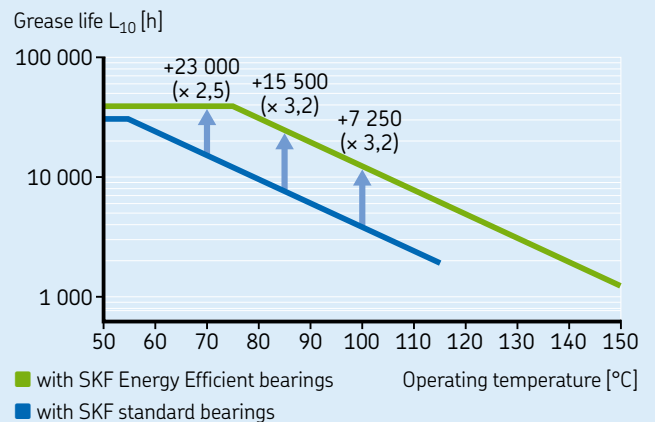


Diagram 2

Grease life comparison between SKF Energy Efficient and standard SKF deep groove ball bearings

Operating conditions: Speed factor $A = 300\ 000\ \text{mm/min}$
Load: $P = 0,066 C$



Test results

Frictional moment

The frictional moment of an SKF Energy Efficient bearing (E2.6306-2Z/C3) was measured under various operating conditions. When compared with the frictional moment of a standard SKF shielded deep groove ball bearing, the E2 bearing showed, on average, approximately a 50% reduction (→ **diagram 3**). Compared to other manufacturers' bearings, the percentage reduction in the frictional moment could be even greater.

Cage behaviour

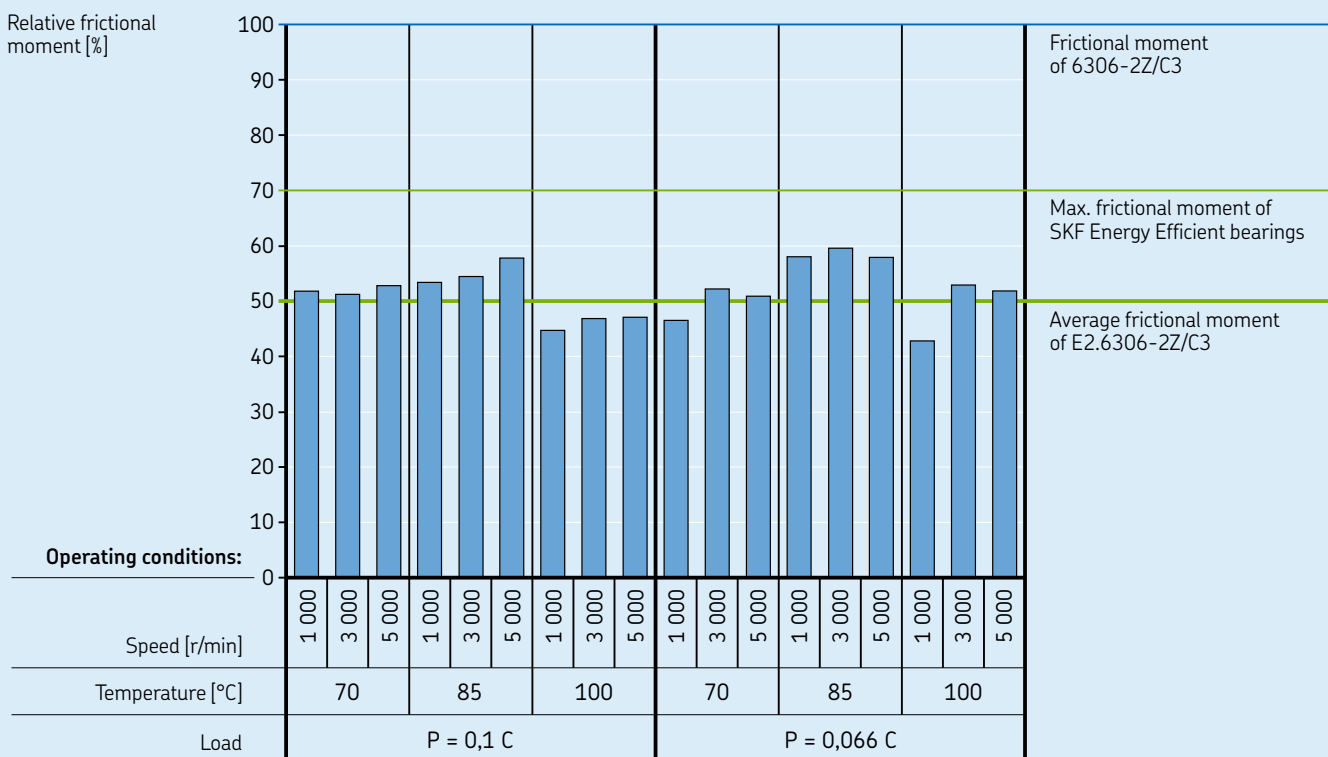
The cage design is one of the key features of SKF Energy Efficient deep groove ball bearings. The fundamental redesign produced a lighter cage that is less susceptible to deformation during operation. **Fig. 1** shows the reduced deformation experienced by a polyamide cage of an E2 bearing when compared to the polyamide cage of a standard SKF bearing.



Fig. 1
A polyamide cage from a standard SKF bearing and an E2 bearing are running at 8 000 r/min. The E2 cage on the right shows significantly less deformation.

Diagram 3

Frictional moment of an SKF Energy Efficient bearing compared to an SKF standard bearing



Operating temperature

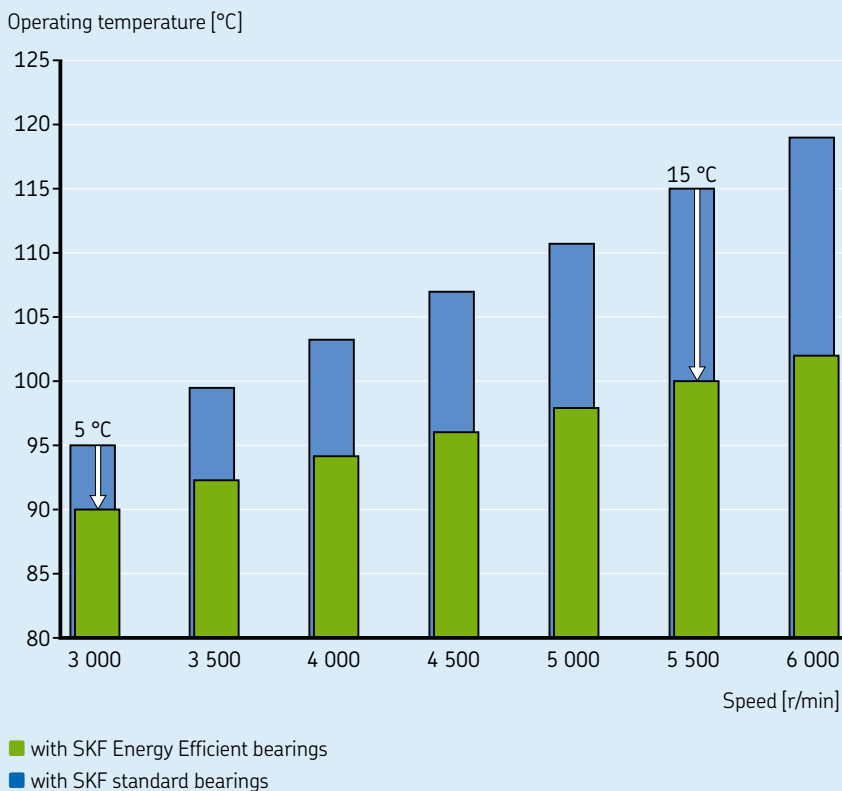
The operating temperatures of SKF Energy Efficient bearings and standard SKF bearings were measured at certain speeds and compared (→ **diagram 4**). Test conditions were:

- Bearing: 6205-2Z/C3
- Running time: 24 h at each speed interval
- Ambient temperature: room temperature
- Load: 0,5 kN radial

The test showed that when compared to a standard SKF bearing, the E2 bearing ran 5 to 15 °C cooler, depending on speed.

Diagram 4

Operating temperature at different speeds, test results



Application recommendations

Determining the fatigue life using life equations

The method used to determine fatigue life is the same for both SKF E2 deep groove ball bearings and standard SKF deep groove ball bearings.

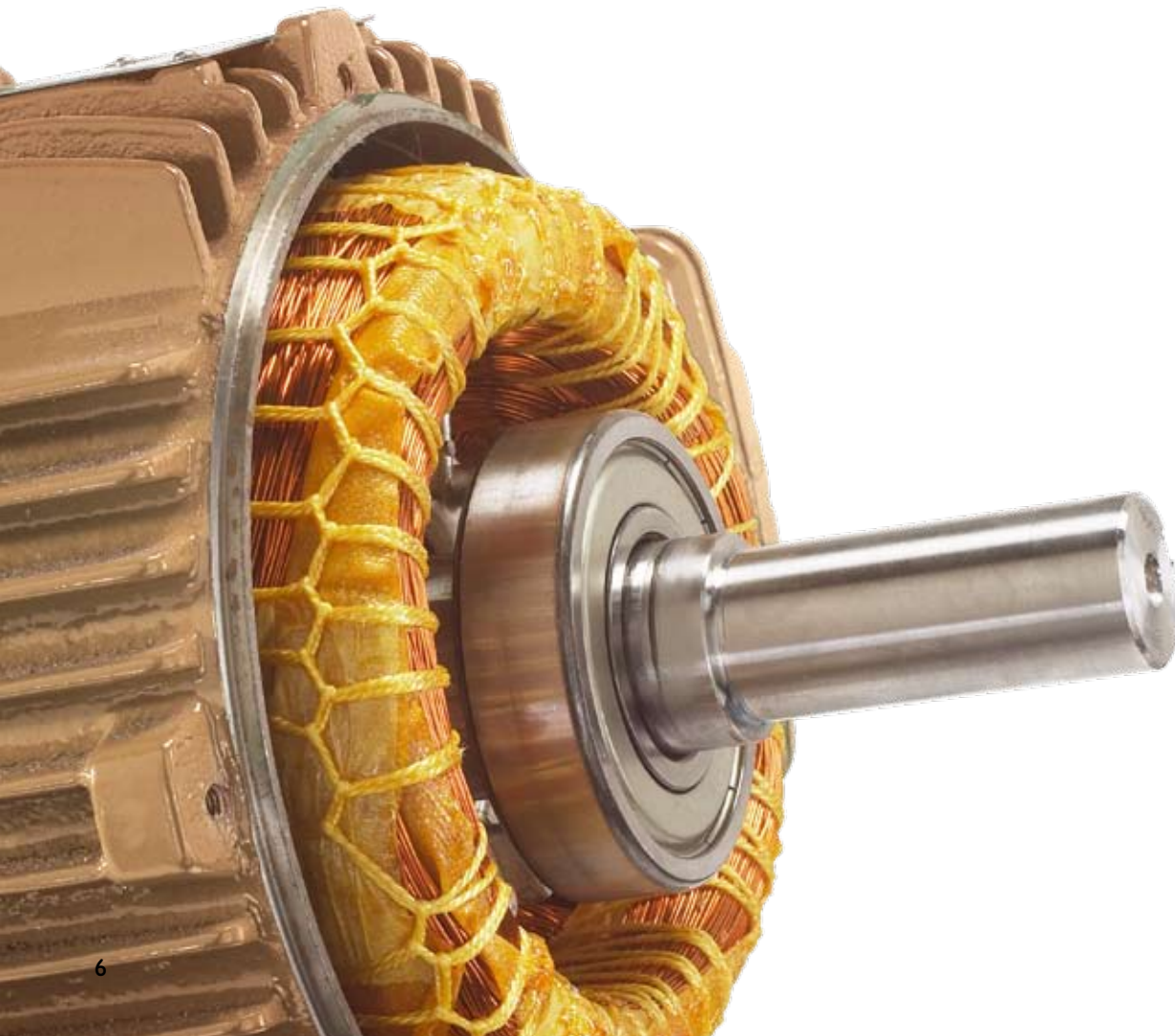
SKF recommends using the SKF rating life equations as described in the *SKF General Catalogue* or the *SKF Interactive Engineering Catalogue* available online at www.skf.com.

Determining the permissible speed

Operating under the recommended load conditions ($P \leq 0,125 C$), the permissible speed of SKF Energy Efficient deep groove ball bearings is equal to the limiting speed as listed in the product table. If an SKF E2 deep groove ball bearing is to be operated outside the recommended operating conditions or above the limiting speed, contact the SKF application engineering service.

Calculating the frictional moment

Calculating the frictional moment for SKF Energy Efficient deep groove ball bearings can only be done with the calculation tools provided in the *SKF Interactive Engineering Catalogue* available online at www.skf.com. The formulae and factors provided in the *SKF General Catalogue* are not valid for SKF Energy Efficient bearings.



Determining the service life of the grease

Under the recommended operating conditions, the service life of the grease in shielded SKF Energy Efficient deep groove ball bearings defines the service life of the bearing and can be estimated using **diagram 5**. The estimate is based on an L_{10} grease life. This is defined as the period of time, at the end of which, 90% of a sufficiently large group of seemingly identical bearings are still reliably lubricated.

Grease life depends mainly on the following factors:

- operating temperature
- speed
- load

The diagram provides grease life estimates based on operating temperature and speed. It is valid for light loads ($P \leq 0,05 C$) and bearings on a horizontal shaft. For more heavily loaded bearings, the grease life must be reduced. Appropriate reduction factors are listed in **table 1**. For bearings on a vertical shaft, the grease life should be halved. The speed is considered using the speed factor A:

$$A = n d_m$$

where

A = speed factor [mm/min]

n = rotational speed [r/min]

d_m = bearing mean diameter [mm]
= 0,5 (d + D)

To make adjustments for other operating conditions, refer to the recommendations in the *SKF General Catalogue* or contact the SKF application engineering service.

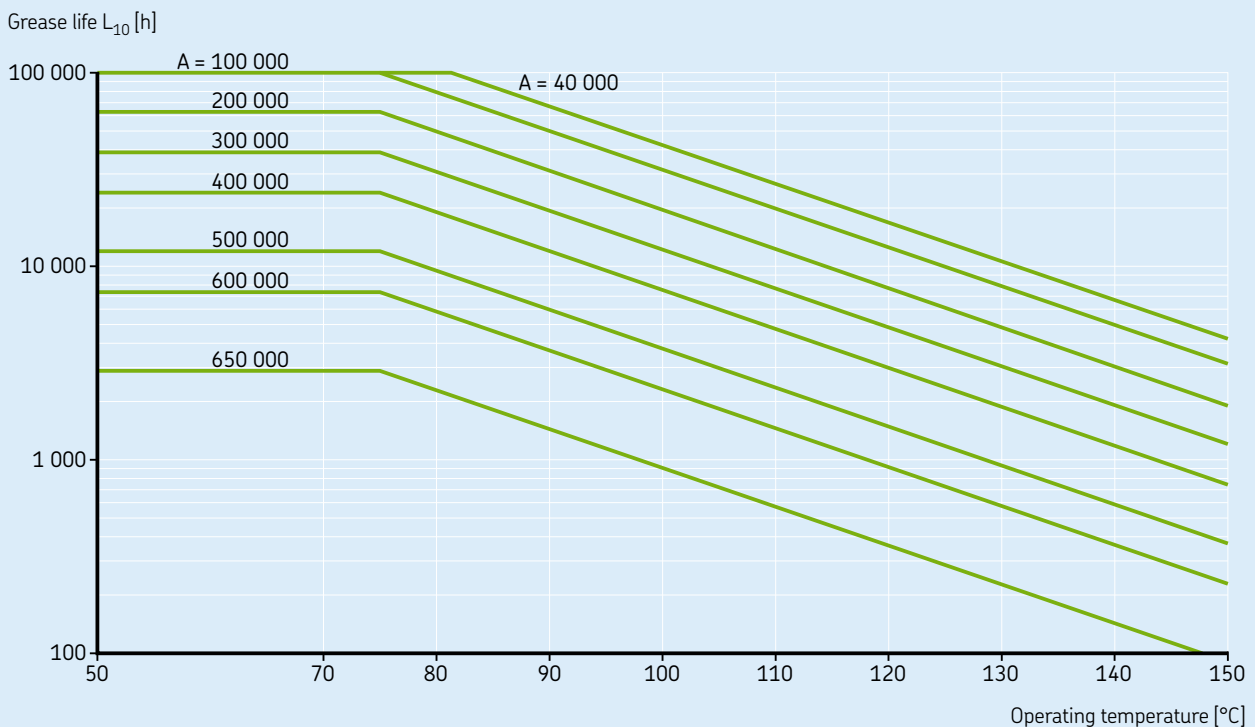
Table 1

Reduction factors for the grease life, depending on load

Load P	Reduction factor
$\leq 0,05 C$	1
0,1 C	0,7
0,125 C	0,5
0,25 C	0,2

Diagram 5

Grease life for SKF Energy Efficient deep groove ball bearings for load $P = 0,05 C$



Product data

SKF Energy Efficient deep groove ball bearings are available in the 60, 62 and 63 dimension series. The current assortment is listed in the product table. Bore sizes range from 5 to 60 mm.

The assortment will be expanded according to customer demands. For the most up-to-date information, contact your local SKF representative or visit www.skf.com/e2.

Designs

Bearings with shields

SKF Energy Efficient deep groove ball bearings are fitted on both sides with a shield made of sheet steel, as standard. The bearings are supplied filled with a special low-noise, low-friction SKF grease (→ **table 2**). The grease fill is not identified in the bearing designation. The quantity of grease fills some 25 to 35% of the free space in the bearing.

The bearings are lubricated for life and are maintenance-free. They should not be washed or heated to temperatures above 80 °C. Shielded bearings are primarily intended for applications where the inner ring rotates. If the outer ring rotates, there is a risk that the grease will leak from the bearing at high speeds.

Open bearings

For open SKF Energy Efficient deep groove ball bearings, contact the SKF application engineering service or your local SKF representative. To achieve the maximum performance of SKF Energy Efficient deep groove ball bearings such as double the lubrication interval, open bearings must be greased with the proper quantity of SKF LEGE 2 grease.

Table 2

Grease in SKF Energy Efficient deep groove ball bearings				
Thickener	Lithium soap			
Base oil type	Synthetic oil			
NLGI consistency class	2			
Temperature range [°C]	-50	55	150	190
[°F]	-60	130	300	375

Cages

SKF Energy Efficient deep groove ball bearings are fitted with a ball centred snap-type cage made of a temperature-resistant glass fibre reinforced composite polymer. The cage design is not identified in the bearing designation.

Bearing data

Dimensions

The boundary dimensions of SKF Energy Efficient deep groove ball bearings are in accordance with ISO 15:1998. This makes the bearings dimensionally interchangeable with deep groove ball bearings of the same size in the same dimension series.

Tolerances

SKF Energy Efficient deep groove ball bearings are manufactured to P6 tolerances for dimensional accuracy. The width tolerance is reduced to:

- 0/-60 µm for bearings with an outside diameter ≤ 110 mm
- 0/-100 µm for bearings with an outside diameter > 110 mm

The running accuracy depends on the bearing size and corresponds to:

- P5 tolerances for bearings with an outside diameter ≤ 52 mm
- P6 tolerances for bearings with an outside diameter > 52 mm ≤ 110 mm
- Normal tolerances for bearings with an outside diameter > 110 mm

Internal clearance

SKF Energy Efficient deep groove ball bearings are manufactured with C3 radial internal clearance as standard. Bearings with radial internal clearance other than C3 can be supplied on request.

Misalignment

SKF Energy Efficient deep groove ball bearings have the same operating characteristics as standard SKF deep groove ball bearings. In other words, depending on the various influencing factors, the permissible angular misalignment lies between 2 and 10 minutes of arc. Any misalignment will increase bearing noise and reduce bearing service life. For additional information, refer to the *SKF General Catalogue* or the *SKF Interactive Engineering Catalogue* available online at www.skf.com.

Minimum load

Rolling bearings should always be subjected to a given minimum load. The requisite minimum radial load to be applied to SKF Energy Efficient deep groove ball bearings can be estimated using

$$F_{rm} = \frac{k_r}{T} (5,2 n)^{2/3} \left(\frac{d_m}{100} \right)^2$$

where

F_{rm} = minimum radial load [kN]

k_r = minimum load factor

0,025 for bearings in the
60 and 62 series

0,03 for bearings in the 63 series

T = operating temperature [°C]

n = rotational speed [r/min]

d_m = bearing mean diameter [mm]
= 0,5 (d + D)

When starting at low temperatures, even greater minimum loads may be required. For applications like electric motors, where the requisite radial load is not sufficient, springs can be used to apply an axial preload instead.

Axial load carrying capacity

SKF Energy Efficient deep groove ball bearings have the same axial load carrying capacity as standard SKF deep groove ball bearings. If they are subjected to purely axial loads, this load should generally not exceed the value of 0,5 C_0 . Small bearings (bore diameter up to approximately 12 mm) and bearings in the 60 series should not be subjected to an axial load greater than 0,25 C_0 . Excessive axial load can lead to a reduction in bearing service life.

Equivalent bearing loads

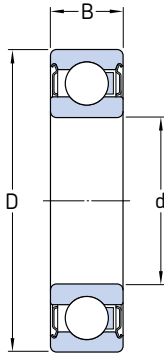
Equivalent bearing loads for SKF Energy Efficient deep groove ball bearings can be calculated the same way as for standard SKF deep groove ball bearings. For additional information, refer to the *SKF General Catalogue* or the *SKF Interactive Engineering Catalogue* available online at www.skf.com.

Designations and package identification

The designations for SKF Energy Efficient deep groove ball bearings follow the basic SKF designation system. However, the prefix "E2." has been added to avoid confusion. SKF Energy Efficient bearings are supplied in a new standard box.

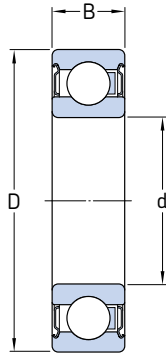


E2 shielded deep groove ball bearings
d 5 – 20 mm

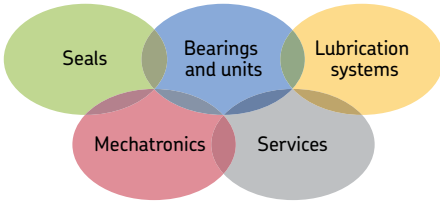


Principal dimensions			Basic load ratings		Fatigue load limit P_u	Speed ratings		Mass	Designations
d	D	B	dynamic C	static C_0		Reference speed	Limiting speed		
mm			kN		kN	r/min	kg	–	
5	16	5	1,14	0,38	0,016	104 000	55 000	0,005	E2.625-2Z
	19	6	2,21	0,95	0,04	90 000	47 000	0,009	E2.635-2Z
6	19	6	2,21	0,95	0,04	90 000	47 000	0,008	E2.626-2Z
	22	7	3,32	1,37	0,06	80 000	42 000	0,013	E2.607-2Z E2.627-2Z
8	22	7	3,32	1,37	0,06	80 000	42 000	0,012	E2.608-2Z
	24	8	3,71	1,66	0,072	75 000	37 000	0,017	E2.628-2Z
9	24	7	3,71	1,66	0,072	75 000	37 000	0,014	E2.609-2Z
	26	8	4,62	1,93	0,08	70 000	36 000	0,020	E2.629-2Z
10	26	8	4,62	1,93	0,08	70 000	36 000	0,019	E2.6000-2Z
	30	9	5,07	2,32	0,098	61 000	32 000	0,032	E2.6200-2Z
	35	11	8,32	3,4	0,143	55 000	29 000	0,053	E2.6300-2Z
12	28	8	5,07	2,32	0,098	66 000	33 000	0,022	E2.6001-2Z
	32	10	7,02	3,1	0,132	55 000	29 000	0,037	E2.6201-2Z
	37	12	9,95	4,15	0,176	49 000	25 000	0,060	E2.6301-2Z
15	32	9	5,53	2,75	0,118	55 000	28 000	0,030	E2.6002-2Z
	35	11	7,8	3,75	0,16	47 000	25 000	0,045	E2.6202-2Z
	42	13	11,4	5,3	0,224	41 000	21 000	0,082	E2.6302-2Z
17	35	10	5,85	3	0,127	49 000	25 000	0,039	E2.6003-2Z
	40	12	9,56	4,75	0,2	41 000	21 000	0,065	E2.6203-2Z
	47	14	13,8	6,55	0,275	37 000	19 000	0,12	E2.6303-2Z
20	42	12	9,36	5	0,212	41 000	21 000	0,069	E2.6004-2Z
	47	14	12,7	6,55	0,275	35 000	19 000	0,11	E2.6204-2Z
	52	15	16,3	7,8	0,34	33 000	17 000	0,14	E2.6304-2Z

E2 shielded deep groove ball bearings
d 25 – 60 mm



Principal dimensions			Basic load ratings		Fatigue load limit P_u	Speed ratings		Mass	Designations
d	D	B	dynamic	static C_0		Reference speed	Limiting speed		
mm			kN		kN	r/min		kg	–
25	47	12	11,1	6,1	0,26	35 000	18 000	0,08	E2.6005-ZZ
	52	15	13,8	7,65	0,325	30 000	16 000	0,13	E2.6205-ZZ
	62	17	22,9	11,6	0,49	27 000	15 000	0,23	E2.6305-ZZ
30	55	13	12,7	7,35	0,31	31 000	16 000	0,12	E2.6006-ZZ
	62	16	19,5	11,2	0,475	26 000	14 000	0,20	E2.6206-ZZ
	72	19	28,6	16	0,67	22 000	13 000	0,35	E2.6306-ZZ
35	72	17	25,5	15,3	0,64	22 000	12 000	0,29	E2.6207-ZZ
	80	21	33,8	19	0,815	21 000	11 000	0,46	E2.6307-ZZ
40	80	18	30,7	18,6	0,78	19 000	10 000	0,37	E2.6208-ZZ
	90	23	41	24	1,02	19 000	9 900	0,63	E2.6308-ZZ
45	85	19	32,5	20,4	0,865	18 000	9 900	0,41	E2.6209-ZZ
	100	25	52,7	31,5	1,34	17 000	8 700	0,83	E2.6309-ZZ
50	110	27	62,4	38	1,6	15 000	7 800	1,05	E2.6310-ZZ
55	120	29	71,5	45	1,9	14 000	7 300	1,35	E2.6311-ZZ
60	130	31	81,9	52	2,2	13 000	6 500	1,70	E2.6312-ZZ



The Power of Knowledge Engineering

Drawing on five areas of competence and application-specific expertise amassed over more than 100 years, SKF brings innovative solutions to OEMs and production facilities in every major industry worldwide. These five competence areas include bearings and units, seals, lubrication systems, mechatronics (combining mechanics and electronics into intelligent systems), and a wide range of services, from 3-D computer modelling to advanced condition monitoring and reliability and asset management systems. A global presence provides SKF customers uniform quality standards and worldwide product availability.



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