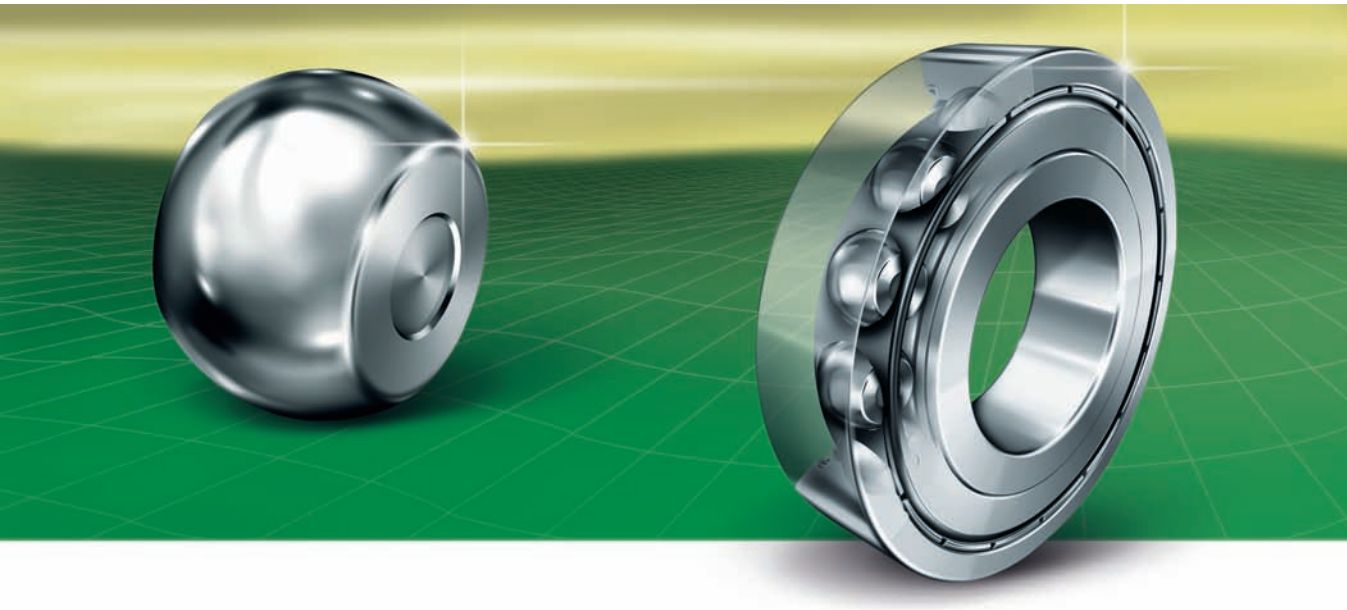


Single Row Ball Roller Bearings

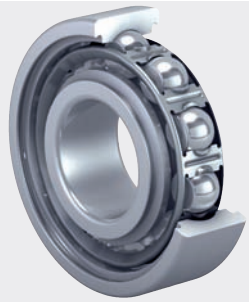
New design between ball and roller bearings

SCHAEFFLER GROUP
INDUSTRIAL

Single row ball roller bearings

Open

BXRE

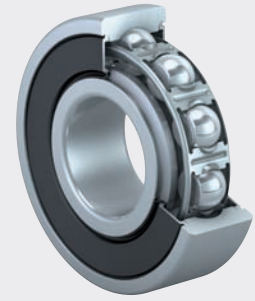


Gap seals

BXRE..-2Z

Lip seals

BXRE..-2HRS, BXRE..-2RSR



Single row ball roller bearings

Features

A new generation of rolling bearings

The single row ball roller bearing BXRE from Schaeffler Group Industrial represents a completely new generation of rolling bearings.

This type follows the simple and progressive design philosophy of reducing the ball as a standard rolling element to only what is necessary for transmitting the load. On both sides of the ball, the areas not involved in transmitting load were therefore removed. The result is a new geometry and a narrower rolling element than the classical ball, the ball roller.

This gives a versatile, self-retaining rolling bearing with a solid section outer ring, an inner ring and ball cage, containing a large number of ball rollers.

Closing the gap between the ball bearing and roller bearing

The ball roller bearing is similar in construction to the deep groove ball bearing, is robust in operation, easy to maintain and is available open or sealed on both sides.

The dimensions conform to DIN 625, which means that the bearings can be used in the design envelope specified in accordance with this standard.

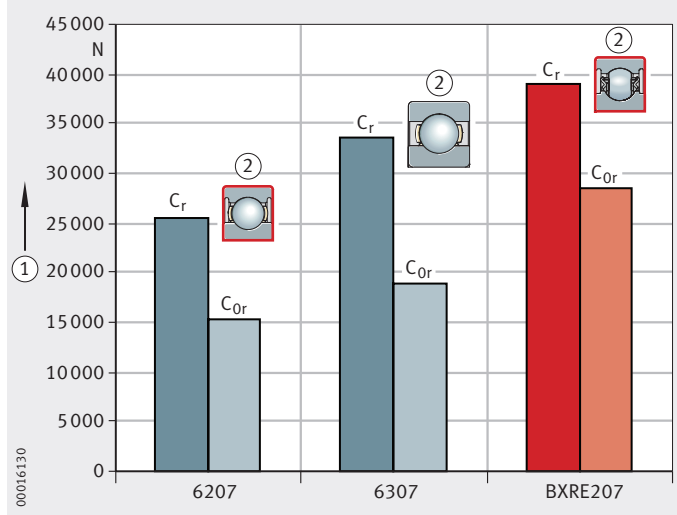
For suitability of ball roller bearings in comparison with other bearing types, see page 5.

Small cross section, high load carrying capacity

The cross-section of the ball roller bearing corresponds to that of series 62. Its load carrying capacity even exceeds that of series 63, *Figure 1*.

For the bearing arrangement, this means that

- a smaller design envelope is required in order to achieve the same performance or
- increased performance is available from the same design envelope.



① Load carrying capacity
② Cross-section
C_r = basic dynamic load rating (radial)
C_{0r} = basic static load rating (radial)

Figure 1
Cross-section and load carrying capacity (cross-section values)

Radial and axial load carrying capacity

Due to the raceway geometry and the rolling elements, ball roller bearings can support moderate axial loads in both directions as well as very high radial loads.

High degree of filling

The good radial load carrying capacity is achieved by the fact that the bearing contains up to 50% more rolling elements compared to a deep groove ball bearing. For example, the deep groove ball bearing 6207 contains nine rolling elements, while the comparable size BXRE207 contains fourteen.

In order to achieve the high degree of filling of more than 90%, Schaeffler has developed special assembly technology for introducing the ball rollers.

Compensation of angular misalignments

The angular adjustment facility of single row ball roller bearings is limited, so the bearing positions must be well aligned.

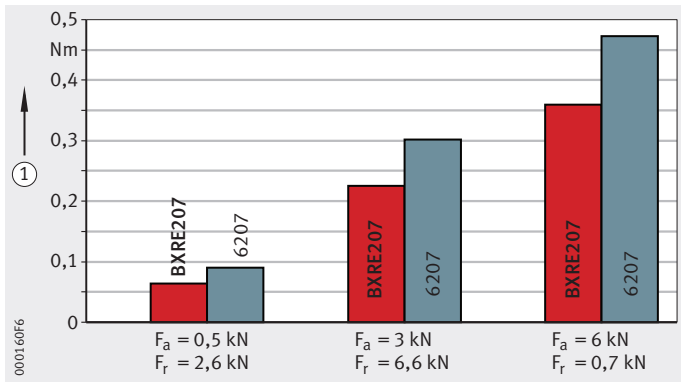
Misalignments can lead to unfavourable running of the ball rollers and induce additional loads in the bearing that affect the operating life. In order to keep these loads low, the adjustment angles permissible for single row ball roller bearings are smaller than those for deep groove ball bearings.

The permissible angular misalignments are 2′ to 8′, dependent on the load.

Low frictional torque

Due to the large number of rolling elements and the resulting lower forces acting on the rolling elements, ball roller bearings run with less friction than standard ball bearings with a comparable load carrying capacity and give higher performance for the same design envelope.

The comparison of the stationary frictional torque moment between a BXRE207 and a deep groove ball bearing 6207 is shown as a function of load in *Figure 2*.



① Frictional torque
F_a = axial dynamic bearing load
F_r = radial dynamic bearing load

Figure 2
Comparison of frictional torques

Ball bearings, ball roller bearings, cylindrical roller bearings – comparison

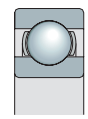
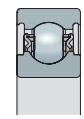
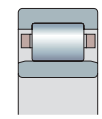
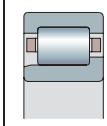
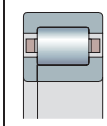
The different rolling bearing types have specific characteristics due to their design. Depending on the type, they are suitable for widely differing applications.

Ball roller bearings are designed such that they fulfil a range of technical and economic requirements to an excellent degree. This new type can be used to achieve optimum designs for new bearing arrangements and to replace existing bearing arrangements.

The following overview shows comparable rolling bearing types and describes their suitability for the requirements placed on a bearing.

In the application, the information in this TPI as well as in Catalogue HR 1, Rolling Bearings, must be observed.

Preliminary bearing selection

Criteria	Rolling bearings				
	Deep groove ball bearings DIN 625	Ball roller bearings	Cylindrical roller bearings DIN 5 412		
					
		BXRE	NU, N	NJ	NUP
Radial load carrying capacity	+	++	+++	+++	+++
Axial load carrying capacity	+	++	––	++	+
Combined load	++	+	––	–	++
Alternating axial load	+	––	––	––	++
Locating bearing	+++	++	––	+	+++
Suitability for high speeds	+++	++	–	–	–
Elongation in the bearing	––	––	+++	–	––
Elongation by means of a sliding seat	+	+	––	––	+
Friction behaviour	+++	+++	++	++	++
Lubrication (grease chamber)	++	+++	++	++	++

+++ Very good
++ Good
+ Normal
– Restricted
–– Not suitable

Single row ball roller bearings

Sealing

The bearings are available open as well as with gap seals or lip seals.

Designs with gap seals have the suffix 2Z, bearings with lip seals have the suffix 2HRS or 2RSR.

Other seal designs are available by agreement.

Lubrication

Open bearings can be lubricated with grease or oil.

Bearings sealed on both sides are greased for life using a lithium soap grease with a mineral oil base.

The further guidelines on grease types and greasing in Catalogue HR 1, Rolling Bearings, chapter Lubrication, must be observed.

Grease chamber

Due to the flattened areas on the balls and the specific cage design, the grease chamber in the bearing is significantly larger.

For example, a BXRE207 has a grease chamber over 40% larger than a deep groove ball bearing 6207. As a result, ball roller bearings are maintenance-free for many applications.

If relubrication is required, this gives a considerable extension in the relubrication intervals.

Matched bearing pairs

By agreement, matched bearing pairs in an O, X or tandem arrangement are available.

Sets in an O arrangement can support axial loads in both directions as well as tilting moments.

Sets in an X arrangement can support axial loads in both directions but are not suitable for tilting moments.

For high axial loads in one direction, bearing pairs in a tandem arrangement are suitable.

For the design of matched bearing sets, see also Catalogue HR 1, Rolling Bearings, chapter Deep groove ball bearings.

Operating temperature

Open bearings and bearings with gap seals can be used at temperatures from –40 °C to +120 °C.

Ball roller bearings with lip seals are suitable for operating temperatures from –40 °C to +110 °C. The temperature is restricted by the grease and the sealing ring material.

Dimensional stability

Ball roller bearings are heat treated and dimensionally stable up to +120 °C.

Temperatures above +120 °C require special heat treatment. Such designs are available by agreement and are identified by the suffixes S0 to S4 in accordance with DIN 623-1.

The information on suffixes for higher temperatures in Catalogue HR 1, Rolling Bearings, chapter Bearing data, must be observed.

Cage

Single row ball roller bearings are supplied with a single-piece sheet steel window cage.

For special applications, cages are available made from polyamide PA66.

Suffixes

Suffixes for available designs, see table.

Available designs

Suffix	Description	Design
DB	Two ball roller bearings in O arrangement, matched clearance-free	Available by agreement
DF	Two ball roller bearings in X arrangement, matched clearance-free	
DT	Two ball roller bearings in tandem arrangement, matched clearance-free	
TVH	Cage made from glass fibre reinforced polyamide PA66	
2HRS	Lip seals on both sides in series 60, 62	Standard
2RSR	Lip seals on both sides	
2Z	Gap seals on both sides	

Areas of application

Ball roller bearings BXRE are particularly suitable for an application where:

- the available radial and axial design envelope is small
- high radial loads and moderate axial loads are present
- the requirement is for low frictional torques.

They are suitable for bearing arrangements in:

- electric motors
- washing machines
- chain saws
- industrial gearboxes
- general machine building applications.

Design and safety guidelines

Dynamic load carrying capacity and life

The fatigue behaviour of the material determines the dynamic load carrying capacity of a rolling bearing.

The dynamic load carrying capacity is described in terms of the basic dynamic load rating and the basic rating life L_{10} or L_{10h} in accordance with DIN ISO 281.

The fatigue life is dependent on:

- the load
- the operating speed
- the statistical probability of the first appearance of failure.

For rotating rolling bearings, the decisive parameter is the basic dynamic load rating C_r, see dimension table.

Basic rating life

The basic rating life L_{10} and L_{10h} is determined as follows:

$$L_{10} = \left(\frac{C}{P}\right)^p$$

$$L_{10h} = \frac{16\,666}{n} \cdot \left(\frac{C}{P}\right)^p$$

L_{10} — 10^6 revolutions
The basic rating life in millions of revolutions is the life reached or exceeded by 90% of a sufficiently large group of apparently identical bearings before the first evidence of material fatigue develops

L_{10h} — h
The basic rating life in operating hours according to the definition for L_{10}

C (C_r) — N
Basic radial dynamic load rating, see dimension table

P — N
Equivalent dynamic bearing load for combined load, see page 9

p — –
Life exponent for ball bearings: p =3

n — min^{-1}
Operating speed.

For calculation of the adjusted rating life and the expanded adjusted rating life, see Catalogue HR 1, Rolling Bearings, chapter Load carrying capacity and life.

Equivalent dynamic bearing load

The equivalent dynamic bearing load P is a calculated value. This value is constant in magnitude and direction; it is a radial load for radial bearings and an axial load for axial bearings.

If the load P is used, this gives the same rating life as the combined load occurring in practice.

For bearings under dynamic loading, the following applies:

Load ratio and equivalent dynamic bearing load

Load ratio	Equivalent dynamic bearing load
$\frac{F_a}{F_r} \leqq e$	$P = F_r$
$\frac{F_a}{F_r} > e$	$P = X \cdot F_r + Y \cdot F_a$

P N
Equivalent dynamic bearing load for combined load

F_a N
Axial dynamic bearing load

F_r N
Radial dynamic bearing load

e –
Calculation factor, see table Calculation factors

X –
Calculation factor (radial load factor), see table Calculation factors

Y –
Calculation factor (axial load factor), see table Calculation factors.

The values in the table Calculation factors are valid for normal fits:
- shaft to j5 or k5, housing to J6.

Calculation factors

$\frac{f_0 \cdot F_a}{C_{0r}}$	Factor for radial internal clearance								
	CN			C3			C4		
	e	X	Y	e	X	Y	e	X	Y
0,3	0,22	0,56	2	0,32	0,46	1,7	0,4	0,44	1,4
0,5	0,24	0,56	1,8	0,35	0,46	1,56	0,43	0,44	1,31

f_0 –
Factor for deep groove ball bearings, see Catalogue HR 1, Rolling Bearings, chapter Deep groove ball bearings, section Design and safety guidelines

F_a N
Axial dynamic bearing load

C_{0r} N
Basic static load rating, see dimension table.

Operating life

The operating life is defined as the life actually achieved by the bearing. It may differ significantly from the calculated value.

Due to the wide variety of possible installation and operating conditions, it is not possible to precisely predetermine the operating life. The most reliable way of arriving at a close estimate is by comparison with similar applications.

Static load carrying capacity

Very high static loads or shock loads can cause plastic deformation on the raceways and rolling elements. This deformation limits the static load carrying capacity of the rolling bearing with respect to the permissible noise level during operation of the bearing.

Rolling bearings that undergo rotary movement only rarely or not at all are specified in accordance with the basic static load rating C_0. This is, according to DIN ISO 76, a constant radial load C_{0r} for radial bearings.

For further information on the static load carrying capacity, see Catalogue HR 1, Rolling Bearings, chapter Load carrying capacity and life.

Static load safety factor

In addition to dimensioning on the basis of the fatigue limit life, it is advisable to check the static load safety factor S_0.

The static load safety factor indicates the security against impermissible permanent deformations in the bearing.

$$S_0 = \frac{C_0}{P_0}$$

S_0 –
Static load safety factor

C_0 N
Basic radial static load rating, see dimension table

P_0 N
Equivalent static bearing load.

Axial load carrying capacity

If the bearings are subjected to axial load only, the axial should not exceed the value $F_a = 0{,}5 \cdot C_0$. If the axial loads are too high, this can considerably reduce the operating life of the bearings.

If alternating axial load is present, please consult Schaeffler.

Minimum radial load

In order to ensure operation without slippage, the bearings must be subjected to a minimum load $F_{r\,min}$ in a radial direction.
This applies particularly in the case of high speeds and high accelerations. In continuous operation, a minimum radial load of the order of $P/C_r > 0{,}02$ is therefore necessary.

Speed suitability

Ball roller bearings have a speed parameter of $n \cdot d_m = 600\,000$ and therefore do not permit speeds as high as those of comparable deep groove ball bearings.

Running noise

Despite the large number of rolling elements, the running noise is comparable with that of standard deep groove ball bearings of the same size.

Design of bearing arrangements

Shaft and housing tolerances

For recommended shaft and housing tolerances, see Catalogue HR 1, Rolling Bearings, chapter Design of bearing arrangements.

Mounting dimensions

The dimension tables give the maximum dimension of the radius r_a and the diameters of the abutment shoulders D_a and d_a.

Accuracy

The main dimensions of single row ball roller bearings correspond to DIN 625-1.

The dimensional and geometrical tolerances correspond to tolerance class PN to DIN 620. Bearings with the tolerance classes P6 and P5 to DIN 620 are available by agreement.

The width tolerance of matched bearings differs from these.

For the width tolerance of the bearing rings, see Catalogue HR 1, Rolling Bearings, chapter Deep groove ball bearings.

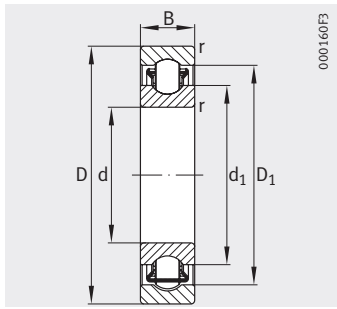
Radial internal clearance

The radial internal clearance corresponds to the internal clearance group CN to DIN 620-4.

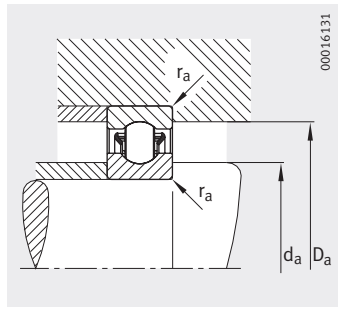
Bearings with the internal clearance C2 or C3 and other internal clearance values are available by agreement.

Ball roller bearings

Single row
Open



BXRE



Mounting dimensions

Dimension table · Dimensions in mm

Designation[1]	Mass[2]	Dimensions						Mounting dimensions			Basic load ratings		Fatigue limit load	Limiting speed[3]	Reference speed	Interchange with deep groove ball bearings
	m	d	D	B	r	D_1	d_1	d_a	D_a	r_a	dyn. C_r	stat. C_{0r}	C_{ur}	n_G	n_B	
	≈kg				min.	≈	≈	min.	max.	max.	N	N	N	min^{-1}	min^{-1}	Series
BXRE08	0,013	**8**	22	7	0,3	18,5	14,5	10	20	0,3	4 400	2 370	120	37 000	22 300	**60**
BXRE000	0,02	**10**	26	8	0,3	21,1	15,6	12	24	0,3	7 100	3 700	187	33 500	19 900	**60**
BXRE001	0,023	**12**	28	8	0,3	23,1	17,6	14	26	0,3	7 700	4 200	214	30 000	17 500	**60**
BXRE002	0,032	**15**	32	9	0,3	26,6	21,1	17	30	0,3	8 500	5 200	265	25 500	15 700	**60**
BXRE003	0,042	**17**	35	10	0,3	29,1	23,6	19	33	0,3	8 800	5 800	295	23 100	15 200	**60**
BXRE004	0,066	**20**	42	12	0,6	35,4	27,6	23,2	38,8	0,6	15 200	9 500	480	19 400	11 500	**60**
BXRE005	0,086	**25**	47	12	0,6	40,4	32,6	28,2	43,8	0,6	16 600	11 600	590	16 700	10 200	**60**
BXRE006	0,124	**30**	55	13	1	47,2	38,9	34,6	50,4	1	19 800	15 200	770	14 100	8 600	**60**
BXRE007	0,166	**35**	62	14	1	53,7	44,5	39,6	57,4	1	24 800	20 000	1 010	12 400	7 300	**60**
BXRE008	0,202	**40**	68	15	1	59,7	49,6	44,6	63,4	1	29 500	24 300	1 230	11 100	6 500	**60**
BXRE009	0,258	**45**	75	16	1	65,7	55,6	49,6	70,4	1	31 000	27 500	1 400	10 000	6 000	**60**
BXRE010	0,283	**50**	80	16	1	70,7	60,6	54,6	75,4	1	32 500	31 000	1 570	9 200	5 400	**60**
BXRE011	0,414	**55**	90	18	1,1	79,2	67,3	61	84	1	42 000	39 000	1 970	8 300	4 950	**60**
BXRE012	0,446	**60**	95	18	1,1	84,2	72,3	66	89	1	42 500	41 500	2 100	7 700	3 950	**60**

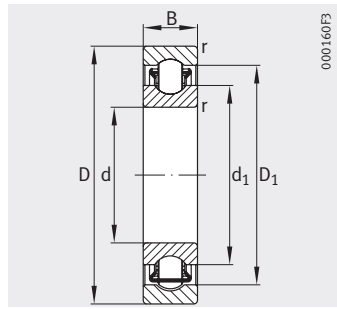
1) Available by agreement.

2) The values apply for bearings of the basic design (open, without greasing). Greased and sealed bearings will differ slightly in mass from these values.

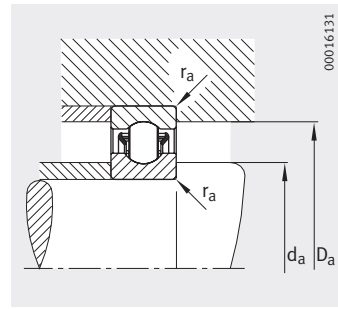
3) $n \cdot d_m = 600\,000$.

Ball roller bearings

Single row
Open



BXRE



Mounting dimensions

Dimension table (continued) · Dimensions in mm

Designation[1]	Mass[2]	Dimensions						Mounting dimensions			Basic load ratings		Fatigue limit load	Limiting speed[3]	Reference speed	Interchange with deep groove ball bearings
	m	d	D	B	r	D_1	d_1	d_a	D_a	r_a	dyn. C_r	stat. C_{0r}	C_{ur}	n_G	n_B	
	≈kg				min.	≈	≈	min.	max.	max.	N	N	N	min^{-1}	min^{-1}	Series
BXRE200	0,033	**10**	30	9	0,6	23,9	17	14,2	25,8	0,6	9 100	4 450	226	30 000	17 800	**62**
BXRE201	0,039	**12**	32	10	0,6	25,9	19	16,2	27,8	0,6	10 100	5 200	265	27 500	16 900	**62**
BXRE202	0,046	**15**	35	11	0,6	28,9	22	19,2	30,8	0,6	10 900	6 100	310	24 000	15 700	**62**
BXRE203	0,067	**17**	40	12	0,6	33,2	24,9	21,2	35,8	0,6	14 900	8 500	430	21 100	13 000	**62**
BXRE204	0,11	**20**	47	14	1	38,7	29,5	25,6	41,4	1	18 100	10 800	550	17 900	11 900	**62**
BXRE205	0,138	**25**	52	15	1	43,9	34,4	30,6	46,4	1	21 800	13 900	700	15 600	10 400	**62**
BXRE206	0,206	**30**	62	16	1	52,2	41,2	35,6	56,4	1	28 000	19 300	930	13 000	8 100	**62**
BXRE207	0,308	**35**	72	17	1,1	60,6	47,8	42	65	1	39 000	28 500	1 430	11 200	6 400	**62**
BXRE208	0,397	**40**	80	18	1,1	67,8	54	47	73	1	44 000	33 000	1 670	10 000	5 700	**62**
BXRE209	0,417	**45**	85	19	1,1	73,1	58,7	52	78	1	48 500	37 000	1 860	9 200	5 400	**62**
BXRE210	0,495	**50**	90	20	1,1	78,5	63,5	57	83	1	54 000	43 000	2 180	8 600	5 200	**62**
BXRE211	0,67	**55**	100	21	1,5	86,8	70,4	64	91	1,5	64 000	52 000	2 650	7 700	4 450	**62**
BXRE212	0,85	**60**	110	22	1,5	95,8	77,6	69	101	1,5	78 000	64 000	2 750	7 000	3 800	**62**
BXRE303	0,122	**17**	47	14	1	37,7	27,6	22,6	41,4	1	19 700	11 100	560	18 800	11 600	**63**
BXRE304	0,151	**20**	52	15	1,1	42,2	31,2	27	45	1	23 200	23 200	680	16 700	10 400	**63**
BXRE305	0,253	**25**	62	17	1,1	50,7	37,9	32	55	1	30 500	18 500	940	13 800	8 700	**63**
BXRE306	0,371	**30**	72	19	1,1	59,3	44,7	37	65	1	42 000	27 000	1 370	11 800	7 100	**63**
BXRE307	0,493	**35**	80	21	1,5	66,8	51,3	44	71	1,5	50 000	34 000	1 730	10 300	6 200	**63**
BXRE308	0,68	**40**	90	23	1,5	74,3	57,9	49	81	1,5	55 000	39 500	1 990	9 200	5 900	**63**
BXRE309	0,9	**45**	100	25	1,5	83,4	64,3	54	91	1,5	73 000	53 000	2 650	8 300	5 100	**63**

1) Available by agreement.

2) The values apply for bearings of the basic design (open, without greasing). Greased and sealed bearings will differ slightly in mass from these values.

3) $n \cdot d_m = 600\,000$.

Chain saw – crankshaft bearing arrangement

The manually guided chain saw is driven by an air-cooled single-cylinder two-stroke petrol engine.

On the front of the saw housing is an elongated metal cutting bar, also known as a blade, with a circumferential slot. The saw chain runs in the slot.

The chain has teeth on its outer edge and is driven at the rear end of the bar by the engine via a centrifugal clutch.

Depending on the engine power, the saw can reach speeds of up to 12 m/s. Thanks to their enormous cutting force and ergonomically designed shape, such power saws are handy, robust, reliable, efficient and durable tools in agriculture and forestry.

Requirements

The crankshaft converts the oscillating linear motion of the piston into rotary motion by means of a connecting rod and transmits the engine torque due to the piston force for driving the saw chain to the clutch.

The crankshaft main bearings are open deep groove ball bearings 6202 supporting and guiding the mounted crankshaft via the shaft journal.

Operation involves radial loads of 2 500 N and speeds up to 8 000 min^{-1}.

In order to increase engine power, the design of the saw is being revised. In order to support increased power, the radial load carrying capacity of the rolling bearings as well as their rating life must be adjusted upwards.

The design envelope of the bearings is restricted to the existing dimensions; larger bearings are therefore not an option.

Design solution

The existing deep groove ball bearings are replaced by dimensionally identical ball roller bearings of series BXRE202, *Figure 1*.

Due to the larger number of rolling elements, the basic radial dynamic load rating C_r of these bearings is increased by 39% compared to the load carrying capacity of the series previously fitted. As a result, the basic rating life in operating hours L_{10h} was increased by a factor of 2,5.

In comparison with the design 6202, the maximum Hertzian pressure p_H is reduced by approx. 11%. This reduces the wear at the rolling contact. Furthermore, less strain is placed on the grease in the bearing.

The static load safety factor of 2,5 is above the guide value required for this application of $S_0 > 2$.

Through the use of the ball roller bearing with considerably greater performance capability and reduced friction, the targeted performance increase could be achieved within the same design envelope, see table.

At the same time, it was possible to avoid incurring the costs for a complete redesign of the adjacent construction to new dimensions and for a larger bearing that could reliably support the higher radial loads.

The connecting rod is guided on the crank journal by a needle roller and cage assembly KZK.

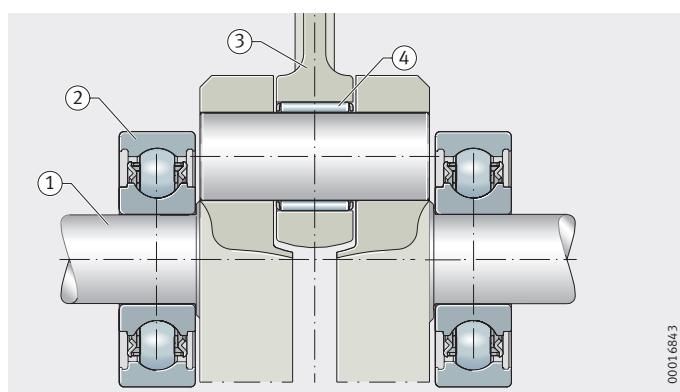
Design and performance data

Series	Number of rolling elements	Basic rating life	Static load safety factor	Hertzian pressure	Basic load ratings	
					dyn.	stat.
		L_{10h}	S_0 [1]	p_H	C_r	C_{0r}
	Z	h		N/mm²	N	N
6202	8	45	1,5	3 382	7 800	3 570
BXRE202	11	113	2,5	3 006	10 900	6 100

[1] $\overline{\text{Guide value}} > 2$.

Lubrication

The ball roller bearings are lubricated by the two-stroke fuel. Due to the petrol/oil mix of 1:50, lubricant starvation is present.



① Shaft journal
② Ball roller bearing BXRE202
③ Connecting rod
④ Needle roller and cage assembly KZK

Figure 1
Crankshaft bearing arrangement

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