BALL SPLINE
ROTARY BALL SPLINE
STROKE BALL SPLINE
BALL SCREW SPLINE

BALL SPLINE

The NB ball spline is a linear motion mechanism utilizing the rolling motion of ball elements that can sustain loads and transfer torque simultaneously. It can be used in a wide variety of applications including robotics and transport type equipment.

STRUCTURE AND ADVANTAGES

The NB ball spline consists of a spline shaft with raceway grooves and a spline nut. The spline nut consists of an outer cylinder (main body), retainer, side rings, and ball elements that is designed and manufactured to achieve a reliably smooth motion.

High Load Capacity and Long Travel Life

The raceway grooves are machined to a radius close to that of the ball elements. The large ball contact area results in high load capacity and long travel life.

Wide Variety of Configurations

Spline shaft sizes with diameters from 4mm to 100mm are available. Several types of Spline nut are available: cylindrical types (SSP/SSPM), and flange types (SSPF/SSPT). Material option of Stainless steel (SUS440C or equivalent) is also available. They can be specified to suit various applications.

Anti-corrosion Specification

In addition to the stainless steel version, you can also select the LB option with low-temperature black chrome treatment. The surface treatment is applied to the shaft and outer cylinder body for rust prevention.

High Accuracy Torque Transmission

Due to the effective contact angle between the raceway grooves and the balls, the NB ball spline can transfer large torque. By adjusting preload it is possible to obtain a higher rigidity and a higher positioning accuracy.

Ease of Additional Custom Machining

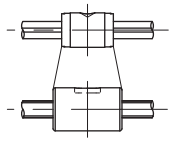
Since a round shaft with raceway grooves is used, NB ball spline shafts can be easily machined to customized specifications.

High-Speed Motion and High-Speed Rotation

The outer cylinder is compact and well balanced, resulting in good performance at high speed.

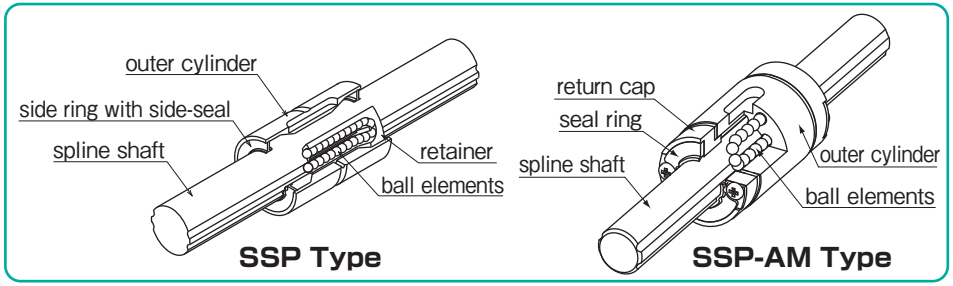
Light Weight and Compactness

The NB ball spline SSP-AM type has a smaller spline-nut diameter compared to the conventional SSP type nut on the same shaft diameter. The SSP-AM type is best suited for the chip-mounter head device and the multiaxial applications. Anti-corrosion type is also available.



comparison between SSP4AM and SSP4
nut outer dia.
20% smaller
nut length
25% shorter

Figure B-1 Basic Structure of NB Ball Spline

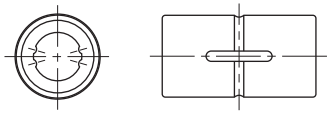
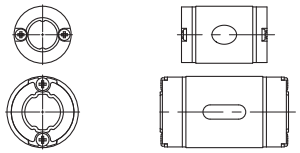
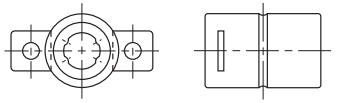
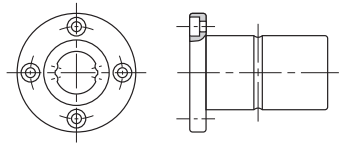
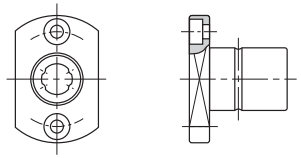
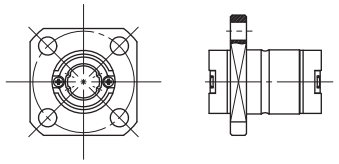


TYPES

TYPES OF SPLINE NUT

A wide variety of spline nut designs are available and all spline nuts come with side-seals as a standard feature.

Table B-1 Types of Spline Nut

type of nut		shape and advantage	page
cylindrical type	SSP SSPS	 ・cylindrical spline nut with key groove ・with special key ・nominal diameter: SSP4-100 : SSPS4-25	P.B-18
	SSP-AM SSPS-AM	 ・light and compact nut ・countersink for fixing (SSP4AM) ・with special key ・nominal diameter: 4-10	P.B-20
	SSPM	 ・cylindrical spline nut without key groove ・with two lock plates for fixing ・nominal diameter: 6-10	P.B-22
flange type	SSPF SSPFS	 ・spline nut with flange ・nominal diameter: SSPF6-60 : SSPFS6-25	P.B-24
	SSPT	 ・spline nut with a two side cut flange ・nominal diameter: 6-10	P.B-26
	SSPT-AM SSPK-AM SSPTS-AM SSPKS-AM	 ・light and compact nut with flange ・nominal diameter: 4-10	P.B-28

TYPES OF SPLINE SHAFT

Depending on the application requirements, either a ground spline shaft or a non-ground (commercial grade) spline shaft is available.

Table B-2

type of spline shaft	shape and advantage	
ground spline shaft		・precision ground and precision machined surface finish ・high precision ・possible to machine ends of spline shaft and surface treatment ・nominal diameter: 4-100
commercial shaft (non-ground)		・for general industrial use ・cost effective ・possible to machine ends of spline shaft and surface treatment ・nominal diameter: 20-50 ・maximum length: 5000mm (refer to page B-33)

SPECIFICATION

Table B-3 shows the NB Ball Spline material and operating temperature.

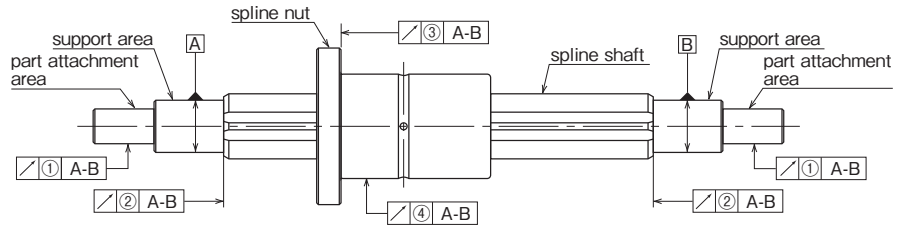
Table B-3 Material and Operating Temperature Range

type	nut		spline shaft	operating temperature range
	outer cylinder	return cap /retainer		
SSP	steel	resin	steel	−20℃~80℃
SSP -C				
SSP -AM				
SSPM				
SSPF				
SSPF -C				
SSPT				
SSPT -AM				
SSPK -AM				
SSPS	stainless steel		stainless steel	
SSPS -AM				
SSPFS				
SSPTS -AM				
SSPKS -AM				

ACCURACY

The NB ball spline is measured for accuracy at the points shown in Figure B-2 and categorized as either high-grade (blank) or precision-grade (P). Contact NB for accuracy information on the commercial type ball spline.

Figure B-2 Accuracy Measurement Points



Note: The support area is the portion where, for example, radial bearings are attached in order to support the spline shaft.
The part attachment area is the portion to which other parts, such as gears are attached.

Tolerance of Spline Shaft Groove Torsion (Max.)

The groove torsion is indicated per 100mm, arbitrarily set as the effective length of the spline shaft section.

Table B-4
Tolerance of Spline Shaft Groove Torsion (Max.)

type of shaft	ground shaft	
accuracy grade	high	precision (P)
tolerance	13μm／100mm	6μm／100mm

Table B-5 Tolerance Relative to Spline Support Area (Max.) unit : μm

part number	radial runout of part attachment area ①		radial runout of the end of the spline shaft section ② (when grinding is requested on the drawing)		radial runout of the flange ③	
	high-grade	precision-grade	high-grade	precision-grade	high-grade	precision-grade
SSP 4・4AM	14	8	9	6	11	8
SSP 5AM						
SSP 6・6AM						
SSP 8・8AM						
SSP 10・10AM	17	10			13	9
SSP 13A	19	12	11	8		
SSP 16A						
SSP 20A						
SSP 25A	22	13	13	9	16	11
SSP 30A						
SSP 40A	25	15	16	11	19	13
SSP 50A						
SSP 60A	29	17	19	13	22	15
SSP 80A					—	—
SSP 80AL						
SSP100A	34	20	22	15		
SSP100AL						
SSP 20	19	12	11	8	13	9
SSP 25	22	13	13	9	16	11
SSP 30						
SSP 40	25	15	16	11	19	13
SSP 50						
SSP 60	29	17	19	13	22	15

Table B-6 ④Radial Runout of Outer Surface of Spline Nut Relative to Spline Shaft Support Area (Max.) unit : μm

total length of spline shaft (mm)		size																	
		4 4AM		5AM 6 6AM		8 8AM		10 10AM		13A 16A 20A·20		25A·25 30A·30		40A·40 50A·50		60A·60 80A 80AL		100A 100AL	
greater than	or less	high-grade	precision grade	high-grade	precision grade	high-grade	precision grade	high-grade	precision grade	high-grade	precision grade	high-grade	precision grade	high-grade	precision grade	high-grade	precision grade	high-grade	precision grade
—	200	46	26	46	26	46	26	36	20	34	18	32	18	32	16	30	16	30	16
200	315	89	—	89	57	89	57	54	32	45	25	39	21	36	19	34	17	32	17
315	400	—	—	126	—	126	82	68	41	53	31	44	25	39	21	36	19	34	17
400	500	—	—	—	—	163	—	82	51	62	38	50	29	43	24	38	21	35	19
500	630	—	—	—	—	—	—	102	65	75	46	57	34	47	27	41	23	37	20
630	800	—	—	—	—	—	—	—	—	92	58	68	42	54	32	45	26	40	22
800	1,000	—	—	—	—	—	—	—	—	115	75	83	52	63	38	51	30	43	24
1,000	1,250	—	—	—	—	—	—	—	—	153	97	102	65	76	47	59	35	48	28
1,250	1,600	—	—	—	—	—	—	—	—	256*	180*	210	140	175	105	70	43	55	33
1,600	2,000	—	—	—	—	—	—	—	—	394	314	311	241	224	154	179	109	65	40

★ SSP13A, 16A maximum length: 1,500mm
★★ Please contact NB for shaft lengths exceeding 2,000mm.

PRELOAD AND CLEARANCE

The preload is categorized into three different levels: standard, light (T1), and medium (T2). A preload cannot be specified with the commercial grade spline shaft.

Table B-7 Preload and Clearance unit : μm

part number	standard	light* (T1)	medium** (T2)
SSP 4・4AM	0～+3	−3～0	−
SSP 5AM			
SSP 6・6AM			
SSP 8・8AM			
SSP 10・10AM			
SSP 13A	−3～+1	−8～−3	−13～−8
SSP 16A			
SSP 20A・20	−4～+2	−12～−4	−20～−12
SSP 25A・25			
SSP 30A・30			
SSP 40A・40	−6～+3	−18～−6	−30～−18
SSP 50A・50			
SSP 60A・60			
SSP 80A			
SSP 80AL			
SSP100A	−8～+4	−24～−8	−40～−24
SSP100AL			

Table B-8 Preload and Operating Condition

preload	preload symbol	operating conditions
standard	blank	minute vibration is applied. a precise motion is required. a torque in a given direction is applied.
light	T1*	slight vibration is applied. slight torsional load is applied. cyclic torque is applied.
medium	T2**	shock/vibration is applied. over-hang load is applied. torsional load is applied.

*.** Since the contrary relation of preload anddynamic frictional resistance, dynamic frictional resistance will increase when applying preload.
** The outer diameter of the outer cylinder of SSP and SSPF type medium preload (T2) products may be deformed by preload and deviate from the tolerance of the dimension table.

RIGIDITY AND PRELOAD

The rolling elements of the ball spline deform elastically due to the applied load. The amount of deformation depends on the type of rolling element. It is proportional to the 2/3 power for ball elements. For rollers, it is proportional to the 9/10 power. In either case, the rate of deformation decreases as the applied load increases. Greater rigidity is achieved by applying a preload.

A preload causes internal stress within the ball spline, resulting in some reduction in lifetime. However, when the ball spline is used under shock or vibration loading conditions, a preload will absorb the load and will actually help lengthen the life time. Because the preload causes elastic deformation of the rolling elements, it becomes less tolerable to the installation dimensional errors. Extreme care should be exercised in machining the installation surface.

Figure B-3 Elastic Deformation of Rolling Elements

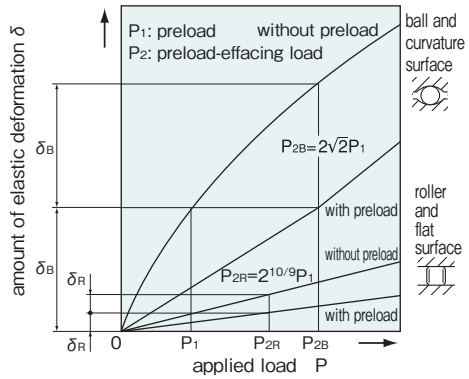


Table B-9 Level of Preload

preload	symbol	effect of preload: vibration absorption ability	self-aligning ability	lifetime	rigidity	frictional resistance	operating conditions	applicable part number
clearance	---	increases	reduces	reduces	increases	increases	light motion is required. installation errors to be absorbed.	Please contact NB
standard	blank						minute vibration is applied. accurate motion is required. moment is applied in a given direction.	SSP,SSP-AM, SPR,SPB, SPLFS,SPBR
light	T1						light vibration is applied. light torsional load is applied. moment is applied.	SSP, SSP-AM, SPR,SPB
medium	T2						shock and vibration are applied. over-hang load is applied. torsional load is applied.	SSP, SPR, SPB

STRENGTH OF SPLINE SHAFT

The ball spline has larger load ratings compared to ball bush. Also, the ball spline can sustain radial load, moment (bending moment) and torque (twisting moment) at the same time. Thus, it is necessary to consider the strength of ball spline shaft.

Using the following equations, select the size of ball spline.

$$\sigma \geqq \frac{M}{Z} \quad \cdots\cdots (1)$$

σ: permissible bending stress of spline shaft (98N/mm^2)
M: bending moment onto spline shaft (N·mm)
Z: modulus of section (mm^3)
(refer to Table B-10 on page B-9)

Twisting Moment Only

$$\tau_a \geqq \frac{T}{Z_P} \quad \cdots\cdots (2)$$

Ta: permissible twisting stress of spline shaft (49N/mm^2)
T: twisting moment onto spline shaft (N·mm)
Zp: polar modulus of section (mm^3)
(refer to Table B-10 on page B-9)

Bending Moment and Twisting Moment Combined

Calculate equivalent bending moment (Me) by using equation (3).Then, substitute Me into equation (1) for shaft size selection.

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

Me: equivalent bending moment (N·mm)
M: bending moment onto spline shaft (N·mm)
T: twisting moment onto spline shaft (N·mm)

Rigidity of Spline Shaft

The rigidity of spline shaft is expressed in the torsional angle (θ) caused by twisting moment.
For high accuracy smooth motion, it is necessary to keep the torsional angle within 0.25° per 1,000mm.

$$\theta = \frac{T \cdot L}{G \cdot I_P} \cdot \frac{360}{2\pi} \quad \cdots\cdots (4)$$

$$\text{Rigidity} = 0.25° \geqq \frac{1{,}000}{L}\theta \quad \cdots\cdots (5)$$

θ: torsional angle (°)
T: twisting moment onto spline shaft (N·mm)
L: spline shaft length (mm)
G: shearing modulus (SUJ2) 7.9×10^4 (N/mm^2)
(SUS) 7.69×10^4 (N/mm^2)
Ip: polar moment of inertia of area (mm^4)
(refer to Table B-10 on page B-9)

Figure B-4 Bending Moment

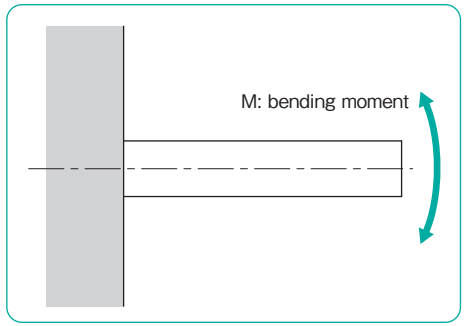


Figure B-5 Twisting Moment

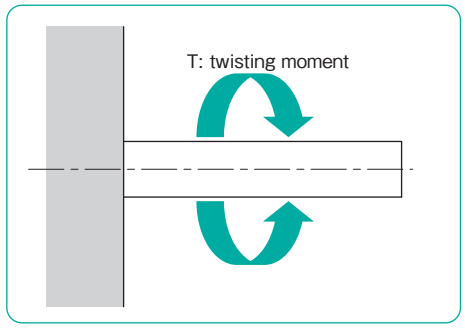


Figure B-6 Deformation of Spline Shaft by Twisting Moment

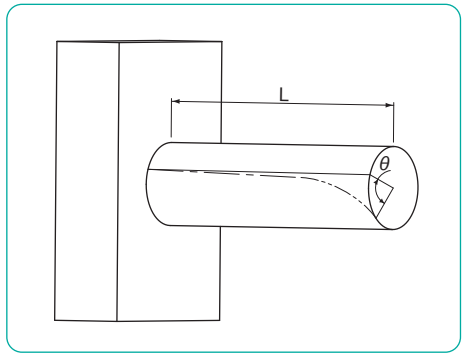


Table B-10 (1) Cross-sectional Characteristics of Spline Shaft (1)

part number	Ix moment of inertia of area mm^4	Iy moment of inertia of area mm^4	Zx modulus of section mm^3	Zy modulus of section mm^3
SSP 4	1.17×10^1	1.23×10^1	5.90	6.15
SSP 6	5.91×10^1	6.20×10^1	1.97×10^1	2.07×10^1
SSP 8	1.90×10^2	1.97×10^2	4.76×10^1	4.94×10^1
SSP 10	4.60×10^2	4.81×10^2	9.22×10^1	9.62×10^1
SSP 13A	1.31×10^3	1.38×10^3	2.03×10^2	2.13×10^2
SSP 16A	2.98×10^3	3.16×10^3	3.73×10^2	3.96×10^2
SSP 20A	7.35×10^3	7.74×10^3	7.36×10^2	7.74×10^2
SSP 25A	1.79×10^4	1.88×10^4	1.43×10^3	1.51×10^3
SSP 30A	3.65×10^4	3.94×10^4	2.44×10^3	2.63×10^3
SSP 40A	1.14×10^5	1.24×10^5	5.73×10^3	6.24×10^3
SSP 50A	2.80×10^5	3.04×10^5	1.12×10^4	1.22×10^4
SSP 60A	5.90×10^5	6.32×10^5	1.97×10^4	2.11×10^4
SSP 80A SSP 80AL	1.93×10^6	1.99×10^6	4.83×10^4	4.98×10^4
SSP100A SSP100AL	4.68×10^6	4.86×10^6	9.38×10^4	9.72×10^4
SSP 20	5.03×10^3	5.35×10^3	5.54×10^2	5.89×10^2
SSP 25	1.27×10^4	1.36×10^4	1.10×10^3	1.19×10^3
SSP 30	2.74×10^4	2.99×10^4	1.96×10^3	2.14×10^3
SSP 40	8.70×10^4	9.52×10^4	4.66×10^3	5.09×10^3
SSP 50	2.15×10^5	2.37×10^5	9.19×10^3	1.01×10^4
SSP 60	4.49×10^5	4.95×10^5	1.59×10^4	1.76×10^4
SSP 4AM	1.18×10^1	1.26×10^1	6.01	6.28
SSP 5AM	2.77×10^1	3.00×10^1	1.11×10^1	1.20×10^1
SSP 6AM	5.89×10^1	6.26×10^1	1.96×10^1	2.09×10^1
SSP 8AM	1.88×10^2	1.98×10^2	4.71×10^1	4.96×10^1
SSP10AM	4.53×10^2	4.82×10^2	9.06×10^1	9.65×10^1

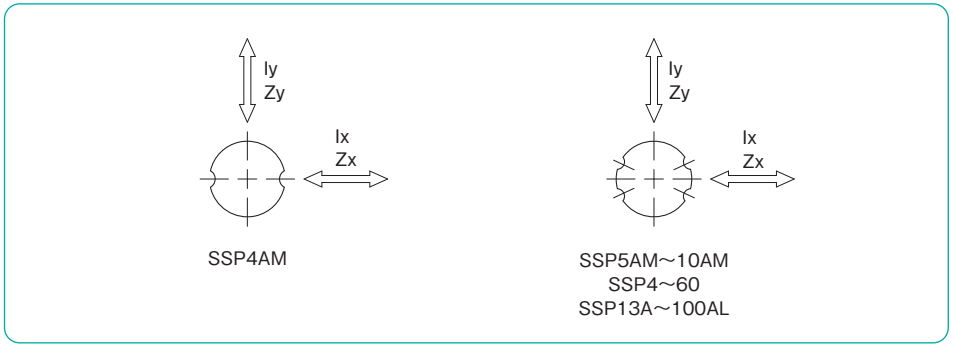


Table B-10 (2) Cross-sectional Characteristics of Spline Shaft (2)

part number	I_P polar moment of inertia of area mm⁴	Z_P polar modulus of section mm³	C=1/48EI 1/N・mm² SUJ2	equivalent to SUS440C
SSP 4	2.41×10^{1}	1.20×10^{1}	8.57×10^{-9}	8.83×10^{-9}
SSP 6	1.21×10^{2}	4.04×10^{1}	1.71×10^{-9}	1.76×10^{-9}
SSP 8	3.88×10^{2}	9.69×10^{1}	5.32×10^{-10}	5.47×10^{-10}
SSP 10	9.42×10^{2}	1.88×10^{2}	2.19×10^{-10}	2.26×10^{-10}
SSP 13A	2.70×10^{3}	4.16×10^{2}	7.66×10^{-11}	7.89×10^{-11}
SSP 16A	6.15×10^{3}	7.68×10^{2}	3.39×10^{-11}	3.49×10^{-11}
SSP 20A	1.51×10^{4}	1.51×10^{3}	1.38×10^{-11}	1.42×10^{-11}
SSP 25A	3.68×10^{4}	2.94×10^{3}	5.65×10^{-12}	5.82×10^{-12}
SSP 30A	7.57×10^{4}	5.05×10^{3}	2.79×10^{-12}	–
SSP 40A	2.39×10^{5}	1.20×10^{4}	8.83×10^{-13}	–
SSP 50A	5.86×10^{5}	2.34×10^{4}	3.60×10^{-13}	–
SSP 60A	1.22×10^{6}	4.08×10^{4}	1.71×10^{-13}	–
SSP 80A	3.92×10^{6}	9.81×10^{4}	5.24×10^{-14}	–
SSP 80AL				
SSP100A	9.55×10^{6}	1.91×10^{5}	2.16×10^{-14}	–
SSP100AL				
SSP 20	1.04×10^{4}	1.14×10^{3}	2.01×10^{-11}	2.07×10^{-11}
SSP 25	2.63×10^{4}	2.29×10^{3}	7.97×10^{-12}	8.21×10^{-12}
SSP 30	5.73×10^{4}	4.10×10^{3}	3.69×10^{-12}	–
SSP 40	1.82×10^{5}	9.75×10^{3}	1.16×10^{-12}	–
SSP 50	1.01×10^{5}	1.93×10^{4}	4.69×10^{-13}	–
SSP 60	9.46×10^{5}	3.35×10^{4}	2.25×10^{-13}	–
SSP 4AM	2.44×10^{1}	1.23×10^{1}	8.56×10^{-9}	8.82×10^{-9}
SSP 5AM	5.77×10^{1}	2.31×10^{1}	3.65×10^{-9}	3.76×10^{-9}
SSP 6AM	1.22×10^{2}	4.05×10^{1}	1.72×10^{-9}	1.77×10^{-9}
SSP 8AM	3.86×10^{2}	9.66×10^{1}	5.37×10^{-10}	5.53×10^{-10}
SSP10AM	9.35×10^{2}	1.87×10^{2}	2.23×10^{-10}	2.30×10^{-10}

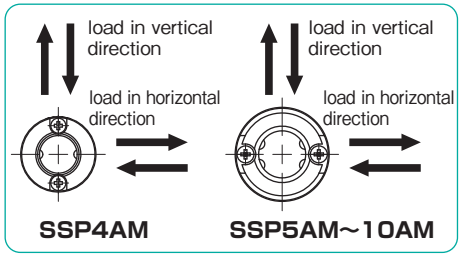
LOAD RATING

The load rating for SSP-AM type depends on the direction of load.

Table B-11 LOAD RATING

		SSP4AM	SSP5AM~10AM
basic dynamic load rating	vertical	C	C
	horizontal	1.73×C	1.22×C
basic static load rating	vertical	C_0	C_0
	horizontal	1.73×C_0	1.22×C_0

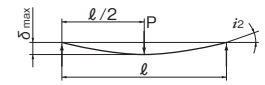
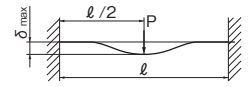
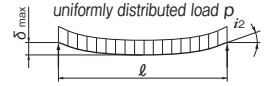
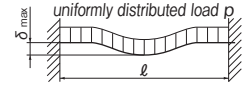
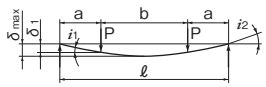
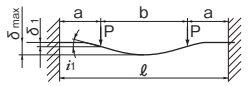
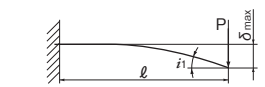
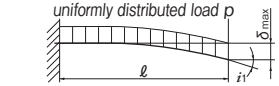
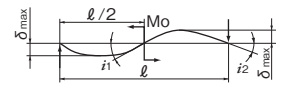
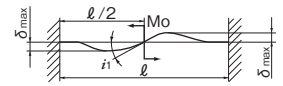
Figure B-7 Load Direction



CALCULATION OF DEFLECTION AND DEFLECTION ANGLE OF SPLINE SHAFT

The following formulas are used to obtain the deflection and its angle of the ball spline shaft.
Typical conditions are listed in Table B-12.

Table B-12 Formulas for Calculating Deflection and Deflection Angle

	support method	specification	formula for deflection	formula for deflection angle
1	support | support		$\delta_{max}=\frac{P\ell^3}{48EI}=P\ell^3C$	$i_1=0$ $i_2=\frac{P\ell^2}{16EI}=3P\ell^2C$
2	fixed | fixed		$\delta_{max}=\frac{P\ell^3}{192EI}=\frac{1}{4}P\ell^3C$	$i_1=0$ $i_2=0$
3	support | support		$\delta_{max}=\frac{5p\ell^4}{384EI}=\frac{5}{8}p\ell^4C$	$i_2=\frac{p\ell^3}{24EI}=2p\ell^3C$
4	fixed | fixed		$\delta_{max}=\frac{p\ell^4}{384EI}=\frac{1}{8}p\ell^4C$	$i_2=0$
5	support | support		$\delta_1=\frac{Pa^3}{6EI}\left(2+\frac{3b}{a}\right)=8Pa^3\left(2+\frac{3b}{a}\right)C$ $\delta_{max}=\frac{Pa^3}{24EI}\left(\frac{3\ell^2}{a^2}-4\right)=2Pa^3\left(\frac{3\ell^2}{a^2}-4\right)C$	$i_1=\frac{Pab}{2EI}=24PabC$ $i_2=\frac{Pa(a+b)}{2EI}=24Pa(a+b)C$
6	fixed | fixed		$\delta_1=\frac{Pa^3}{6EI}\left(2-\frac{3a}{\ell}\right)=8Pa^3\left(2-\frac{3a}{\ell}\right)C$ $\delta_{max}=\frac{Pa^3}{24EI}\left(2+\frac{3b}{a}\right)=2Pa^3\left(2+\frac{3b}{a}\right)C$	$i_1=\frac{Pa^2b}{2EI\ell}=\frac{24Pa^2bC}{\ell}$ $i_2=0$
7	fixed | free		$\delta_{max}=\frac{P\ell^3}{3EI}=16P\ell^3C$	$i_1=\frac{P\ell^2}{2EI}=24P\ell^2C$ $i_2=0$
8	fixed | free		$\delta_{max}=\frac{p\ell^4}{8EI}=6p\ell^4C$	$i_1=\frac{p\ell^3}{6EI}=8p\ell^3C$ $i_2=0$
9	support | support		$\delta_{max}=\frac{\sqrt{3}Mo\,\ell^2}{216EI}=\frac{2\sqrt{3}}{9}Mo\,\ell^2C$	$i_1=\frac{Mo\,\ell}{12EI}=4Mo\,\ell C$ $i_2=\frac{Mo\,\ell}{24EI}=2Mo\,\ell C$
10	fixed | fixed		$\delta_{max}=\frac{Mo\,\ell^2}{216EI}=\frac{2}{9}Mo\,\ell^2C$	$i_1=\frac{Mo\,\ell}{16EI}=3Mo\,\ell C$ $i_2=0$

δ_1: deflection at the concentrated load point (mm) δ_{max}: maximum deflection (mm) i_1: deflection angle at the concentrated load point (rad) i_2: deflection angle at the support point (rad) Mo: moment (N・mm) P: concentrated load (N) p: uniformly distributed load (N/mm) a,b: concentrated load point distance (mm) ℓ: span (mm) I: moment of inertia of area (mm⁴) (refer to Table B-10 on page B-9) E: modulus of longitudinal elasticity (SUJ2) 2.06×10^5 (N/mm²) (SUS) 2.0×10^5 (N/mm²) C: 1/48EI (1/N・mm²)

ALLOWABLE ROTATIONAL SPEED OF SPLINE SHAFT

When the rotational speed is increased and approaches the spline shaft resonant frequency, the spline shaft is disabled from further operation. This speed is called the critical speed and can be obtained by the following equations. In order to leave a sufficient safety margin, the allowable operating speed should be set at about 80% of the calculated value.

Using the following equations, select the size of ball spline shaft. First, calculate I_d and A by equation (2) and (3) then, substitute the values into equation (1).

$$N_C = 60 \cdot \frac{\lambda^2}{2\pi \cdot L^2} \cdot \sqrt{\frac{E \cdot I_d \times 10^3}{\gamma \cdot A}} \quad \cdots\cdots (1)$$

Nc: critical speed (rpm)
L: support distance (mm)
E: modulus of longitudinal elasticity (SUJ2)2.06×10^5 (N/mm^2)
(SUS)2.0 ×10^5 (N/mm^2)
γ: density (SUJ2)7.85×10^{-6} (kg/mm^3)
(SUS)7.75×10^{-6} (kg/mm^3)

I_d: Minimum Moment of Inertia of Area (mm^4)

$$I_d = \frac{\pi \cdot d^4}{64} \quad \cdots\cdots (2)$$

d: maximum machined-down diameter with no spline grooves left (refer to Table B-13)

A: Minimum Cross-sectional Area of the Spline Shaft (mm^2)

$$A = \frac{\pi \cdot d^2}{4} \quad \cdots\cdots (3)$$

d: maximum machined-down diameter with no spline grooves left (refer to Table B-13)

λ: coefficient of mounting method
(refer to Figure B-8)
fixed-free λ=1.875
supported-supported λ=3.142
fixed-supported λ=3.927
fixed-fixed λ=4.730

Figure B-8 Mounting Method

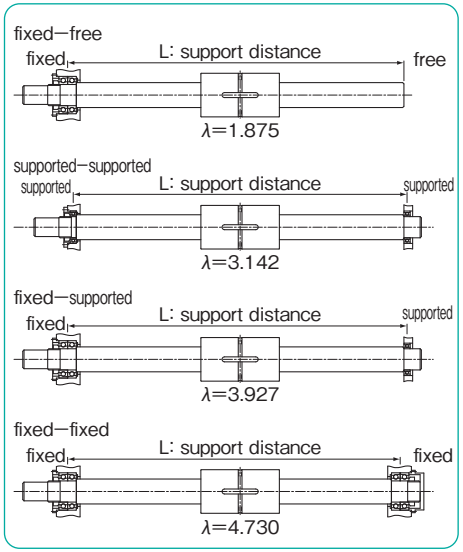
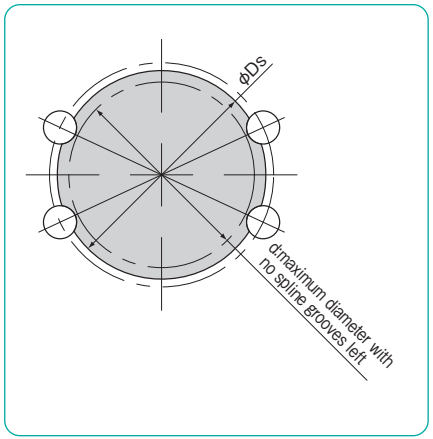


Table B-13 Spline Shaft Profile

part number	d: maximum diameter with no spline grooves left mm
SSP 4	3.5
SSP 6	5.3
SSP 8	7.2
SSP 10	9
SSP 13A	11.7
SSP 16A	14.2
SSP 20A	17.9
SSP 25A	22.4
SSP 30A	26.8
SSP 40A	35.5
SSP 50A	44.6
SSP 60A	54
SSP 80A	73.9
SSP 80AL	
SSP100A	92
SSP100AL	

part number	d: maximum diameter with no spline grooves left mm
SSP20	16.4
SSP25	20.6
SSP30	24.8
SSP40	33.1
SSP50	41.4
SSP60	49.7
SSP 4AM	3.4
SSP 5AM	4.3
SSP 6AM	5.2
SSP 8AM	7.1
SSP10AM	8.8



The maximum diameter (d) is recommended as the shaft diameter of the support area leaving no spline grooves after end-machining.

RATED LIFE CALCULATION

When the ball elements are used as the rolling elements in ball splines, the following equations are used to calculate the life of ball spline:

For radial load

$$L = \left(\frac{f_c}{f_w} \cdot \frac{C}{P}\right)^3 \cdot 50$$

For torque load

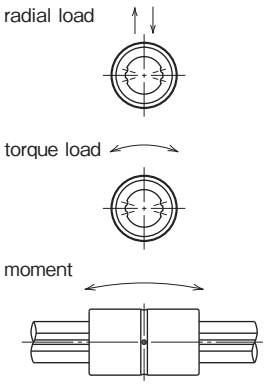
$$L = \left(\frac{f_c}{f_w} \cdot \frac{C_T}{T}\right)^3 \cdot 50$$

L: rated life (km) f_c: contact coefficient f_w: load coefficient
C: basic dynamic load rating (N) P: applied load (N)
C_T: basic dynamic torque rating (N·m) T: applied torque (N·m)
* Refer to page Eng-6 for the coefficients
** The load rating of the commercial spline is approximately 70% of the standard ball spline.

$$L_h = \frac{L \cdot 10^6}{2 \cdot \ell_s \cdot n_1 \cdot 60}$$

L_h: life time (hr) ℓ_s: stroke length (mm)
L: rated life (km) n_1: number of cycles per minute (cpm)

Figure B-9 Radial Load and Torque Load



MOUNTING

Fit between Spline Nut and Housing

A transition fit is used for the SSP/SSPM-type spline nut and its housing bore to minimize the clearance. If high accuracy is not required, then a clearance fit can be used. Regarding the SSPT/SSPF type spline nut, for a light load and little torque application a hole slightly larger than the outer diameter of the nut can suffice. The mounting surface for the flange influences the perpendicularity and parallelism. Please make sure that the accuracy of the mounting surface is correct.

Table B-14 Fit for the Spline Nut

type of spline nut	clearance fit	transition fit
SSP	H7	J6
SSP-AM		
SSPM		

Insertion of Spline Nut

When inserting a spline nut into the housing, use a jig like the one shown in Figure B-10. Carefully insert the nut so as to not hit the side ring and seal.

Figure B-10 Insertion of Spline Nut into Housing

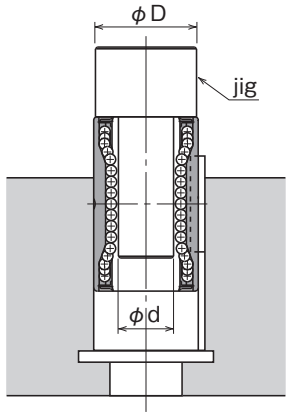


Table B-15 Recommended Jig Dimensions unit : mm

part number	D	d	part number	D	d
SSP 4	9.5	3.5	SSP20	31.5	16.5
SSP 6	13.5	5	SSP25	36.5	20.5
SSP 8	15.5	7	SSP30	44.5	25
SSP 10	20.5	8.5	SSP40	59.5	33
SSP 13A	23.5	12	SSP50	74	41
SSP 16A	30.5	14.5	SSP60	89	50
SSP 20A	34.5	18			
SSP 25A	41.5	22.5	SSP 4AM	7.5	3
SSP 30A	46.5	27	SSP 5AM	9.5	4
SSP 40A	63.5	35.6	SSP 6AM	11.5	5
SSP 50A	79	44	SSP 8AM	14.5	7
SSP 60A	89	53.5	SSP10AM	18.5	8.5
SSP 80A	119	74			
SSP 80AL					
SSP100A	149	92			
SSP100AL					

OPERATING CONDITIONS

The performance of the ball spline is affected by the operating conditions of the application. The operating conditions should, therefore be carefully taken into consideration.

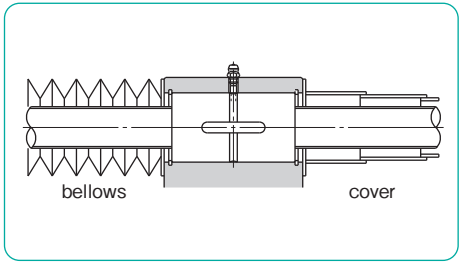
Dust Prevention

Foreign particles or dust in the ball spline nut affects the motion accuracy and shortens the life time. Standard seals will perform well against dust prevention under normal operating conditions; however, in a harsh environment, it is necessary to attach bellows or protective covers.
(refer to Figure B-11)

Operating Temperature

Since the retainer is made of resin, the operating temperature should never exceed 80℃.

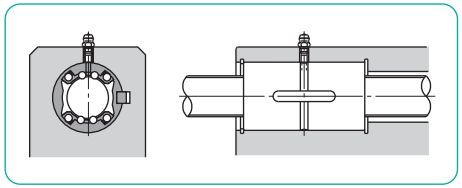
Figure B-11 Example of Dust Prevention



LUBRICATION

The NB ball spline is prelubricated with lithium soap based grease prior to shipment for immediate use. Please re-lubricate with a similar type of grease periodically depending on the operating conditions.
Low dust generation grease is available from NB standard grease. (refer to page Eng-51)
For use in special environments such as clean room and in vacuum, products without lubricant or with specified lubricant can be used depending on the situation. Please contact NB for further information.
A special syringe lubricant dispenser (refer to Figure page Eng-53) is available from NB as an option.
Please consider this for narrow spaces or when it is difficult to inject grease.
The NB ball spline has seals as standard. The seals work well to contain the grease inside the nut especially for the ground shaft, since the seal shape approximates the spline shaft profile.

Figure B-12 Example of Lubrication Mechanism

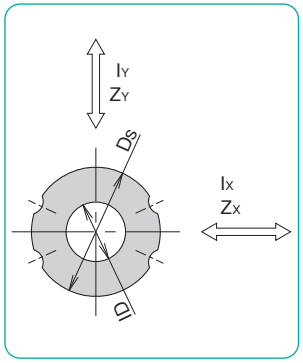


HOLLOW SPLINE SHAFT

NB provides hollow shafts. It can be used for running cable, air piping, and weight reduction. Table B-16 shows the standard hollow shaft. If you are looking for a standard hollow shaft, specify the symbol "T" after the total length of the spline shaft in the part number. It is possible to manufacture the inner diameter different from the standard hollow shaft, if so please contact NB.

Table B-16 Standard Hollow Spline Shaft

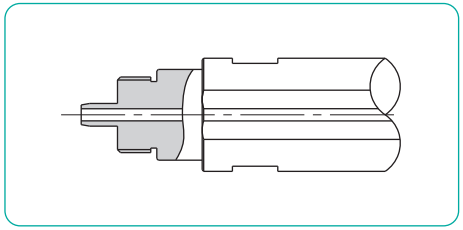
part number	shaft diameter Ds mm	inner diameter ID mm	moment of inertia of area Ix mm⁴	moment of inertia of area Iy mm⁴	modulus of section Zx mm³	modulus of section Zy mm³
SSP 4	4	1.5	1.15×10^{1}	1.21×10^{1}	5.77	6.02
SSP 6	6	2	5.83×10^{1}	6.13×10^{1}	1.94×10^{1}	2.04×10^{1}
SSP 8	8	3	1.86×10^{2}	1.93×10^{2}	4.66×10^{1}	4.84×10^{1}
SSP 10	10	4	4.48×10^{2}	4.69×10^{2}	8.97×10^{1}	9.37×10^{1}
SSP 13A	13	6	1.26×10^{3}	1.32×10^{3}	1.93×10^{2}	2.03×10^{2}
SSP 16A	16	8	2.78×10^{3}	2.96×10^{3}	3.48×10^{2}	3.70×10^{2}
SSP 20A	20	10	6.87×10^{3}	7.25×10^{3}	6.87×10^{2}	7.25×10^{2}
SSP 25A	25	15	1.54×10^{4}	1.64×10^{4}	1.23×10^{3}	1.31×10^{3}
SSP 4AM	4	1.5	1.16×10^{1}	1.23×10^{1}	5.88	6.16
SSP 5AM	5	2	2.69×10^{1}	2.92×10^{1}	1.08×10^{1}	1.17×10^{1}
SSP 6AM	6	2	5.82×10^{1}	6.18×10^{1}	1.94×10^{1}	2.06×10^{1}
SSP 8AM	8	3	1.84×10^{2}	1.94×10^{2}	4.61×10^{1}	4.86×10^{1}
SSP 10AM	10	4	4.40×10^{2}	4.70×10^{2}	8.81×10^{1}	9.40×10^{1}



SPECIAL REQUIREMENTS

Based on customer drawings and requirements NB offers shaft-end machining, spline nut machining, surface treatment, etc. Please contact NB for special requirements.

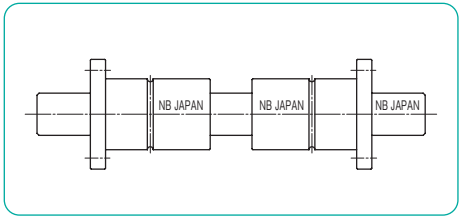
Figure B-13 Example of Shaft-end Machining



NUT ORIENTATION

Unless otherwise specified, the orientation of two NB ball spline nuts SSPM, SSPF, SSPT and SSPT(K)-AM type is shown in Figure B-14. In other cases please specify the orientation of nut(s) with shaft.

Figure B-14 Nut Orientation and NB mark



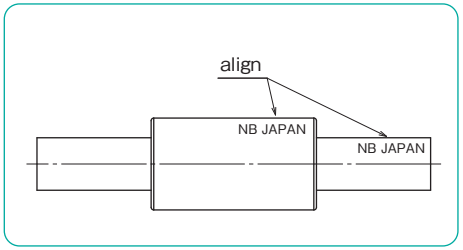
USE AND HANDLING PRECAUTIONS

NB ball spline must be handled with care as it is a precise component. Please note the following points.

A Set of Spline Nut and Spline Shaft

The ball spline's accuracy and preload is guaranteed when spline nut and shaft are aligned as shown in Figure B-15. Please make sure to align the NB marks when reinserting the shaft.
When inserting the spline shaft into the spline nut, ensure that the ball elements do not drop out. This is done by aligning the raceway grooves of the shaft with the rows of ball elements and the seal lip of the nut. Then, carefully insert the spline shaft through the spline nut. In case that the nut is preloaded, please exercise additional care.

Figure B-15 NB mark Alignment



Excessive Moment

One spline nut can sustain high moments, however, excessive moment makes the spline nut unbalanced and unstable during motion. Please use more than one spline nut for high moment or high accuracy applications.

MOUNTING

Mounting of SSP Type

Examples of installing the SSP type are shown in Figures B-16 and B-17.

Figure B-16 Using a Retaining Ring

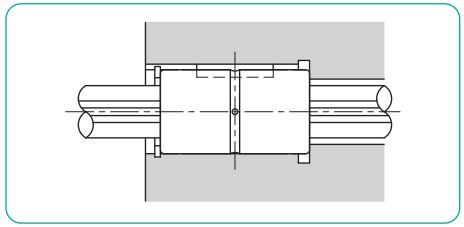
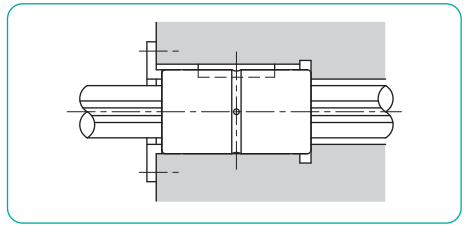


Figure B-17 Using a Push Plate



Key

The SSP and SSP-AM type spline nut come with a key shown in Figure B-18.

Figure B-18 Key for SSP Type

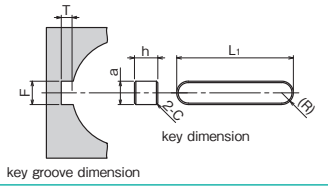


Table B-17 Major Dimensions of Key and Key Groove

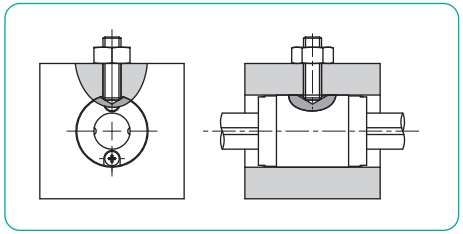
part number	key dimensions a	tolerance	h	tolerance	L1	C	recommended key groove dimensions F	tolerance	T	tolerance
	mm	μm	mm	μm	mm	mm	mm	μm	mm	mm
SSP 4	2	+16 +6	2	0 −25	6	0.2	2	+21 +11	1	+0.1 0
SSP 6	2.5		2.5		10.5		2.5		1.5	
SSP 8	2.5		2.5		10.5		2.5		1.5	
SSP 10	3		3		13		3		1.7	
SSP 13A	3		3		15		3		1.7	
SSP 16A	3.5	+24 +12	3.5	0 −30	17.5	0.5	3.5	+30 +18	1.8	
SSP 20A	4		4		29	0.3	4		1.8	
SSP 25A	4		4		36	0.5	4		1.8	
SSP 30A	4		4		42	0.5	4		1.8	
SSP 40A	6		6		52	0.5	6		2.8	
SSP 50A	8	+30/+15	7	0 −36	58	0.5	8	+37.5/+22.5	3.3	+0.2 0
SSP 60A	12	+36 +18	8		67	0.8	12	+45 +27	3.3	
SSP 80A	16		10		76	0.5	16		4.3	
SSP 80AL					110				4.3	
SSP100A	20	+43 +22	13	0 −43	110	0.8	20	+53.5 +32.5	6.4	
SSP100AL					160				6.4	
SSP 20	4	+24 +12	4	0 −30	26	0.2	4	+30 +18	1.8	+0.1 0
SSP 25	5		5		33	0.3	5		2.3	
SSP 30	7	+30 +15	7	0 −36	41	0.3	7	+37.5 +22.5	3.3	+0.2 0
SSP 40	10		8		55	0.5	10		3.8	
SSP 50	15	+36 +18	10		60	0.5	15	+45 +27	5.3	
SSP 60	18		11	0/−43	68	0.5	18		5.4	
SSP 5AM	2	+16 +6	2	0 −25	6	0.2	2	+21 +11	1	+0.1 0
SSP 6AM	2		2		8		2		1	
SSP 8AM	2.5		2.5		8.5		2.5		1.5	
SSP10AM	3		3		11		3		1.7	

For anti-corrosion specification, the material of the key is stainless steel.

Mounting of SSP4AM Type

Example of installing the SSP4AM type are shown in Figure B-19. M2 screw is used for mounting.
In process of mounting, please be careful with spline nut.

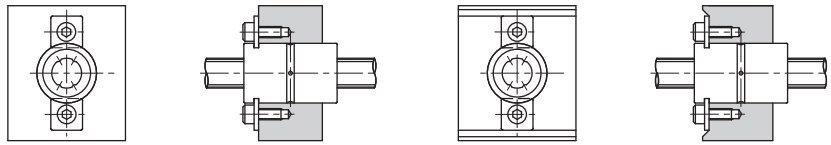
Figure B-19 Mounting of SSP4AM Type



Mounting of SSPM Type

Examples of installing the SSPM type are shown in Figures B-20～25.

Figure B-20 Using F Type Lock Plates



F Type Lock Plate (Standard Plate)

The lock plate shown in Figure B-21 is provided with the SSPM spline nut.
Material: SUS304CSP

Table B-18 F Type Lock Plate

part number	K mm	G mm	t mm	R mm	applicable spline nut
FP 6	6.8	2.9	1.0	0.5	SSPM 6
FP 8	8.5	3.5	1.2	0.5	SSPM 8
FP10	8.5	3.5	1.2	0.5	SSPM10

Figure B-21 F Type Lock Plate

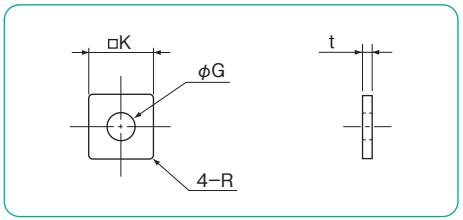
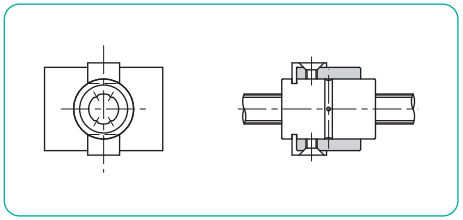


Figure B-22 Using LP Type Lock Plates

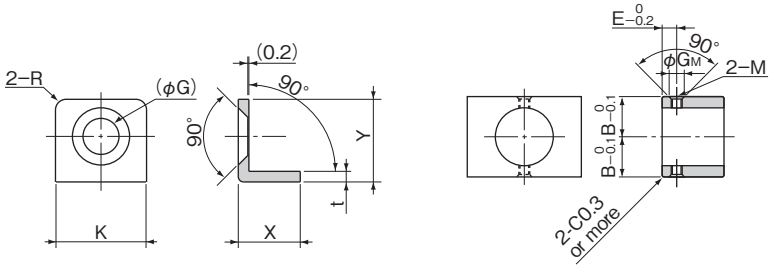


LP Type Lock Plate (Optional Plate)

The LP type lock plate is also available for purchase with the SSPM spline nut.

Material: SUS304CSP

Figure B-23 LP Type Lock Plate



When using the LP type lock plate, please machine the housing as shown above.

Table B-19 LP Type Lock Plate

part number	lock plate major dimensions						machined housing dimensions				applicable spline nut
	K mm	G mm	t mm	R mm	X mm	Y mm	B mm	E mm	GM mm	M	
LP 6	8.6	3.8	1.0	1	5.85	7.8	11.1	3.3	3.5	M2.5	SSPM 6
LP 8	9.15	4.5	1.2	1	6.45	9.2	12.3	4.0	4.2	M3	SSPM 8
LP10	9.15	4.5	1.2	1	6.45	9.2	14.8	4.0	4.2	M3	SSPM10

Figure B-24 Using Special Lock Plates (1)

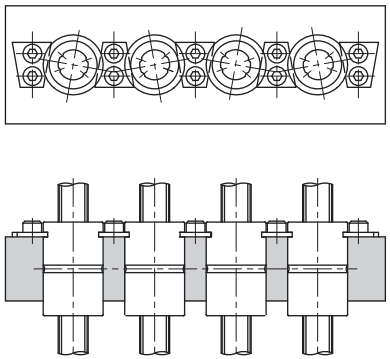
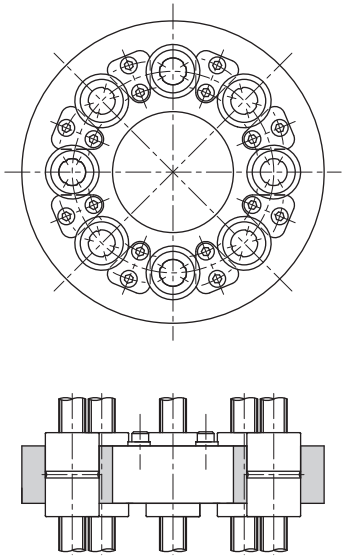


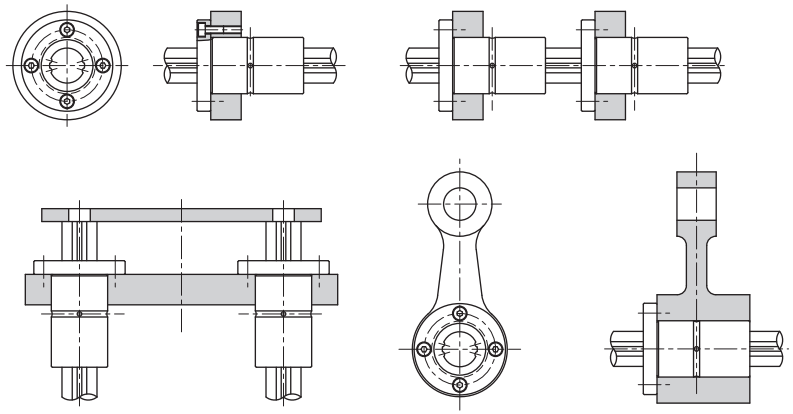
Figure B-25 Using Special Lock Plates (2)



Mounting of SSPF Type

Examples of installing the SSPF type are shown in Figure B-26.

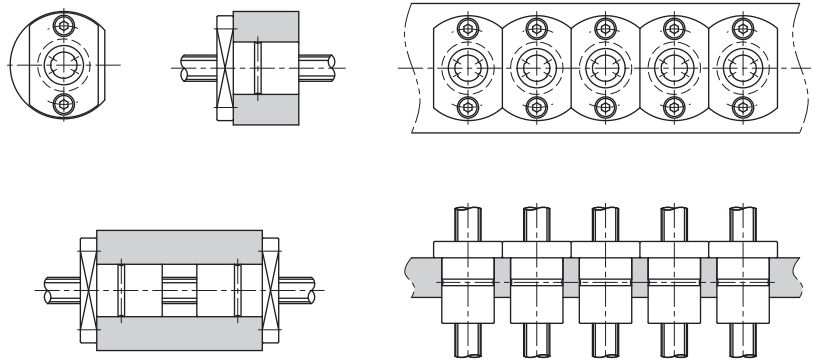
Figure B-26 Examples of installing SSPF Type



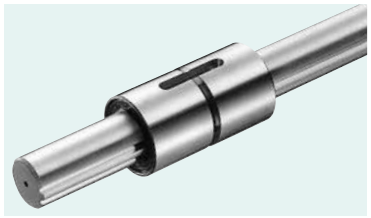
Mounting of SSPT Type

Examples of installing SSPT type are shown in Figure B-27.

Figure B-27 Examples of installing SSPT Type



SSP TYPE
– Cylindrical Spline Nut –



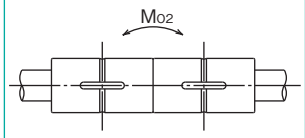
part number structure

example **SSP 25A - 1 - T1 - 450 T - P -LB -KGLA /CU**

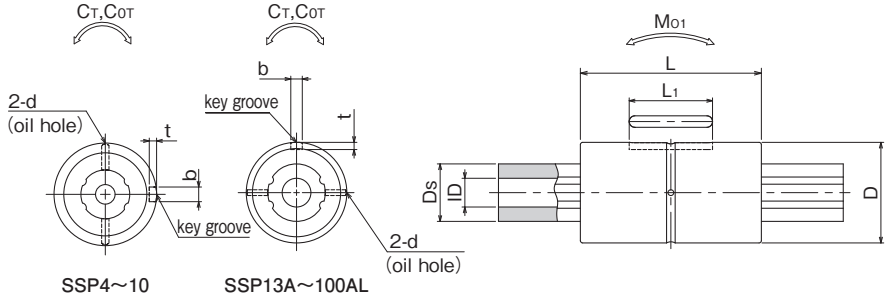
example **SSP 80A L - 2 - T1 - 600 - P -LB -KGLA /CU**

- specification — **SSP**: standard; **SSPS**: anti-corrosion
- nominal diameter
- nut length※1 — **blank**: standard; **L**: long
- number of nuts attached to one shaft
- preload symbol — **blank**: standard; **T1**: light; **T2**: medium
- spline shaft total length
- hollow spline shaft (not available in stainless steel) — **blank**: standard shaft; **T**: standard hollow shaft※2
- accuracy grade — **blank**: high; **P**: precision
- with low temperature black chrome treatment
- grease symbol (refer to page Eng-51) — **blank**: standard grease; **-KGLA**: lithium-based low dust generation grease; **-KGU**: urea-based low dust generation grease; **-KGF**: anti-fretting grease
- with special specification

※1: only for 80A, 100A
※2: For standard hollow shafts, refer to P.B-14 for specifications.



When two spline nuts are used in close contact.



SSP4～10　　SSP13A～100AL

※SSP4 spline nut does not come with any oil hole.

part number		major dimensions										
		D		L		b		t		L1	d	
standard	anti-corrosion	mm	tolerance μm	mm	tolerance mm	mm	tolerance μm	mm	tolerance mm	mm	mm	
SSP 4	SSPS 4	10	0/−9	16	0 −0.2	2	+14 0	1.2	+0.05 0	6	—	
SSP 6	SSPS 6	14	0 −11	25		2.5		1.2		10.5	1	
SSP 8	SSPS 8	16		25		2.5		1.2		10.5	1.5	
SSP 10	SSPS10	21		33		3		1.5		13	1.5	
SSP 13A	SSPS13A	24		36		3		1.5		15	1.5	
SSP 16A	SSPS16A	31	0 −16	50	0 −0.3	3.5	+18 0	2		17.5	2	
SSP 20A	SSPS20A	35		63		4		2.5		29	2	
SSP 25A	SSPS25A	42		71		4		2.5		36	3	
SSP 30A	—	47		80		4		2.5		42	3	
SSP 40A	—	64	0 −19	100		6		3.5		52	4	
SSP 50A	—	80		125		8	+22/0	4		58	4	
SSP 60A	—	90	0 −22	140		12	+27 0	5		67	4	
SSP 80A	—	120		160	0 −0.4	16		6	+0.1 0	76	5	
SSP 80AL	—	120		217						110		
SSP100A	—	150	0 −25	185		20	+33 0	7		110	5	
SSP100AL	—	150		248						160		
SSP 20	SSPS20	32	0 −16	60	0/−0.2	4	+18 0	2.5	+0.05 0	26	2	
SSP 25	SSPS25	37		70	0 −0.3	5		3		33	3	
SSP 30	—	45		80		7	+22 0	4		41	3	
SSP 40	—	60	0 −19	100		10		4.5		55	4	
SSP 50	—	75		112		15	+27 0	5		60	4	
SSP 60	—	90	0/−22	127		18		6		68	4	

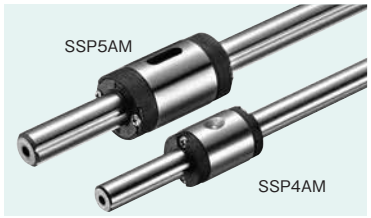
SSP type spline nut comes with a key (refer to page B-16).

Ds		ID (inner diameter)	basic torque rating dynamic	basic torque rating static	basic load rating dynamic	basic load rating static	allowable static moment		mass		size
mm	tolerance μm	mm	CT N・m	COT N・m	C kN	Co kN	MO1 N・m	MO2 N・m	nut kg	shaft kg/m	
4	0 −12	1.5	0.74	1.05	0.86	1.22	1.97	10.3	0.0065	0.10	4
6		2	1.5	2.4	1.22	2.28	5.1	40	0.019	0.21	6
8	0 −15	3	2.1	3.7	1.45	2.87	7.4	50	0.023	0.38	8
10		4	4.4	8.2	2.73	5.07	18.0	116	0.054	0.60	10
13	0 −18	6	21	39.2	2.67	4.89	13.7	109	0.07	1.0	13A
16		8	60	110	6.12	11.2	46	299	0.15	1.5	16A
20	0 −21	10	105	194	8.9	16.3	110	560	0.22	2.4	20A
25		15	189	346	12.8	23.4	171	1,020	0.33	3.7	25A
30		—	307	439	18.6	23.2	181	1,470	0.36	5.38	30A
40	0 −25	—	674	934	30.8	37.5	358	2,940	0.95	9.55	40A
50		—	1,290	2,950	40.3	64.9	690	4,080	1.9	15.0	50A
60	0 −30	—	1,570	3,420	47.7	79.5	881	5,470	2.3	21.6	60A
80		—	4,500	6,460	92.8	108	1,990	10,500	6.4	39	80A
			5,980	9,690	123	162	4,310	20,980	9.1		80AL
100	0 −35	—	9,180	12,000	151	160	3,350	18,200	11.2	61	100A
			12,100	18,000	200	240	7,210	35,600	15.8		100AL
18.2	0 −21	—	83	133	7.84	11.3	63	500	0.2	2.0	20
23		—	162	239	12.3	16.1	104	830	0.22	3.1	25
28		—	289	412	18.6	23.2	181	1,470	0.35	4.8	30
37.4	0 −25	—	637	882	30.8	37.5	358	2,940	0.81	8.6	40
47		—	1,390	3,180	46.1	74.2	696	4,400	1.5	13.1	50
56.5	0/−30	—	2,100	4,800	58.0	127	1,300	8,800	2.5	19	60

1kN≒102kgf　1N・m≒0.102kgf・m

SSP-AM TYPE

– Light and Compact Type –

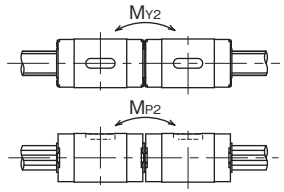


part number structure

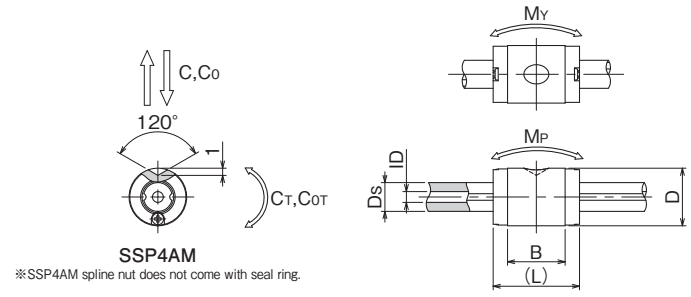
example **SSP 8 AM - 1 - T1 - 450 T - P -LB -KGLA /CU**

- specification — **SSP AM**: standard; **SSPS AM**: anti-corrosion
- nominal diameter
- number of nuts attached to one shaft
- preload symbol — **blank**: standard; **T1**: light
- spline shaft total length
- hollow spline shaft (not available in stainless steel) — **blank**: standard shaft; **T**: standard hollow shaft※
- accuracy grade — **blank**: high; **P**: precision
- with low temperature black chrome treatment
- grease symbol (refer to page Eng-51) — **blank**: standard grease; **-KGLA**: lithium-based low dust generation grease; **-KGU**: urea-based low dust generation grease; **-KGF**: anti-fretting grease
- with special specification

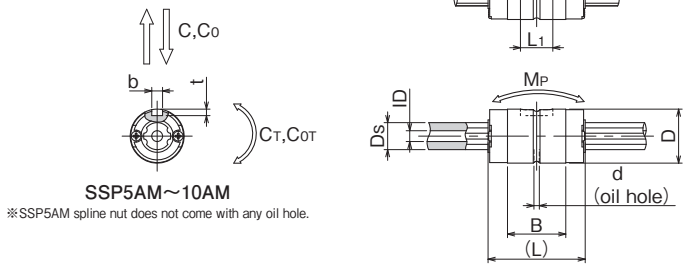
※For standard hollow shafts, refer to P.B-14 for specifications.
Note:SSP(S)4AM does not come with side-seals.



When two spline nuts are used in close contact.



SSP4AM
※SSP4AM spline nut does not come with seal ring.



SSP5AM～10AM
※SSP5AM spline nut does not come with any oil hole.

part number		major dimensions											
		D		L	B	b		t	L1	d	Ds h7		
standard	anti-corrosion	mm	tolerance μm	mm	mm	mm	tolerance μm	+0.05 0 mm	mm	mm	mm	tolerance μm	
SSP 4AM	SSPS 4AM	8	0 −9	12	8	—	—	—	—	—	4	0 −12	
SSP 5AM	SSPS 5AM	10		18	10.8	2	+14 0	1.2	6	—	5		
SSP 6AM	SSPS 6AM	12	0 −11	21	13	2		1.2	8	1	6		
SSP 8AM	SSPS 8AM	15		25	14.9	2.5		1.5	8.5	1.2	8	0 −15	
SSP10AM	SSPS10AM	19	0 −13	30	18	3		1.8	11	1.5	10		

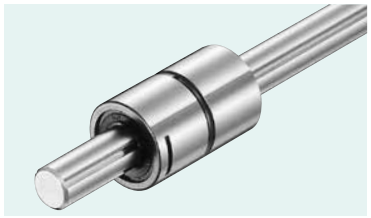
SSP (S) 5AM-10AM type spline nut come with a key (refer to page B-16).

ID (inner diameter)	basic torque rating dynamic CT	basic torque rating static C0T	basic load rating dynamic C	basic load rating static C0	allowable static moment MP / MP2	allowable static moment MY / MY2	mass nut	mass shaft	size
mm	N・m	N・m	N	N	N・m	N・m	g	g/100mm	
1.5	0.72	1.00	314	438	0.59 3.36	1.03 5.82	2.5	9.7	4AM
2	2.33	4.05	825	1,160	2.10 13.4	2.56 16.3	5.1	14.9	5AM
2	2.95	5.27	890	1,290	2.55 16.5	3.11 20.1	9.2	21.6	6AM
3	5.85	9.83	1,330	1,810	4.11 27.8	5.00 33.8	15.8	38.4	8AM
4	12.4	19.4	2,270	2,870	7.84 52.5	9.53 63.9	30.7	59.8	10AM

Allowable static moment MP2 and MY2 are the values when two spline nuts are used on close contact.

1kN≒102kgf　1N・m≒0.102kgf・m

SSPM TYPE
— Keyless Spline Nut —

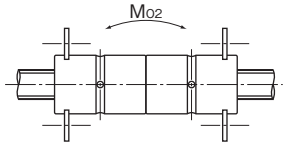


part number structure

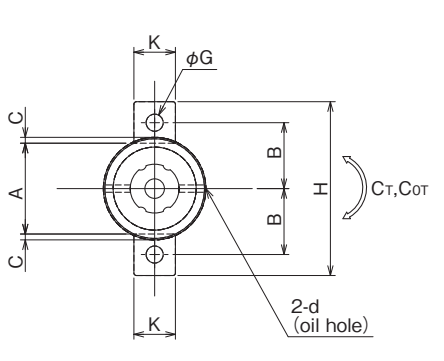
example **SSPM 10 - 2 - T1 - 200 T - P -LB -KGLA /CU**

- **SSPM** type
- **10** nominal diameter
- **2** number of nuts attached to one shaft
- **T1** preload symbol — **blank**: standard, **T1**: light
- **200** spline shaft total length
- **T** hollow spline shaft — **blank**: standard shaft, **T**: standard hollow shaft※
- **P** accuracy grade — **blank**: high, **P**: precision
- **-LB** with low temperature black chrome treatment
- **-KGLA** grease symbol (refer to page Eng-51) — **blank**: standard grease, **-KGLA**: lithium-based low dust generation grease, **-KGU**: urea-based low dust generation grease, **-KGF**: anti-fretting grease
- **/CU** with special specification

※For standard hollow shafts, refer to P.B-14 for specifications.



When two spline nuts are used in close contact.



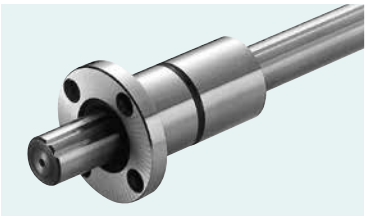
part number	major dimensions												
	D		L		F	W	C	A	d	B	H	K
	mm	tolerance μm	mm	tolerance mm	mm	mm	mm	mm	mm	mm	mm	mm
SSPM 6	14	0 −11	25	0 −0.2	2.2	1.1	1.0	12.0	1	9.4	25.6	6.8
SSPM 8	16		25		2.7	1.3	1.2	13.6	1.5	11	30.6	8.5
SSPM10	21	0/−13	33		2.7	1.3	1.2	18.6	1.5	13.5	35.6	8.5

Two F type lock plates per SSPM type spline nut are provided (refer to page B-17).

G	t	Ds		ID (inner diameter)	basic torque rating dynamic	basic torque rating static	basic load rating dynamic	basic load rating static	allowable static moment		mass nut	mass shaft	size
			tolerance		CT	COT	C	Co	MO1	MO2			
mm	mm	mm	μm	mm	N・m	N・m	kN	kN	N・m	N・m	kg	kg/m	
2.9	1.0	6	0/−12	2	1.5	2.4	1.22	2.28	5.1	40	0.019	0.21	**6**
3.5	1.2	8	0 −15	3	2.1	3.7	1.45	2.87	7.4	50	0.023	0.38	**8**
3.5	1.2	10		4	4.4	8.2	2.73	5.07	18.0	116	0.054	0.60	**10**

1kN≒102kgf　1N・m≒0.102kgf・m

SSPF TYPE
– Flange Type Nut –

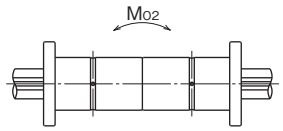


part number structure

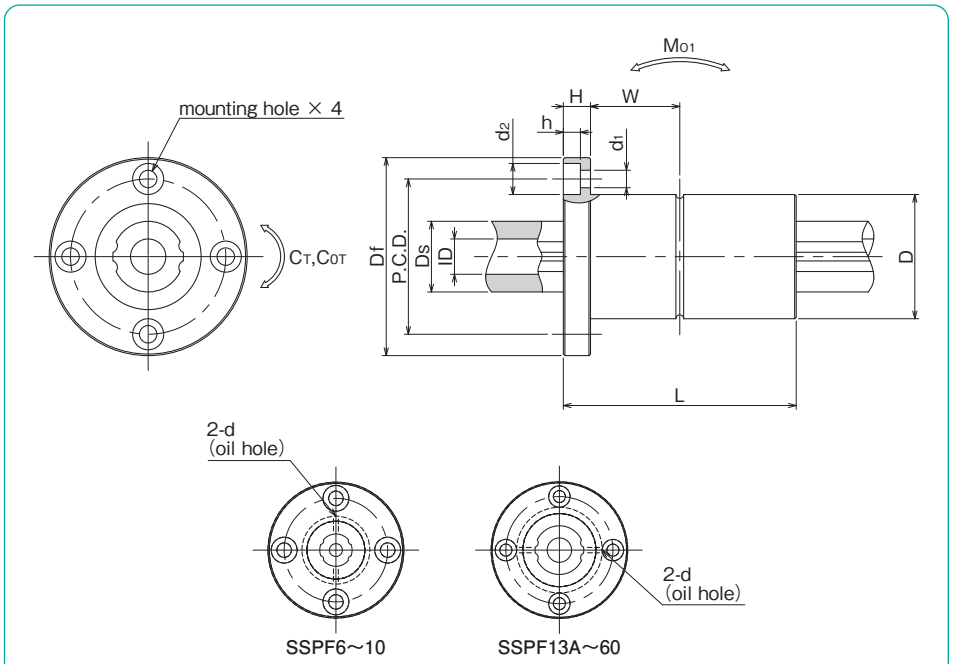
example **SSPF 25A - 2 - T1 - 450 T - P -LB -KGLA /CU**

- specification — **SSPF**: standard; **SSPFS**: anti-corrosion
- nominal diameter
- number of nuts attached to one shaft
- preload symbol — **blank**: standard; **T1**: light
- spline shaft total length
- hollow spline shaft (not available in stainless steel) — **blank**: standard shaft; **T**: standard hollow shaft※
- accuracy grade — **blank**: high; **P**: precision
- with low temperature black chrome treatment
- grease symbol (refer to page Eng-51) — **blank**: standard grease; **-KGLA**: lithium-based low dust generation grease; **-KGU**: urea-based low dust generation grease; **-KGF**: anti-fretting grease
- with special specification

※For standard hollow shafts, refer to P.B-14 for specifications.



When two spline nuts are used in close contact.



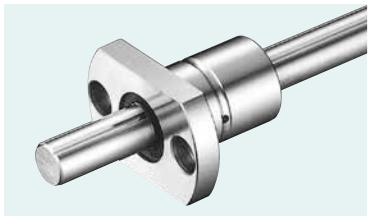
part number		major dimensions									
		D		L		Df	H	P.C.D.	d1×d2×h	W	
standard	anti-corrosion	mm	tolerance μm	mm	tolerance mm	mm	mm	mm	mm	mm	
SSPF 6	SSPFS 6	14	0 −11	25	0 −0.2	30	5	22	3.4×6.5×3.3	7.5	
SSPF 8	SSPFS 8	16		25		32	5	24	3.4×6.5×3.3	7.5	
SSPF10	SSPFS10	21	0 −13	33		42	6	32	4.5×8×4.4	10.5	
SSPF13A	SSPFS13A	24		36		43	7	33	4.5×8×4.4	11	
SSPF16A	SSPFS16A	31	0 −16	50		50	7	40	4.5×8×4.4	18	
SSPF20A	SSPFS20A	35		63		58	9	45	5.5×9.5×5.4	22.5	
SSPF25A	SSPFS25A	42		71	0 −0.3	65	9	52	5.5×9.5×5.4	26.5	
SSPF30A	—	47		80		75	10	60	6.6×11×6.5	30	
SSPF40A	—	64	0 −19	100		100	14	82	9×14×8.6	36	
SSPF50A	—	80		125		124	16	102	11×17.5×11	46.5	
SSPF60A	—	90	0/−22	140		129	18	107	11×17.5×11	52	
SSPF20	SSPFS20	32	0 −16	60	0/−0.2	51	7	40	4.5×8×4.4	23	
SSPF25	SSPFS25	37		70	0 −0.3	60	9	47	5.5×9.5×5.4	26	
SSPF30	—	45		80		70	10	54	6.6×11×6.5	30	
SSPF40	—	60	0 −19	100		90	14	72	9×14×8.6	36	
SSPF50	—	75		112		113	16	91	11×17.5×11	40	
SSPF60	—	90	0/−22	127		129	18	107	11×17.5×11	45.5	

d	Ds		ID (inner diameter)	basic torque rating dynamic CT	basic torque rating static COT	basic load rating dynamic C	basic load rating static Co	allowable static moment MO1	allowable static moment MO2	mass nut	mass shaft	size
mm	mm	tolerance μm	mm	N・m	N・m	kN	kN	N・m	N・m	kg	kg/m	
1	6	0/−12	2	1.5	2.4	1.22	2.28	5.1	40	0.037	0.21	6
1.5	8	0 −15	3	2.1	3.7	1.45	2.87	7.4	50	0.042	0.38	8
1.5	10		4	4.4	8.2	2.73	5.07	18.0	116	0.094	0.6	10
1.5	13	0 −18	6	21	39.2	2.67	4.89	13.7	109	0.1	1	13A
2	16		8	60	110	6.12	11.2	46	299	0.2	1.5	16A
2	20	0 −21	10	105	194	8.9	16.3	110	560	0.33	2.4	20A
3	25		15	189	346	12.8	23.4	171	1,020	0.45	3.7	25A
3	30		—	307	439	18.6	23.2	181	1,470	0.55	5.38	30A
4	40	0 −25	—	674	934	30.8	37.5	358	2,940	1.41	9.55	40A
4	50		—	1,290	2,950	40.3	64.9	690	4,080	2.73	15.0	50A
4	60	0/−30	—	1,570	2,620	47.7	79.5	881	5,470	3.2	21.6	60A
2	18.2	0 −21	—	83	133	7.84	11.3	63	500	0.22	2	20
3	23		—	162	239	12.3	16.1	104	830	0.32	3.1	25
3	28		—	289	412	18.6	23.2	181	1,470	0.51	4.8	30
4	37.4	0 −25	—	637	882	30.8	37.5	358	2,940	1.15	8.6	40
4	47		—	1,390	3,180	46.1	74.2	696	4,400	2.1	13.1	50
4	56.5	0/−30	—	2,100	4,800	58.0	127	1,300	8,800	3.3	19	60

1kN≒102kgf　1N・m≒0.102kgf・m

SSPT TYPE

– Two Side Cut Flange Type –

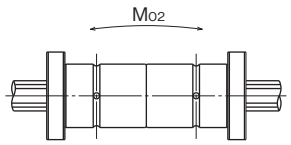


part number structure

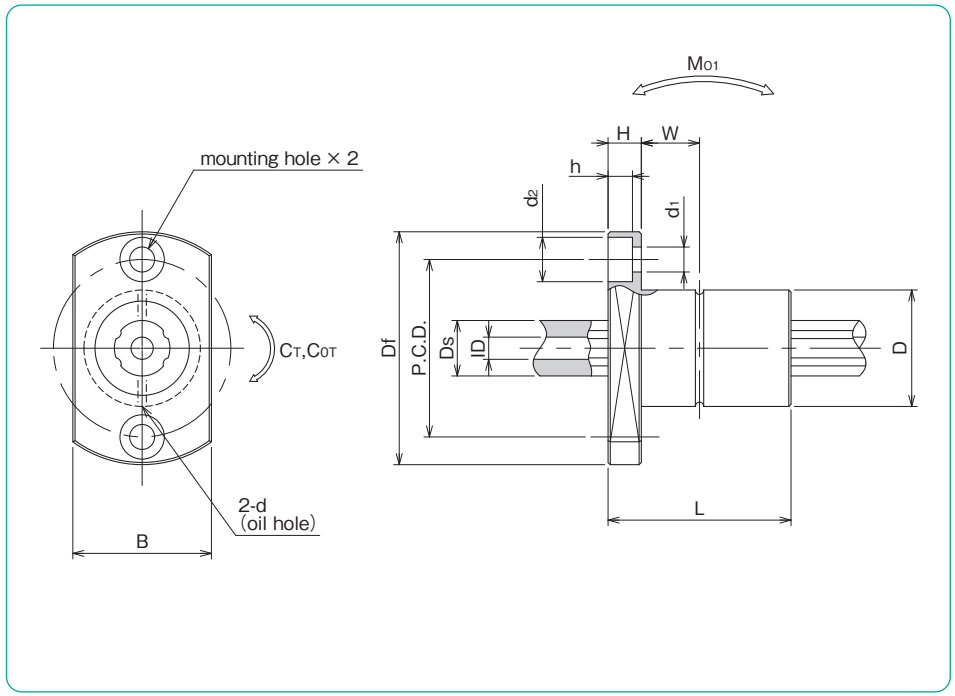
example **SSPT 10 - 2 - T1 - 200 T - P -LB -KGLA /CU**

- **SSPT** type
- nominal diameter
- number of nuts attached to one shaft
- preload symbol
  blank: standard
  T1: light
- spline shaft total length
- hollow spline shaft
  blank: standard shaft
  T: standard hollow shaft※
- accuracy grade
  blank: high
  P: precision
- with low temperature black chrome treatment
- grease symbol
  (refer to page Eng-51)
  blank: standard grease
  -KGLA: lithium-based low dust generation grease
  -KGU: urea-based low dust generation grease
  -KGF: anti-fretting grease
- with special specification

※For standard hollow shafts, refer to P.B-14 for specifications.



When two spline nuts are used in close contact.



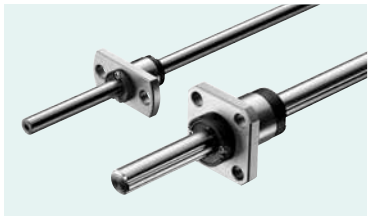
part number	major dimensions										
	D		L		Df	B	H	P.C.D.	d1×d2×h	W	
	mm	tolerance μm	mm	tolerance mm	mm	mm	mm	mm	mm	mm	
SSPT 6	14	0 −11	25	0 −0.2	30	18	5	22	3.4×6.5×3.3	7.5	
SSPT 8	16		25		32	21	5	24	3.4×6.5×3.3	7.5	
SSPT10	21	0/−13	33		42	25	6	32	4.5×8×4.4	10.5	

d	Ds		ID (inner diameter)	basic torque rating		basic load rating		allowable static moment		mass		size
		tolerance		dynamic	static	dynamic	static			nut	shaft	
mm	mm	μm	mm	CT N・m	COT N・m	C kN	Co kN	MO1 N・m	MO2 N・m	kg	kg/m	
1	6	0/−12	2	1.5	2.4	1.22	2.28	5.1	40	0.029	0.21	**6**
1.5	8	0 −15	3	2.1	3.7	1.45	2.87	7.4	50	0.035	0.38	**8**
1.5	10		4	4.4	8.2	2.73	5.07	18.0	116	0.075	0.6	**10**

1kN≒102kgf　1N・m≒0.102kgf・m

SSPT-AM TYPE
SSPK-AM TYPE

— Light and Compact Flange Type —

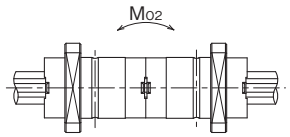


part number structure

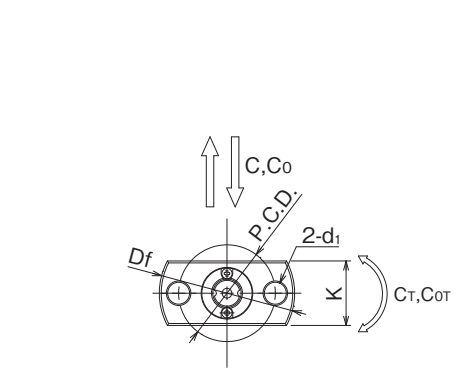
example **SSP 8 AM - 1 - T1 - 450 T - P -LB -KGLA /CU**

- specification (4AM)
  SSPT AM: standard
  SSPTS AM: anti-corrosion
  (5AM~10AM)
  SSPK AM: standard
  SSPKS AM: anti-corrosion
- nominal diameter
- number of nuts attached to one shaft
- preload symbol
  blank: standard
  T1: light
- spline shaft total length
- hollow spline shaft (not available in stainless steel)
  blank: standard shaft
  T: standard hollow shaft※
- accuracy grade
  blank: high
  P: precision
- with low temperature black chrome treatment
- grease symbol
  (refer to page Eng-51)
  blank: standard grease
  -KGLA: lithium-based low dust generation grease
  -KGU: urea-based low dust generation grease
  -KGF: anti-fretting grease
- with special specification

※For standard hollow shafts, refer to P.B-14 for specifications.
Note: Nut material of SSPT-AM and SSPK-AM is stainless steel.

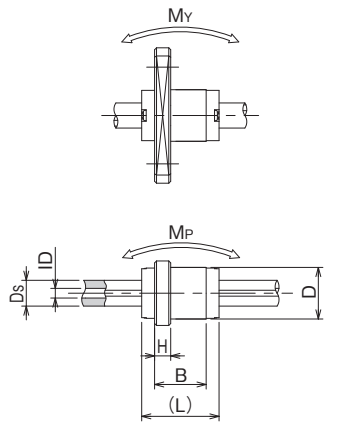


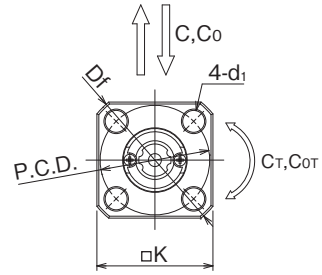
When two spline nuts are used in close contact.



SSPT4AM

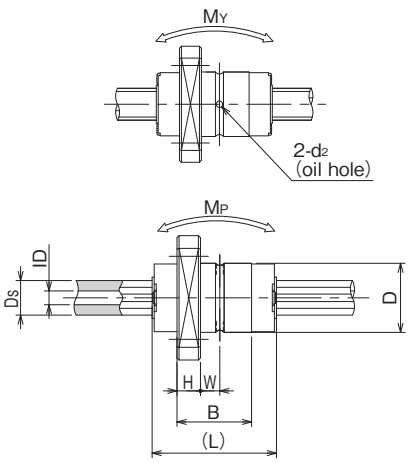
※SSPT4AM spline nut does not come with seal ring.





SSPK5AM~10AM

※SSPK5AM spline nut does not come with oil groove.



part number		major dimensions										
		D h6	tolerance	L	B	Df	K	H	P.C.D.	d1	W
standard	anti-corrosion	mm	μm	mm	mm	mm	mm	mm	mm	mm	mm
SSPT 4AM	SSPTS 4AM	8	0 −9	12	8	21	10	2.5	15	3.4	—
SSPK 5AM	SSPKS 5AM	10		18	10.8	23	18	3.4	17	3.4	2.8
SSPK 6AM	SSPKS 6AM	12	0 −11	21	13	25	20	3	19	3.4	3.5
SSPK 8AM	SSPKS 8AM	15		25	14.9	28	22	3.95	22	3.4	3.5
SSPK10AM	SSPKS10AM	19	0 −13	30	18	36	28	4	28	4.5	5

d2	Ds h7	tolerance	ID (inner diameter)	basic torque rating dynamic CT	basic torque rating static C0T	basic load rating dynamic C	basic load rating static C0	allowable static moment MP / MP2	allowable static moment MY / MY2	mass nut	mass shaft	size
mm	mm	μm	mm	N・m	N・m	N	N	N・m	N・m	g	g/100mm	
—	4	0 −12	1.5	0.72	1.00	314	438	0.59 3.36	1.03 5.82	5.0	9.7	4AM
1	5		2	2.33	4.05	825	1,160	2.10 13.4	2.56 16.3	10.7	14.9	5AM
1	6		2	2.95	5.27	890	1,290	2.55 16.5	3.11 20.1	14.7	21.6	6AM
1.2	8	0 −15	3	5.85	9.83	1,330	1,810	4.11 27.8	5.00 33.8	23.9	38.4	8AM
1.5	10		4	12.4	19.4	2,270	2,870	7.84 52.5	9.53 63.9	44.0	59.8	10AM

Allowable static moment MP2 and MY2 are the values when two spline nuts are used in close contact. 1N≒102gf 1N・m≒102gf・m

STANDARD AND MAXIMUM LENGTH

Standard and maximum length of NB ball spline shaft are shown in Table B-20.

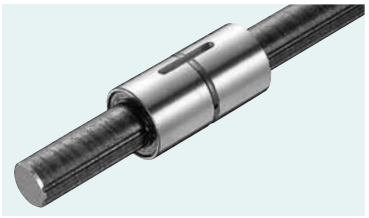
Table B-20 Standard and Maximum Length of SSP Type

unit : mm

size	standard length					maximum length high-grade	maximum length precision-grade P
4	100	150	200	300		315	200
5	150	200	300	400		400	315
6	150	200	300	400		400	315
8	150	200	300	400	500	500	400
10	200	300	400	500	600	630	630
13A	200	300	400	500	600	1,500	1,500
16A	200	300	400	500	600	1,500	1,500
20A	300	500	1,000			2,000	2,000
25A	300	500	1,000				
30A	300	500	1,000				
40A	500	1,000					
50A	500	1,000					
60A	500	1,000					
80A	–						
80AL	–						
100A	–						
100AL	–						
20	300	500	1,000			2,000	2,000
25	300	500	1,000				
30	300	500	1,000				
40	500	1,000					
50	500	1,000					
60	500	1,000					

・Applicable to rotary ball spline SPR, SPB-KP, SPB type and stroke spline SPLFS type, except for precision-grade of SPR and SPLFS type.
・Please contact NB for shaft lengths exceeding maximum length.

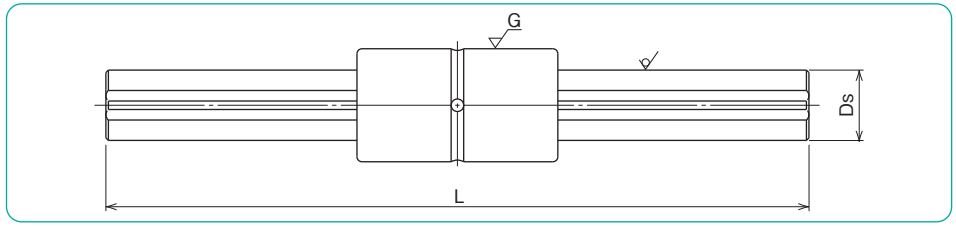
COMMERCIAL BALL SPLINE



part number structure

example **SSPF 25 C - 2 - 436 /CU**

- SSPF: nut shape — SSP: cylindrical type; SSPF: flange type
- 25: nominal diameter
- C: commercial spline shaft
- 2: number of nuts attached to one shaft
- 436: spline shaft total length
- /CU: with special specification



part number		Ds mm	basic torque rating dynamic C_T N·m	basic torque rating static C_{0T} N·m	basic load rating dynamic C kN	basic load rating static C_0 kN	allowable static moment M_{01} N·m	allowable static moment M_{02} N·m
SSP20A	SSPF20A	20	73.5	135	6.23	11.4	77.0	392
SSP25A	SSPF25A	25	132	242	8.96	16.3	119	714
SSP30A	SSPF30A	30	214	307	13.0	16.2	126	1,020
SSP40A	SSPF40A	40	471	653	21.5	26.2	250	2,050
SSP50A	SSPF50A	50	903	2,060	28.2	45.4	483	2,850
SSP20	SSPF20	18.2	58.1	93.1	5.48	7.91	44.1	350
SSP25	SSPF25	23	113	167	8.61	11.2	72.8	581
SSP30	SSPF30	28	202	288	13.0	16.2	126	1,020
SSP40	SSPF40	37.4	445	617	21.5	26.2	250	2,050
SSP50	SSPF50	47	973	2,220	32.2	51.9	487	3,080

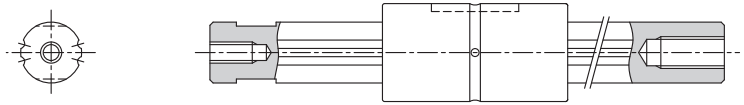
・Tolerance of total length
total length up to 4,000: JIS B0405 coarse grade
total length greater than 4,000: ±5.0mm
contact NB for tolerances other than those listed above
・Please refer to dimension tables for nut shape and dimensions.
・The above rated torque, rated load, and static allowable moment are approximately 70% of the values of the ground shaft.

nominal diameter	standard length L mm					
all size	500	1,000	2,000	3,000	4,000	5,000

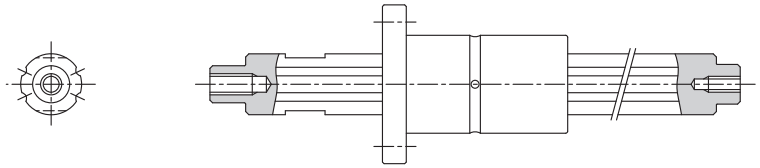
・contact NB for special specifications based on the customer's drawings for further consideration.

EXAMPLES OF MACHINING

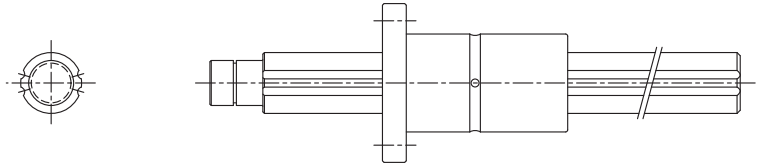
Center tap on both ends and milling



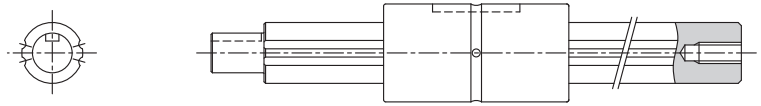
Step-down on both ends, center tap and milling



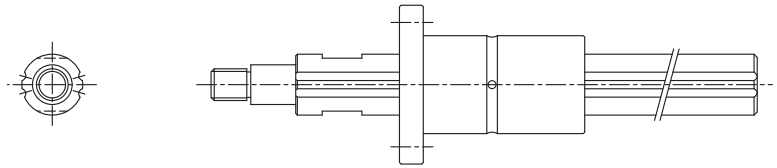
Ring groove on step-down



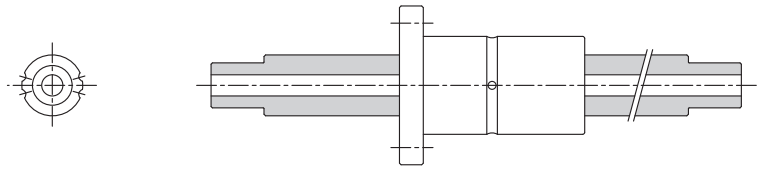
Step-down, center tap and key groove



Threading on step-down and milling



Step-down on both ends with hollow spline shaft



We can also handle a variety of other machining. Additional machining to outer cylinder is also available. Please contact NB for details.

ROTARY BALL SPLINE

The NB rotary ball spline can be used for both rotational motion and linear motion. The applications include SCARA robots, vertical shaft of assembly equipment, tool changers, and loaders, etc.

STRUCTURE AND ADVANTAGES

The NB Rotary Ball Spline nut consists of a spline nut and a rotating portion using either cross rollers for SPR or balls for SPB.

High Accuracy

Ball Splines transfer torque and achieve accurate positioning in the linear direction.
By adding the rotating portion, Rotary Ball Splines can achieve accurate positioning in the linear and rotational directions.

Half the Parts, Reduction in Installation Cost

The Spline nut and rotary bearing are combined in order to significantly reduce the number of parts, compared to conventional system.
The combination also reduces the housing thickness to a minimum, resulting in light weight and easy installation.

Compact and High Rigidity(SPR type)

The cross rollers are directly attached to the ball spline's outer cylinder, resulting in a compact and light design.
SPR type has high rigidity despite its compactness.
The tool changer is one typical application.

High Rigidity and High Speed(SPB type)

SPB type is a combination of a spline nut and angular contact bearings.
The rotary portion is a set of angular contact bearings which are aligned in the back-to-back duplex manner.
SPB type can bear radial, axial, and moment loads in a well-balanced way, thus best suited to high speed rotational applications.

Figure B-28 Structure of SPR type

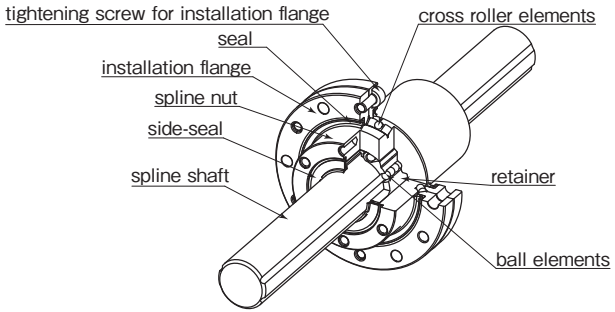
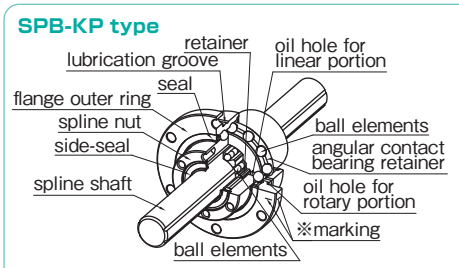
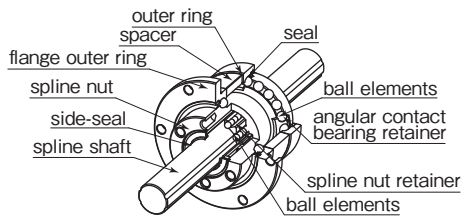


Figure B-29 Structure of SPB-KP type and SPB type



※When lubricating linear portion, both oil hole linear and rotary can match by aligning the raceway grooves of the shaft with the marking of flange outer ring.



SPECIFICATION

Refer to table B-21 for NB rotary ball spline material and operating temperature range.

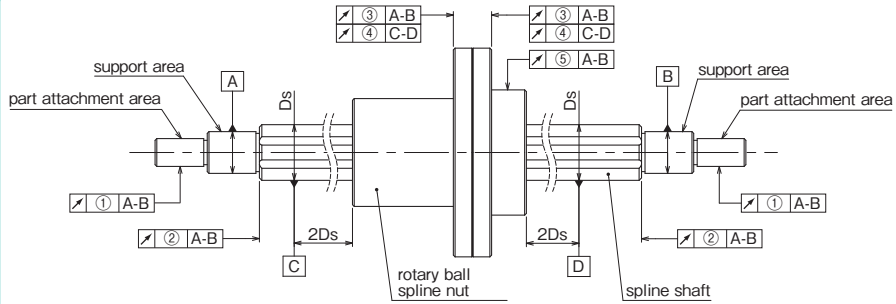
Table B-21 Material and Operating Temperature Range

type	nut		spline shaft	operating temperature range
	outer cylinder	return cap /retainer		
SPR SPB-KP SPB	steel	resin	steel	−20℃～80℃

ACCURACY OF SPR TYPE

The accuracy of SPR type is measured at the points shown in Figure B-30.

Figure B-30 Accuracy Measurement Points



Note: The support area is the portion where, for example, radial bearings are attached in order to support the spline shaft.
The part attachment area is the portion to which other parts, such as gears are attached.
④ indicate radial runout during rotational motion.

Tolerance of Spline Shaft Groove Torsion (Max.)

The groove torsion is indicated per 100㎜, arbitrarily set as the effective length of the spline shaft section.

Table B-22 Tolerance of Spline Shaft Groove Torsion (Max.)

tolerance
13μm／100mm

Table B-23 Tolerance Relative to Spline Support Area (Max.) unit : μm

part number	①radial runout of part attachment area	②radial runout of the end of the spline shaft section (when grinding is requested on the drawing)	③radial runout of the flange
SPR 6	14	9	14
SPR 8			
SPR10	17		
SPR13	19	11	18
SPR16			
SPR20A			
SPR25A	22	13	21
SPR30A			
SPR40A	25	16	25
SPR50A			
SPR60A	29	19	29
SPR20	19	11	18
SPR25	22	13	21
SPR30			
SPR40	25	16	25
SPR50			
SPR60	29	19	29

Table B-24 Tolerance during rotational movement of the cross roller rotating part (Max.) unit : μm

part number	④radial runout of part attachment area
SPR 6	10
SPR 8	
SPR10	
SPR13	
SPR16	
SPR20A	
SPR25A	
SPR30A	
SPR40A	
SPR50A	15
SPR60A	
SPR20	10
SPR25	
SPR30	
SPR40	
SPR50	15
SPR60	

Table B-25 ⑤Radial Runout of Outer Surface of Nut Relative to Spline Support Area (Max.) unit : μm

spline shaft total length (mm)		size					
greater than	or less	6 8	10	13 16 20A,20	25A,25 30A,30	40A,40 50A,50	60A,60
—	200	46	36	34	32	32	30
200	315	89	54	45	39	36	34
315	400	126	68	53	44	39	36
400	500	163*	82	62	50	43	38
500	630	—	102	75	57	47	41
630	800	—	—	92	68	54	45
800	1,000	—	—	115	83	63	51
1,000	1,250	—	—	153	102	76	59
1,250	1,600	—	—	256*	210	175	70
1,600	2,000	—	—	394	311	224	179

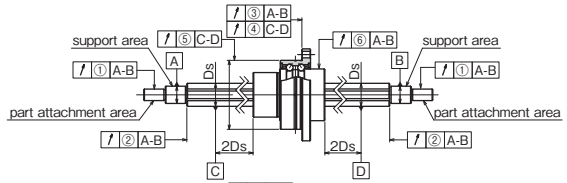
*SPR6 shaft Max. length: 400mm SPR13, SPR16 Max.length: 1,500mm.
※ Please contact NB for spline shafts exceeding 2,000mm.

ACCURACY OF SPB TYPE

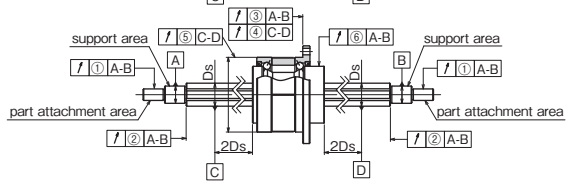
The accuracy of SPB type is measured at the points shown in Figure B-31.

Figure B-31 Accuracy Measurement Points

SPB-KP type



SPB type



Note : The support area is the portion where, for example, radial bearings are attached in order to support the spline shaft.
The part attachment area is the portion to which other parts, such as gears, are attached.
④ and ⑤ indicate radial runout during rotational motion.

Tolerance of Spline Shaft Groove Torsion (Max.)

The groove torsion is indicated per 100mm, arbitrarily set as the effective length of the spline shaft section.

Table B-26 Tolerance of Spline Shaft Groove Torsion (Max.)

accuracy grade	high	precision (P)
tolerance	13μm/100mm	6μm/100mm

Table B-27 Tolerance Relative to Spline Support Area (Max.) unit : μm

part number	①radial runout of part attachment area		②radial runout of the end of the spline shaft section (when grinding is requested on the drawing)		③radial runout of the flange	
	high-grade	precision-grade(P)	high-grade	precision-grade(P)	high-grade	precision-grade(P)
SPB 6KP	14	8	9	6	14	10
SPB 8KP						
SPB10KP	17	10				
SPB13KP	19	12	11	8	18	13
SPB16KP,16						
SPB20KP,20						
SPB25KP,25	22	13	13	9	21	16

Table B-28 Tolerance of Angular Contact Bearing Rotation (Max.) unit : μm

part number	④runout of flange mounting side		⑤radial runout of outer ring	
	high-grade	precision-grade(P)	high-grade	precision-grade(P)
SPB 6KP	6	6	8	8
SPB 8KP				
SPB10KP				
SPB13KP	8	8	9	9
SPB16KP,16				
SPB20KP,20			10	10
SPB25KP,25				

Table B-29 ⑥Radial Runout of Spline Nut Relative to Spline Support Area(Max.) unit : μm

spline shaft total length (mm)		size									
		6		8		10		13,16,20		25	
greater than	or less	high-grade	precision-grade(P)	high-grade	precision-grade(P)	high-grade	precision-grade(P)	high-grade	precision-grade(P)	high-grade	precision-grade(P)
—	200	46	26	46	26	36	20	34	18	32	18
200	315	89	57	89	57	54	32	45	25	39	21
315	400	126	—	126	82	68	41	53	31	44	25
400	500	—	—	163	—	82	51	62	38	50	29
500	630	—	—	—	—	102	65	75	46	57	34
630	800	—	—	—	—	—	—	92	58	68	42
800	1,000	—	—	—	—	—	—	115	75	83	52
1,000	1,250	—	—	—	—	—	—	153	97	102	65
1,250	1,600	—	—	—	—	—	—	256*	180*	210	140
1,600	2,000	—	—	—	—	—	—	394	314	311	241

*SPB16, 13KP, and 16KP shaft maximum length : 1,500mm
※Please contact NB for spline shafts exceeding 2,000mm.

PRELOAD AND CLEARANCE

Preload and clearance of linear motion are available with a standard preload(blank), light preload(T1), and medium preload(T2).

Table B-30 Preload and Clearance of SPR Type unit : μm

	part number	standard	light (T1)	medium (T2)
linear motion	SPR 6	0～+3	− 3～0	−
	SPR 8			
	SPR10			
	SPR13	−3～+1	− 8～−3	−13～− 8
	SPR16			
	SPR20A	−4～+2	−12～−4	−20～−12
	SPR25A			
	SPR30A			
	SPR40A	−6～+3	−18～−6	−30～−18
	SPR50A			
	SPR60A			
	SPR20	−4～+2	−12～−4	−20～−12
	SPR25			
	SPR30			
	SPR40	−6～+3	−18～−6	−30～−18
	SPR50			
	SPR60			

Table B-31 Preload and Clearance of SPB-KP and SPB Type(Linear Motion) unit : μm

part number	standard	light (T1)	medium (T2)
SPB 6KP	0～+3	−3～0	−
SPB 8KP			
SPB10KP			
SPB13KP	−3～+1	−8～−3	−13～−8
SPB16KP,16			
SPB20KP,20	−4～+2	−12～−4	−20～−12
SPB25KP,25			

Please contact NB for other than preload standards above.

Table B-32 Preload and Operating Conditions

preload	symbol	operating conditions
standard	blank	minute vibration is applied. a precise motion is required. moment is applied in a given direction.
light*	T1	light vibration is applied. light torsional load is applied. cyclic torque is applied.
medium*	T2	shock/vibration is applied. over-hang load is applied. torsional load is applied.

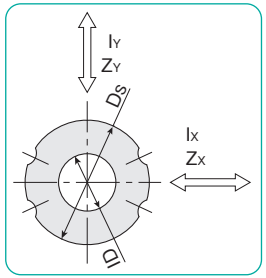
* Since the contrary relation of preload and dynamic frictional resistance, dynamic friction resistance will increase when applying preload.

HOLLOW SPLINE SHAFT

NB provides hollow shafts. It can be used for running cable, air piping, and weight reduction. Table B-33 shows the standard hollow shaft. If you are looking for a standard hollow shaft, specify the symbol "T" after the total length of the spline shaft in the part number. It is possible to manufacture the inner diameter different from the standard hollow shaft, if so please contact NB.

Table B-33 Standard Hollow Spline Shaft

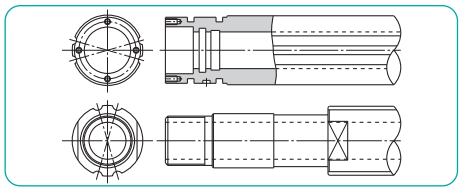
nominal diameter SPR	nominal diameter SPB-KP SPB	outer diameter Ds mm	inner diameter ID mm	moment of inertia of area Ix mm⁴	moment of inertia of area Iy mm⁴	modulus of section Zx mm³	modulus of section Zy mm³
6	6	6	2	5.83×10^{1}	6.13×10^{1}	1.94×10^{1}	2.04×10^{1}
8	8	8	3	1.86×10^{2}	1.93×10^{2}	4.66×10^{1}	4.84×10^{1}
10	10	10	4	4.48×10^{2}	4.69×10^{2}	8.97×10^{1}	9.37×10^{1}
13	13	13	6	1.26×10^{3}	1.32×10^{3}	1.93×10^{2}	2.03×10^{2}
16	16	16	8	2.78×10^{3}	2.96×10^{3}	3.48×10^{2}	3.70×10^{2}
20A	20	20	10	6.87×10^{3}	7.25×10^{3}	6.87×10^{2}	7.25×10^{2}
25A	25	25	15	1.54×10^{4}	1.64×10^{4}	1.23×10^{3}	1.31×10^{3}



SPECIAL REQUIREMENTS

NB provides customization such as shaft-end machining, spline nut machining, and surface treatment per customer requests.Please contact NB for the inner diameter of SPR20～SPR60.

Figure B-32 Examples of Shaft-end Machining



MOUNTING

The flange attachment screws of SPR type have been pre-adjusted for smooth rotary movement and should never be loosened. Shock loading to the flange assembly should be avoided as this can degrade the accuracy of movement and deteriorate the overall performance.
The spacer of SPB type is properly adjusted to produce the best preload condition. Shock loading to the spacer should be avoided as this can change the preload condition and deteriorate the accuracy.
Please fix the mounting screws diagonally. The recommended torque values for medium-hardness steel screws are listed in Table B-34.

Table B-34 Recommended Torque unit : N・m

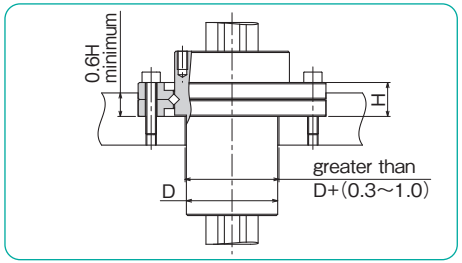
mounting screw	M2	M2.5	M3	M4	M5	M6	M8
recommended torque	0.4	0.9	1.4	3.2	6.6	11.2	27.6

(for alloy steel screw)

SPR Type

When the flange of SPR type is to be used with a faucet joint (as shown in Figure B-33) the housing bore should be machined to a tolerance of H7 and to a minimum depth of 60% of the flange thickness. If only a light load is applied to the SPR in operation, the flange can be used without a pilot end.

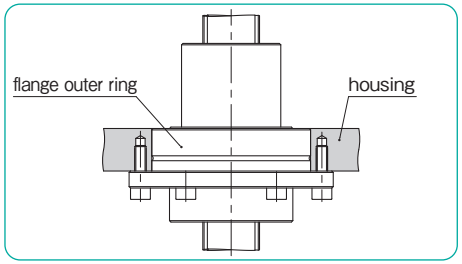
Figure B-33 SPR type Mounting Method



SPB-KP Type

The housing bore for the SPB-KP type should be matched to a tolerance of H7 and keep enough depth (as shown in Figure B-34) so that the outer ring is inside the housing.

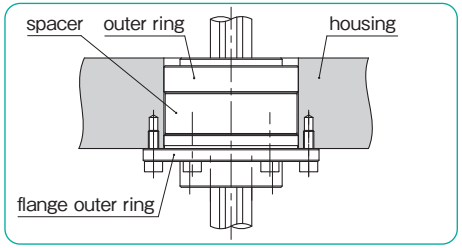
Figure B-34 SPB-KP type Mounting Method



SPB Type

The housing bore for the SPB type should be machined to a tolerance of H7 and contain enough depth so that the outer ring is inside the housing. If not, the outer ring may fall off.

Figure B-35 SPB type Mounting Method



Insertion of Spline Shaft

When inserting the spline shaft into the rotary ball spline nut, ensure that the ball elements do not drop out. This is done by aligning the raceway grooves of the shaft with the rows of ball elements and seal -lip of the nut. Then, carefully insert the spline shaft through the spline nut.

LUBRICATION

Since NB rotary ball spline nuts are equipped with seals at both the spline portion and the rotational portion, the lubricant is retained for an extended period of time. The spline nut is prelubricated with lithium soap based grease prior to shipment for immediate use. Please relubricate with a similar type of grease periodically depending on the operating conditions.
Low dust generation grease is available from NB standard grease. (refer to page Eng-51)
However, an oil lubricant is recommended for high-speed applications. A grease fitting or machining oil holes is optional (Figure B-36-39), please contact NB for details.

SPR Type

A grease fitting for rotational portion and machining oil hole for spline portion are optional.

Figure B-36 Example of Installed Grease Fitting

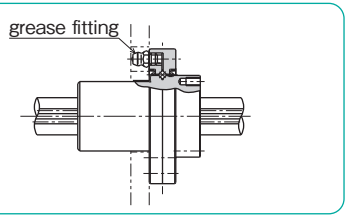
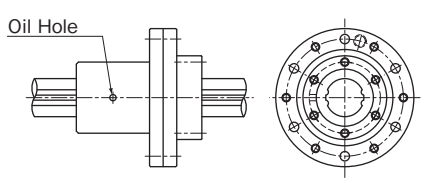


Figure B-37 SPR type Oil Hole



SPB-KP Type

Lubrication is done through oil hole on the outer ring. It is applied the spline portion and the cross roller portion simultaneously.

SPB Type

Rotational portion has an oil hole as a standard. For lubrication, it is recommended to mount a grease fitting or oil hole to housing. Machining oil hole for spline portion is available. Please contact NB.

Figure B-38 SPB-KP type Oil Hole

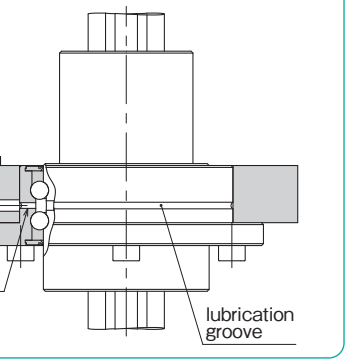
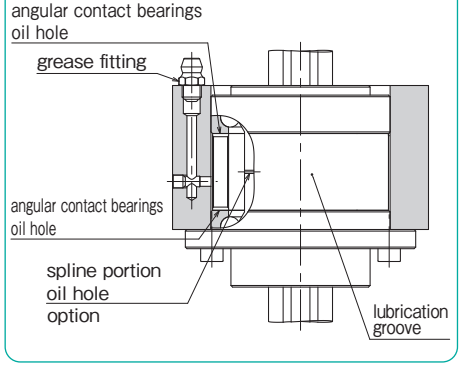


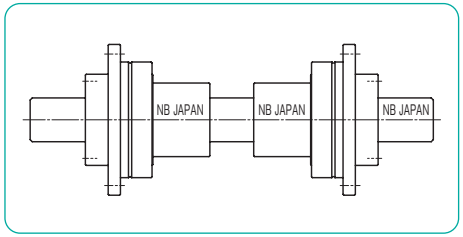
Figure B-39 SPB type Oil Hole



NUT ORIENTATION

Unless otherwise specified, the orientation of two nuts SPR, SPB-KP and SPB type is shown in Figure B-40. In other cases please specify the orientation of nut(s) with shaft.

Figure B-40 Nut Orientation and NB mark

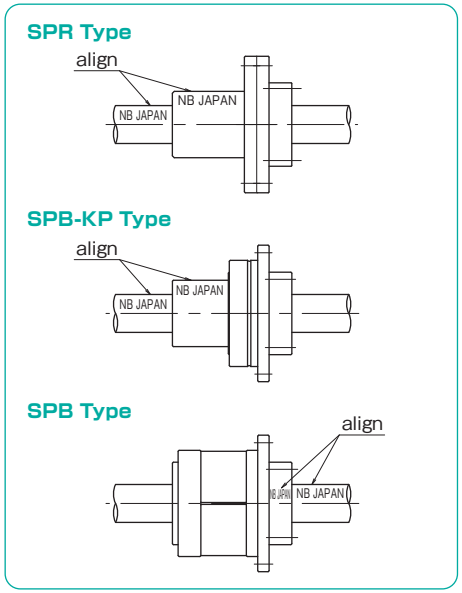


OPERATING CONDITIONS

A Set of Spline Nut and Spline Shaft

The ball spline's accuracy and preload is guaranteed when spline nut and shaft are aligned as shown in Figure B-41. Please make sure to align the NB marks when reinserting the shaft.
At this time, both NB marks on the nut and shaft should be aligned in the same direction as when delivered.
When inserting the spline shaft into the spline nut, ensure that the ball elements do not drop out. This is done by aligning the receway grooves of the shaft with the rows of ball elements and the seal lip of the nut. Then, carefully insert the spline shaft through the spline nut. In case that the nut is preloaded, please exercise additional care. And also, do not disassemble the spline nut.

Figure B-41 NB mark Alignment



SPR Type

Please do not loosen the fastening screws for installation flange. The fastening screws are properly adjusted. Please handle with great care, the accuracy is affected if an excessive impact is applied.

SPB Type

Please do not adjust the spacer. The spacer is adjusted to provide a proper spacing for the best preload condition. Please handle with great care, the accuracy is affected if the spacer is slipped by an impact, etc..

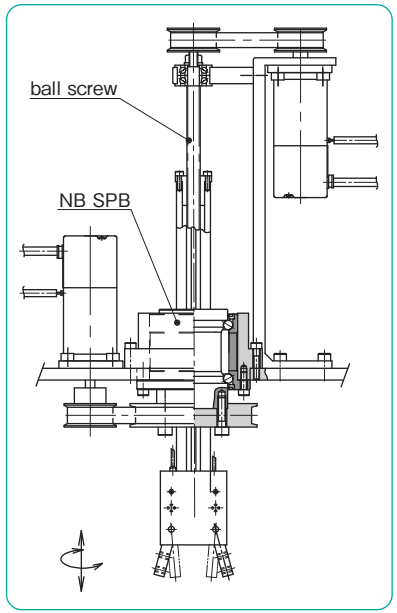
Operating Temperature

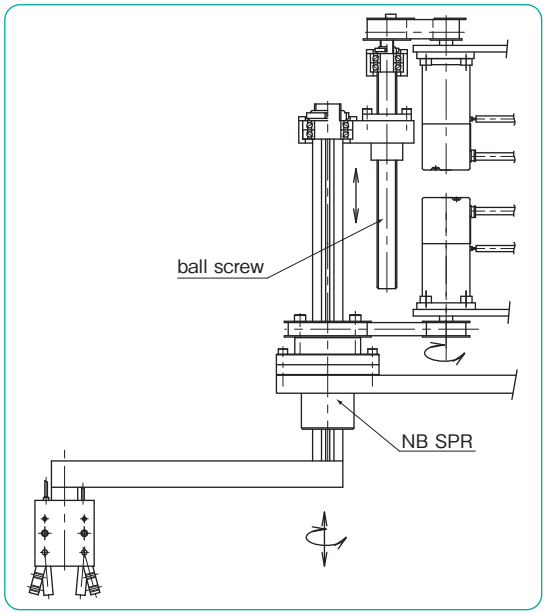
Resin retainers are used in the rotary ball spline, since the operating temperature should never exceed 80℃.

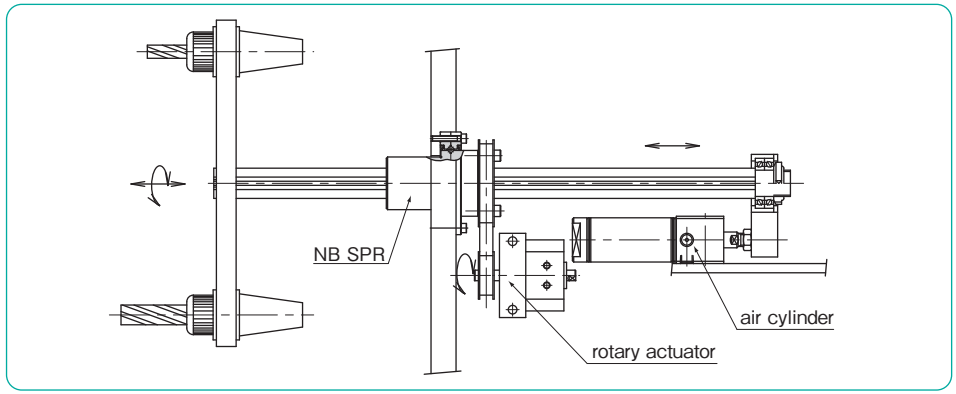
Dust Prevention

Foreign particles or dust in the rotary ball spline nut affect the motion accuracy and shorten the lifetime. Standard seals will perform well for dust prevention under normal operating conditions; however, in a harsh environment, it is necessary to attach bellows or protective covers.

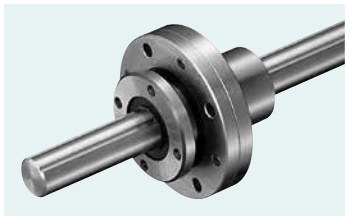
APPLICATION EXAMPLES

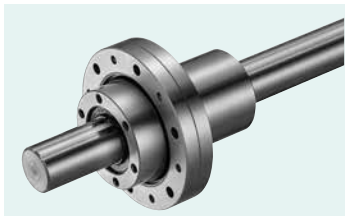






SPR TYPE



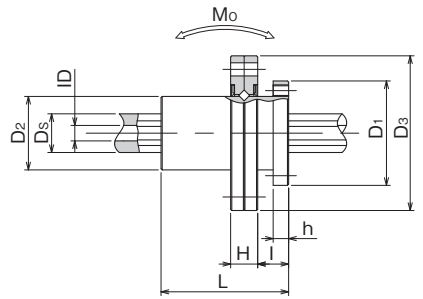


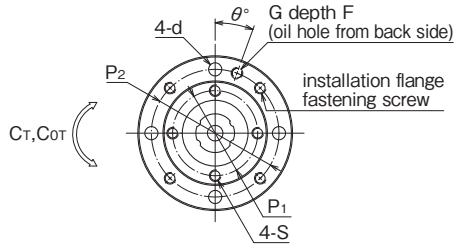
part number structure

example **SPR 25A - 2 - T1 - 450 T -LB -KGLA /CU**

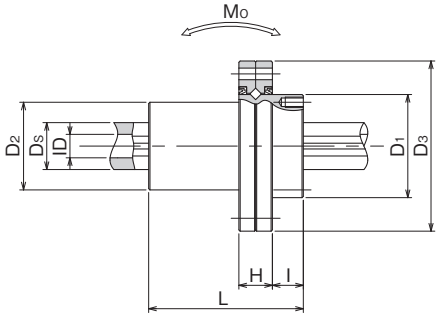
- **SPR** — SPR type
- **25A** — nominal diameter
- **2** — number of nuts attached to one shaft
- **T1** — preload symbol
  blank: standard
  T1: light
  T2: medium
- **450** — spline shaft total length
- **T** — hollow spline shaft
  blank: standard shaft
  T: standard hollow shaft※
- **-LB** — with low temperature black chrome treatment
- **-KGLA** — grease symbol (refer to page Eng-51)
  blank: standard grease
  -KGLA: lithium-based low dust generation grease
  -KGU: urea-based low dust generation grease
  -KGF: anti-fretting grease
- **/CU** — with special specification

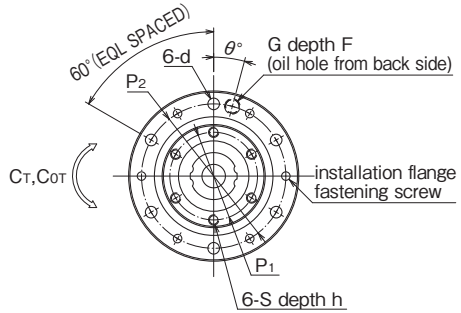
※For standard hollow shafts, refer to P.B-40 for specifications.





SPR6～10





SPR13～60

part number	major dimensions D1 mm	D1 tolerance μm	D2 mm	L mm	L tolerance mm	P1 P.C.D. mm	S	h mm	major dimensions of cross roller bearing I mm	H mm	D3 mm	D3 tolerance μm	P2 P.C.D. mm	d mm	G	F mm	θ	spline shaft Ds mm	Ds tolerance μm
SPR 6	20		13	25		16	M2	2.5	5	6.5	30	0/−21	24	2.4	M3	5	20°	6	0/−12
SPR 8	22	0	15	25		18	M2.5	3	6	6.5	33		27	2.9	M3	5	20°	8	0
SPR10	27	−21	19	33	0	22	M3	4	8	7	40	0	33	3.4	M3	5	20°	10	−15
SPR13	29		24	36	−0.2	24	M3	5	8	9	50	−25	42	3.4	M3	5	15°	13	0
SPR16	36	0	31	50		30	M4	6	10	11	60		50	4.5	M3	5	15°	16	−18
SPR20A	44	−25	35	63		38	M4	7	12	13	72	0	62	4.5	M6×0.75	5.5	15°	20	
SPR25A	55		42	71		47	M5	8	13	16	82	−30	72	4.5	M6×0.75	7	15°	25	0
SPR30A	61	0	47	80		52	M6	10	17	17	100		86	6.6	M6×0.75	7.5	15°	30	−21
SPR40A	76	−30	64	100	0	66	M6	10	23	20	120	0	104	9	M6×0.75	9	15°	40	0
SPR50A	92	0	80	125	−0.3	80	M8	13	24	22	134	−35	118	9	M6×0.75	10	15°	50	−25
SPR60A	107	−35	90	140		95	M8	13	25	25	155	0	137	9	M6×0.75	11.5	15°	60	0/−30
SPR20	40	0	34	60	0/−0.2	34	M4	7	12	13	66	−40	56	4.5	M6×0.75	5.5	15°	18.2	
SPR25	50	−25	40	70		42	M5	8	13	16	78	0	68	4.5	M6×0.75	7	15°	23	0
SPR30	61	0	47	80	0	52	M6	10	17	17	100	−30	86	6.6	M6×0.75	7.5	15°	28	−21
SPR40	76	−30	62	100	−0.3	64	M6	10	23	20	120	0	104	9	M6×0.75	9	15°	37.4	0
SPR50	88	0	75	112		77	M8	13	24	22	130	−35	114	9	M6×0.75	10	15°	47	−25
SPR60	102	−35	90	127		90	M8	13	25	25	150	0	132	9	M6×0.75	11.5	15°	56.5	0/−30

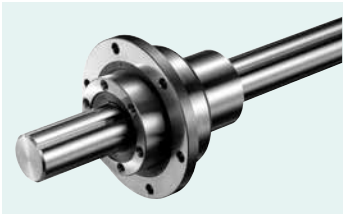
Please contact NB for the grease fitting and relubrication method.

ID (inner diameter) mm	ball spline basic torque rating dynamic CT N・m	basic torque rating static COT N・m	basic load rating dynamic C kN	basic load rating static Co kN	cross roller bearing basic load rating dynamic CR kN	basic load rating static COR kN	※maximum revolutions rpm	allowable static moment Mo N・m	moment of inertia for the spline nut kg·cm²	moment of inertia for the spline shaft kg·cm²/mm	moment of inertia for the rotating part kg·cm²	mass nut kg	mass shaft kg/m	size
2	1.5	2.4	1.22	2.28	0.6	0.5	2,940	5.1	0.01	9.45×10^{-6}	0.04	0.04	0.21	6
3	2.1	3.7	1.45	2.87	1.2	1.10	2,580	7.4	0.01	3.02×10^{-5}	0.05	0.05	0.38	8
4	4.4	8.2	2.73	5.07	2.4	2.45	2,060	18.0	0.03	7.35×10^{-5}	0.12	0.09	0.60	10
6	21	39.2	2.67	4.89	2.9	3.70	1,350	13.7	0.11	2.11×10^{-4}	0.32	0.17	1.0	13
8	60	110	6.12	11.2	5.6	6.70	1,080	46	0.38	4.79×10^{-4}	0.79	0.33	1.5	16
10	105	194	8.9	16.3	6.55	8.79	890	110	0.91	1.18×10^{-3}	1.93	0.57	2.4	20A
15	189	346	12.8	23.4	9.63	12.7	700	171	2.41	2.87×10^{-3}	3.73	0.81	3.7	25A
—	307	439	18.6	23.2	11.8	17.1	640	181	3.74	5.93×10^{-3}	9.43	1.19	5.38	30A
—	674	934	30.8	37.5	23.0	32.3	510	358	13.0	1.87×10^{-2}	22.4	2.25	9.55	40A
—	1,290	2,950	40.3	64.9	27.8	44.0	430	690	34.1	4.56×10^{-2}	36.8	3.57	15.0	50A
—	1,570	3,420	47.7	79.5	29.0	48.8	370	881	62.2	9.54×10^{-2}	73.8	5.03	21.6	60A
—	83	133	7.84	11.3	5.90	7.35	980	63	0.66	8.11×10^{-4}	1.37	0.45	2.0	20
—	162	239	12.3	16.1	9.11	11.5	770	104	1.71	2.05×10^{-3}	3.20	0.75	3.1	25
—	289	412	18.6	23.2	11.8	17.1	640	181	4.08	4.47×10^{-3}	9.43	1.25	4.8	30
—	637	882	30.8	37.5	23.0	32.3	510	358	13.0	1.42×10^{-2}	22.4	2.30	8.6	40
—	1,390	3,180	46.1	74.2	27.2	42.1	450	696	25.5	3.54×10^{-2}	32.8	3.10	13.1	50
—	2,100	4,800	58.0	127	26.5	42.6	400	1,300	52.8	7.38×10^{-2}	67.5	4.70	19	60

※Maximum revolutions with grease lubrication.
Contact NB for further information in case oil lubrication is required.

1kN≒102kgf　1N・m≒0.102kgf・m

SPB-KP TYPE

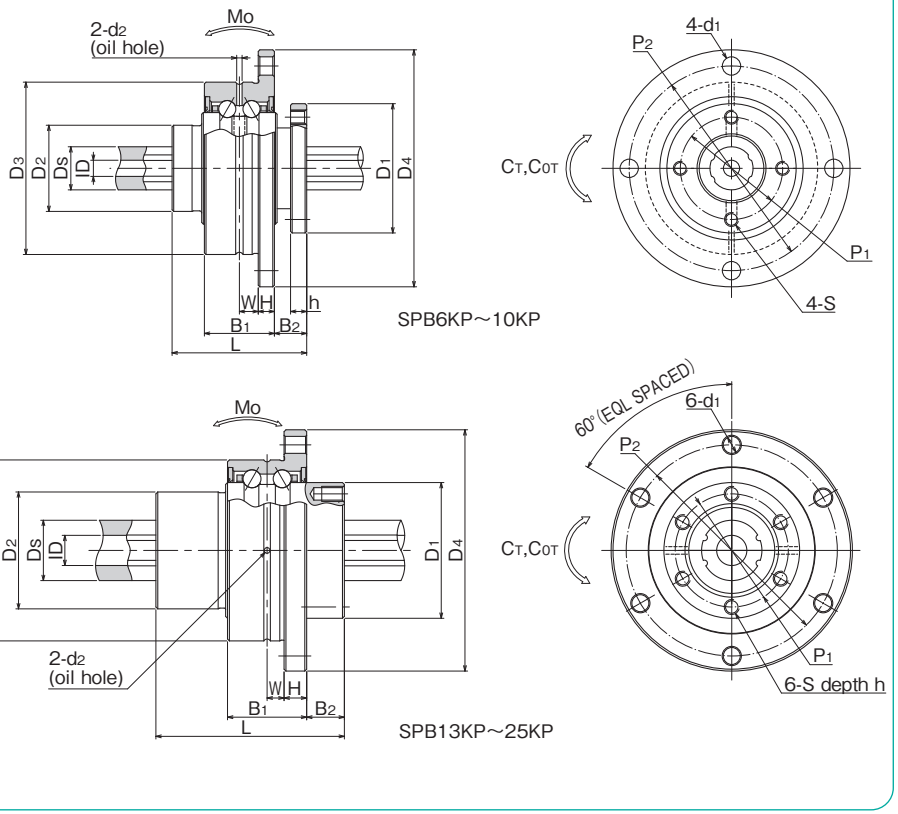


part number structure

example **SPB 20 KP - 1 - T1 - 450 T - P -LB -KGLA /CU**

- **SPB KP type**
- nominal diameter
- number of nuts attached to one shaft
- preload symbol
  blank: standard
  T1: light
  T2: medium
- spline shaft total length
- hollow spline shaft
  blank: standard shaft
  T: standard hollow shaft※
- accuracy grade
  blank: high
  P: precision
- with low temperature black chrome treatment
- grease symbol (refer to page Eng-51)
  blank: standard grease
  -KGLA: lithium-based low dust generation grease
  -KGU: urea-based low dust generation grease
  -KGF: anti-fretting grease
- with special specification

※For standard hollow shafts, refer to P.B-40 for specifications.



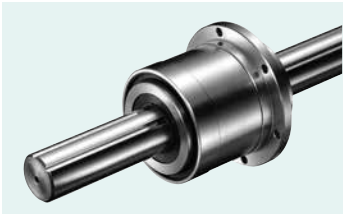
part number	major dimensions							major dimensions of angular contact bearing									
	D1 h7	tolerance	D2	L	P1 P.C.D.	S	h	D3 g6	tolerance	D4	H	B1	B2	P2 P.C.D.	d1	W	d2
	mm	μm	mm	mm	mm		mm	mm	μm	mm	mm	mm	mm	mm	mm	mm	mm
SPB 6KP	20	0 -21	14	25	16	M2	3	28	-7 -20	38	3	13	6	33	2.4	3.5	1
SPB 8KP	24		16	25	19	M2.6	3	32	-9 -25	44	3	13	6	38	3.4	3.5	1
SPB10KP	28		21	33	23	M3	4	36		48	3	15	9	42	3.4	4.5	1
SPB13KP	30		24	36	25	M3	5	44		56	4	18	9	50	3.4	5	1
SPB16KP	36	0 -25	31	50	30	M4	6	48		64	6	21	10	56	4.5	4.5	1.5
SPB20KP	43.5		35	63	36	M5	8	56	-10 -29	72	6	21	12	64	4.5	4.5	1.5
SPB25KP	52	0 -30	42	71	44	M5	8	66		86	7	25	13	75	5.5	5.5	1.5

spline shaft Ds	tolerance	ID (inner diameter)	rotary ball spline basic torque rating dynamic	basic torque rating static	basic load rating dynamic	basic load rating static	angular contact bearings basic load rating dynamic	basic load rating static	※maximum revolutions	allowable static moment	moment of inertia for the spline nut	moment of inertia for the spline shaft	moment of inertia for the rotating part	mass nut	mass shaft	size
			CT	COT	C	Co	CR	COR		Mo						
mm	μm	mm	N·m	N·m	kN	kN	kN	kN	rpm	N·m	kg·cm²	kg·cm²/mm	kg·cm²	kg	kg/m	
6	0 -12	2	1.5	2.4	1.22	2.28	4.35	2.74	8,100	5.1	0.01	9.45×10^{-6}	0.08	0.07	0.21	6
8	0 -15	3	2.1	3.7	1.45	2.87	4.54	3.13	7,000	7.4	0.03	3.02×10^{-5}	0.13	0.10	0.38	8
10		4	4.4	8.2	2.73	5.07	6.86	4.82	6,200	18.0	0.06	7.35×10^{-5}	0.21	0.14	0.60	10
13	0 -18	6	21	39.2	2.67	4.89	9.45	7.01	5,000	13.7	0.16	2.11×10^{-4}	0.49	0.23	1.0	13
16		8	60	110	6.12	11.2	10.2	8.56	4,200	46	0.43	4.79×10^{-4}	0.90	0.37	1.5	16
20	0 -21	10	105	194	8.9	16.3	10.9	10.1	3,600	110	1.00	1.18×10^{-3}	1.44	0.55	2.4	20
25		15	189	346	12.8	23.4	13.7	12.9	3,100	171	2.22	2.87×10^{-3}	3.36	0.84	3.7	25

※Maximum revolutions with grease lubrication.
Contact NB for further information in case oil lubrication is required.

1kN≒102kgf 1N·m≒0.102kgf·m

SPB TYPE

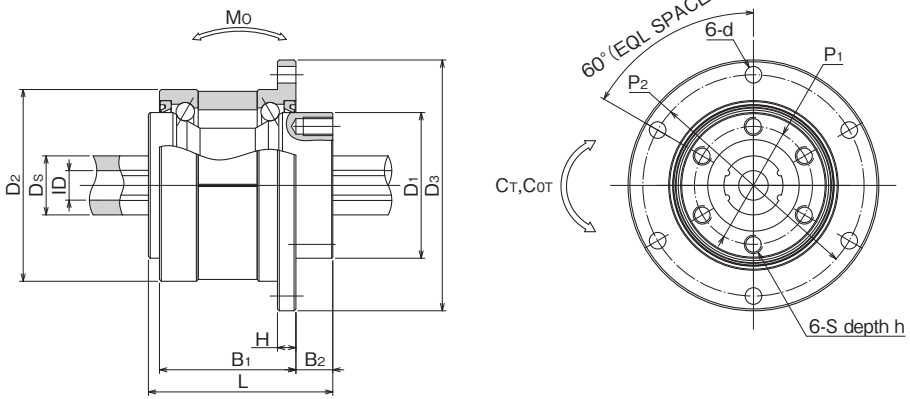


part number structure

example **SPB 20 - 1 - T1 - 450 T - P -LB -KGLA /CU**

- **SPB** — SPB type
- **20** — nominal diameter
- **1** — number of nuts attached to one shaft
- **T1** — preload symbol
  blank: standard
  T1: light
  T2: medium
- **450** — spline shaft total length
- **T** — hollow spline shaft
  blank: standard shaft
  T: standard hollow shaft※
- **P** — accuracy grade
  blank: high
  P: precision
- **-LB** — with low temperature black chrome treatment
- **-KGLA** — grease symbol (refer to page Eng-51)
  blank: standard grease
  -KGLA: lithium-based low dust generation grease
  -KGU: urea-based low dust generation grease
  -KGF: anti-fretting grease
- **/CU** — with special specification

※For standard hollow shafts, refer to P.B-40 for specifications.



part number	major dimensions D1h7	tolerance	L	P1 P.C.D.	S	h	major dimensions of angular contact bearing D2	tolerance	D3	H	B1	B2	P2 P.C.D.	d	spline shaft Ds	tolerance
	mm	μm	mm	mm		mm	mm	μm	mm	mm	mm	mm	mm	mm	mm	μm
SPB16	39.5	0	50	32	M5	8	52	0	68	5	37	10	60	4.5	16	0/−18
SPB20	43.5	−25	63	36	M5	8	56	−7	72	6	48	12	64	4.5	20	0
SPB25	53	0/−30	71	45	M6	8	62		78	6	55	13	70	4.5	25	−21

ID (inner diameter)	rotary ball spline basic torque rating dynamic CT	static COT	basic load rating dynamic C	static Co	angular contact bearings basic load rating dynamic CR	static COR	※maximum revolutions	allowable static moment Mo	moment of inertia for the spline nut	moment of inertia for the spline shaft	moment of inertia for the rotating part	mass nut	shaft	size
mm	N・m	N・m	kN	kN	kN	kN	rpm	N・m	kg・cm²	kg・cm²/mm	kg・cm²	kg	kg/m	
8	60	110	6.12	11.2	13.0	12.8	4,000	46	0.59	4.79×10^{-4}	1.63	0.54	1.5	**16**
10	105	194	8.9	16.3	17.4	17.2	3,600	110	1.01	1.18×10^{-3}	2.55	0.70	2.4	**20**
15	189	346	12.8	23.4	22.1	22.5	3,200	171	2.00	2.87×10^{-3}	3.85	0.92	3.7	**25**

※Maximum revolutions with grease lubrication.
Contact NB for further information in case oil lubrication is required.

1kN≒102kgf 1N・m≒0.102kgf・m

STROKE BALL SPLINE

The NB stroke ball spine SPLFS type is a highly accurate linear motion bearing with a limited stroke, to which both radial load and torque can be applied at the same time. It operates with extremely low dynamic friction.

STRUCTURE AND ADVANTAGES

The NB stroke ball spline consists of a nut and a shaft both with raceway grooves. The flanged spline nut consists of an outer cylinder, a retainer, side-rings, and ball elements.
Since the retainer in the nut is equipped with ball pockets, the ball elements do not contact each other, which allows for a smooth linear motion. The stroke is limited since the retainer is a non-circulating type. For normal operation, it is recommended to consider 80% of the maximum stroke shown in the dimension table as an actual stroke length.

Extremely low Dynamic Friction and Low Noise

The rolling elements are separated by the ball pockets so that they do not contact each other. The stroke length is limited, but extremely low dynamic friction and low noise are realized because the rolling elements do not circulate.

Compact-Size

With the nut about 20% smaller than those of conventional ball splines, it contributes to space saving.

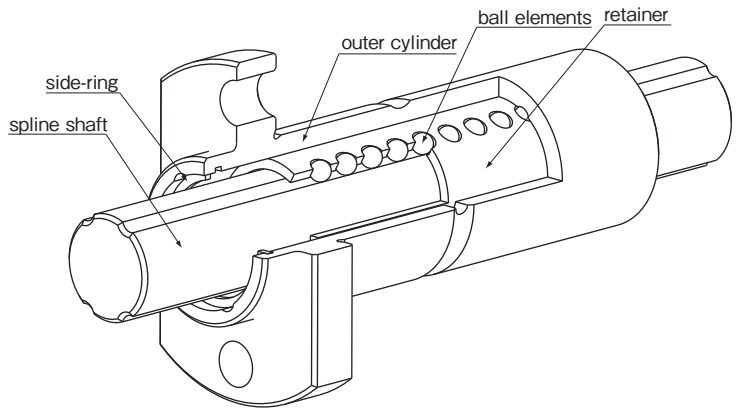
All Stainless Steel Type

Since all the components are made of stainless steel, this stroke ball spline has an excellent corrosion resistance and heat resistance (operating temperature: −20 to 140℃). It is ideal for clean room or vacuum applications.

Lubrication

A lubricant groove and two lubrication holes are provided on the outer surface of the nut, which allows for an easy designing of grease replenishment.

Figure B-42 Structure of SPLFS type



SPECIFICATION

Refer to table B-35 for NB stroke ball spline material and operating temperature range.

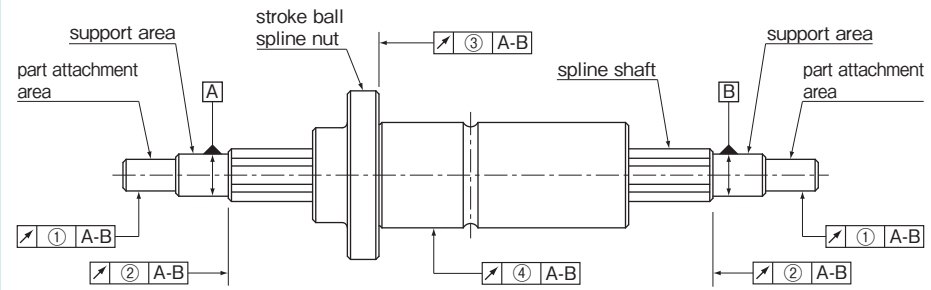
Table B-35 Material and Operating Temperature Range

type	nut		spline shaft	operating temperature range
	outer cylinder	retainer		
SPLFS	stainless steel	stainless steel	stainless steel	−20℃~ 140℃

ACCURACY

The accuracy of the NB stroke ball spline is measured at the points shown in Figure B-43.

Figure B-43 Accuracy Measurement Points



Note: The support area is the portion where, for example, radial bearings are attached in order to support the spline shaft. The part attachment area is the portion to which other parts, such as gears are attached.

Tolerance of Spline Shaft Groove Torsion (Max.)

The groove torsion is indicated per 100㎜, arbitrarily set as the effective length of the spline shaft section.

Table B-36 Tolerance of Spline Shaft Groove Torsion (Max.)

tolerance
13μm/100mm

Table B-37 Tolerance Relative to Spline Support Area (Max.) unit : μm

part number	① radial runout of part attachment area	② radial runout of the end of the spline shaft section	③ radial runout of the flange
SPLFS 6	14	9	11
SPLFS 8	14	9	11
SPLFS10	17	9	13
SPLFS13	19	11	13
SPLFS16	19	11	13

Table B-38 ④Radial Runout of Outer Surface of Spline Nut Relative to Spline Support Area (Max.) unit : μm

spline shaft total length (㎜)		size		
greater than	or less	6、8	10	13、16
—	200	46	36	34
200	315	89	54	45
315	400	126	68	53
400	500	163*	82	62
500	630	—	102	75
630	800	—	—	92
800	1,000	—	—	115
1,000	1,250	—	—	153
1,250	1,500	—	—	256

* SPLFS6 maximum shaft length: 400 mm

PRELOAD AND CLEARANCE

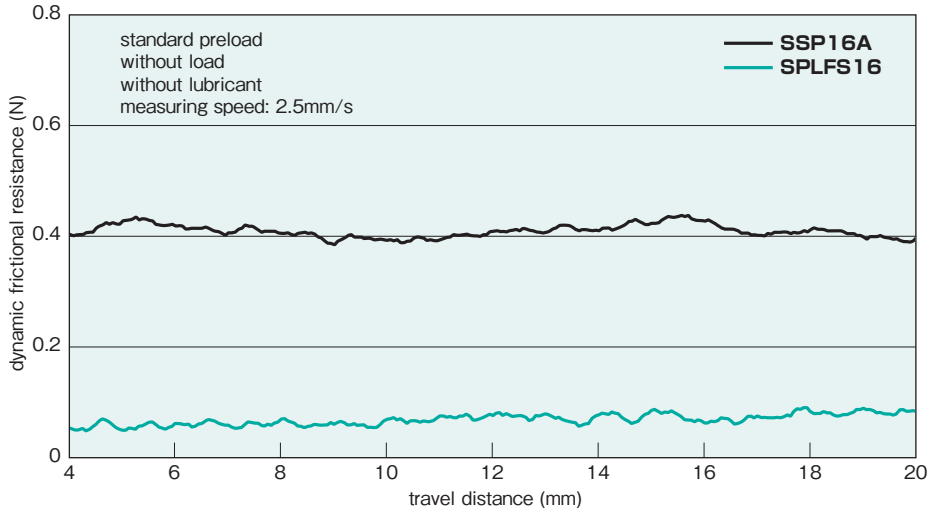
Preload and clearance are expressed in terms of clearance in the rotational direction. For the SPLFS type, only the standard preload is available as shown in Table B-39. Please contact NB if a special preload is required.

Table B-39 Preload and Clearance unit : μm

part number	standard
SPLFS 6	−4~0
SPLFS 8	−4~0
SPLFS10	−4~0
SPLFS13	−4~0
SPLFS16	−4~0

COMPARISON OF DYNAMIC FRICTIONAL RESISTANCE

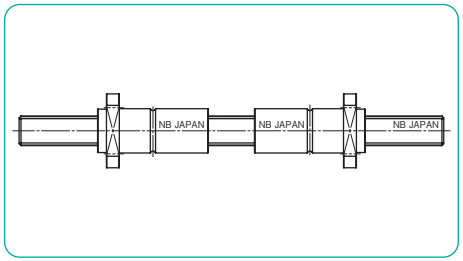
Figure B-44 Comparison of Dynamic Frictional Resistance



NUT ORIENTATION

Unless otherwise specified, the orientation of two nuts NB stroke ball spline is shown in Figure B-45. In other cases please specify the orientation of nut(s) with shaft.

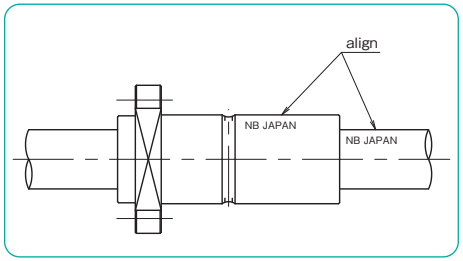
Figure B-45 Nut Orientation and NB mark



USE AND HANDLING PRECAUTIONS

A Set of Spline Nut and Spline Shaft

Figure B-46



The ball spline's accuracy and preload is guaranteed when spline nut and shaft are aligned as shown in Figure B-46. Please make sure to align the NB marks when reinserting the shaft.

At this time, both NB marks on the nut and shaft should be aligned in the same direction as when delivered.

When inserting the spline shaft into the spline nut, ensure that the ball elements do not drop out. This is done by aligning the raceway grooves of the shaft with the rows of ball elements and the seal lip of the nut. Then, carefully insert the spline shaft through the spline nut. In case that the nut is preloaded, please exercise additional care. And also, do not disassemble the spline nut.

Dust Prevention

Since the stroke ball spline is designed and manufactured for operation with an extremely low dynamic frictional resistance, seals that increase frictional resistance are not equipped as a standard feature. Please contact NB for a special requirement of seals. For use under harsh conditions, the stroke ball spline should be protected using bellows and protective covers.

Maximum Stroke

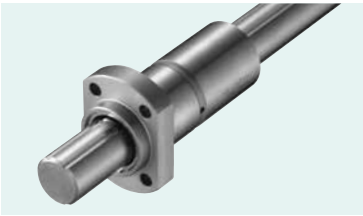
The maximum stroke in the dimension table is the stroke limit.

Retainer Slippage

If the stroke ball spline is used at a high speed or with a vertical shaft, or under an asymmetric load or oscillation, a retainer slippage may occur. For general operation, it is recommended to consider 80% of the maximum stroke length shown in the dimension table as the stroke length.
To prevent the retainer slippage, it is recommended to conduct a full-stroke movement of the nut whenever necessary in order for the retainer to be relocated to the center.

SPLFS TYPE

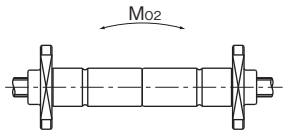
– Two Side Cut Flange Type –



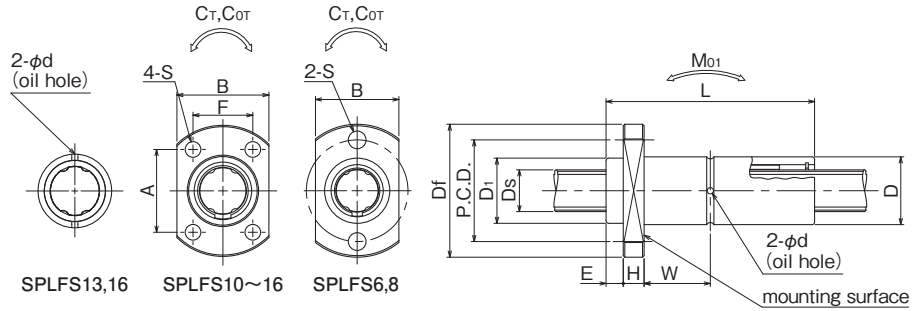
part number structure

example **SPLFS 16 - 2 - 200 -LB -KGLA /CU**

- SPLFS type
- nominal diameter
- number of nuts attached to one shaft
- spline shaft total length
- with low temperature black chrome treatment
- grease symbol (refer to page Eng-51)
  - **blank**: standard grease
  - **-KGLA**: lithium-based low dust generation grease
  - **-KGU**: urea-based low dust generation grease
  - **-KGF**: anti-fretting grease
- with special specification



When two spline nuts are used in close contact.



part number	maximum stroke	major dimensions											
		D		D1	L		E	Df	H	B	P.C.D.	A	F
	mm	mm	tolerance μm	mm	mm	tolerance mm	mm	mm	mm	mm	mm	mm	mm
SPLFS 6	22	11	0 −8	10	40	0 −0.2	3.3	23	4	14	17	—	—
SPLFS 8	20	13		12.5	40		3.3	25.5	4	16	19.5	—	—
SPLFS10	28	16		15.5	50		3.3	28.5	5	20	—	18	13
SPLFS13	24	20	0 −9	19.5	50		4.8	36	5	25	—	22	17
SPLFS16	26	24		23.5	60		4.8	40	7	29	—	25	19

S	W	d	Ds		basic torque rating		basic load rating		allowable static moment		mass		size
					dynamic CT	static COT	dynamic C	static Co	M01	M02	nut	shaft	
mm	mm	mm	mm	tolerance μm	N・m	N・m	kN	kN	N・m	N・m	g	kg/m	
3.4	12.7	1.2	6	0/−12	2.3	3.8	1.8	3.0	11.2	45	21.5	0.21	**6**
3.4	12.7	1.2	8	0 −15	3.3	5.5	2.02	3.37	13.1	52	27.0	0.38	**8**
3.4	16.7	1.5	10		6.5	10.9	3.21	5.35	25.6	102	47.7	0.6	**10**
3.4	15.2	1.5	13	0 −18	27.6	50.7	4.15	7.6	38.8	155	75.3	1.0	**13**
4.5	18.2	2.0	16		62.8	115	7.66	14	88.3	353	123.5	1.5	**16**

1kN≒102kgf　1N・m≒0.102kgf・m

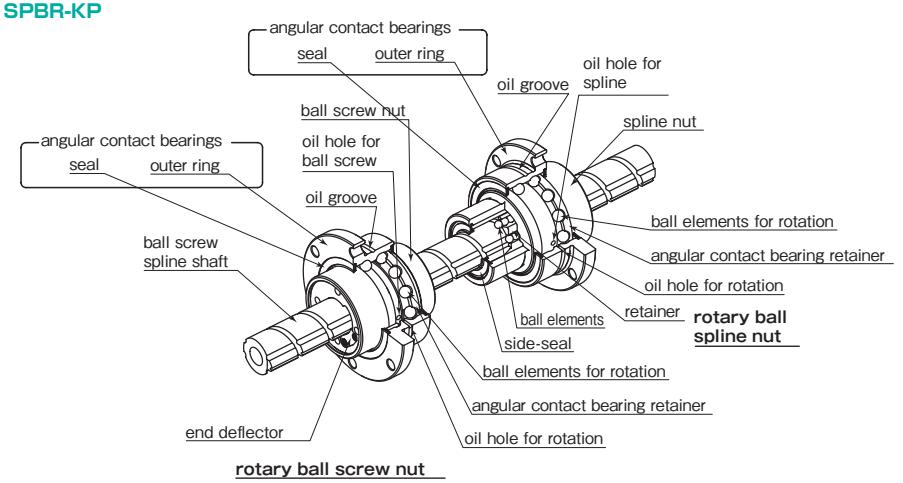
BALL SCREW SPLINE

STRUCTURE AND ADVANTAGES

The NB Ball Screw Spline consists of a highly accurate and highly rigid Ball Screw nut and Ball Spline nut attached to the ball screw spline shaft which has a screw groove and spline grooves.
SPBR type has a Rotary Ball Screw nut and Rotary Ball Spline nut.
Rotary Ball Screw nut is an integration of ball screw nut and angular contact bearings.
Rotary Ball Spline nut is an integration of ball spline nut and angular contact bearings.
SPBF type has a Rotary Ball Screw nut and a Ball Spline nut.
A single axis of the NB Ball Screw Spline can provide positioning, linear and rotary motion as well as combined spiral motion.
The typical applications are SCARA robot, assembly machine, loader, etc.

Figure B-47 Structure of SPBR-KP type, SPBF-KP type

SPBR-KP



SPBF-KP

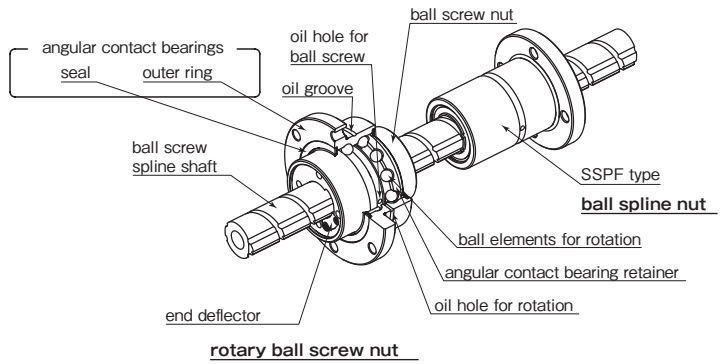
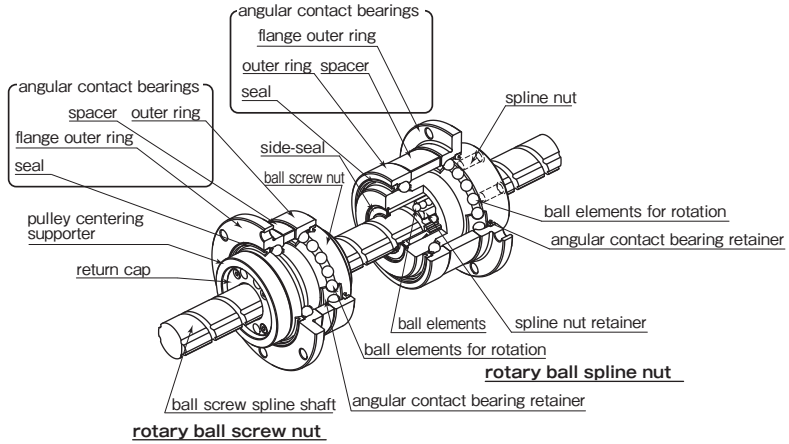
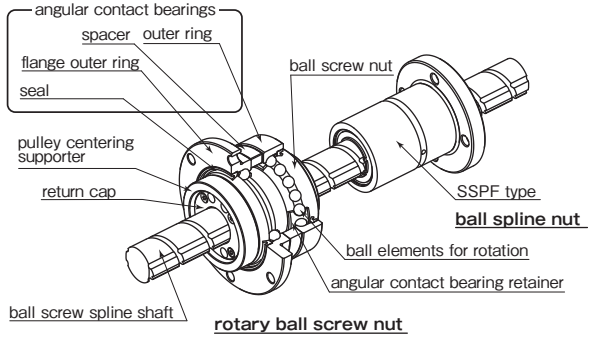


Figure B-48 Structure of SPBR type, SPBF type

SPBR type



SPBF type



SPECIFICATION

Refer to table B-40 for NB ball screw spline material and operating temperature range.

Table B-40 Material and Operating Temperature Range

type	nut		spline shaft	operating temperature range
	outer cylinder	return cap /retainer		
SPBR	steel	resin	steel	−20℃～80℃
SPBF				

PRELOAD

The preload is properly adjusted for the ball screw nut, spline nut, and angular contact bearings.
Please contact NB for preload specification.

USE AND HANDLING PRECAUTIONS

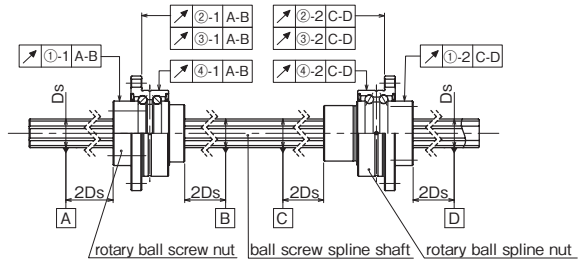
- Please do not adjust the spacer for SPBR and SPBF type. The spacer is adjusted to provide a proper spacing for the best preload condition.
- Please do not remove the Rotary Ball Screw nut from the shaft. There is no ball-retainer in the Rotary Ball Screw nut.
- Please use the pulley centering supporter when attaching the pulley to the return-cap for SPBR and SPBF type.

ACCURACY

The NB Ball Screw Spline is measured for accuracy at the points shown in Figure B-49.

Figure B-49 Accuracy Measurement points

SPBR-KP type



SPBF-KP type

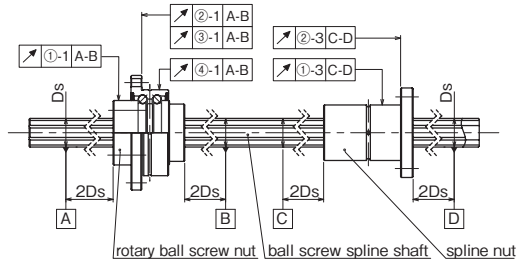


Table B-41 Tolerance of Spline Shaft Groove Torsion (Max.)

tolerance
13μm/100mm

The groove torsion is indicated per 100mm, arbitrarily set within the effective length of the spline shaft section.

Table B-42 Grade of Ball Screw Groove

C5

Applied to lead angle accuracy only

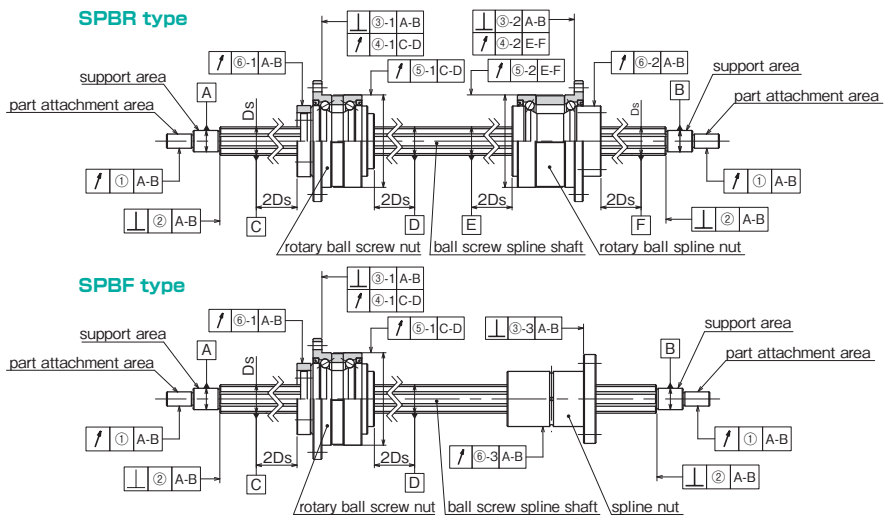
Table B-43 Accuracy tolerance of each component (Max.) unit: μm

part number	① radial runout of the outer surface			② radial runout of flange attachment surface		
	①-1	①-2	①-3	②-1	②-2	②-3
SPBR16KP,SPBF16KP	15	33	33	16	18	13
SPBR20KP,SPBF20KP	19	39	39			
SPBR25KP,SPBF25KP				18	21	16

Table B-44 Accuracy tolerance during rotational movement of angular rotating area (Max.) unit: μm

part number	③ radial runout of flange mounting side		④ radial runout of outer ring	
	③-1	③-2	④-1	④-2
SPBR16KP	8	8	9	9
SPBR20KP			10	10
SPBR25KP				

Figure B-50 Accuracy Measurement points



Note: The support area is the portion where, for example, radial bearings are attached in order to support the spline shaft.
The part attachment area is the portion to which other parts, such as gears, are attached.
④、⑤indicate radial runout of rotational movement of angular rotating area.

Table B-45 Tolerance of Spline Shaft Groove Torsion (Max.)

tolerance
13μm/100mm

The groove torsion is indicated per 100mm, arbitrarily set within the effective length of the spline shaft section.

Table B-46 Grade of Ball Screw Groove

C5

Applied to lead angle accuracy only

Table B-47 Tolerance Relative to Spline Support Area (Max.) unit: μm

part number	① radial runout of the component attachment area	② radial runout of the spline shaft surface (Applicable only for ground shaft)	③ radial runout of flange attachment surface		
			③-1	③-2	③-3
SPBR16,SPBF16	19	11	16	18	13
SPBR20,SPBF20					
SPBR25,SPBF25	22	13	18	21	16

Table B-48 Accuracy tolerance during rotational movement of angular rotating area (Max.) unit: μm

part number	④ radial runout of flange mounting side		⑤ radial runout of outer ring	
	④-1	④-2	⑤-1	⑤-2
SPBR16	8	8	9	9
SPBR20			10	10
SPBR25				

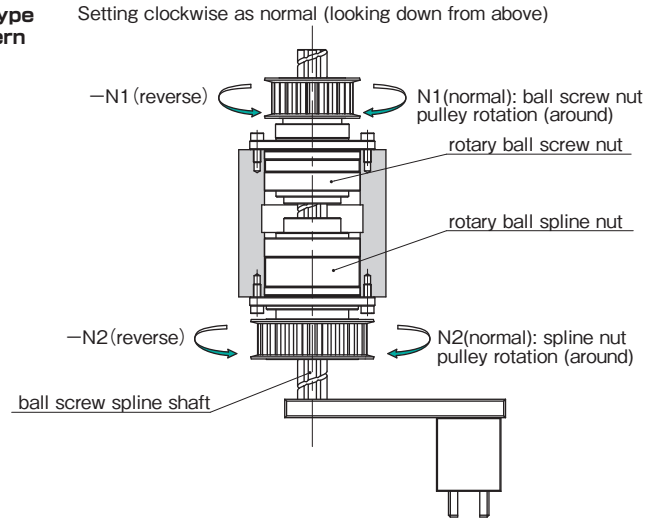
Table B-49 Radial Runout of Spline Nut Relative to Spline Support Area (Max.) unit: μm

ball screw spline shaft total length (mm)		part number:SPBR,SPBF			
		⑥-1		⑥-2,-3	
greater than	or less	16,20	25	16,20	25
–	200	40	35	18	18
200	315	45	40	25	21
315	400	55	45	31	25
400	500	60	50	38	29
500	630	75	60	46	34
630	800	90	70	58	42
800	1,000	120	85	75	52

SPBR (-KP) TYPE MOTION PATTERN

One set of SPBR(-KP) type can handle linear, rotational, and spiral motion.

SPBR(-KP) type Motion Pattern



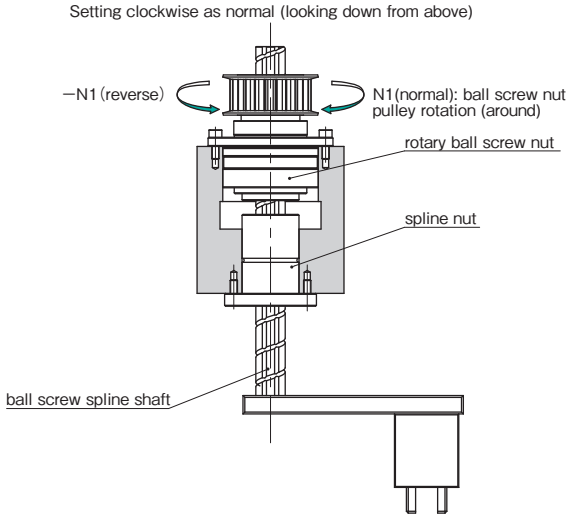
motion	input		output			
	ball screw nut	spline nut	motion direction	travel distance (linear direction)		revolution (rotational direction)
1.up・down	N_1 (normal)	0	①	$L=N_1 \cdot R$ (up)		0
	$-N_1$ (reverse)	0	②	$L=-N_1 \cdot R$ (down)		0
2.rotation	$N_1=N_2$ (normal)	(normal)	①	0		N_2 (normal)
	$-N_1=-N_2$ (reverse)	(reverse)	②	0		$-N_2$ (reverse)
3.spiral	0	N_2 (normal)	①	$L=N_2 \cdot R$ (down)		N_2 (normal)
	0	$-N_2$ (reverse)	②	$L=-N_2 \cdot R$ (up)		$-N_2$ (reverse)
	N_1 (normal) $-N_1$ (reverse)	N_2 (normal)	①	$L=(N_2-(\pm N_1)) \cdot R$	in case of $N_2-(\pm N_1)>0$ (down)	N_2 (normal)
			④		in case of $N_2-(\pm N_1)<0$ (up)	
		$-N_2$ (reverse)	③	$L=(-N_2-(\pm N_1)) \cdot R$	in case of $-N_2-(\pm N_1)>0$ (down)	$-N_2$ (reverse)
			②		in case of $-N_2-(\pm N_1)<0$ (up)	

L : travel distance [mm] R : ball screw lead [mm] N1 : ball screw nut pulley rotation (around) N2 : ball spline nut pulley rotation (around)

SPBF (-KP) TYPE MOTION PATTERN

SPBF(-KP) type can handle linear motion.

SPBF(-KP) type Motion Pattern



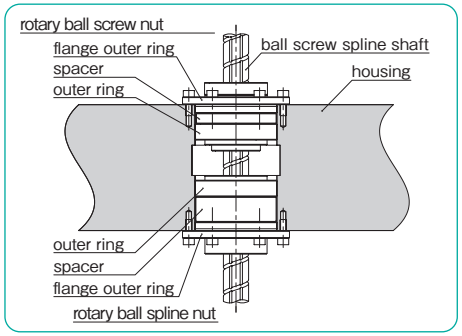
motion	input	output	
	ball screw nut	motion direction	travel distance (linear direction)
1.up・down ② ①	N_1 (normal)	①	$L=N_1 \cdot R$ (up)
	$-N_1$ (reverse)	②	$L=-N_1 \cdot R$ (down)

L : travel distance [mm]　R : ball screw lead [mm]　N1 : ball screw nut pulley rotation (around)

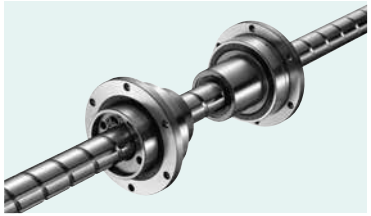
MOUNTING

For SPBR and SPBF types, please finish the holes of the housing with H7 tolerance as shown in Figure B-51 and ensure that both the flange outer ring and outer ring are inserted into the housing. If the flange is not inserted deeply, it may not be able to receive the load properly, or if only the flange outer ring is inserted deeply, the spacer may slip out, which may reduce the accuracy and make it unusable.

Figure B-51　Mounting of SPBR type



SPBR-KP TYPE

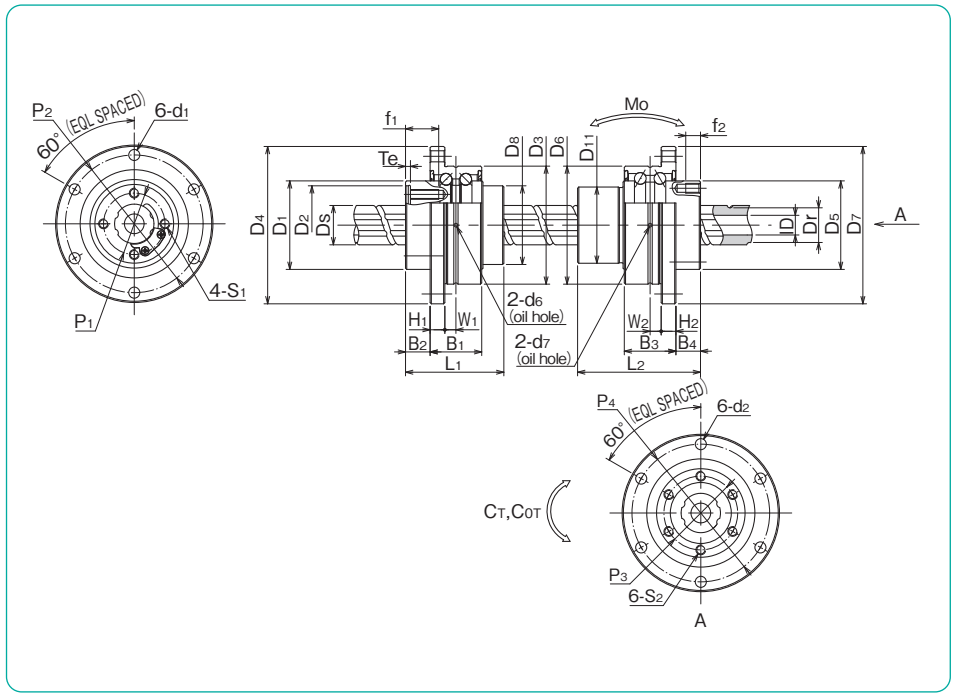


part number structure

example **SPBR 20 KP - 450 T -LB -KGLA /CU**

- SPBR-KP type
- nominal diameter
- ball screw spline shaft total length
- hollow shaft
- with low temperature black chrome treatment
- grease symbol (refer to page Eng-51)
  blank: standard grease
  -KGLA: lithium-based low dust generation grease
  -KGU: urea-based low dust generation grease
  -KGF: anti-fretting grease
- with special specification

Note : Hollow shaft is used for standard type.



ROTARY BALL SCREW NUT

part number	major dimensions										major dimensions of angular contact bearings						
	D_1 h7	tolerance	D_2 H7	tolerance	D_8	L_1	P_1 P.C.D.	S_1	f_1	Te	D_3 g6	tolerance	D_4	H_1	B_1	B_2	P_2 P.C.D.	d_1
	mm	μm	mm	μm	mm	mm	mm		mm	mm	mm	μm	mm	mm	mm	mm	mm	mm
SPBR16KP	36	0 −25	32	+25 0	32	40	25	M4	13.5	2	48	-9/-25	64	6	21	10	56	4.5
SPBR20KP	43.5		39		39	48	31	M5	16.5	2.5	56	−10 −29	72	6	21	11	64	4.5
SPBR25KP	52	0/−30	47		47	58	38	M6	20	3	66		86	7	25	13	75	5.5

part number	W_1	d_6	ball screw spline shaft D_s	shaft inner diameter ID	lead	root diameter Dr	ball screw basic load rating dynamic Ca	ball screw basic load rating static Coa	angular contact bearings basic load rating dynamic C_{aR}	angular contact bearings basic load rating static C_{oaR}	※ maximum revolutions	moment of inertia for the nut	moment of inertia for the ball screw shaft	mass nut	mass shaft	ball screw nut maximum revolutions based on Dm·N	size
	mm	mm	mm	mm	mm	mm	kN	kN	kN	kN	rpm	$kg \cdot cm^2$	$kg \cdot cm^2/mm$	kg	kg/m	rpm	
SPBR16KP	4.5	1.5	16	8	16	13.7	4.3	6.5	7.30	11.3	4,400	0.43	4.19×10^{-4}	0.36	1.10	4,210	16
SPBR20KP	4.5	1.5	20	10	20	17.5	5.7	9.4	7.69	13.3	3,700	1.01	1.05×10^{-3}	0.53	1.73	3,360	20
SPBR25KP	5.5	1.5	25	15	25	21.7	8.5	14.6	10.5	19.4	3,100	2.49	2.35×10^{-3}	0.90	2.27	2,710	25

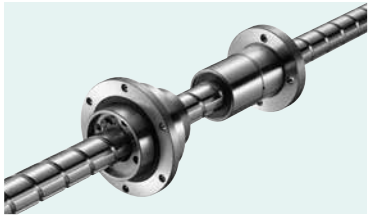
ROTARY BALL SPLINE NUT

part number	major dimensions							major dimensions of angular contact bearings							
	D_5 h7	tolerance	D_{11}	L_2	P_3 P.C.D.	S_2	f_2	D_6 g6	tolerance	D_7	H_2	B_3	B_4	P_4 P.C.D.	d_2
	mm	μm	mm	mm	mm		mm	mm	μm	mm	mm	mm	mm	mm	mm
SPBR16KP	36	0 −25	31	50	30	M4	6	48	-9/-25	64	6	21	10	56	4.5
SPBR20KP	43.5		35	63	36	M5	8	56	−10 −29	72	6	21	12	64	4.5
SPBR25KP	52	0/−30	42	71	44	M5	8	66		86	7	25	13	75	5.5

part number	W_2	d_7	ball spline basic torque rating dynamic C_T	ball spline basic torque rating static C_{OT}	ball spline basic load rating dynamic C	ball spline basic load rating static Co	angular contact bearings basic load rating dynamic C_R	angular contact bearings basic load rating static C_{OR}	※ maximum revolutions	allowable static moment Mo	moment of inertia	mass nut	size
	mm	mm	N·m	N·m	kN	kN	kN	kN	rpm	N·m	$kg \cdot cm^2$	kg	
SPBR16KP	4.5	1.5	60	110	6.12	11.2	10.2	8.56	4,200	46	0.43	0.37	16
SPBR20KP	4.5	1.5	105	194	8.9	16.3	10.9	10.1	3,600	110	1.00	0.55	20
SPBR25KP	5.5	1.5	189	346	12.8	23.4	13.7	12.9	3,100	171	2.22	0.84	25

・Please select the smallest maximum revolutions (rpm) in case that more than one portion rotate at the same time.
※Maximum revolutions with grease lubrication.
・Moment of inertia is calculated excluding the angular contact bearings.
・Maximum length of ball screw spline shaft : 600mm

SPBF-KP TYPE

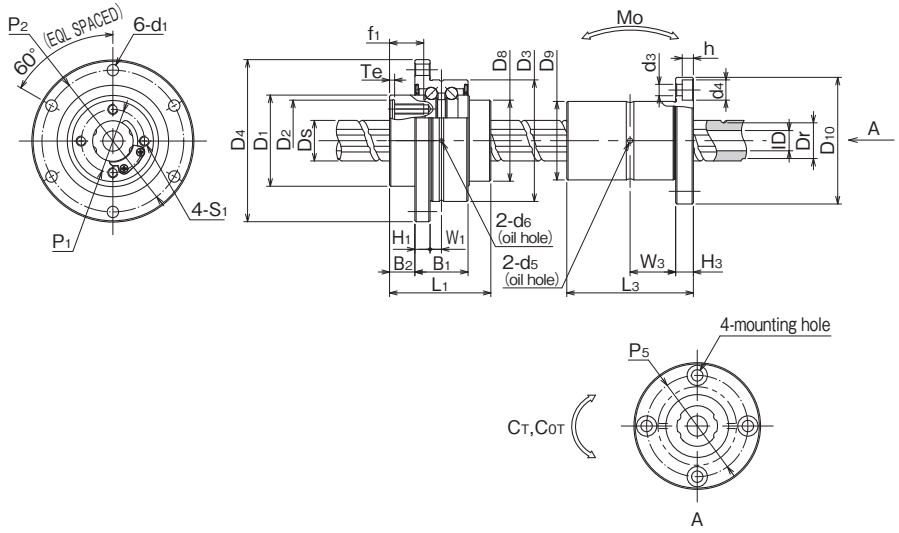


part number structure

example **SPBF 20 KP - 450 T -LB -KGLA /CU**

- SPBF-KP type
- nominal diameter
- ball screw spline shaft total length
- hollow shaft
- with low temperature black chrome treatment
- grease symbol (refer to page Eng-51)
  blank: standard grease
  -KGLA: lithium-based low dust generation grease
  -KGU: urea-based low dust generation grease
  -KGF: anti-fretting grease
- with special specification

Note : Hollow shaft is used for standard type.



ROTARY BALL SCREW NUT

part number	major dimensions										major dimensions of angular contact bearings						
	D1 h7	tolerance	D2 H7	tolerance	D8	L1	P1 P.C.D.	S1	f1	Te	D3 g6	tolerance	D4	H1	B1	B2	P2 P.C.D.	d1
	mm	μm	mm	μm	mm	mm	mm		mm	mm	mm	μm	mm	mm	mm	mm	mm	mm
SPBF16KP	36	0 −25	32	+25 0	32	40	25	M4	13.5	2	48	-9/-25	64	6	21	10	56	4.5
SPBF20KP	43.5		39		39	48	31	M5	16.5	2.5	56	−10 −29	72	6	21	11	64	4.5
SPBF25KP	52	0/-30	47		47	58	38	M6	20	3	66		86	7	25	13	75	5.5

part number	W1	d6	ball screw spline shaft Ds	shaft inner diameter ID	lead	root diameter Dr	ball screw basic load rating dynamic Ca	ball screw basic load rating static Coa	angular contact bearings basic load rating dynamic CaR	angular contact bearings basic load rating static CoaR	※ maximum revolutions	moment of inertia for the nut	moment of inertia for the ball screw shaft	mass nut	mass shaft	ball screw nut maximum revolutions based on Dm·N	size
	mm	mm	mm	mm	mm	mm	kN	kN	kN	kN	rpm	kg·cm²	kg·cm²/mm	kg	kg/m	rpm	
SPBF16KP	4.5	1.5	16	8	16	13.7	4.3	6.5	7.30	11.3	4,400	0.43	4.19×10^{-4}	0.36	1.10	4,210	16
SPBF20KP	4.5	1.5	20	10	20	17.5	5.7	9.4	7.69	13.3	3,700	1.01	1.05×10^{-3}	0.53	1.73	3,360	20
SPBF25KP	5.5	1.5	25	15	25	21.7	8.5	14.6	10.5	19.4	3,100	2.49	2.35×10^{-3}	0.90	2.27	2,710	25

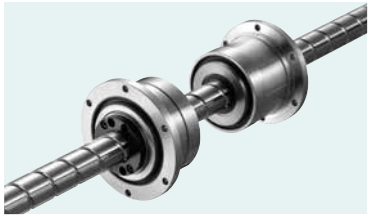
BALL SPLINE NUT

part number	major dimensions							
	D9 h6	tolerance	L3	tolerance	D10	H3	P5 P.C.D.	d3×d4×h
	mm	μm	mm	mm	mm	mm	mm	mm
SPBF16KP	31	0 −16	50	0 −0.2	50	7	40	4.5×8×4.4
SPBF20KP	35		63		58	9	45	5.5×9.5×5.4
SPBF25KP	42		71	0/−0.3	65	9	52	5.5×9.5×5.4

part number	W3	d5	basic torque rating dynamic CT	basic torque rating static COT	basic load rating dynamic C	basic load rating static Co	allowable static moment Mo	moment of inertia	mass nut	size
	mm	mm	N·m	N·m	kN	kN	N·m	kg·cm²	kg	
SPBF16KP	18	2	60	110	6.12	11.2	46	0.43	0.2	16
SPBF20KP	22.5	2	105	194	8.9	16.3	110	1.00	0.33	20
SPBF25KP	26.5	3	189	346	12.8	23.4	171	2.22	0.45	25

・Please select the smallest maximum revolutions (rpm) in case that more than one portion rotate at the same time.
※Maximum revolutions with grease lubrication.
・Moment of inertia is calculated excluding the angular contact bearings.
・Maximum length of ball screw spline shaft : 600mm

SPBR TYPE

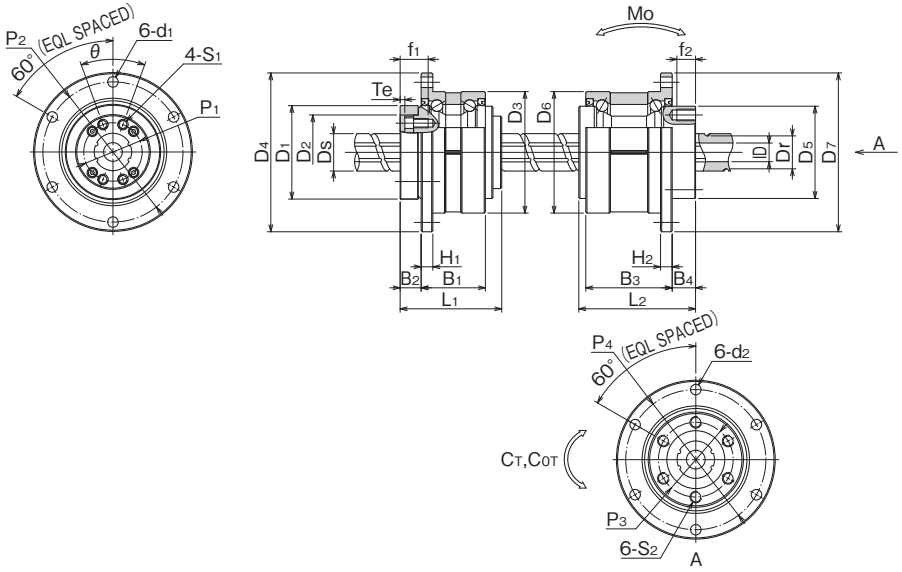


part number structure

example **SPBR 20 - 450 T -LB -KGLA /CU**

- **SPBR**: SPBR type
- **20**: nominal diameter
- **450**: ball screw spline shaft total length
- **T**: hollow spline shaft — **blank:** standard shaft; **T:** standard hollow shaft※
- **-LB**: with low temperature black chrome treatment
- **-KGLA**: grease symbol (refer to page Eng-51) — **blank**: standard grease; **-KGLA**: lithium-based low dust generation grease; **-KGU**: urea-based low dust generation grease; **-KGF**: anti-fretting grease
- **/CU**: with special specification

※For standard hollow shafts, refer to P.B-40 for specifications.



ROTARY BALL SCREW NUT

part number	major dimensions										major dimensions of angular contact bearings						
	D_1 h7	tolerance	D_2 H7	tolerance	L_1	P_1 P.C.D.	θ	S_1	f_1	Te	D_3	tolerance	D_4	H_1	B_1	B_2	P_2 P.C.D.	d_1
	mm	μm	mm	μm	mm	mm			mm	mm	mm	μm	mm	mm	mm	mm	mm	mm
SPBR16	40	0 −25	32	+25 0	43.5	25	40°	M4	12	2	52	0 −7	68	5	27.5	9	60	4.5
SPBR20	50		39		54	31	40°	M5	16	2	62		78	6	34	11	70	4.5
SPBR25	58	0/−30	47		65	38	40°	M6	19	3	72		92	8	43	12.5	81	5.5

part number	ball screw spline shaft Ds	ID (inner diameter)	lead	root diameter Dr	ball screw basic load rating dynamic Ca	ball screw basic load rating static Coa	angular contact bearings basic load rating dynamic C_{aR}	angular contact bearings basic load rating static C_{oaR}	※ maximum revolutions	moment of inertia for the nut	moment of inertia for the ball screw shaft	mass nut	mass shaft	ball screw nut maximum revolutions based on Dm·N	size
	mm	mm	mm	mm	kN	kN	kN	kN	rpm	kg·cm²	kg·cm²/mm	kg	kg/m	rpm	
SPBR16	16	8	16	13.4	4.62	8.59	11.1	22.2	4,000	0.60	4.43×10^{-4}	0.45	1.47	4,170	16
SPBR20	20	10	20	17.2	5.77	12.2	14.4	30.5	3,200	1.75	1.12×10^{-3}	0.76	2.33	3,410	20
SPBR25	25	15	25	21.9	8.62	19.2	18.2	39.8	2,800	3.86	2.74×10^{-3}	1.26	3.65	2,690	25

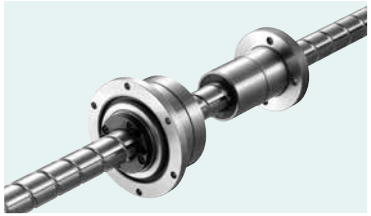
ROTARY BALL SPLINE NUT

part number	major dimensions						major dimensions of angular contact bearings							
	D_5 h7 h7	tolerance	L_2	P_3 P.C.D.	S_2	f_2	D_6	tolerance	D_7	H_2	B_3	B_4	P_4 P.C.D.	d_2
	mm	μm	mm	mm		mm	mm	μm	mm	mm	mm	mm	mm	mm
SPBR16	39.5	0 −25	50	32	M5	8	52	0 −7	68	5	37	10	60	4.5
SPBR20	43.5		63	36	M5	8	56		72	6	48	12	64	4.5
SPBR25	53	0/−30	71	45	M6	8	62		78	6	55	13	70	4.5

ball spline basic torque rating dynamic C_T	ball spline basic torque rating static C_{OT}	ball spline basic load rating dynamic C	ball spline basic load rating static Co	angular contact bearings basic load rating dynamic C_R	angular contact bearings basic load rating static C_{OR}	※ maximum revolutions	allowable static moment Mo	moment of inertia	mass nut
N·m	N·m	kN	kN	kN	kN	rpm	N·m	kg·cm²	kg
60	110	6.12	11.2	13.0	12.8	4,000	46	0.59	0.54
105	194	8.9	16.3	17.4	17.2	3,600	110	1.01	0.70
189	346	12.8	23.4	22.1	22.5	3,200	171	2.00	0.92

・Please select the smallest maximum revolutions (rpm) in case that more than one portion rotate at the same time.
※Maximum revolutions with grease lubrication.
・Moment of inertia is calculated excluding the angular contact bearings.
・Maximum length of ball screw spline shaft : 1,000mm

SPBF TYPE

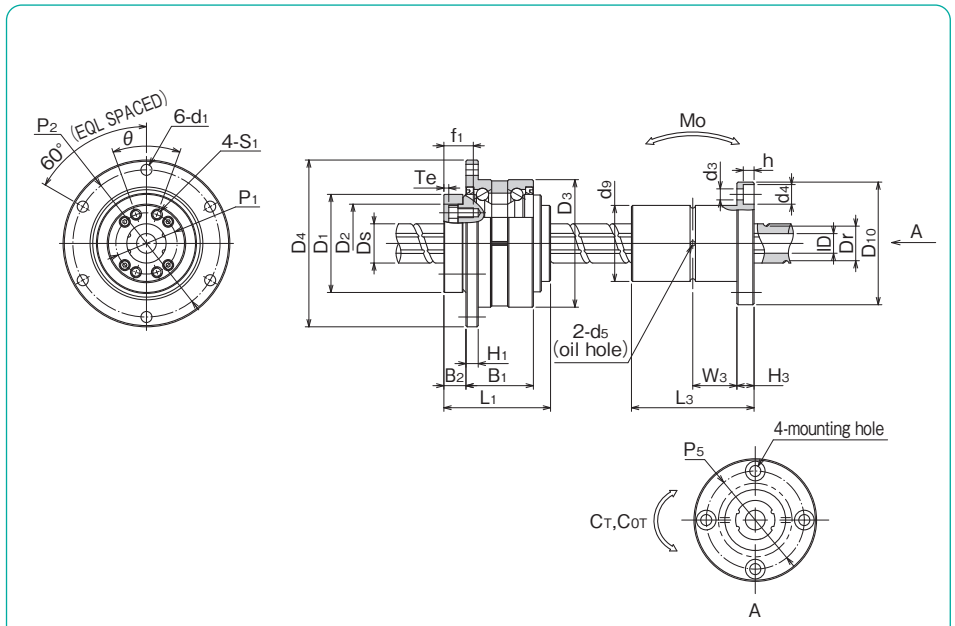


part number structure

example **SPBF 20 - 450 T -LB -KGLA /CU**

- **SPBF** — SPBF type
- **20** — nominal diameter
- **450** — ball screw spline shaft total length
- **T** — hollow spline shaft; **blank:** standard shaft; **T:** standard hollow shaft※
- **-LB** — with low temperature black chrome treatment
- **-KGLA** — grease symbol (refer to page Eng-51); **blank**: standard grease; **-KGLA**: lithium-based low dust generation grease; **-KGU**: urea-based low dust generation grease; **-KGF**: anti-fretting grease
- **/CU** — with special specification

※For standard hollow shafts, refer to P.B-40 for specifications.



ROTARY BALL SCREW NUT

part number	major dimensions											major dimensions of angular contact bearings							
	D1 h7	tolerance	D2 H7	tolerance	L1	P1 P.C.D.	θ	S1	f1	Te		D3	tolerance	D4	H1	B1	B2	P2 P.C.D.	d1
	mm	μm	mm	μm	mm	mm			mm	mm		mm	μm	mm	mm	mm	mm	mm	mm
SPBF16	40	0 −25	32	+25 0	43.5	25	40°	M4	12	2		52	0 −7	68	5	27.5	9	60	4.5
SPBF20	50		39		54	31	40°	M5	16	2		62		78	6	34	11	70	4.5
SPBF25	58	0/−30	47		65	38	40°	M6	19	3		72		92	8	43	12.5	81	5.5

BALL SPLINE NUT

part number	major dimensions							
	D9 h6	tolerance	L3	tolerance	D10	H3	P5 P.C.D.	d3×d4×h
	mm	μm	mm	mm	mm		mm	mm
SPBF16	31	0 −16	50	0 −0.2	50	7	40	4.5×8×4.4
SPBF20	35		63		58	9	45	5.5×9.5×5.4
SPBF25	42		71	0/−0.3	65	9	52	5.5×9.5×5.4

・Please select the smallest maximum revolutions (rpm) in case that more than one portion rotate at the same time.
※Maximum revolutions with grease lubrication.
・Moment of inertia is calculated excluding the angular contact bearings.
・Maximum length of ball screw spline shaft : 1,000mm

ball screw spline shaft Ds	ID (inner diameter)	lead	root diameter Dr	ball screw basic load rating dynamic Ca	ball screw basic load rating static Coa	angular contact bearings basic load rating dynamic CaR	angular contact bearings basic load rating static CoaR	※ maximum revolutions	moment of inertia for the nut	moment of inertia for the ball screw shaft	mass nut	mass shaft	ball screw nut maximum revolutions based on Dm·N	size
mm	mm	mm	mm	kN	kN	kN	kN	rpm	kg·cm²	kg·cm²/mm	kg	kg/m	rpm	
16	8	16	13.4	4.62	8.59	11.1	22.2	4,000	0.60	4.43×10^{-4}	0.46	1.47	4,170	16
20	10	20	17.2	5.77	12.2	14.4	30.5	3,200	1.75	1.12×10^{-3}	0.76	2.33	3,410	20
25	15	25	21.9	8.62	19.2	18.2	39.8	2,800	3.86	2.74×10^{-3}	1.26	3.65	2,690	25

W	d5	basic torque rating dynamic CT	basic torque rating static COT	basic load rating dynamic C	basic load rating static Co	allowable static moment Mo	moment of inertia	mass nut
mm	mm	N·m	N·m	kN	kN	N·m	kg·cm²	kg
18	2	60	110	6.12	11.2	46	0.59	0.2
22.5	2	105	194	8.9	16.3	110	1.01	0.33
26.5	3	189	346	12.8	23.4	171	2.00	0.45