Selection / Calculation
Anti-Friction bearing

Maximal permissible load

The maximal permissible load is defined by the static basic load rating C0. If static loads are a combination of radial and axial loads, the equivalent static load will have to be calculated.

P_o	static equivalent load (kN) Series BRM, BRF, PM, PF, WLK: $P_o = Fr + Yo \cdot Fa$ Series BRTF, BRTM, WLT: $P_o = Fr + 5 \cdot Fa$
F_a	axial load (kN)
F_r	radial load (kN)
Y_o	axial factor, static, see tables
C_o	basic static load rating (kN), see tables

Permissible load

$$P_0 \leq C_0 \text{ (N)}$$

nominal service life

DURBAL® - Premium - products with integral self- aligning ball bearing series
Types BRM, BRF, PM, PF, WLK

P	dynamic equivalent load (kN) Series BRM, BRF, PM, PF, WLK: $Po = Fr + Y \cdot Fa$ Series BRTF, BRTM, WLT: $Po = Fr + 9{,}5 \cdot Fa$
C	basic dynamic load rating (kN), see tables
Y	axial factor, dynamic, see tables
$Gh_{rot.}$	nominal service life for rotation (hours of operation)
$Gh_{osz.}$	nominal service life for oscillating movement (hours of operation)
ß	half of swivelling angle (degree), ß = 90 should be used for rotation **Condition:** swivelling angle ß ≥ 3° For swivelling angles ß < 3° we recommend the use of DURBAL®- heavy-duty plain bearing rod ends
n	rotation speed (min^{-1})
f	frequency of oscillation (min^{-1})

rotating:

$$G_{h_{rot.}} = 10^6 \, \frac{\left(\frac{C}{P}\right)^3}{60 \cdot n} \text{ (h)}$$

oscillating:

$$G_{h_{osz.}} = 10^6 \, \frac{\left(\frac{C}{P\sqrt[3]{\frac{\beta}{90}}}\right)^3}{60 \cdot f} \text{ (h)}$$

rotating:

$$G_{h_{rot.}} = 10^6 \frac{\left(\frac{C}{P}\right)^{3,333}}{60 \cdot n} \text{ (h)}$$

oscillating:

$$G_{h_{osz.}} = 10^6 \frac{\left(\frac{C}{P\sqrt[3]{\frac{ß}{90}}}\right)^{3,333}}{60 \cdot f} \text{ (h)}$$

Calculation example

At the rotating side of a crank mechanism a DURBAL®- Premium – antifriction bearing rod end should be installed. The expected service life amounts to at least 5000 hours.

Known: rotation speed $n = 300\ min^{-1}$, radial load $Fr = 0{,}75$ kN

Selected: BRF 8 C = 4,0 kN

$$G_{h_{rot.}} = 10^6 \frac{\left(\frac{C}{P}\right)^{3}}{60 \cdot n}$$

$$= 10^6 \frac{\left(\frac{4{,}0}{0{,}75}\right)^{3}}{60 \cdot 300} = \underline{\underline{8428 \text{ h} > 5000 \text{ h}}} \quad ☑$$

Selection / Calculation

Sliding bearing construction maintenance free[01]

Permissible load

The maximal permissible load is calculated by using equation (1). If static loads are a combination of radial and axial loads, the equivalent static load will have to be calculated.

$P_{max.}$	maximum permissible load (kN)
C_0	static basic load (KN), see tables
C_2	temperature factor, see table (4)
C_4	factor for type of load, see table (3)
P	equivalent dynamic load (kN)
F_r	radial load (kN)
F_a	axial load (kN), condition: $F_a \leq 0{,}3 \cdot F_r$

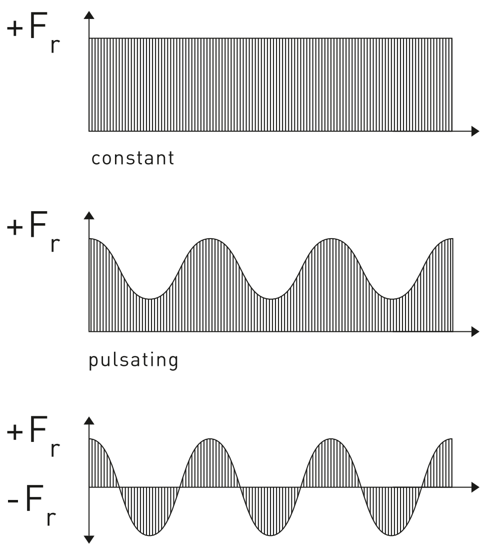
Permissible load

$$P_{max.} = C_0 \cdot C_2 \cdot C_4 \qquad \textbf{(1)}$$

$$P = F_r + Y x\ F_a \leq P_{max} \qquad \textbf{(2)}$$

The axial factor Y is taken from the table below. Intermediate values can be interpolated linearly.

Load ratio	$\frac{F_a}{F_r}$	0,1	0,2	0,3
Axial factor	Y	0,8	1	1,5



Load		Factor C_4
constant	time	1,0
pulsating	time	0,3
alternating	time	0,2

(3)

Temperature factor C_2				
Temperature			C_2	
	up to	60° C	1,0	
60° C	to	80° C	0,8	
80° C	to	100° C	0,7	
100° C	to	120° C	0,6	
120° C	to	140° C	0,4	steel / PTFE
140° C	to	200° C	0,3	steel / PTFE

(4)

Permissible sliding velocity

The permissible sliding velocity of our heavy-duty rod ends and spherical-plain bearings mainly depends on the load and temperature conditions. Heat generated by friction in our products is the main limitation on sliding velocity. When selecting our product size, it is necessary to determine the sliding velocity and the pv-value, which is a product of the specific bearing load **p** (N/mm^2) and the sliding velocity **v** (m/s).

P	specific bearing load (N/mm^2)
C	basic dynamic load rating (N), see tables
k	specific load factor (N/mm^2) for DURBAL® - tribological pairing $k = 50\ N/mm^2$

$$p = k \cdot \frac{P}{C}$$

V_m	mean sliding velocity (m/s)
d_k	pivot ball diameter (mm), see tables
ß	half swivelling angle (degree), for swivelling angle > 180° ß = 90° to be used
f	frequency of oscillation (min^{-1})

$$V_m = 5{,}82 \cdot 10^{-7} \cdot d_k \cdot ß \cdot f$$

Permissible Factor pV
p = specific pressure (N/mm2)
Vm = average sliding speed (m/s)

Sliding pairing	v max (m/s)	p x Vm (N/mm_2 x m/s)
Polyamid - PFTE - Fibreglass Compound	0,15	0,50
Steel on PTFE	0,40	0,41

G	nominal service life (number of oscillations or revolutions)
G_h	nominal service life (hours)
C_1	load direction factor, see table (5)
C_3	material factor, see alignment chart (6)

nominal service life

$$G = C_1 \cdot C_2 \cdot C_3 \cdot \frac{3}{d_k \cdot ß} \cdot \frac{C}{P} \cdot 10^8$$

$$G_h = C_1 \cdot C_2 \cdot C_3 \cdot \frac{5}{d_k \cdot ß \cdot f} \cdot \frac{C}{P} \cdot 10^6$$

Load direction factor C_1

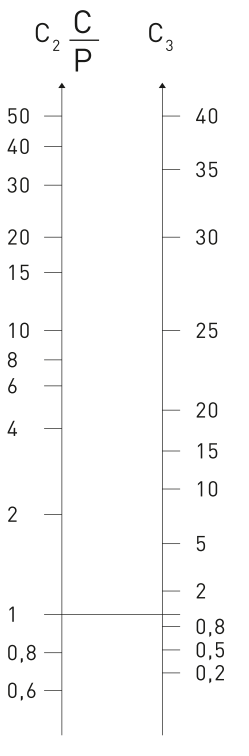
Single load direction: C_1= 1,0

Alternating load direction,

at f < 30 min^{-1}: **C_1 = 0,250**

at f > 30 min^{-1}: **C_1 = 0,125**

(5)



(6)

Selection / Calculation

Sliding bearing construction maintenance free[02]

Calculation example

The rod end assembly of a conveyor equipment calls for a heavy-duty rod end with a service life of 7000 hours in conjunction with an alternating acting load of 5 kN. 25 swivelling movements with a swivelling angle of 20° take place per minute. The operating temperature amounts to approx. 60° C. The choice is a DURBAL®-heavy-duty rod end EF 15-20-501 with: C = 13,4 kN, dk = 22 mm.

Checking the permissible load of the rod end

$$P_{max.} = 41 \cdot 0{,}2 \cdot 1{,}0 = 8{,}2\ kN > 5{,}0\ kN$$ ☑

C_0	= 41 kN
C_2	= 1,0 (temperature 60° C)
C_4	= 0,2 (alternating load)

Checking the permissible sliding velocity

$$V_m = 5{,}82 \cdot 10^{-7} \cdot d_k \cdot ß \cdot f = 5{,}82 \cdot 10^{-7} \cdot 22 \cdot 10 \cdot 25$$

$$= \underline{\underline{0{,}0032\ m/s < 0{,}15\ m/s}}$$ ☑

Checking the p · V -value

$$p = k \cdot \frac{P}{C} = 50 \cdot \frac{5000}{13400} = 18{,}66\ N/mm^2$$

$$pV = p \cdot V_m$$

$$pV = 18{,}66 \cdot 0{,}0032$$

$$= 0{,}06\ N/mm^2 \cdot m/s < 0{,}5\ N/mm2 \cdot m/s$$ ☑

$$G_h = C_1 \cdot C_2 \cdot C_3 \cdot \frac{5}{d_k \cdot ß \cdot f} \cdot \frac{C}{P} \cdot 10^6$$

$$G_h = 0{,}25 \cdot 1{,}0 \cdot 12 \cdot \frac{5}{22 \cdot 10 \cdot 25} \cdot \frac{13{,}4}{5{,}0} \cdot 10^6$$

$$= \underline{\underline{7308\ h > 7000\ h}}$$ ☑

C_1	= 0,25 (alternating load direction, f = 25 min^{-1}< 30 min^{-1})

$$C_3 \rightarrow C_2 \cdot \frac{C}{P} = 1{,}0 \cdot \frac{13{,}4}{5{,}0} = 2{,}68$$

see alignment chart (6) $C_3 = 12$

d_8	= 22 mm
f	= 25 min1
ß	= 10° (half the swivelling angle 20° = 10°)
C	= 13,4 kN
P	= 5,0 kN