

# 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.

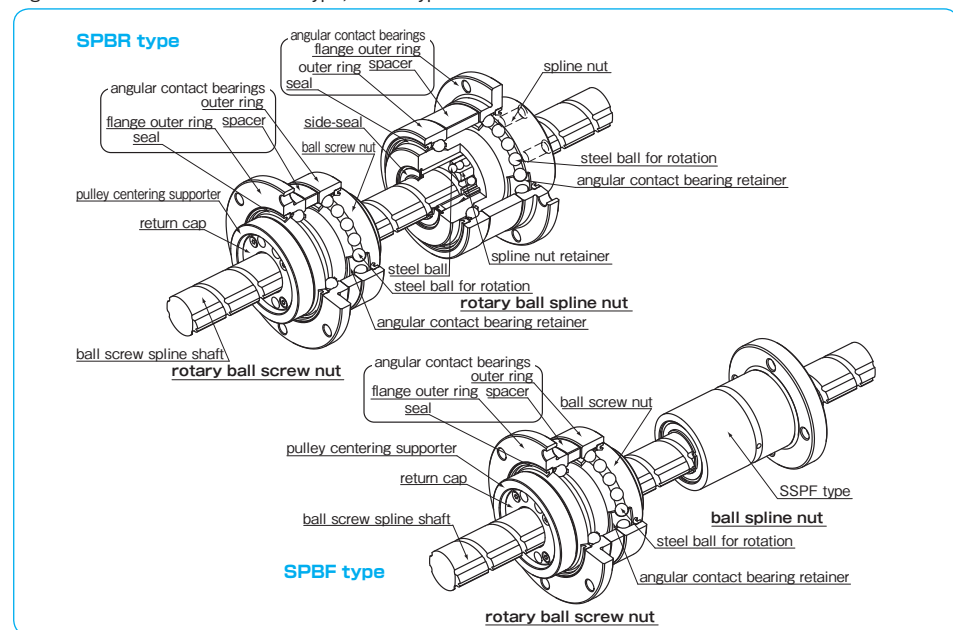
Rotary Ball Spline nut is an integration of ball spline nut and angular contact bearings.

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-46 Structure of SPBR type, SPBF type



## ACCURACY

The NB Ball Screw Spline is measured for accuracy at the points shown in Figure B-47.

Figure B-47 Accuracy Measurement Points

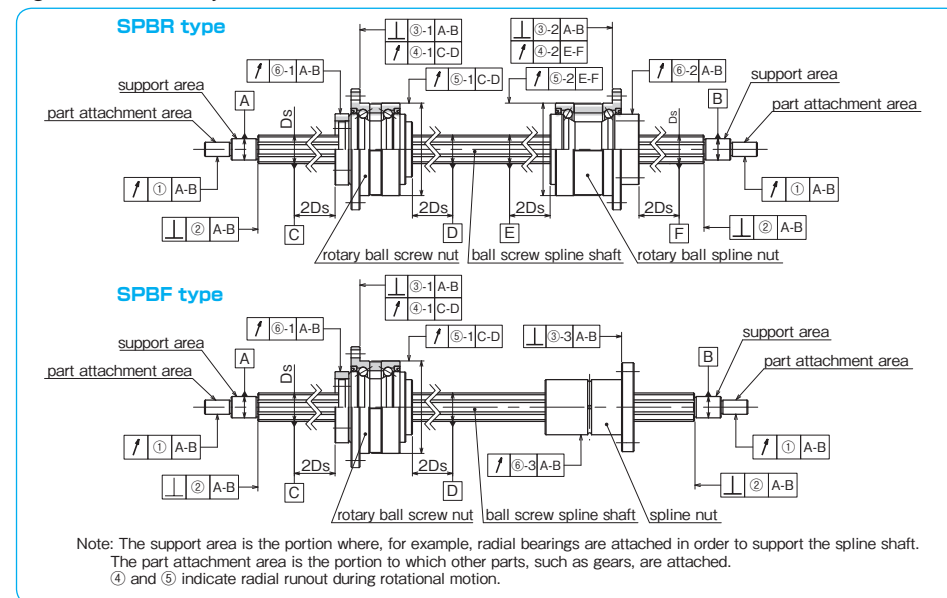


Table B-35 Tolerance of Spline Shaft Groove Torsion (Max.)

tolerance
13μm/100mm

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

Table B-36 Grade of Ball Screw Groove

tolerance
C5

Applied to lead angle accuracy only

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

unit: μm

part number	① radial runout of part attachment area	② perpendicularity of the end of the spline shaft section (when grinding is requested on the drawing)	③ perpendicularity of the flange		
			③-1	③-2	③-3
SPBR16,SPBF16	19	11	16	18	13
SPBR20,SPBF20					
SPBR25,SPBF25	22	13	18	21	16

Table B-38 Radial Runout of Outer Surface of Rotary Spline Nut Relative to Spline Shaft 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-39 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

## PRELOAD

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

Please contact NB for preload specification.

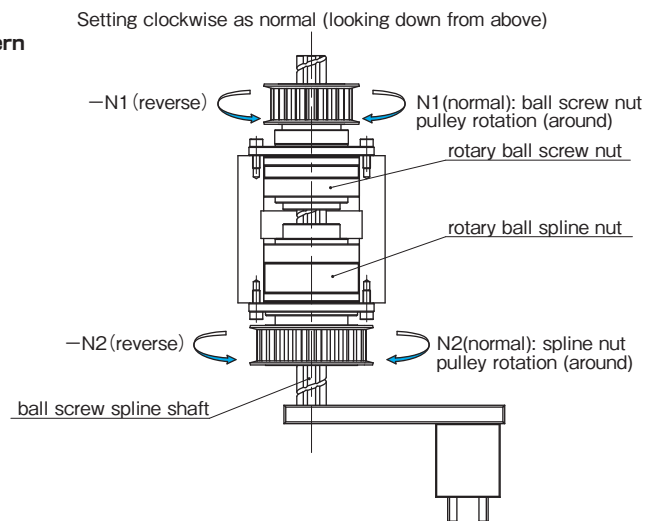
## USE AND HANDLING PRECAUTIONS

- Please do not adjust the spacer. 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.

**SPBR TYPE MOTION PATTERN**

One set of SPBR type can handle linear, rotational, and spiral motion.

**SPBR type Motion Pattern**



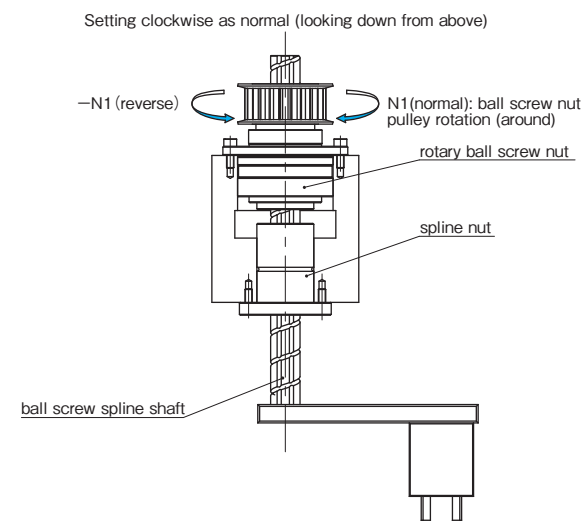
motion	input		motion direction	output		
	ball screw nut	spline nut		travel distance (linear direction)	revolution (rotational direction)	
	N <sub>1</sub> (normal)	0	①	L=N <sub>1</sub> ·R (up)	0	
	-N <sub>1</sub> (reverse)	0	②	L=-N <sub>1</sub> ·R (down)	0	
	N <sub>1</sub> =N <sub>2</sub> (normal)		①	0	N <sub>2</sub> (normal)	
	-N <sub>1</sub> =-N <sub>2</sub> (reverse)		②	0	-N <sub>2</sub> (reverse)	
	0	N <sub>2</sub> (normal)	①	L=N <sub>2</sub> ·R (down)	N <sub>2</sub> (normal)	
	0	-N <sub>2</sub> (reverse)	②	L=-N <sub>2</sub> ·R (up)	-N <sub>2</sub> (reverse)	
	N <sub>1</sub> (normal)	N <sub>2</sub> (normal)	①	L=(N <sub>2</sub> - (±N <sub>1</sub> ))·R	in case of N <sub>2</sub> - (±N <sub>1</sub> )>0 (down)	N <sub>2</sub> (normal)
			④		in case of N <sub>2</sub> - (±N <sub>1</sub> )<0 (up)	
-N <sub>1</sub> (reverse)	-N <sub>2</sub> (reverse)	③	L=(-N <sub>2</sub> - (±N <sub>1</sub> ))·R	in case of -N <sub>2</sub> - (±N <sub>1</sub> )>0 (down)	-N <sub>2</sub> (reverse)	
		②		in case of -N <sub>2</sub> - (±N <sub>1</sub> )<0 (up)		

L : travel distance [mm] R : ball screw lead [mm] N<sub>1</sub> : ball screw nut pulley rotation (around) N<sub>2</sub> : ball spline nut pulley rotation (around)

**SPBF TYPE MOTION PATTERN**

SPBF type can handle linear motion.

**SPBF type Motion Pattern**



motion	input		motion direction	output	
	ball screw nut	spline nut		travel distance (linear direction)	revolution (rotational direction)
	N <sub>1</sub> (normal)	0	①	L=N <sub>1</sub> ·R (up)	0
	-N <sub>1</sub> (reverse)	0	②	L=-N <sub>1</sub> ·R (down)	0

L : travel distance [mm] R : ball screw lead [mm] N<sub>1</sub> : ball screw nut pulley rotation (around)

**STANDARD AND MAXIMUM LENGTH**

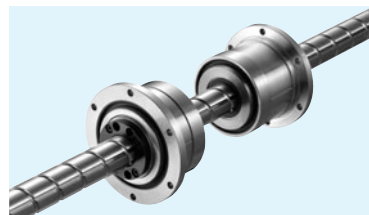
Standard and maximum length of NB ball screw spline shaft are shown in Table B-40.

Table B-40 Standard and Maximum Length of SPBR Type unit : mm

size	standard length			maximum length
	300	500	1,000	
16	300	500	1,000	1,000
20	300	500	1,000	
25	300	500	1,000	

· Please contact NB for shaft lengths exceeding maximum length.

# SPBR TYPE



## part number structure

example **SPBR 16 - 300 / CU**

SPBR type

with special specification

nominal diameter

ball screw spline shaft total length

Note: retainer material is resin.

## ROTARY BALL SCREW NUT

part number	major dimensions										major dimensions of angular contact bearings						
	D <sub>1</sub>	h7	D <sub>2</sub>	H7	L <sub>1</sub>	P <sub>1</sub>	θ	S <sub>1</sub>	f <sub>1</sub>	T <sub>e</sub>	D <sub>3</sub>	D <sub>4</sub>	H <sub>1</sub>	B <sub>1</sub>	B <sub>2</sub>	P <sub>2</sub>	d <sub>1</sub>
	mm	μm	mm	tolerance μm	mm	P.C.D. mm	°	mm	mm	mm	mm	mm	mm	mm	mm	P.C.D. mm	mm
<b>SPBR16</b>	40	0	32		43.5	25	40°	M4	12	2	52	68	5	27.5	9	60	4.5
<b>SPBR20</b>	50	-25	39	+25 0	54	31	40°	M5	16	2	62	78	6	34	11	70	4.5
<b>SPBR25</b>	58	0/-30	47		65	38	40°	M6	19	3	72	92	8	43	12.5	81	5.5

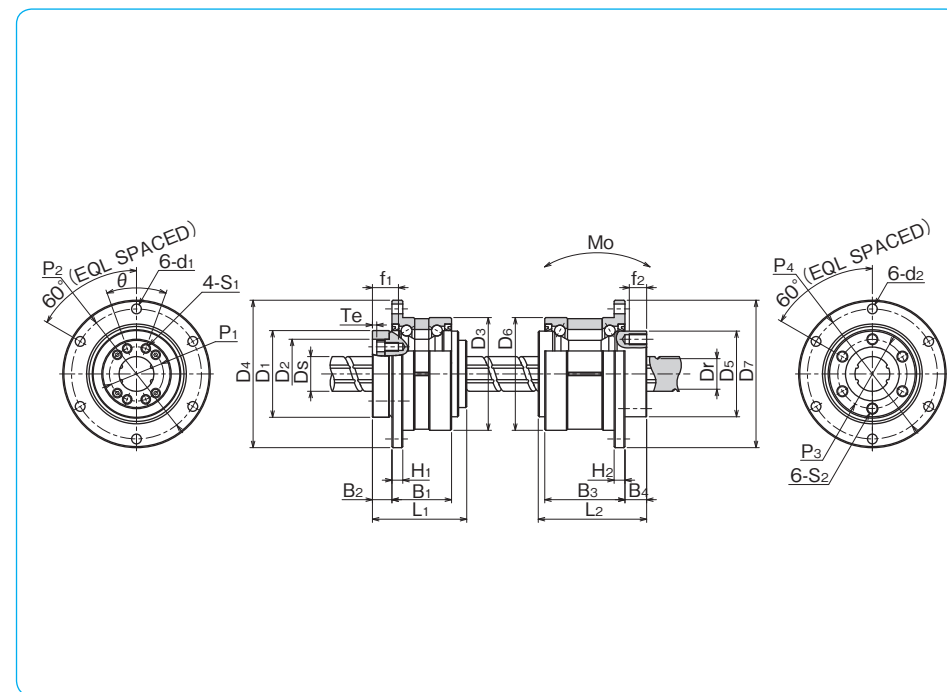
## ROTARY BALL SPLINE NUT

part number	major dimensions						major dimensions of angular contact bearings						
	D <sub>5</sub>	h7	L <sub>2</sub>	P <sub>3</sub>	S <sub>2</sub>	f <sub>2</sub>	D <sub>6</sub>	D <sub>7</sub>	H <sub>2</sub>	B <sub>3</sub>	B <sub>4</sub>	P <sub>4</sub>	d <sub>2</sub>
	mm	tolerance μm	mm	P.C.D. mm	mm	mm	mm	mm	mm	mm	mm	P.C.D. mm	mm
<b>SPBR16</b>	39.5	0	50	32	M5	8	52	68	5	37	10	60	4.5
<b>SPBR20</b>	43.5	-25	63	36	M5	8	56	72	6	48	12	64	4.5
<b>SPBR25</b>	53	0/-30	71	45	M6	8	62	78	6	55	13	70	4.5

\*Please select the smallest maximum revolutions (rpm) in case that more than one portion rotate at the same time.

※Maximum revolutions with grease lubrication.

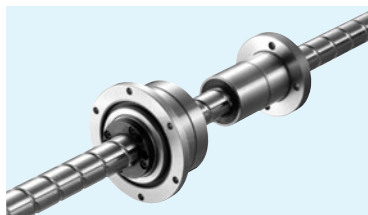
\*Moment of inertia is calculated excluding the angular contact bearings.



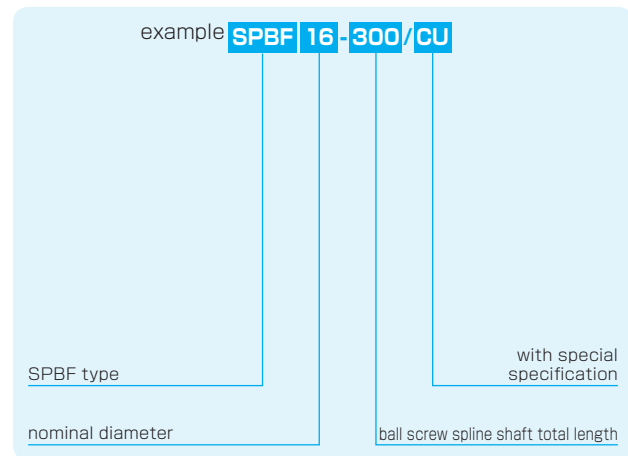
ball screw spline shaft D <sub>s</sub>	lead	root diameter D <sub>r</sub>	ball screw basic load rating		angular contact bearings basic load rating		moment of inertia for the nut	moment of inertia for the ball screw shaft	mass		ball screw nut maximum revolutions based on D <sub>m</sub> -N rpm	size	
			dynamic	static	dynamic	static			nut	shaft			
			Ca kN	Coa kN	Ca <sub>R</sub> kN	Coa <sub>R</sub> kN			kg	kg/m			
16	16	13.4	4.62	8.59	11.1	22.2	4,000	0.60	4.43×10 <sup>-4</sup>	0.45	1.47	4,179	16
20	20	17.2	5.77	12.2	14.4	30.5	3,200	1.75	1.12×10 <sup>-3</sup>	0.76	2.33	3,414	20
25	25	21.9	8.62	19.2	18.2	39.8	2,800	3.86	2.74×10 <sup>-3</sup>	1.26	3.65	2,692	25

ball spline				angular contact bearings			allowable static moment Mo	moment of inertia	mass nut
basic torque rating dynamic	static	basic load rating dynamic	static	basic load rating dynamic	static	maximum revolutions			
C <sub>T</sub> N·m	Co <sub>T</sub> N·m	C kN	Co kN	C <sub>R</sub> kN	Co <sub>R</sub> kN	rpm	N·m	kg·cm <sup>2</sup>	kg
60	110	6.12	11.2	13.0	12.8	4,000	46	0.63	0.54
105	194	8.9	16.3	17.4	17.2	3,600	110	1.10	0.70
189	346	12.8	23.4	22.1	22.5	3,200	171	2.14	0.92

# SPBF TYPE



## part number structure



## ROTARY BALL SCREW NUT

part number	major dimensions										major dimensions of angular contact bearings						
	D <sub>1</sub> h7 mm	h7 tolerance μm	D <sub>2</sub> H7 mm	H7 tolerance μm	L <sub>1</sub> mm	P <sub>1</sub> P.C.D. mm	θ	S <sub>1</sub>	f <sub>1</sub> mm	T <sub>e</sub> mm	D <sub>3</sub> tolerance μm	D <sub>4</sub> mm	H <sub>1</sub> mm	B <sub>1</sub> mm	B <sub>2</sub> mm	P <sub>2</sub> P.C.D. mm	d <sub>1</sub> mm
<b>SPBF16</b>	40	0	32	+25 0	43.5	25	40°	M4	12	2	52	68	5	27.5	9	60	4.5
<b>SPBF20</b>	50	-25	39	0	54	31	40°	M5	16	2	62	78	6	34	11	70	4.5
<b>SPBF25</b>	58	0/-30	47	0	65	38	40°	M6	19	3	72	92	8	43	12.5	81	5.5

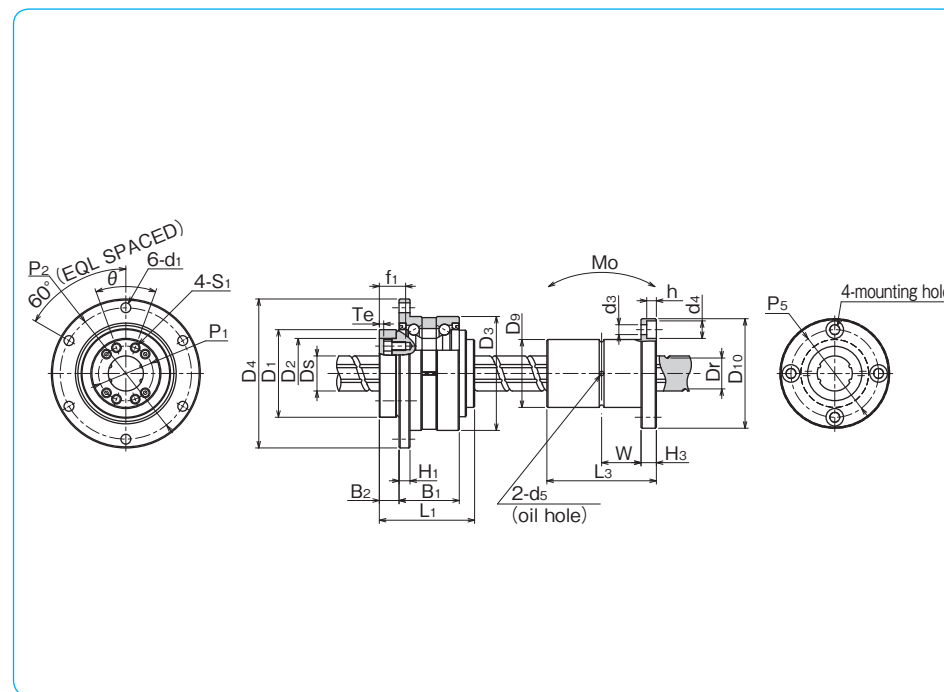
## BALL SPLINE NUT

part number	major dimensions							
	D <sub>9</sub> h6 mm	h6 tolerance μm	L <sub>3</sub> mm	L <sub>3</sub> tolerance mm	D <sub>10</sub> mm	H <sub>3</sub> mm	P <sub>5</sub> P.C.D. mm	d <sub>3</sub> ×d <sub>4</sub> ×h mm
<b>SPBF16</b>	31	0	50	0	50	7	40	4.5×8×4.4
<b>SPBF20</b>	35	-16	63	-0.2	58	9	45	5.5×9.5×5.4
<b>SPBF25</b>	42	-16	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.



ball screw spline shaft Ds	lead	root diameter Dr	ball screw		angular contact bearings		moment of inertia for the nut	moment of inertia for the ball screw shaft	mass		ball screw nut maximum revolutions based on Dm·N	size	
			basic load rating dynamic Ca kN	static Coa kN	dynamic CaR kN	static CoaR kN			maximum revolutions	nut			shaft
16	16	13.4	4.62	8.59	11.1	22.2	4,000	0.60	4.43×10 <sup>-4</sup>	0.45	1.47	4,179	16
20	20	17.2	5.77	12.2	14.4	30.5	3,200	1.75	1.12×10 <sup>-3</sup>	0.76	2.33	3,414	20
25	25	21.9	8.62	19.2	18.2	39.8	2,800	3.86	2.74×10 <sup>-3</sup>	1.26	3.65	2,692	25

W	d <sub>5</sub>	basic torque rating		basic load rating		allowable static moment Mo	moment of inertia	mass nut
		dynamic C <sub>T</sub> N·m	static C <sub>0r</sub> N·m	dynamic C kN	static C <sub>0</sub> kN			
18	2	60	110	6.12	11.2	46	0.52	0.2
22.5	2	105	194	8.9	16.3	110	1.11	0.33
26.5	3	189	346	12.8	23.4	171	2.01	0.45