TSK Linear Bearings

Features of TSK Linear Bearings

Compact Design

As four to six lines of balls smoothly circulate the narrow circuit to receive the load, the compact design is possible in line with the compact power supply and drive mechanism designs.

Compatibillity

As the dimension tolerances of bearing parts are fully standardized, the full compatibility is retained and the fitting clearances are unchanged.

Low Noise

As the retainer is made of resin material, it generates a minimum of noise during drive and gives the smoothest circulation of balls.

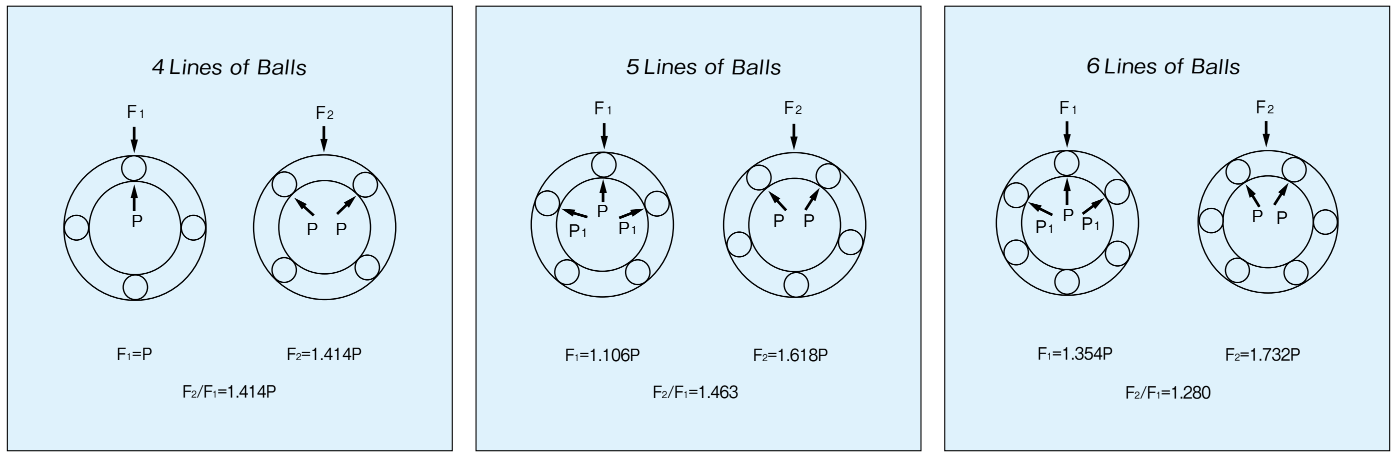
High Precision and Compactness

Using the TSK linear motion bearing with the high-precision TSK linear shafts gives a precise and smooth linear motion to make the whole machine smaller and lighter in weight.

Long Life

Since each portion of the bearing is made of choice materials and then being hardened and precision-machined according to strict quality control stardards, long-term operational life is guaranteed. See the chart below for details.

The figure of relationship between Rated load and Ball Line Disposition



Friction Factors of Linear Motion Bearings

One big feature of linear motion bearings is, from its structure, a minimal friction resistance and the starting friction is far lesser than that of plain bearings to give a least energy consumption optimal for a labor-saving machine.
Factors vital for determining the friction resistance of linear bearings are as follows and are represented by their sum.

1. Rolling friction between ball and shaft, ball and casing
2. Sliding friction between balls due to ball rolling
3. Sliding friction between ball and retainer
4. Sliding friction of seals
5. Viscosity resistance of lubricant

Types and amount of lubricant may especially be unexpectedly decisive factors in friction. Be careful of supplying adequate type and amount of lubricant according to use conditions.

$$F = F_0 + \mu W$$

F =Frictional resistance force
F_0=Seal resistance force
μ =Coefficient of friction
W=Load

The factor F_0 is a friction peculiar to each bearing and may be rendered unchanged in regular use conditions though it changes, if strictly speaking, with stroke speeds. The factor μW usually increases in proportion to the load W but the μ tends to increase due to the sliding friction inside the bearing at the load below 20kgf.
Normally, the friction factor is 0.001 to 0.003 and is as small as one several tenths when compared with plain bearings.

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Rated Running Life

The rated running life is the total running distance of a group of bearings of which 90% run without flaking under the same conditions.

Formula for Rated Running Life

The rated running life of linear motion bearing is affected by the load on the bearings, disposition of ball lines, hardness of shaft, working temperature, running speed, shock or vibration and moment loads. The running life is calculated by the following formula :

$$L = \left(\frac{C \cdot f_H \cdot f_B \cdot f_t}{f_P \cdot P}\right)^3 \times 50\text{km}$$

L =Rated Runnig Life (km)
C =Basic Dynamic Rated Load (N)
P =Working Load (N)
f_H =Hardness Factor of Shaft
f_t =Working Temperature Factor
f_P =Load Factor
f_B =Ball Line Disposition Factor

If the bearing drive stroke lengths and the reciprocal numbers per minute are fixed, the following formula is used for calculating life time from the rated running life :

$$L_h = \left(\frac{L \cdot 10^6}{2 \cdot \ell_s \cdot n \cdot 60}\right)$$

L_h=Running Life Time (hr)
L =Rated Running Life (km)
ℓ_s=Stroke Lengths (mm)
n =Reciprocal Numbers per Minute

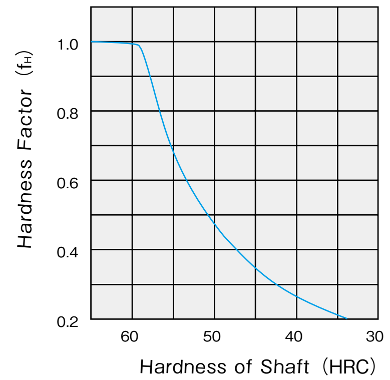
C……Basic Dynamic Rated Load

The basic dynamic rated load is a certain load for making 90% of bearing of the same forms and dimensions run for 50km without flaking due to the rolling fatigue if a linear motion bearing is driven with a single ball line situated just below the working load.

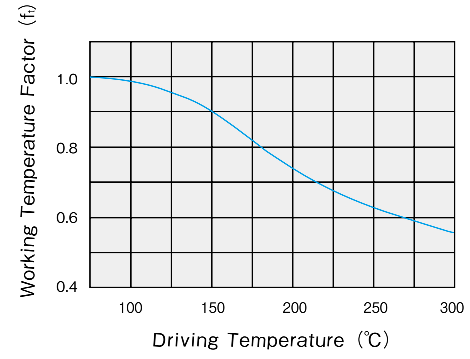
Co……Basic Static Rated Load

A linear motion ball bearing partially forms a permanent deformation between the balls and the circulation circuit under the excessive load or shock. If the degree of the permanent deformation surpasses a certain level, the smooth bearing movement is hindered. The basic static rated load is defined as the limit of the allowable static load and is represented by the static load with the fixed direction and magnitude so as to give the permanent deformation 0.0001 × of the ball diameter of the rotary contact section subject to the maximum stress.

■Hardness Factor of Shaft



■Working Temperature Factor



■Load Factor (fp)

Driving Conditions		f_p
No impact and vibration	slow speed	1.0～1.2
Slight impact and vibration	medium speed	1.2～2.0
Considerable impact and vibration	fast speed	2.0～3.5

■Recommended Dimensions for Bearing Parts and Shafts

Unit : μm

<table>
<tr><th rowspan="3">Designations</th><th colspan="4">Inner Diameter</th><th colspan="2" rowspan="2">Length (L)</th><th colspan="2" rowspan="2">Groove Dis (B)</th><th colspan="4">Recommended Shaft Outer Dia.</th></tr>
<tr><th colspan="2">Upper Class</th><th colspan="2">Super-Precise</th><th colspan="2">Upper Class</th><th colspan="2">Super-Precise</th></tr>
<tr><th>Upper Limit</th><th>Lower Limit</th><th>Upper Limit</th><th>Lower Limit</th><th>Upper Limit</th><th>Lower Limit</th><th>Upper Limit</th><th>Lower Limit</th><th>Upper Limit</th><th>Lower Limit</th><th>Upper Limit</th><th>Lower Limit</th></tr>
<tr><td>TB−6</td><td rowspan="3">0</td><td rowspan="3">-8</td><td rowspan="3">0</td><td rowspan="3">-5</td><td rowspan="5">0</td><td rowspan="3">-200
(-300)</td><td rowspan="5">+240</td><td rowspan="5">-240</td><td>-6</td><td>-14</td><td>-4</td><td>-9</td></tr>
<tr><td>TB−8～TB−10</td><td>-6</td><td>-15</td><td>-4</td><td>-10</td></tr>
<tr><td>TB−12～TB−16</td><td>-6</td><td>-17</td><td>-4</td><td>-12</td></tr>
<tr><td>TB−20～TB−30</td><td>0</td><td>-10</td><td>0</td><td>-6</td><td rowspan="2">-300
(-400)</td><td>-6</td><td>-19</td><td>-4</td><td>-13</td></tr>
<tr><td>TB−35～TB−40</td><td>0</td><td>-12</td><td>0</td><td>-8</td><td>-7</td><td>-23</td><td>-5</td><td>-16</td></tr>
</table>

The value in parentheses above is the lower limit value of Length of TBW series.

■Recommended Dimensions for Bearing Diameter and Housing

Unit : μm

<table>
<tr><th rowspan="3">Designations</th><th colspan="4">Outer Diameter (D)</th><th colspan="4">Recommended Housing Inner Dia.</th></tr>
<tr><th colspan="2">Upper Class</th><th colspan="2">Super-Precise</th><th colspan="2">Upper Class</th><th colspan="2">Super-Precise</th></tr>
<tr><th>Upper Limit</th><th>Lower Limit</th><th>Upper Limit</th><th>Lower Limit</th><th>Upper Limit</th><th>Lower Limit</th><th>Upper Limit</th><th>Lower Limit</th></tr>
<tr><td>TB−6</td><td rowspan="2">0</td><td rowspan="2">-10</td><td rowspan="2">0</td><td rowspan="2">-7</td><td>+15</td><td>0</td><td>+9</td><td>0</td></tr>
<tr><td>TB−8～TB−10</td><td>+18</td><td>0</td><td>+11</td><td>0</td></tr>
<tr><td>TB−12～TB−16</td><td>0</td><td>-12</td><td>0</td><td>-8</td><td>+21</td><td>0</td><td>+13</td><td>0</td></tr>
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<tr><td>TB−35～TB−40</td><td>0</td><td>-17</td><td>0</td><td>-11</td><td>+30</td><td>0</td><td>+19</td><td>0</td></tr>
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