5. Computation of the Rotary Stroke Bearing

5.4 Permissible acceleration in the case of linear movement

	Installation			
	horizontal		vertical	
d_w [mm]	q [s²/m]	b_{max} [m/s²]	q [s²/m]	b_{max} [m/s²]
Plastic Ball Cage N 500				
18 - 19	0.5	200	1.35	75
24 - 25	0.5	200	1.4	71
30 - 32	1.1	91	3.1	32
40 - 42	1.1	91	3.2	31
Brass Ball Cage N 501				
4	0.7	150	0.9	110
6	1	100	1.4	70
8 - 12	1.5	67	2	50
14 - 16	1.75	57	2.3	43
18 - 20	2	50	2.6	38
24 - 25	2.5	40	3.3	30
30 - 32	3.3	30	4.4	23
40 - 42	4	25	5.3	19
50 - 52	5	20	6.7	15
63	6.6	15	8.6	11
80	10	10	13	7.6
100	10	10	14	7

Fig. 29

In the case of fast linear movements, large inertia forces can be exerted on the ball cage. With sinusoidal movements, the inertia forces are largest in the end stroke positions.

The magnitude of the inertia forces is affected by the following factors:
- Brass or plastic cage material
- Linear acceleration b
- Cage length l_2
- Horizontal or vertical installation position

The required contact length E is calculated used quotient q from the following equation:

$$\mathbf{E} = \mathbf{q} \cdot \frac{\mathbf{b} \cdot \mathbf{l_2}}{\mathbf{100}} \quad [\text{mm}]$$

b [m/s²]; l_2 [mm]; q [s²/m]

Acceleration b for sinusoidal movement:

$$\mathbf{b} = \left(\frac{\pi \cdot \mathbf{f}}{\mathbf{30}}\right)^2 \cdot \frac{\mathbf{H}}{\mathbf{2000}} \quad [\text{m/s}^2]$$

H [mm]; f [min⁻¹]

The quotient q can be taken from the following tables (Fig 29).

The value calculated for E [mm] is to be compared with the recommended values in the table (Fig. 21). The larger of the two values is used in further calculations.

The tables contain recommended values for the permissible axial acceleration with a ball cage in contact at its full length. These values represent average values which can be exceeded, for example, by increasing the preloading value v.

5.5 Permissible rotary speeds for the ball cage

	Rotary speed of ball cage
d_w [mm]	$n_{k\ max.}$ [min⁻¹]
4 - 8	15000
10 - 12	14000
14 - 16	12000
18 - 20	10000
25	8000
32	6000
40	4000
50	2500
63	2000
80	1500
100	1000

Fig. 30

Computing the rotary speed

With rotary movements, the cage speed n_K – referred to the stationary bearing component in each case – is calculated as follows:

Rotating shaft

$$\mathbf{n_K} = \left(\mathbf{1} - \frac{\mathbf{k}}{\mathbf{k} + \mathbf{d_W}}\right) \cdot \frac{\mathbf{n_W}}{\mathbf{2}} \quad [\text{min}^{-1}]$$

Rotating bush

$$\mathbf{n_K} = \left(\mathbf{1} + \frac{\mathbf{k}}{\mathbf{k} + \mathbf{d_W}}\right) \cdot \frac{\mathbf{n_B}}{\mathbf{2}} \quad [\text{min}^{-1}]$$

where:
d_W [mm] = shaft diameter
k [mm] = ball diameter
n_W [min⁻¹] = rotary speed of shaft
n_B [min⁻¹] = rotary speed of bush

Recommended values for permissible rotary speeds

The maximum permissible rotary speed of a rotary stroke bearing depends on the preloading value v, the load, the lubricating agent and the dissipation of the generated heat.

The given values are to be regarded as recommendations for pure rotary motions. Should a linear motion be added, the conditions will become less favorable, depending on the stroke length and frequency, so that the permissible rotary speeds will be slowed down considerably.

With fast rotary and linear motion, it is best to separate the types of motion.