THK

NEW

Caged Ball Spline

SLS/SLF

Equipped with Caged-Ball Technology. Achieves high speed, low noise and long service life.

For details, visit THK at **www.thk.com**

*Product information is updated regularly on the THK website.

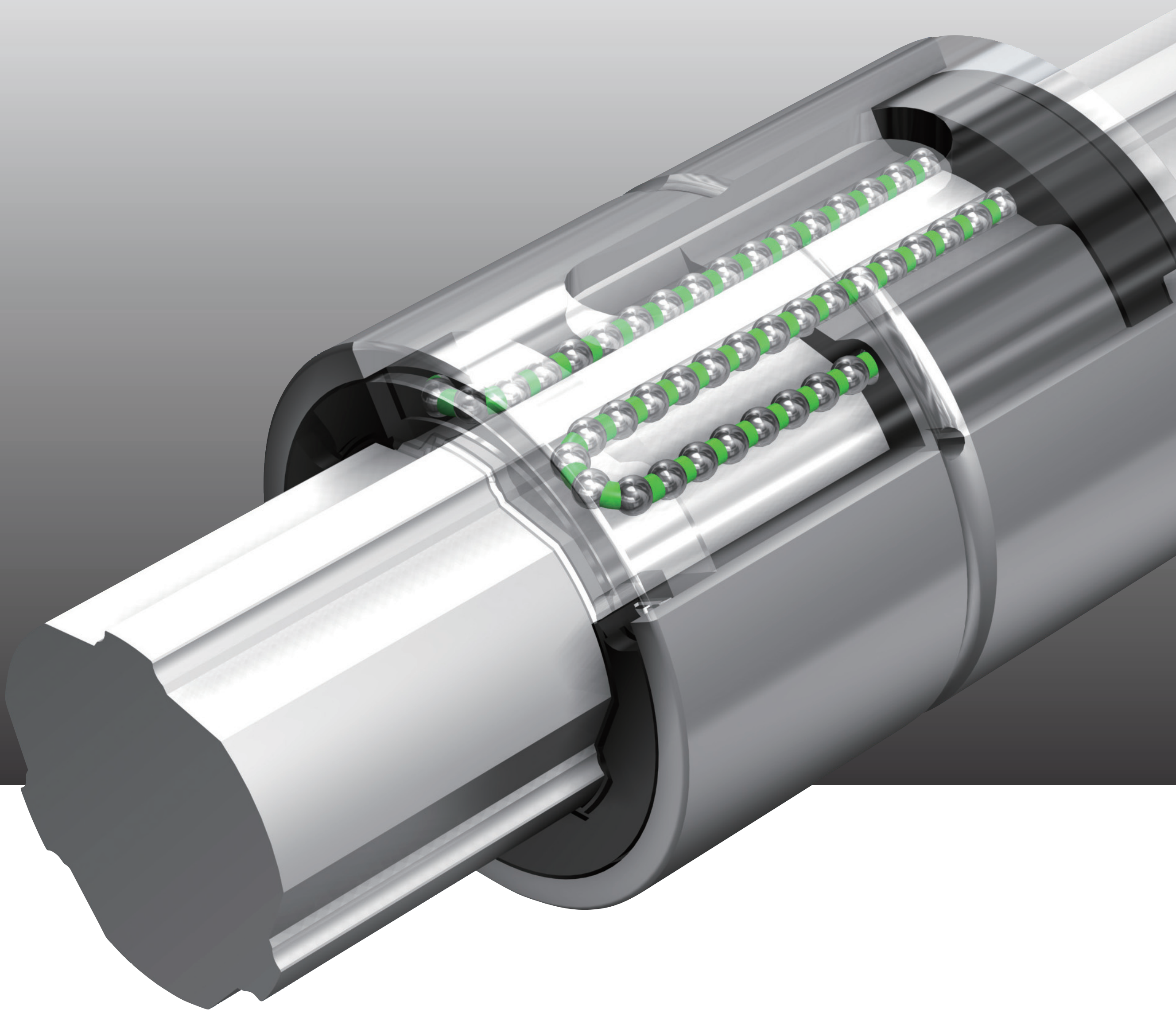
THK CO., LTD.
TOKYO, JAPAN

CATALOG No.360-2E

Caged Ball Spline

Equipped with Caged-Ball Technology.

Achieves high speed, low noise and long service life.
The caged-ball technology, developed by bringing together THK's technologies and know-how, is now integrated in the new Ball Spline.
The integration of the ball cage enables the circulating motion of evenly spaced balls and high-speed response to be achieved. In addition, it eliminates collision and mutual friction between balls, and realizes low noise, pleasant running sound and low particle generation. As the grease retention is increased, long-term maintenance-free operation is also achieved.



Model SLS (medium-load type)

The circumference of the spline nut is shaped in a straight cylinder. Using a key, this model can be secured to the housing, or transmit a torque.

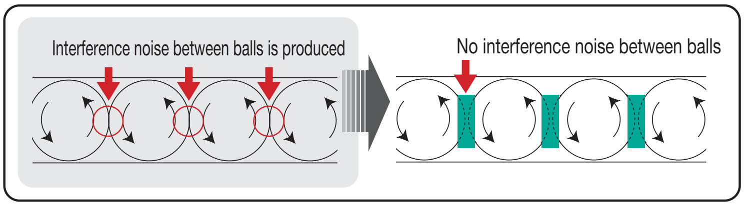
Model SLS-L (heavy-load type)

A heavy-load type with the same outer diameter as model SLS and a longer spline nut. It is optimal in cases where a large torque is applied in a small space, and in cases where an overhang load or moment is applied.

Model SLF

It can easily be assembled, and allows a shorter housing than securing it using a key.

Four Advantages Achieved with the Integration of the Caged-Ball Technology



High-speed Response

Models SLS/SLF adopt the caged-ball technology to enable the circulating motion of evenly spaced balls to be maintained and high-speed response to be achieved, the cycle time of the machine can be improved.

Low Noise, Pleasant Running Sound and Low Particle Generation

Models SLS/SLF adopt the caged-ball technology, they eliminate collision and mutual friction between balls, and realize low noise, pleasant running sound and low particle generation.

Long-term Maintenance-free Operation

Models SLS/SLF adopt the caged-ball technology to substantially increase the grease retention, thus achieving long-term maintenance-free operation.

Smooth Motion (Small Rolling Fluctuation)

Models SLS/SLF adopt the caged-ball technology and a new circulation method, thus achieving stable and smooth motion with small rolling fluctuation.

- ●Model SLS (SLS25 SLS30 SLS40 SLS50 SLS60 SLS70 SLS80 SLS100)
- ●Model SLS-L (SLS25L SLS30L SLS40L SLS50L SLS60L SLS70L SLS80L SLS100L)
- ●Model SLF (SLF25 SLF30 SLF40 SLF50 SLF60 SLF70 SLF80 SLF100)

Caged Ball Spline

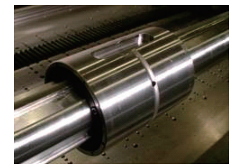
[High Speed]

■ Conditions

Model tested	SLS50
Testing environment	22 to 27.5℃
Stroke	1000mm
Maximum speed	200m/min
Acceleration/deceleration	5G (49m/s^2)
Applied load	Light preload (CL)
Lubricant	THK AFB-LF Grease

Appearance of the test machine (high-speed durability test)

Appearance of the specimen



■Test results

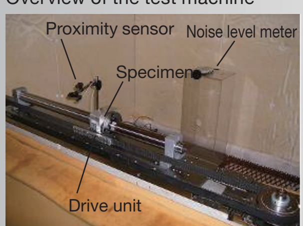
No anomaly after travelling 10,000 km

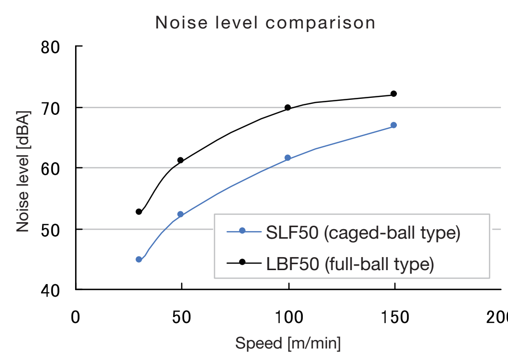
[Low Noise, Pleasant Running Sound]

■ Conditions

Shaft diameters	SLF50/LBF50
Stroke	600mm
Speeds	30,50,100,150m/min
Measuring instrument	Noise level meter

Overview of the test machine



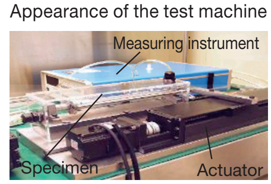


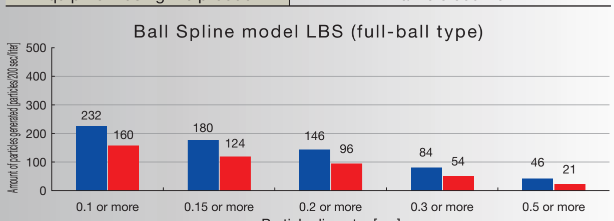
[Low Particle Generation]

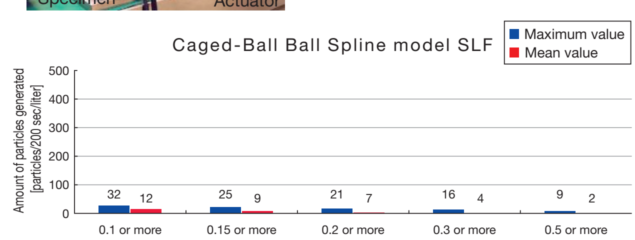
■ Conditions

Model No.	SLF50CL+350LP/LBS50CL+350LP
Maximum speed	30m/min
Acceleration	2.84m/s^2
Stroke	200mm
Amount of air supplied	1ℓ/200sec
Lubricant	THK AFE-CA Grease
Equipment using the product	Particle counter

Appearance of the test machine



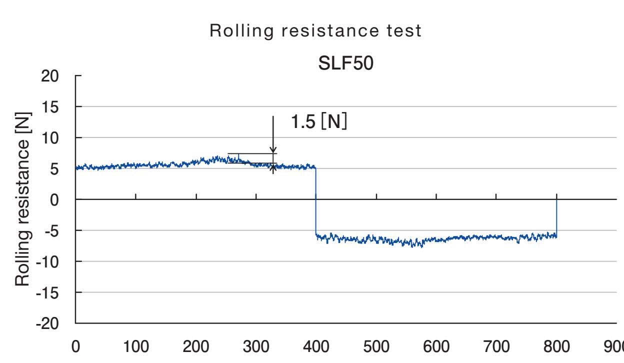




[Smooth Motion (Small Rolling Fluctuation)]

■ Conditions

Model No.	SLF50
Speed	10 mm/sec
Applied load	Medium preload (CM)
Lubricant	THK AFB-LF Grease



Accuracy Standards

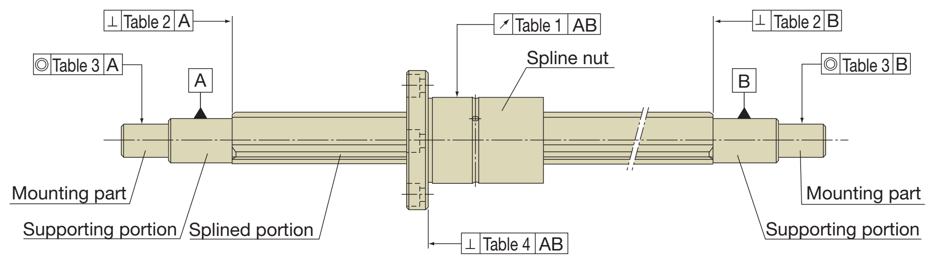


Table 1 Runout of the Spline Nut Circumference in Relation to the Support of the Spline Shaft

Accuracy		Runout(max)											
Nominal shaft diameter / Overall spline shaft length (mm)		25,30			40,50			60,70,80			100		
Above	Or less	Normal	Upper	Precision	Normal	Upper	Precision	Normal	Upper	Precision	Normal	Upper	Precision
—	200	53	32	18	53	32	16	51	30	16	51	30	16
200	315	58	39	21	58	36	19	55	34	17	53	32	17
315	400	70	44	25	63	39	21	58	36	19	55	34	17
400	500	78	50	29	68	43	24	61	38	21	57	35	19
500	630	88	57	34	74	47	27	65	41	23	60	37	20
630	800	103	68	42	84	54	32	71	45	26	64	40	22
800	1000	124	83	—	97	63	38	79	51	30	69	43	24
1000	1250	—	—	—	114	76	47	90	59	35	76	48	28
1250	1600	—	—	—	139	93	—	106	70	43	86	55	33
1600	2000	—	—	—	—	—	—	128	86	54	99	65	40
2000	2500	—	—	—	—	—	—	156	—	—	117	78	49
2500	3000	—	—	—	—	—	—	—	—	—	143	96	61

Table 2 Perpendicularity of the Spline Shaft End Face in Relation to the Support of the Spline Shaft

Accuracy	Perpendicularity (max)		
Nominal shaft diameter	Normal grade (No symbol)	High accuracy grade (H)	Precision Grade (P)
25,30	33	13	9
40,50	39	16	11
60,70,80	46	19	13
100	54	22	15

Table 3 Concentricity of the Part-mounting in Relation to the Support of the Spline Shaft

Accuracy	Perpendicularity (max)		
Nominal shaft diameter	Normal grade (No symbol)	High accuracy grade (H)	Precision Grade (P)
25,30	53	22	13
40,50	62	25	15
60,70,80	73	29	17
100	86	34	20

Table 4 Straightness of the Flange-mounting Surface of the Spline Nut in Relation to the Support of the Spline Shaft

Accuracy	Perpendicularity (max)		
Nominal shaft diameter	Normal grade (No symbol)	High accuracy grade (H)	Precision Grade (P)
25,30	39	16	11
40,50	46	19	13
60,70,80	54	22	15
100	63	25	18

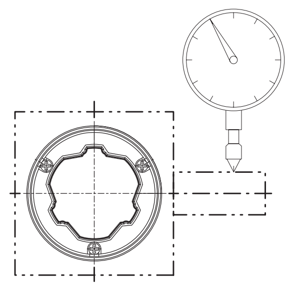
Clearance in the Rotation Direction

With the Ball Spline, the sum of clearances in the circumferential direction is standardized as the clearance in the rotational direction. Specific clearance values are standardized for each model, allowing you to select a clearance that meets the conditions. See the General Catalog for details.

Table 5 Measurement of Clearance in the Rotational Direction

Unit : μm

Nominal shaft diameter	Clearance in the rotational direction		
	Normal	CL	CM
25,30,40	+1 to -2	-2 to -6	-6 to -10
50,60	+2 to -4	-4 to -8	-8 to -12
70,80,100	+4 to -8	-8 to -12	-12 to -20

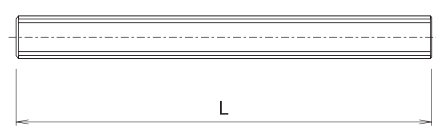


Maximum Manufacturing Length of the Spline Shaft

Table 6 Maximum Manufacturing Length of the Spline Shaft of Models SLS/SLF

Unit : mm

Nominal shaft diameter	Maximum Manufacturing Length : L		
	Normal grade(No symbol)	High accuracy grade(H)	Precision grade(P)
25	2000	1500	1000
30	2000	1600	1250
40	2000	2000	1500
50	3000	2000	1500
60	4000	2000	2000
70	4000	2000	2000
80	4000	2000	2000
100	4000	3000	3000



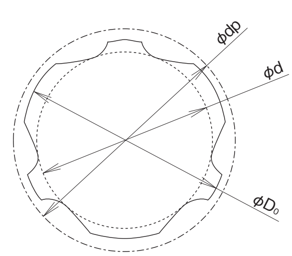
Material: S55C equivalent
Hardness: 58 to 64 HRC

Sectional Shape of the Spline Shaft

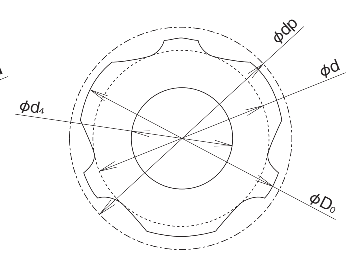
Table 7 Sectional Shape of the Spline Shaft of Models SLS/SLF

Unit : mm

Nominal shaft diameter	Major diameter ϕD₀ h7	Ball center-to-center diameter ϕdp	Minor diameter ϕd	Hole diameter ϕd₄	Mass [kg/m]	Mass of the hollow shaft [kg/m]
25	25	25.2	21.6	12	3.51	2.62
30	30	30.2	25.8	16	5.05	3.47
40	40	40.6	35.2	22	9.18	6.19
50	50	50.6	44.4	25	14.45	10.59
60	60	61.0	54.0	32	21.23	14.90
70	70	71.0	62.8	–	28.57	–
80	80	80.8	71.3	52.5	37.49	20.48
100	100	101.2	90.0	67.5	58.97	30.85



Cross-Sectional Profile of the Spline Shaft



Sectional Shape of the Standard Hollow Type Spline Shaft

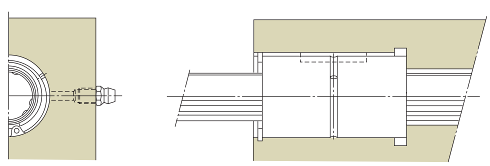
Mounting method

For the fit between the spline nut and the housing, transition fit is commonly used. If the accuracy of the Ball Spline does not need to be very high, clearance fit is recommended.

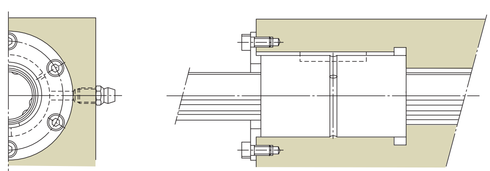
Housing Inner-diameter Tolerance	General conditions	H7
	When clearance needs to be small	J6

Mounting Model SLS

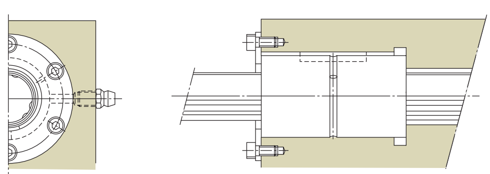
●Examples of mounting the spline nut



Mounting using a snap ring



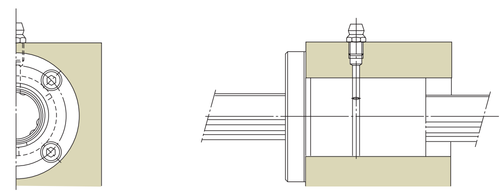
Mounting using a presser flange



Mounting using a stop plate

Mounting Model SLF

●Example of mounting the spline nut



Mounting using a flange

Precautions on mounting the product

- On both ends of the spline nut of Caged Ball Ball Spline model SLS, resin end caps are installed.
  Hitting them or pressing hard may cause damage. You must take care not to apply an excessive load.
- The fastening strength of the spline nut in the axial direction does not need to be very high. However, you must avoid retaining the spline only with a driving fit.

Designing the Strength of the Spline Shaft

The spline shaft of the Ball Spline is a compound shaft capable of receiving a radial load and torque.
When the load and torque are large, the spline shaft strength must be taken into account.

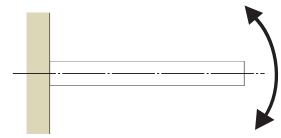
Table 8 Cross-sectional Characteristics of the Spline Shaft

Nominal shaft diameter		Geometrical moment of inertia I mm^4	Modulus section Z mm^3	Polar moment of inertia I_P mm^4	Section modulus Z_P mm^3
25	Solid shaft	1.61×10^4	1.29×10^3	3.22×10^4	2.57×10^3
	Hollow shaft	1.51×10^4	1.20×10^3	3.01×10^4	2.41×10^3
30	Solid shaft	3.33×10^4	2.22×10^3	6.65×10^4	4.43×10^3
	Hollow shaft	3.00×10^4	2.00×10^3	6.01×10^4	4.00×10^3
40	Solid shaft	1.09×10^5	5.47×10^3	2.19×10^5	1.09×10^4
	Hollow shaft	9.79×10^4	4.90×10^3	1.96×10^5	9.79×10^3
50	Solid shaft	2.71×10^5	1.08×10^4	5.41×10^5	2.17×10^4
	Hollow shaft	2.51×10^5	1.01×10^4	5.03×10^5	2.01×10^4
60	Solid shaft	5.83×10^5	1.94×10^4	1.17×10^6	3.89×10^4
	Hollow shaft	5.32×10^5	1.77×10^4	1.06×10^6	3.54×10^4
70	Solid shaft	1.06×10^6	3.02×10^4	2.11×10^6	6.04×10^4
80	Solid shaft	1.82×10^6	4.55×10^4	3.64×10^6	9.10×10^4
	Hollow shaft	1.45×10^6	3.62×10^4	2.90×10^6	7.24×10^4
100	Solid shaft	4.50×10^6	9.00×10^4	9.00×10^6	1.80×10^5
	Hollow shaft	3.48×10^6	6.96×10^4	6.96×10^6	1.36×10^5

[Spline Shaft Receiving a Bending Load]

When a bending load is applied to the spline shaft of a Ball Spline, obtain the spline shaft diameter using the equation (1) below.

$$M = \sigma \cdot Z \quad \text{and} \quad Z = \frac{M}{\sigma} \quad \cdots\cdots\cdots\cdots (1)$$

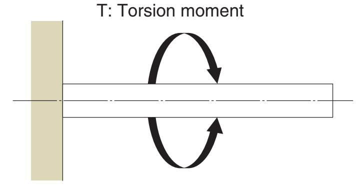


M : Maximum bending moment acting on the spline shaft [N-mm]
σ : Permissible bending stress of the spline shaft [98N/mm²]
Z : Modulus section factor of the spline shaft [mm³]

[Spline Shaft Receiving a Torsion Load]

When a torsion load is applied on the spline shaft of a Ball Spline, obtain the spline shaft diameter using the equation (2) below.

$$T = \tau_a \cdot Z_P \quad \text{and} \quad Z_P = \frac{T}{\tau_a} \quad \cdots\cdots\cdots\cdots (2)$$



T : Maximum torsion moment [N-mm]
τ_a : Permissible torsion stress of the spline shaft [49N/mm²]
Z_p : Polar modulus of section of the spline nut [mm³]

[When the Spline Shaft Simultaneously Receives a Bending Load and a Torsion Load]

When the spline shaft of a Ball Spline receives a bending load and a torsion load simultaneously, calculate two separate spline shaft diameters: one for the equivalent bending moment (M_e) and the other for the equivalent torsion moment (T_e). Then, use the greater value as the spline shaft diameter.

Equivalent bending moment

$$M_e = \frac{M + \sqrt{M^2 + T^2}}{2} = \frac{M}{2}\left\{1 + \sqrt{1 + \left(\frac{T}{M}\right)^2}\right\} \quad \cdots\cdots\cdots\cdots (3)$$

$M_e = \sigma \cdot Z$

Equivalent torsion moment

$$T_e = \sqrt{M^2 + T^2} = M \cdot \sqrt{1 + \left(\frac{T}{M}\right)^2} \quad \cdots\cdots\cdots\cdots (4)$$

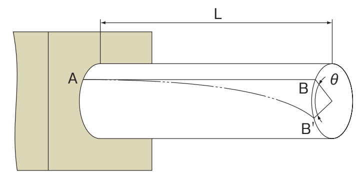
$T_e = \tau_a \cdot Z_p$

[Rigidity of the Spline Shaft]

The rigidity of the spline shaft is expressed as a torsion angle per meter of shaft length. Its value should be limited within 1°/4.

$$\theta = 57.3 \times \frac{T \cdot L}{G \cdot I_P} \quad \cdots\cdots\cdots\cdots (5)$$

$$\text{Rigidity of the shaft} = \frac{\text{Torsion angle}}{\text{Unit length}} = \frac{\theta \cdot \ell}{L} < \frac{1°}{4}$$



θ : Torsion angle [°]
L : Spline shaft length [mm]
G : Transverse elastic modulus [7.9×10⁴N/mm²]
ℓ : Unit length [1000mm]
I_p : Polar moment of inertia [mm⁴]

[Deflection and Deflection Angle of the Spline Shaft]

The deflection and deflection angle of the Ball Spline shaft need to be calculated using equations that meet the relevant conditions. Table9 and Table10 represent these conditions and the corresponding equations.

Table 9 Deflection and Deflection Angle Equations

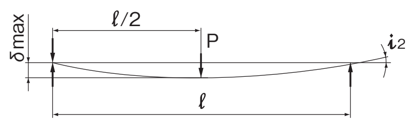
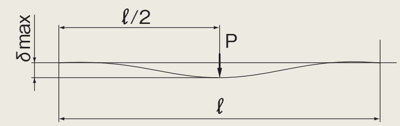
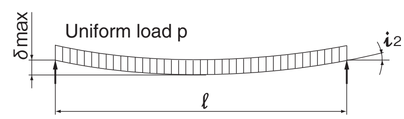
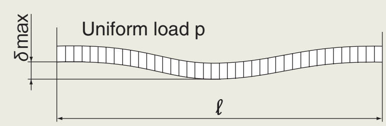
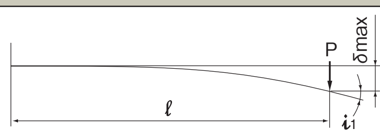
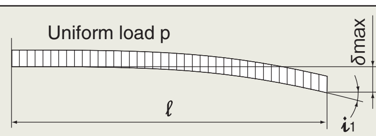
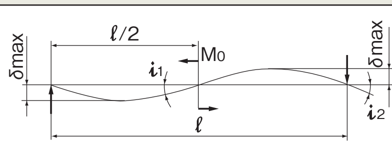
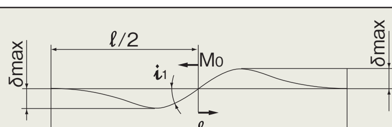
Support method	Condition	Deflection equation	Deflection angle equation
Both ends free		$\delta_{max} = \frac{P\ell^3}{48EI}$	$i_1 = 0$ $i_2 = \frac{P\ell^2}{16EI}$
Both ends fastened		$\delta_{max} = \frac{P\ell^3}{192EI}$	$i_1 = 0$ $i_2 = 0$
Both ends free		$\delta_{max} = \frac{5p\ell^4}{384EI}$	$i_2 = \frac{p\ell^3}{24EI}$
Both ends fastened		$\delta_{max} = \frac{p\ell^4}{384EI}$	$i_2 = 0$

Table 10 Deflection and Deflection Angle Equations

Support method	Condition	Deflection equation	Deflection angle equation
One end fastened		$\delta_{max} = \frac{P\ell^3}{3EI}$	$i_1 = \frac{P\ell^2}{2EI}$ $i_2 = 0$
One end fastened		$\delta_{max} = \frac{p\ell^4}{8EI}$	$i_1 = \frac{p\ell^3}{6EI}$ $i_2 = 0$
Both ends free		$\delta_{max} = \frac{\sqrt{3}M_0\ell^2}{216EI}$	$i_1 = \frac{M_0\ell}{12EI}$ $i_2 = \frac{M_0\ell}{24EI}$
Both ends fastened		$\delta_{max} = \frac{M_0\ell^2}{216EI}$	$i_1 = \frac{M_0\ell}{16EI}$ $i_2 = 0$

δ_{max} : Maximum deflection [mm]

M_0 : Moment [N-mm]

ℓ : Span [mm]

I : Geometrical moment of inertia [mm^4]

i_1 : Deflection angle at loading point

i_2 : Deflection angle at supporting point

P : Concentrated load [N]

p : Uniform load [N/mm]

E : Modulus of longitudinal elasticity 2.06×10^5 [N/mm^2]

[Dangerous Speed of the Spline Shaft]

When a Ball Spline shaft is used to transmit power while rotating, as the rotational speed of the shaft increases, the rotation cycle nears the natural frequency of the spline shaft. It may cause resonance and eventually result in inability to move. Therefore, the maximum rotational speed of the shaft must be limited to below the dangerous speed that does not cause resonance. The dangerous speed of the spline shaft is obtained using the equation (6). (0.8 is multiplied as a safety factor) If the shaft' s rotation cycle exceeds or nears the resonance point during operation,it is necessary to reconsider the spline shaft diameter.

●Dangerous Speed

$$N_c = \frac{60\lambda^2}{2\pi \cdot \ell_b^2} \cdot \sqrt{\frac{E \times 10^3 \cdot I}{\gamma \cdot A}} \times 0.8 \quad \cdots (6)$$

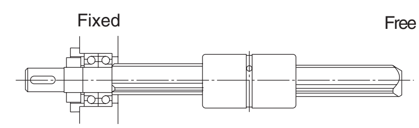
N_c : Dangerous speed [min^{-1}]
ℓ_b : Distance between two mounting surfaces [mm]
E : Young's modulus [$2.06 \times 10^5 N/mm^2$]
I : Minimum geometrical moment of inertia of the shaft [mm^4]

$$I = \frac{\pi}{64} d^4$$ d:Minor diameter [mm]

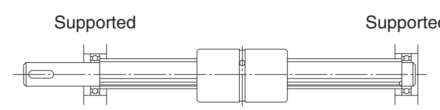
γ : Density (specific gravity) [$7.85 \times 10^{-6} kg/mm^3$]

$$A = \frac{\pi}{4} d^2$$ d:Minor diameter [mm]

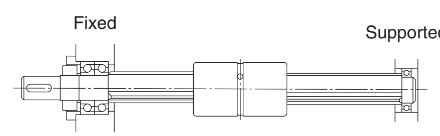
A : Spline shaft cross-sectional area [mm^2]
λ : Factor according to the mounting method
(1)Fixed - free λ=1.875
(2)Supported - supported λ=3.142
(3)Fixed - supported λ=3.927
(4)Fixed - fixed λ=4.73



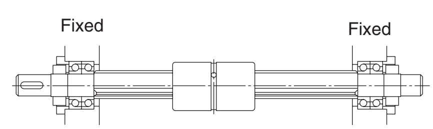
Fixed - free



Supported - supported



Fixed - supported



Fixed - fixed

Predicting the Service Life

[Nominal Life]

The service life of a Ball Spline varies from unit to unit even if they are manufactured through the same process and used in the same operating conditions. Therefore, the nominal life defined below is normally used as a guidepost for obtaining the service life of a Ball Spline.

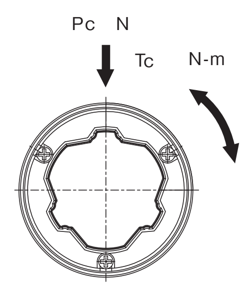
Nominal life is the total travel distance that 90% of a group of identical ball splines independently operating under the same conditions can achieve without showing flaking (scale-like pieces on a metal surface).

[Calculating the Nominal Life]

The nominal life of a Ball Spline varies with types of loads applied during operation: torque load, radial load and moment load. The corresponding nominal life values are obtained using the equations (7) to (10) below. (The basic load ratings in these loading directions are indicated in the specification table for the corresponding model number.)

●When a Torque Load is Applied

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



●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 :	Nominal life [km]	P_C :	Calculated radial load [N]
C_T :	Basic dynamic torque rating [N-m]	f_T :	Temperature factor
T_C :	Calculated torque applied [N-m]	f_C :	Contact factor
C :	Basic dynamic load rating [N]	f_W :	Load factor

●When a Torque Load and a Radial Load are Simultaneously Applied

When a torque load and a radial load are simultaneously applied, calculate the nominal 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 40° i=Number of rows of balls under a load 3
dp : Ball center-to-center diameter [mm]

●When a Moment Load is Applied to a Single Nut or Two Nuts in Close Contact with Each Other

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

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

Pu : Equivalent radial load [N]
(with a moment applied)
K : Equivalent Factors (see Table11)
M : Applied moment [N-mm]
However, M should be within the range of the static permissible moment.

●When a Moment Load and a Radial Load are Simultaneously Applied

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

■Moment Equivalent Factor

Table 11 Moment Equivalent Factor of Models SLS/SLF

Model No.	One spline nut	Two spline nuts in tight contact with each other
SLS/SLF25 SLS25L	0.187 0.148	0.030 0.027
SLS/SLF30 SLS30L	0.153 0.129	0.027 0.024
SLS/SLF40 SLS40L	0.114 0.102	0.021 0.019
SLS/SLF50 SLS50L	0.109 0.091	0.018 0.017
SLS/SLF60 SLS60L	0.080 0.072	0.015 0.014
SLS/SLF70 SLS70L	0.101 0.076	0.016 0.014
SLS/SLF80 SLS80L	0.083 0.072	0.013 0.012
SLS/SLF100 SLS100L	0.068 0.056	0.011 0.010

●Calculating the Service Life Time

When the nominal life (L) has been obtained in the equation above, if the stroke length and the number of reciprocations per minute 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 [min^{-1}]

■f_T:Temperature Factor

Since the service temperature of the Caged Ball Ball Spline is normally 80℃ or below, f_T = 1.0.

■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 Table12.

Note) If uneven load distribution is expected in a large machine, take into account the respective contact factor indicated in Table12.

Table 12 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 and stop. 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 Table13.

Table 13 Load Factor (f_W)

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

●Calculating the Static Safety Factor

When calculating the load applied to the Ball Spline, it is necessary to calculate the mean load used for service life calculation and the maximum load used for static safety factor calculation. In particular, if the start and stop are intensely repeated, a cutting load is applied, or a large moment resulting from an overhang load is applied, then an unexpectedly large load may be applied. When selecting a model, check whether the use is suitable for its maximum load (regardless of whether the product is stationary or operating) by calculating the static safety factor using the equation (12). Table 14 shows reference values for the static safety factor.

$$f_S = \frac{C_0}{P_{max}} \quad \cdots\cdots\cdots (12)$$

f_S : Static safety factor

C_0 : Basic static load rating [N]

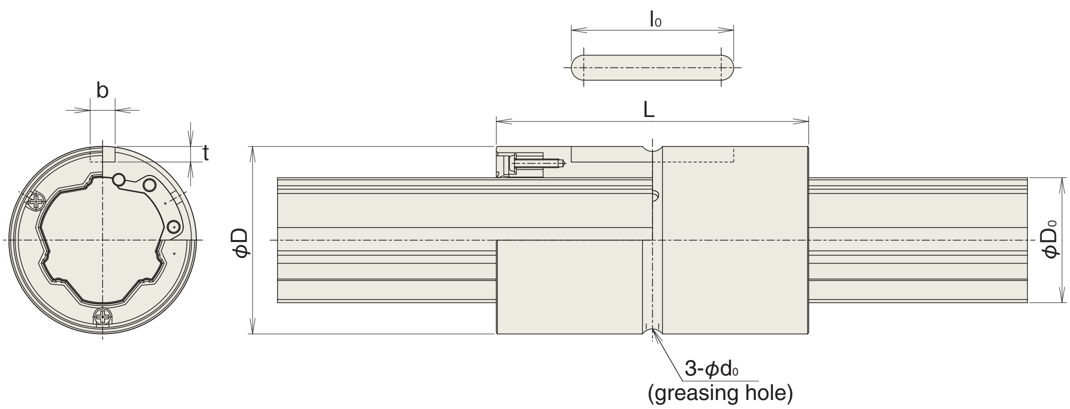
P_{max} : Maximum applied load [N]

* The basic static load rating refers to the static load with constant direction and magnitude at which the sum of the permanent deformation of the rolling element and the permanent deformation of the raceway is 0.0001 time the diameter of the rolling element at the contact point under the maximum stress.

Table 14 Reference Value of Static Safety Factor (f_S)

Machine using the product	Load conditions	Lower limit of f_S
General industrial machinery	Without vibration/impact	1.0 to 3.5
	With vibration/impact	2.0 to 5.0
Machine tool	Without vibration/impact	1.0 to 4.0
	With vibration/impact	2.5 to 7.0

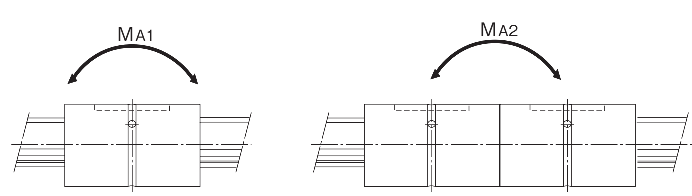
* The reference value of static safety factor may vary depending on the service conditions such as service environment, lubrication state and accuracy, rigidity, etc. of the mounting section.



●Model SLS (Straight type)

Unit: mm

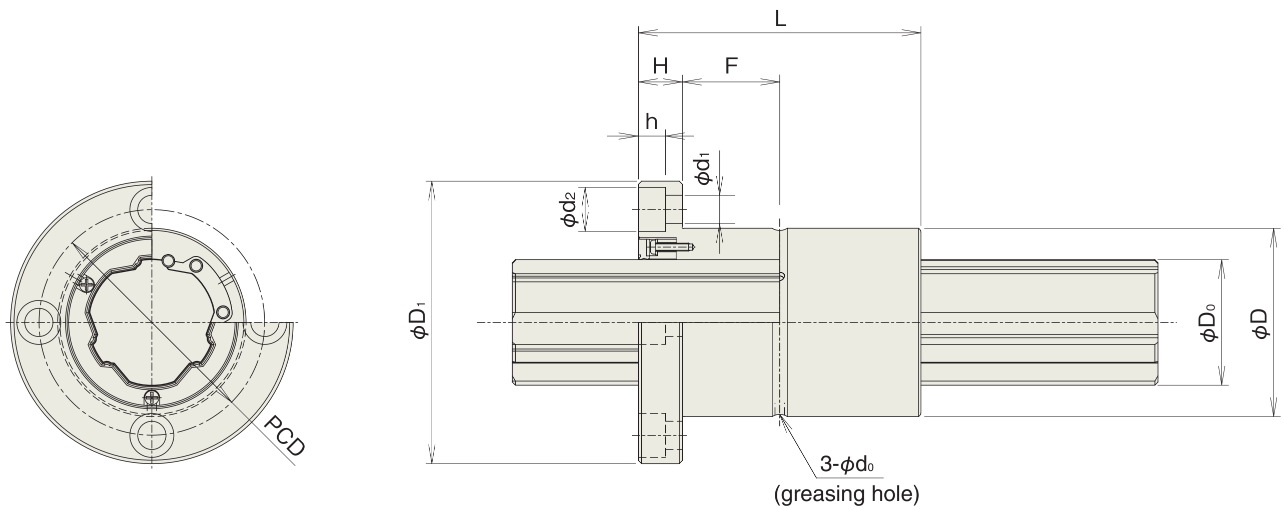
Model No.	Spline nut dimensions								Spline shaft outer diameter	Basic torque rating		Basic load rating		Static permissible moment		Mass	
	Outer diameter		Length		Keyway dimensions			Greasing hole									
	D	Tolerance	L	Tolerance	b H8	t +0.1 0	ℓ0	d0	D0 h7	CT [N-m]	C0T [N-m]	C [kN]	C0 [kN]	MA1 [N-m]	MA2 [N-m]	Spline Nut [kg]	Spline shaft [kg/m]
SLS25 SLS25L	37	0 -0.016	60 70	0 -0.3	5	3	33	2	25	219.9 261.9	306.8 394.5	18.2 21.7	22.5 29.0	136 220	851 1203	0.15 0.18	3.51
SLS30 SLS30L	45		70 80		7	4	41	3	30	366.5 416.4	513.3 616.0	25.4 28.9	31.5 37.8	233 330	1341 1803	0.30 0.34	5.05
SLS40 SLS40L	60	0 -0.019	90 100		10	4.5	55	3	40	818.9 890.0	1135.4 1277.3	42.8 46.5	52.5 59.1	520 652	2801 3529	0.69 0.79	9.18
SLS50 SLS50L	75		100 112		15	5	60	4	50	1373.4 1571.2	1783.1 2165.2	57.6 65.9	66.2 80.4	687 996	4156 5349	1.30 1.47	14.45
SLS60 SLS60L	90	0 -0.022	127 140		18	6	68	4	60	2506.7 2723.2	3321.0 3736.2	87.8 95.3	103.0 115.8	1452 1820	7733 9570	2.25 2.50	21.23
SLS70 SLS70L	100		110 135		18	6	68	4	70	2986.3 3708.4	3474.7 4738.2	89.7 111.4	92.5 126.1	1038 1867	6392 10135	2.13 2.71	28.57
SLS80 SLS80L	120		140 155	0 -0.4	20	7	80	5	80	4664.6 5195.3	5477.4 6390.4	122.8 136.8	127.7 148.9	1739 2327	11482 14491	4.22 4.77	37.49
SLS100 SLS100L	140	0 -0.025	160 185		28	9	93	5	100	8922.3 10424.4	10211.6 12764.6	188.2 219.8	190.7 238.4	3155 4816	19118 26463	5.20 6.22	58.97



Model number cording

2 SLS50 UU CL +700L P K

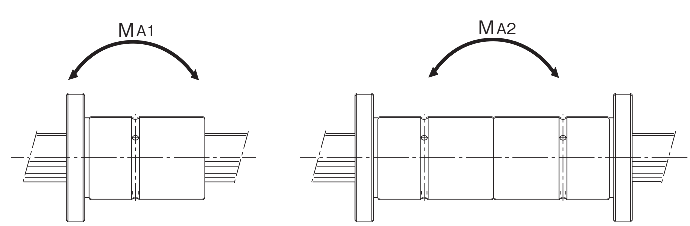
- 2: Number of spline nuts on one shaft (no symbol for one nut)
- SLS50: Model No.
- UU: Contamination protection accessory symbol
  No symbol: No seal
  UU: Rubber seal attached on both ends
  U: Rubber seal attached on either end
- CL: Symbol for clearance in the rotational direction (see page 5)
- +700L: Overall spline shaft length (in mm)
- P: Accuracy symbol (see page 4)
- K: Symbol for standard hollow spline shaft
  No symbol: Solid spline shaft
  K: Hollow spline shaft



Model SLF (Flange type)

Unit: mm

Model No.	Spline nut dimensions											Spline shaft outer diameter	Basic torque rating		Basic load rating		Static permissible moment		Mass	
	Outer diameter		Length		Flange diameter		Greasing hole	H	F	PCD	Mounting hole $d_1 \times d_2 \times h$	D_0 h7	C_T [N-m]	C_{0T} [N-m]	C [kN]	C_0 [kN]	M_{A1} [N-m]	M_{A2} [N-m]	Spline Nut [kg]	Spline shaft [kg/m]
	D	Tolerance	L	Tolerance	D_1	Tolerance	d_0													
SLF25	37	0 -0.016	60	0 -0.3	60	0 -0.2	2	9	21	47	5.5×9.5×5.4	25	219.9	306.8	18.2	22.5	136	851	0.26	3.51
SLF30	45		70		70		3	10	25	54	6.6×11×6.5	30	366.5	513.3	25.4	31.5	233	1341	0.45	5.05
SLF40	60	0 -0.019	90		90		3	14	31	72	9×14×8.6	40	818.9	1135.4	42.8	52.5	520	2801	1.06	9.18
SLF50	75		100		113	0 -0.3	4	16	34	91	11×17.5×11	50	1373.4	1783.1	57.6	66.2	687	4156	1.90	14.45
SLF60	90		127		129		4	18	45.5	107	11×17.5×11	60	2506.7	3321.0	87.8	103.0	1452	7733	3.08	21.23
SLF70	100	0 -0.022	110		142		4	20	47.5	117	14×20×13	70	2986.3	3474.7	89.7	92.5	1038	6392	3.25	28.57
SLF80	120		140	0 -0.4	168		5	22	48	138	16×23×15.2	80	4664.6	5477.4	122.8	127.7	1739	11482	5.82	37.49
SLF100	140	0 -0.025	160		195	0 -0.4	5	25	55	162	18×26×17.5	100	8922.3	10211.6	188.2	190.7	3155	19118	7.66	58.97



Model number cording

2 SLS50 UU CL +700L P K

- 2: Number of spline nuts on one shaft (no symbol for one nut)
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- UU: Contamination protection accessory symbol
  No symbol: No seal
  UU: Rubber seal attached on both ends
  U: Rubber seal attached on either end
- CL: Symbol for clearance in the rotational direction (see page 5)
- +700L: Overall spline shaft length (in mm)
- P: Accuracy symbol (see page 4)
- K: Symbol for standard hollow spline shaft
  No symbol: Solid spline shaft
  K: Hollow spline shaft

THK Caged Ball Spline SLS/SLF

⚠ Precautions on use

●The Spline Nut and the Spline Shaft

- Do not remove the spline nut from the spline shaft unless it is necessary. If reinstalling the spline nut onto the spline shaft after inevitably removing the nut, align the ball position in the spline nut with the groove position of the spline shaft, and gradually insert the spline shaft straight into the spline nut. If the spline shaft is tilted when it is inserted, balls may fall out or the circulation part may be damaged.
- If the spline shaft gets stuck halfway while being inserted into the nut, do not force the shaft into the nut, but pull it out once, recheck the ball position and the groove position of the spline shaft, then gradually insert the shaft straight into the nut.
- After inserting the spline shaft into the spline nut, check whether the spline nut or the spline shaft smoothly moves. If the spline shaft was forcibly inserted, functional loss may have occurred even if the product looks intact.

●Handling

- Do not disassemble the parts. Doing so may cause dust to enter the product or degrade the assembly accuracy.
- Tilting the spline nut or the spline shaft when they are assembled may cause it to fall by its own weight.
- Do not drop or hit the Ball Spline. Doing so may damage it. Applying impact to the product may cause functional loss even if the product looks intact.

●Lubrication

- Thoroughly remove anti-rust oil and feed a lubricant before using the product.
- Do not mix lubricants of different physical properties.
- In locations exposed to constant vibrations or in special environments such as clean rooms, vacuum and low/high temperature, normal lubricants may not be used. Contact THK for details.
- When planning to use a special lubricant, contact THK before using it.
- When adopting oil lubrication, the lubricant may not be distributed throughout the product depending on the mounting orientation of nut. Contact THK for details.
- Lubrication interval varies according to the conditions. Contact THK for details.

●Precautions on Use

- Entrance of foreign material may damage the ball circulation part or cause functional loss. Prevent foreign material, such as dust and cutting chips, from entering the product.
- When planning to use the product in an environment where the coolant penetrates into the spline nut, it may disrupt the function of the product depending on the type of the coolant. Contact THK for details.
- Do not use the product at a temperature above 80℃. Contact THK if you desire to use the product at a temperature above 80℃.
- If foreign material, such as dust or cutting chips, adheres to the product, replenish the lubricant after cleaning the product. For the type of the cleaning fluid to be used, contact THK.
- When using the product in locations exposed to constant vibrations or in special environments such as clean rooms, vacuum and low/high temperature, contact THK in advance.
- Removing the nut from the shaft then reinstalling it onto the shaft may cause balls to fall. Take much care in handling the product.
- If desiring for additional machining, such as dowel hole, to the flange of Ball Spline Nut, please contact THK prior to ordering.

●Storage

- When storing the Ball Spline, enclose it in a package designated by THK and store it in a horizontal orientation while avoiding high temperature, low temperature and high humidity.

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