5.2. Calculating the Rated Life

The rated life of a Ball Spline varies with types of loads applied during operation: torque load, radial load and moment load. The corresponding rated life values are obtained using the equations (7) to (10) below. (The basic load ratings in these loading directions are indicated in the dimensional table for the corresponding model number in the "THK General Catalog - Product Specifications," provided separately.)

5.2.1. When a Torque Load is Applied

$$L = \left(\frac{f_T \cdot f_C}{f_W} \cdot \frac{C_T}{T_C} \right)^3 \times 50 \quad \cdots\cdots\cdots(7)$$

5.2.2. When a Radial Load is Applied

$$L = \left(\frac{f_T \cdot f_C}{f_W} \cdot \frac{C}{P_C} \right)^3 \times 50 \quad \cdots\cdots\cdots(8)$$

L : Rated life (km)
C_T : Basic dynamic torque rating (N·m)
T_C : Calculated torque applied (N·m)
C : Basic dynamic load rating (N)
P_C : Calculated radial load (N)
f_T : Temperature factor (see Fig. 1 on page B-17)
f_C : Contact factor (see table 1 on page B-17)
f_W : Load factor (see table 2 on page B-17)

5.2.3. When a Torque Load and a Radial Load are Simultaneously Applied

When a torque load and a radial load are simultaneously applied, calculate the rated life by obtaining the equivalent radial load using the equation (9) below.

$$P_E = P_C + \frac{4 \cdot T_C \times 10^3}{i \cdot dp \cdot \cos\alpha} \quad \cdots\cdots\cdots(9)$$

P_E : Equivalent radial load (N)
$\cos\alpha$: Contact angle i=Number of rows of balls under a load

Type LBS α=45° i=2(LBS10 or smaller)
i=3(LBS15 or greater)
Type LT α=70° i=2(LT13 or smaller))
i=3(LT16 or greater)

dp : Ball center diameter (mm)
(See tables 3 and 4 on page B-18)

5.2.4. When a Moment Load is Applied with One Spline Nut or Two Spline Nuts in Close Contact with Each Other

Obtain the equivalent radial load using the equation (10) below.

$$P_u = K \cdot M \quad \cdots\cdots\cdots(10)$$

P_u : Equivalent radial load (with a moment applied) (N)
K : Equivalent factor (table 5 on page B-21, table 6 on page B-22)
M : Applied moment (N·mm)
However, M should be within the range of the static permissible moment.

5.2.5. When a Moment Load and a Radial Load are Simultaneously Applied

Calculated the rated life from the sum of the radial load and the equivalent radial load.

5.2.6. Calculating the Service Life Time

When the rated life (L) has been obtained in the equation above, if the stroke length and the number of reciprocations are constant, the service life time is obtained using the equation (11) below.

$$L_h = \frac{L \times 10^3}{2 \times \ell_s \times n_1 \times 60} \quad \cdots\cdots\cdots(11)$$

L_h : Service life time (h)
ℓ_s : Stroke length (m)
n_1 : Number of reciprocations per minute (opm)

■f_T : Temperature factor

When the Ball Spline is used at an ambient temperature exceeding 100°C, the heat may adversely affect the performance of the Ball Spline. In such a case, the rated life must be multiplied by the corresponding temperature factor indicated on the right.
In addition, the Ball Spline must be of a high-temperature type.

Note: If the ambient temperature exceeds 80°C, high-temperature types of seal and retainer are required. Contact THK for details.

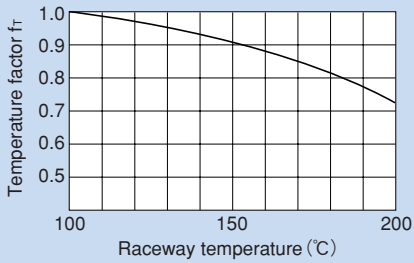


Fig. 1 Temperature Factor (f_T)

■f_C : Contact factor

When multiple spline nuts are used in close contact with each other, their linear motion is affected by moments and mounting accuracy, making it difficult to achieve uniform load distribution. In such applications, multiply the basic load rating (C) and (C_0) by the corresponding contact factor in the table on the right.

Note: If uneven load distribution is expected in a large machine, take into account the respective contact factor indicated in the table on the right.

Table 1 Contact Factor (f_C)

Number of spline nuts in close contact with each other	Contact factor f_C
2	0.81
3	0.72
4	0.66
5	0.61
Normal use	1

■f_W : Load factor

In general, reciprocating machines tend to involve vibrations or impact during operation. It is extremely difficult to accurately determine vibrations generated during high-speed operation and impact during frequent start-up and stop. Therefore, when loads applied on a Ball Spline cannot be measured, or when speed and impact have a significant influence, divide the basic load rating (C or C_0), by the corresponding load factor in the table of empirically obtained data on the right.

Table 2 Load Factor (f_W)

Vibrations/impact	Speed (V)	f_W
Faint	Very low V≦0.25m/s	1 to 1.2
Weak	Slow 0.25<V≦1m/s	1.2 to 1.5
Medium	Medium 1<V≦2m/s	1.5 to 2
Strong	High V>2m/s	2 to 3.5

Table 3 Sectional Shape of the Spline Shaft for Models LBS, LBST, LBF, LBR, LBH, LBG and LBGT

Unit: mm

Nominal shaft diameter	15	20	25	30	40	50	60	70	85	100	120	150
Minor diameter ϕd	11.7	15.3	19.5	22.5	31	39	46.5	54.5	67	81	101	130
Outer diameter ϕD_0	14.5	19.7	24.5	29.6	39.8	49.5	60	70	84	99	117	147
Ball center diameter ϕdp	15	20	25	30	40	50	60	70	85	100	120	150

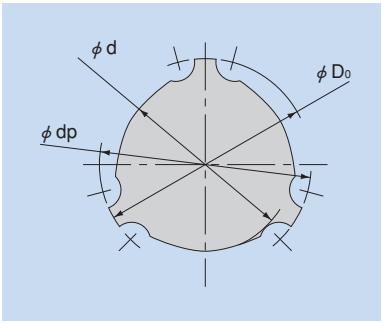
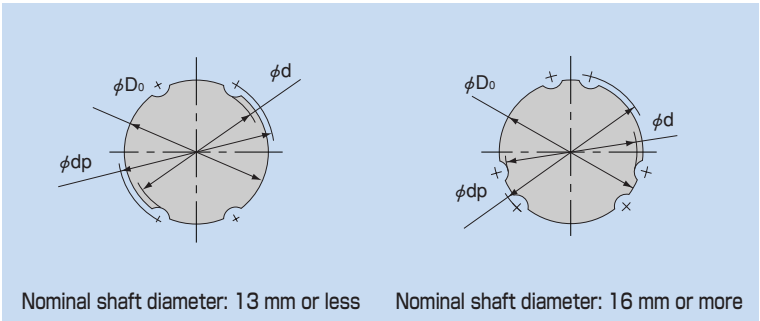


Table 4 Sectional Shape of the Spline Shaft for Models LT, LF, LTR and LTR-A

Unit: mm

Nominal shaft diameter	4	5	6	8	10	13	16	20	25	30	32	40	50	60	80	100
Minor diameter ϕd	3.5	4.5	5	7	8.5	11.5	14.5	18.5	23	28	30	37.5	46.5	56.5	75.5	95
Outer diameter ϕD_0	4	5	6	8	10	13	16	20	25	30	32	40	50	60	80	100
Ball center diameter ϕdp	4.6	5.7	7	9.3	11.5	14.8	17.8	22.1	27.6	33.2	35.2	44.2	55.2	66.3	87.9	109.5
Outer-diameter tolerance	0 −0.012			0 −0.015		0 −0.018		0 −0.021				0 −0.025		0 −0.03		0 −0.035



Nominal shaft diameter: 13 mm or less

Nominal shaft diameter: 16 mm or more