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

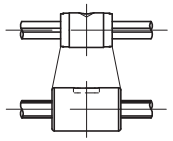
Since a round shaft with raceway grooves is used, NB ball spline shafts can be easily machined to customized specifications.

High-Speed Motion and High-Speed Rotation

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

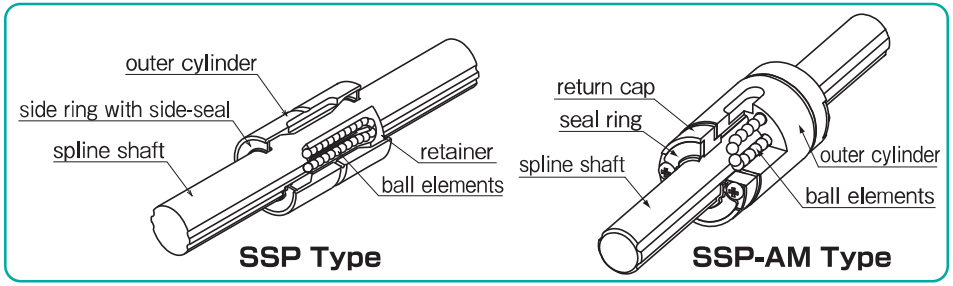
Light Weight and Compactness

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

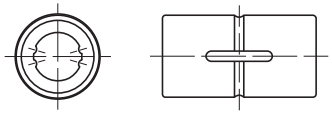
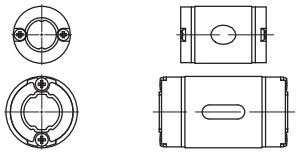
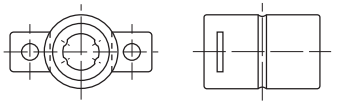
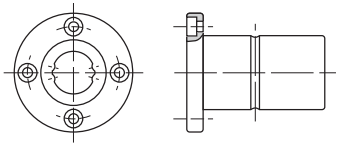
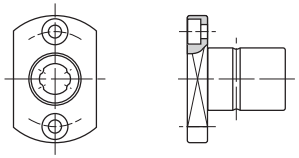
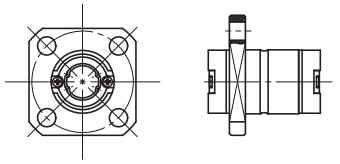


TYPES

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.

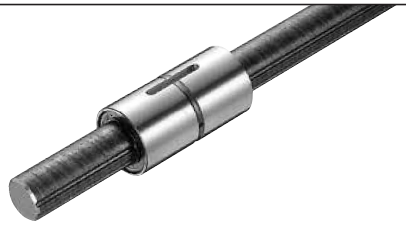
Table B-1 Types of Spline Nut

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.

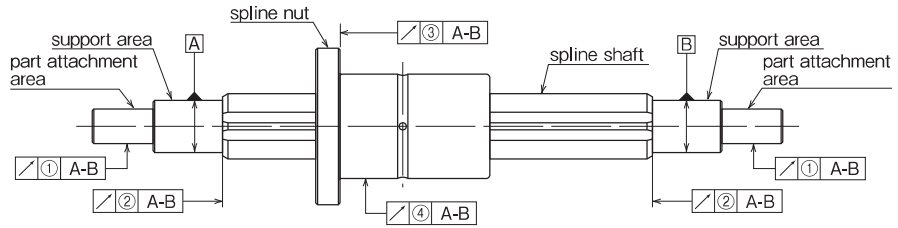
Table B-3 Material and Operating Temperature Range

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

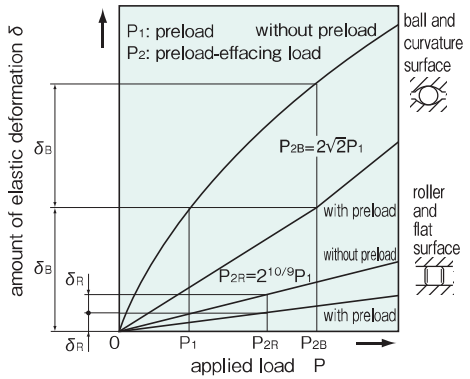


Table B-9 Level of Preload

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

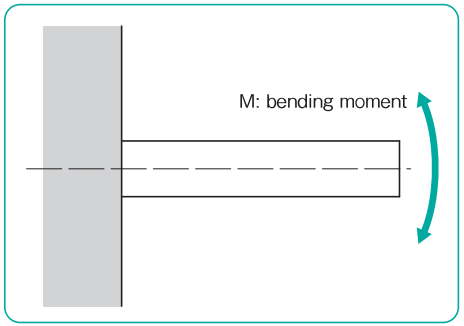


Figure B-5 Twisting Moment

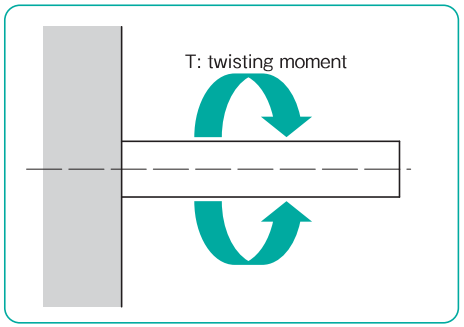


Figure B-6 Deformation of Spline Shaft by Twisting Moment

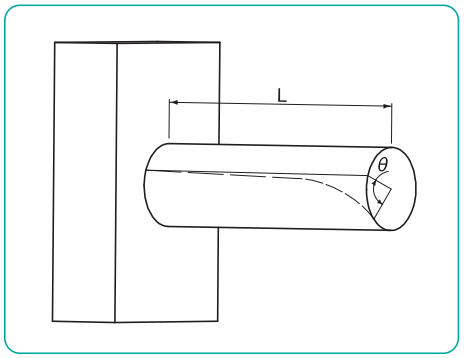
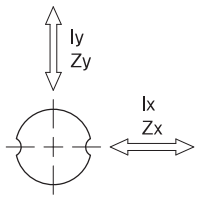
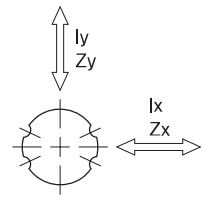


Table B-10 (1) Cross-sectional Characteristics of Spline Shaft (1)

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



SSP4AM



SSP5AM~10AM
SSP4~60
SSP13A~100AL

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 SUJ2 1/N・mm²	C=1/48EI equivalent to SUS440C 1/N・mm²
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}

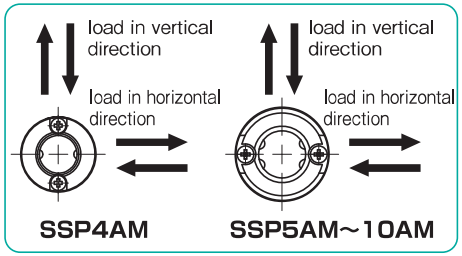
LOAD RATING

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

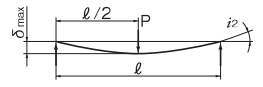
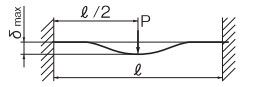
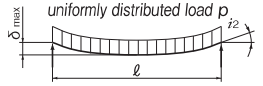
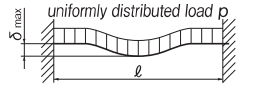
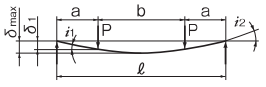
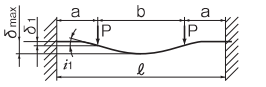
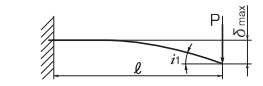
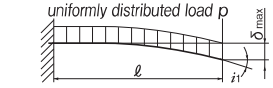
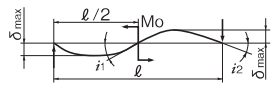
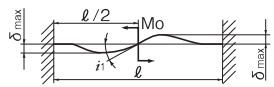
Figure B-7 Load Direction



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).

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

N_C: critical speed (rpm)
L: support distance (mm)
E: modulus of longitudinal elasticity (SUJ2)2.06×10^5 (N/mm²)
(SUS)2.0×10^5 (N/mm²)
γ: density (SUJ2)7.85×10^{-6} (kg/mm³)
(SUS)7.75×10^{-6} (kg/mm³)

I_d: Minimum Moment of Inertia of Area (mm⁴)

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

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

A: Minimum Cross-sectional Area of the Spline Shaft (mm²)

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

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

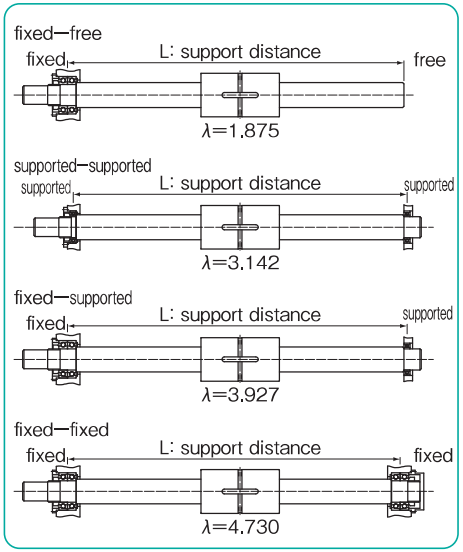
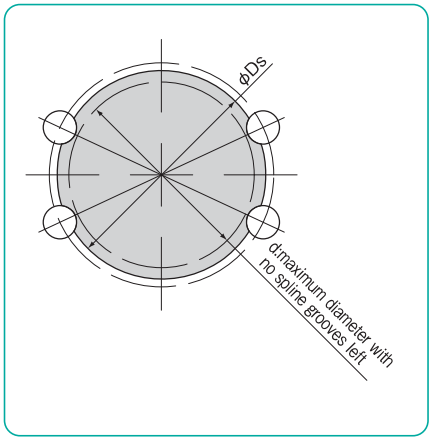


Table B-13 Spline Shaft Profile

part number	d: maximum diameter with no spline grooves left mm	part number	d: maximum diameter with no spline grooves left mm
SSP 4	3.5	SSP20	16.4
SSP 6	5.3	SSP25	20.6
SSP 8	7.2	SSP30	24.8
SSP 10	9	SSP40	33.1
SSP 13A	11.7	SSP50	41.4
SSP 16A	14.2	SSP60	49.7
SSP 20A	17.9		
SSP 25A	22.4	SSP 4AM	3.4
SSP 30A	26.8	SSP 5AM	4.3
SSP 40A	35.5	SSP 6AM	5.2
SSP 50A	44.6	SSP 8AM	7.1
SSP 60A	54	SSP10AM	8.8
SSP 80A SSP 80AL	73.9		
SSP100A SSP100AL	92		



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

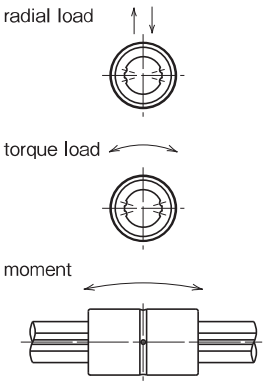
$$L = \left(\frac{f_C}{f_W} \cdot \frac{C_T}{T}\right)^3 \cdot 50$$

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

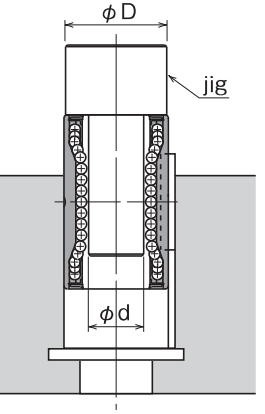


Table B-15 Recommended Jig Dimensions unit : mm

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 SSP 80AL	119	74			
SSP100A SSP100AL	149	92			

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.

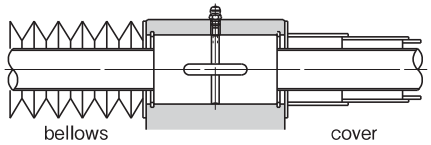
Dust Prevention

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°C.

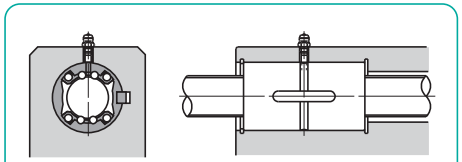
Figure B-11 Example of Dust Prevention



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

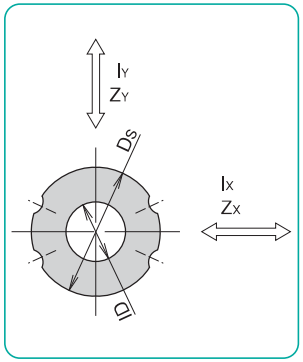


HOLLOW SPLINE SHAFT

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

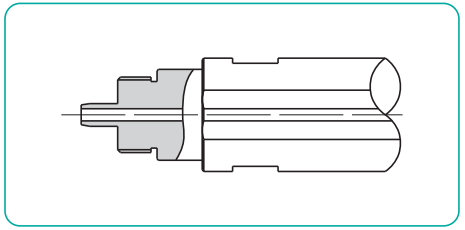
part number	shaft diameter Ds mm	inner diameter ID mm	moment of inertia of area I_X mm^4	moment of inertia of area I_Y mm^4	modulus of section Z_X mm^3	modulus of section Z_Y mm^3
SSP 4	4	1.5	1.15×10^{1}	1.21×10^{1}	5.77	6.02
SSP 6	6	2	5.83×10^{1}	6.13×10^{1}	1.94×10^{1}	2.04×10^{1}
SSP 8	8	3	1.86×10^{2}	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.

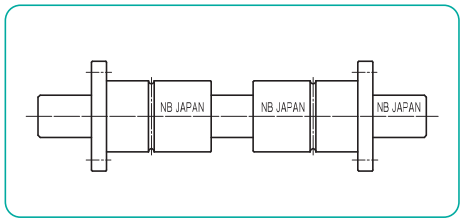
Figure B-13 Example of Shaft-end Machining



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



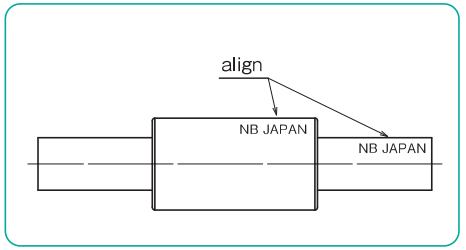
USE AND HANDLING PRECAUTIONS

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

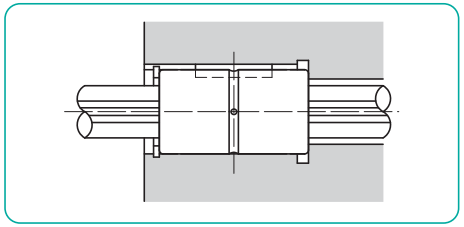
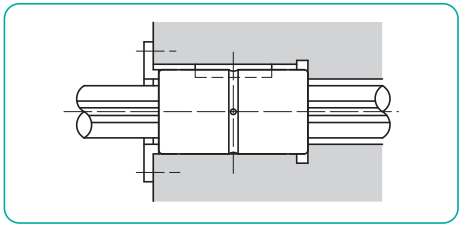


Figure B-17 Using a Push Plate



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

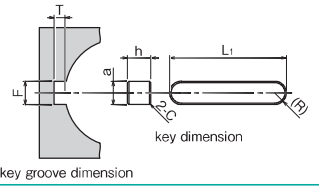


Table B-17 Major Dimensions of Key and Key Groove

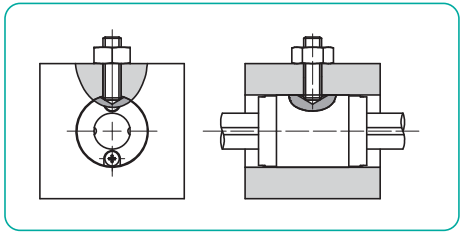
part number	key dimensions						recommended key groove dimensions			
	a		h		L_1	C	F		T	
	mm	tolerance μm	mm	tolerance μm	mm	mm	mm	tolerance μm	mm	tolerance mm
SSP 4	2	+16 +6	2	0 −25	6	0.2	2	+21 +11	1	+0.1 0
SSP 6	2.5		2.5		10.5		2.5		1.5	
SSP 8	2.5		2.5		10.5		2.5		1.5	
SSP 10	3		3		13		3		1.7	
SSP 13A	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	0.5	4		1.8	
SSP 25A	4		4		36	0.3	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.

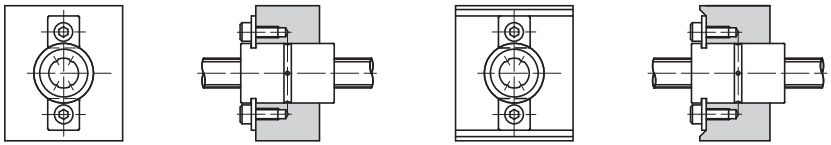
Figure B-19 Mounting of SSP4AM Type



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

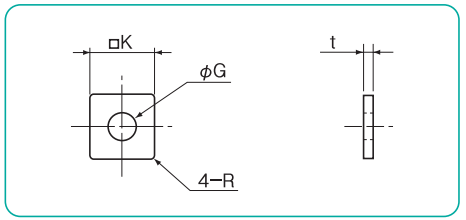
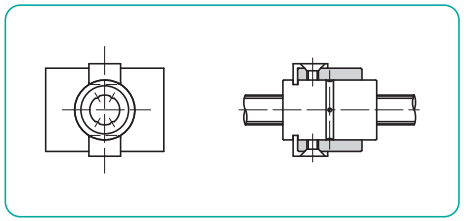


Figure B-22 Using LP Type Lock Plates

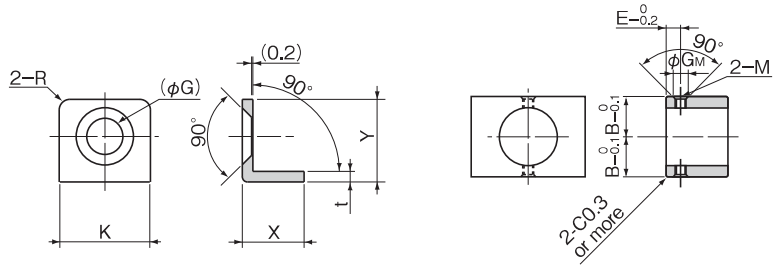


LP Type Lock Plate (Optional Plate)

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)

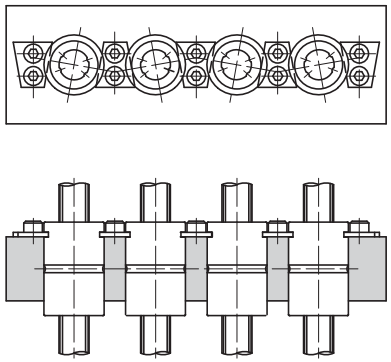
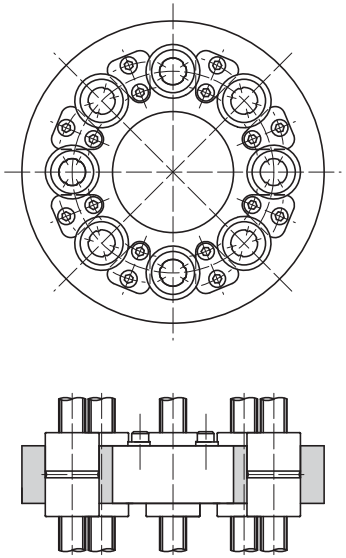


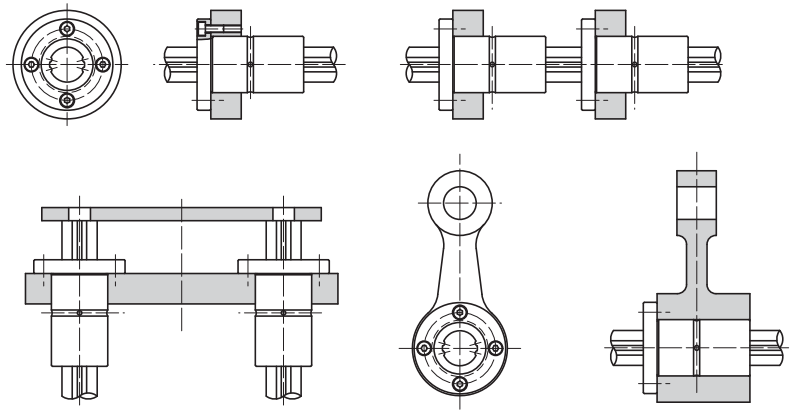
Figure B-25 Using Special Lock Plates (2)



Mounting of SSPF Type

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

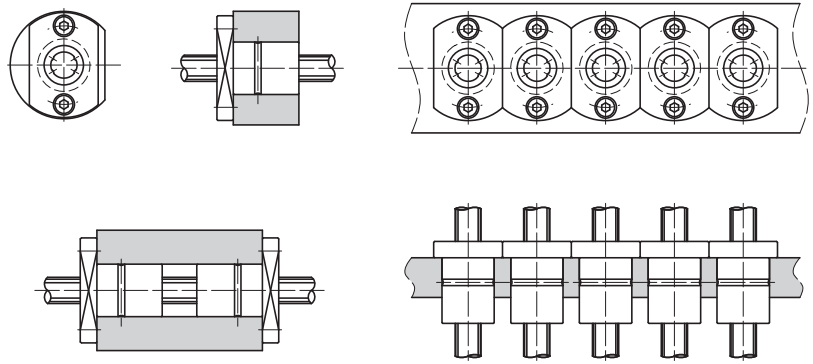
Figure B-26 Examples of installing SSPF Type



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 –

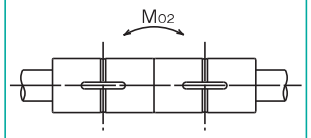
part number structure

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

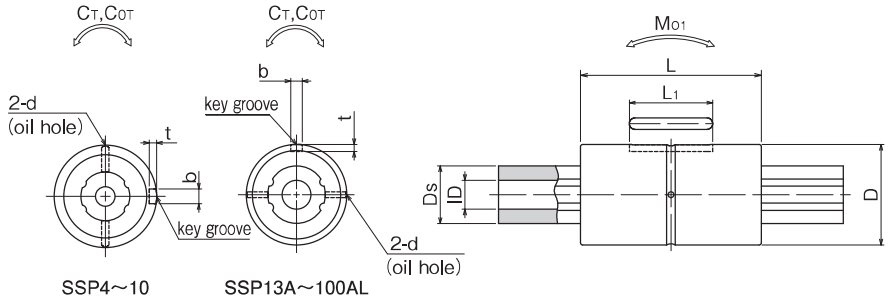
example SSP 80A L -2 -T1 -600 -P -LB -KGLA /CU

- 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
- with special specification
- 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 low temperature black chrome treatment
- accuracy grade — blank: high; P: precision
- hollow spline shaft (not available in stainless steel) — blank: standard shaft; T: standard hollow shaft※2

※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	−13	36		3		1.5		15	1.5	
SSP 16A	SSPS16A	31	0 −16	50		3.5	+18 0	2		17.5	2	
SSP 20A	SSPS20A	35		63		4		2.5		29	2	
SSP 25A	SSPS25A	42		71	0 −0.3	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 nut	mass shaft	size
mm	tolerance μm	mm	CT N・m	COT N・m	C kN	Co kN	MO1 N・m	MO2 N・m	kg	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		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	—	637	882	30.8	37.5	358	2,940	0.81	8.6	40
47	−25	—	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

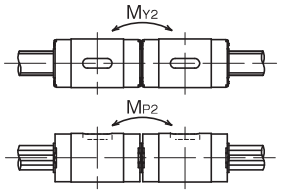
– Light and Compact Type –

part number structure

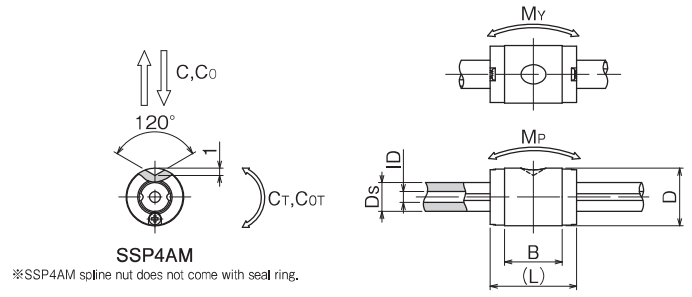
example SSP 8 AM - 1 - T1 - 450 T - P -LB -KGLA /CU

- 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※
- 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 low temperature black chrome treatment
- accuracy grade — blank: high; P: precision
- with special specification

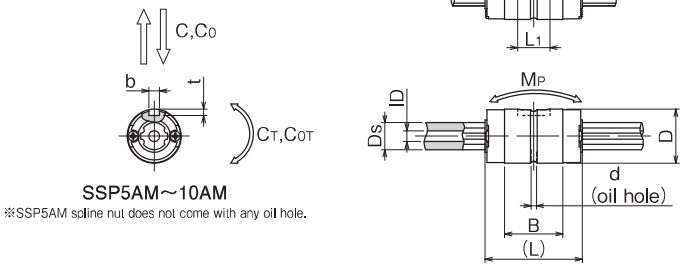
※For standard hollow shafts, refer to P.B-14 for specifications.
Note:SSP(S)4AM does not come with side-seals.



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		

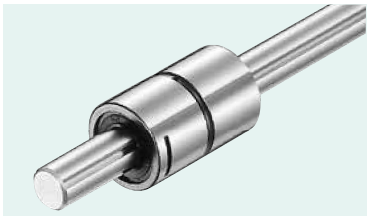
SSP (S) 5AM-10AM type spline nut come with a key (refer to page B-16).

ID (inner diameter)	basic torque rating dynamic	basic torque rating static	basic load rating dynamic	basic load rating static	allowable static moment		mass nut	mass shaft	size
	CT	COT	C	Co	MP / MP2	MY / MY2			
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 –

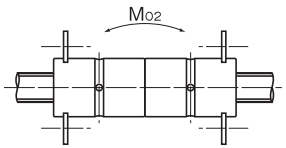


part number structure

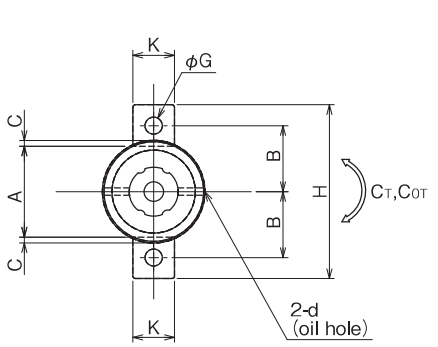
example **SSPM 10 - 2 - T1 - 200 T - P -LB -KGLA /CU**

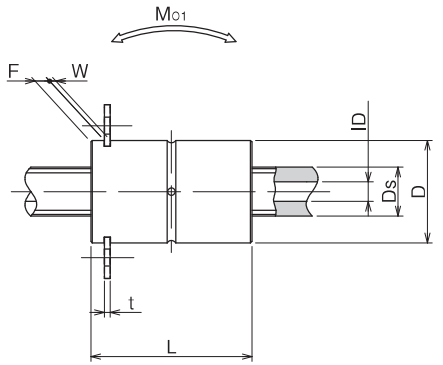
- SSPM type
- nominal diameter
- number of nuts attached to one shaft
- preload symbol
  blank: standard
  T1: light
- spline shaft total length
- hollow spline shaft
  blank: standard shaft
  T: standard hollow shaft※
- accuracy grade
  blank: high
  P: precision
- with low temperature black chrome 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.





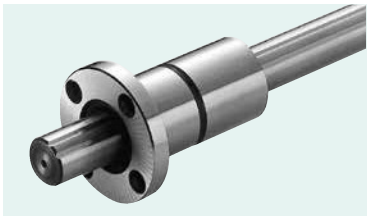
part number	major dimensions												
	D	tolerance	L	tolerance	F	W	C	A	d	B	H	K
	mm	μm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
SSPM 6	14	0	25	0	2.2	1.1	1.0	12.0	1	9.4	25.6	6.8
SSPM 8	16	−11	25	−0.2	2.7	1.3	1.2	13.6	1.5	11	30.6	8.5
SSPM10	21	0/−13	33		2.7	1.3	1.2	18.6	1.5	13.5	35.6	8.5

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	3	2.1	3.7	1.45	2.87	7.4	50	0.023	0.38	**8**
3.5	1.2	10	−15	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 –

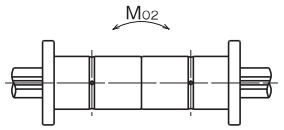


part number structure

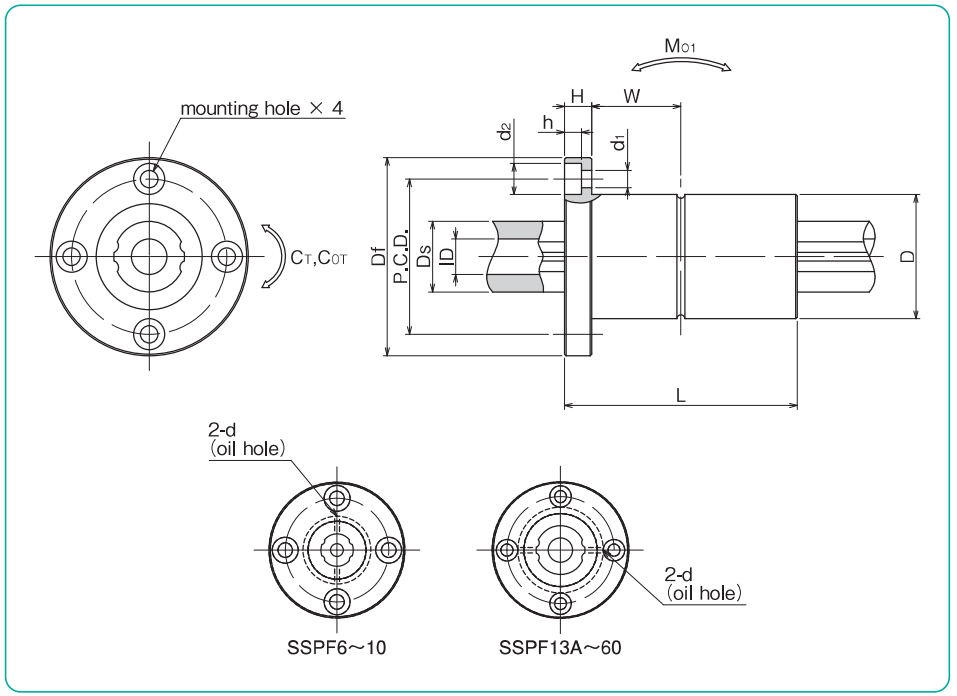
example **SSPF 25A - 2 - T1 - 450 T - P -LB -KGLA /CU**

- 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.



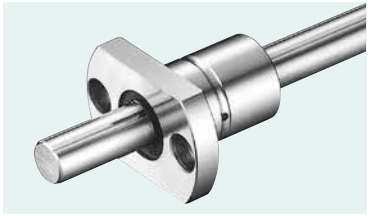
part number		major dimensions									
		D		L		Df	H	P.C.D.	d1×d2×h	W	
standard	anti-corrosion	mm	tolerance μm	mm	tolerance mm	mm	mm	mm	mm	mm	
SSPF 6	SSPFS 6	14	0 −11	25	0 −0.2	30	5	22	3.4×6.5×3.3	7.5	
SSPF 8	SSPFS 8	16		25		32	5	24	3.4×6.5×3.3	7.5	
SSPF10	SSPFS10	21		33		42	6	32	4.5×8×4.4	10.5	
SSPF13A	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 –

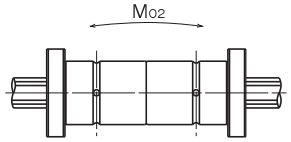


part number structure

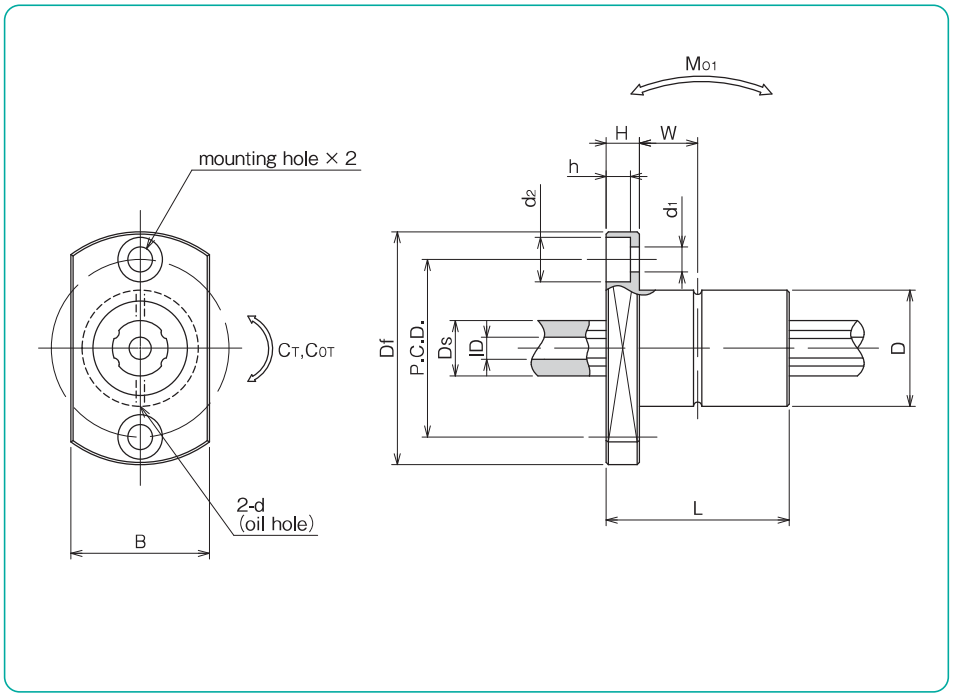
example **SSPT 10 - 2 - T1 - 200 T - P -LB -KGLA /CU**

- 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.

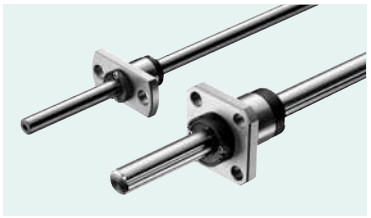


part number	major dimensions										
	D		L		Df	B	H	P.C.D.	d1×d2×h	W	
	mm	tolerance μm	mm	tolerance mm	mm	mm	mm	mm	mm	mm	
SSPT 6	14	0 −11	25	0 −0.2	30	18	5	22	3.4×6.5×3.3	7.5	
SSPT 8	16		25		32	21	5	24	3.4×6.5×3.3	7.5	
SSPT10	21	0/−13	33		42	25	6	32	4.5×8×4.4	10.5	

d	Ds		ID (inner diameter)	basic torque rating 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	0.029	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 –

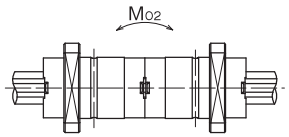


part number structure

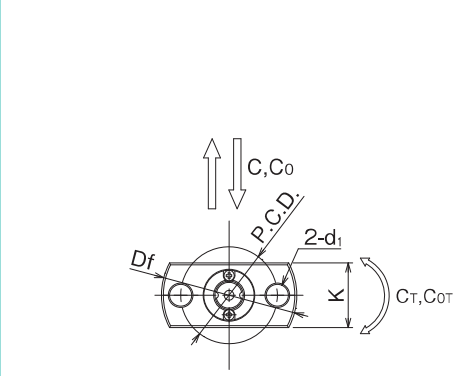
example **SSP 8 AM - 1 - T1 - 450 T - P -LB -KGLA /CU**

- 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.

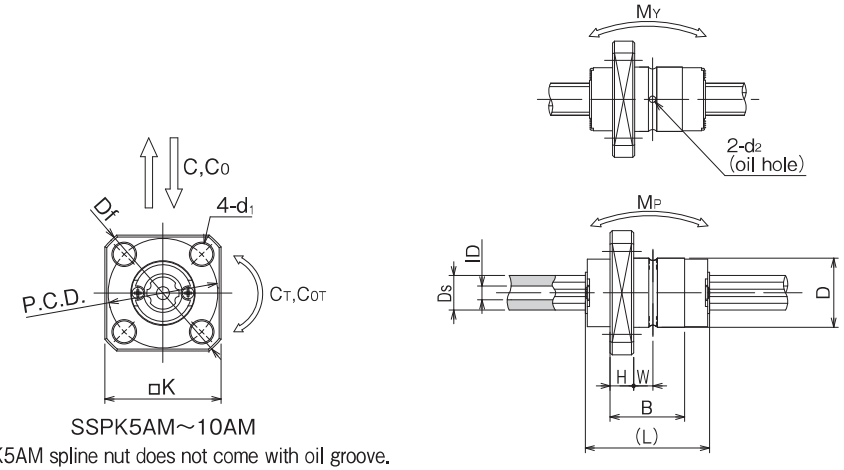


When two spline nuts are used in close contact.



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		L	B	Df	K	H	P.C.D.	d1	W	
standard	anti-corrosion		tolerance									size
		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	–	4AM
SSPK 5AM	SSPKS 5AM	10		18	10.8	23	18	3.4	17	3.4	2.8	5AM
SSPK 6AM	SSPKS 6AM	12	0 −11	21	13	25	20	3	19	3.4	3.5	6AM
SSPK 8AM	SSPKS 8AM	15		25	14.9	28	22	3.95	22	3.4	3.5	8AM
SSPK10AM	SSPKS10AM	19	0 −13	30	18	36	28	4	28	4.5	5	10AM

d2	Ds h7		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
		tolerance										
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.

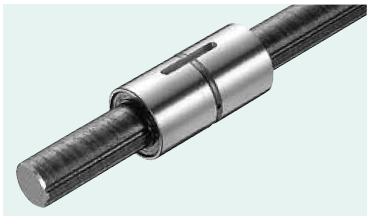
Table B-20 Standard and Maximum Length of SSP Type

unit : mm

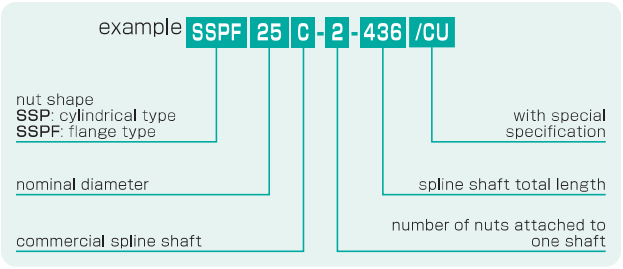
size	standard length					maximum length high-grade	maximum length precision-grade P
4	100	150	200	300		315	200
5	150	200	300	400		400	315
6	150	200	300	400		400	315
8	150	200	300	400	500	500	400
10	200	300	400	500	600	630	630
13A	200	300	400	500	600	1,500	1,500
16A	200	300	400	500	600	1,500	1,500
20A	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					

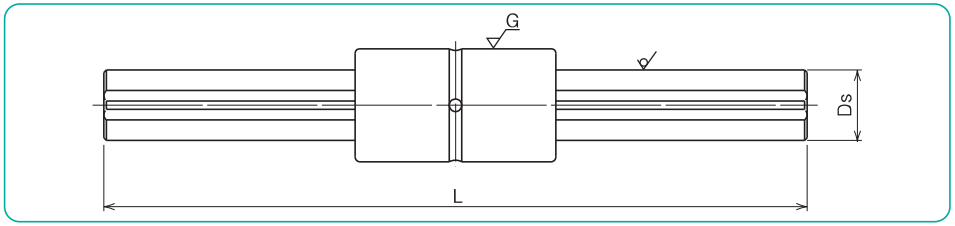
・Applicable to rotary ball spline SPR, SPB-KP, SPB type and stroke spline SPLFS type, except for precision-grade of SPR and SPLFS type.
・Please contact NB for shaft lengths exceeding maximum length.

COMMERCIAL BALL SPLINE



part number structure





part number		Ds mm	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	allowable static moment MO1 N·m	allowable static moment MO2 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

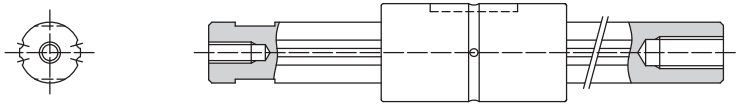
・Tolerance of total length
total length up to 4,000: JIS B0405 coarse grade
total length greater than 4,000: ±5.0mm
contact NB for tolerances other than those listed above
・Please refer to dimension tables for nut shape and dimensions.
・The above rated torque, rated load, and static allowable moment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

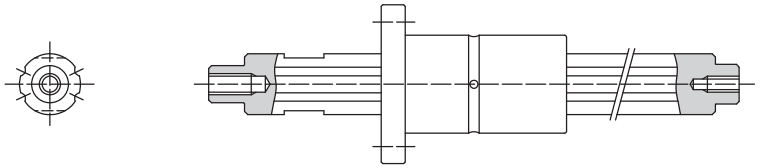
・contact NB for special specifications based on the customer's drawings for further consideration.

EXAMPLES OF MACHINING

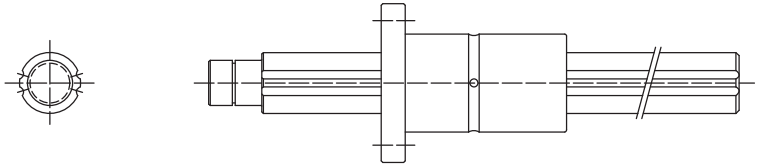
Center tap on both ends and milling



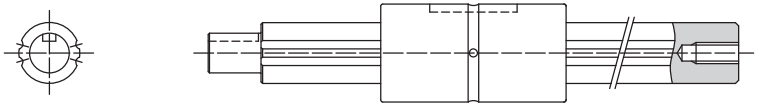
Step-down on both ends, center tap and milling



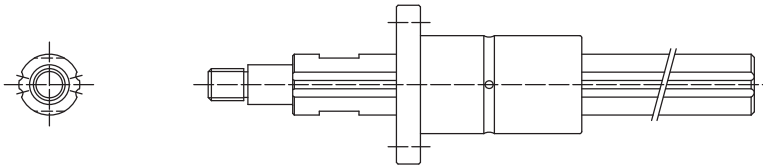
Ring groove on step-down



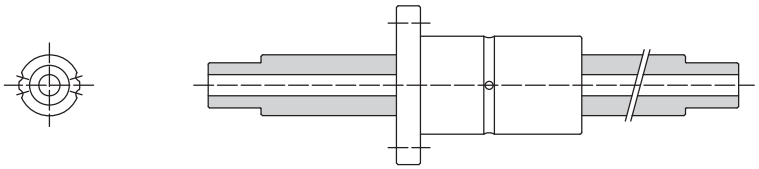
Step-down, center tap and key groove



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.