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公司簡介

本公司成立於1977年，最早從事貿易批發專業銷
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NSB

BALL SPLINE



PRECISION BALL SPLINE



ECONOMY BALL SPLINE



ROTARY BALL SPLINE



SUPER SPLINE BUSH

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PRECISION BALL SPLINE



Dimensions

- R-A (3grooves) -- A20
- R-C (6grooves) -- A21

- FR-A (3grooves) -- A22
- FR-C (6grooves) -- A23

- MR-A (3grooves) -- A24
- MR-C (6grooves) -- A25

- MFR-A (3grooves) -- A26
- MFR-C (6grooves) -- A27

- KR-A (3grooves) -- A28
- KR-C (6grooves) -- A29

- H-A (3grooves) -- A30
- H-C (6grooves) -- A31

- FH-A (3grooves) -- A32
- FH-C (6grooves) -- A33

Dimensions

(Non Circulating ball type)

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- SR-C (6grooves) -- A35

- FSR-A (3grooves) -- A36
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ECONOMY BALL SPLINE



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LSKW -----	B15
LSF -----	B16
LSFL -----	B17
LSFW -----	B18
LST -----	B19
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ROTARY BALL SPLINE

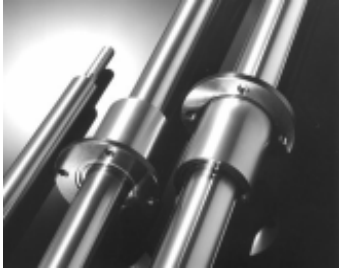


Dimensions

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LS-RY -----	C12
LK-R -----	C13

Features -----	C1
Applications -----	C1
Construction -----	C2
Kind of the sleeve -----	C3
Material . heat . treatment . Hardness -----	C3
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Spline shaft (Special design shaft)	
Maximum length of the shafts -----	C5
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Incomplete length of the groove -----	C6
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SUPER SPLINE BUSH



Features	D1
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Material . heat . treatment . Hardness ----	D2
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Fit	D2
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Dimensions

SSB-F

D3

Document to select ball splines

Basic dynamic rated load and operational life

Basic dynamic rated load (C)

Basic dynamic rated load is defined as the constant load, under which 90 % of the bearings tested can sustain 50 km of running distance without flaking, when a group of linearly guided bearings is driven individually under the same condition.

Basic static rated load (C₀) and factor of safety (S)

Basic static rated load is defined as the load under which balls undergo permanent deformation of more than 0.0001 times of their diameter, at the contact point of steel balls and guide groove, when balls receive maximum stress. In selecting ball spline for specific application, firstly it is necessary they have enough working life, and secondly their maximum load carrying capacity and basic static rated load F_{max} should satisfy the relation expressed in the formula 1-1.

$$F_{\max} = \frac{C_0}{S} \quad (\text{Table 1-1})$$

F_{max} : Maximum load ----- (N)

C₀ : Basic static rated load ----- (N)

S : factor of safety ----- (Table 1-1)

Select the factor of safety from Table 1-1, taking account of external variable load acting on the ball spline, as well a driving condition thereof.

Table 1-1

Conditio of operation	S
Normal operation	1 ~ 3
Operation with Vibration or shock	3 ~ 5

Calculating formula for the life

Life of the NSB ball spline is defined as the time the first symptom of flaking (spalling due to fatigue) appears on sleeve (bushing), guide roller or spline shaft.

In the case where radial load is applied

$$L = \left(\frac{C_r \cdot f_t \cdot f_h \cdot f_p}{F \cdot f_w} \right)^3 L_o \quad (\text{Formula 1-2})$$

In the case where torque is applied

$$L = \left(\frac{C_t \cdot f_t \cdot f_h}{T \cdot f_w} \right)^3 L_o \quad (\text{Formula 1-3})$$

In the case where composite load is applied

(Simultaneous application of radial load and torque)

$$L = \left(\frac{C_r \cdot f_t \cdot f_h \cdot f_p}{\sqrt{\left(\frac{T}{f_s}\right)^2 + F^2} \cdot f_w} \right)^3 L_o \quad (\text{Formula 1-4})$$

- L : Travel life ----- (km)
- C_r : Basic dynamic radial load ----- (N)
- C_t : Basic dynamic torque ----- (N · m)
- F : Working radial load ----- (N)
- T : Working torque ----- (N · m)
- f_s : Composite load factor ----- (Table 1-3)
- f_t : Temperature factor ----- (Fig1-1)
- f_h : Hardness factor ----- (Fig1-2)
- f_w : Load factor ----- (Table 1-2)
- f_p : Ratio of rated load ----- (Fig1-3)
- L_o : Basic travelling life = 50 km

Calculation of the life

The life of the bearing can be calculated by the formula 1-5 taking into account of stroke length and strokes per minutes.

$$LH = \frac{10^6 \cdot L}{120 \cdot St \cdot n} \quad (\text{Formula 1-5})$$

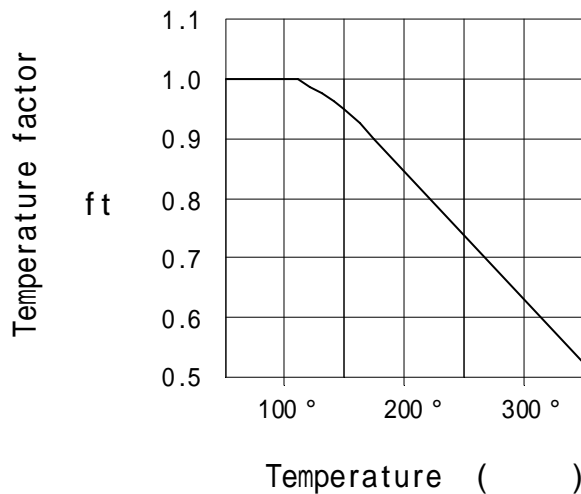
- LH : Life duration----- (hr)
- L : Travel life ----- (km)
- St : Stroke length----- (mm)
- n : Number of reciprocal motion per minute --- (cpm)

Factor affecting the life of the ball splines

Temperature factor (ft)

The basic rating load can only be applied for operating temperature below 100 °C. When operating continuously or temporarily above this temperature, multiplication of the temperature factor is necessary.

Fig 1-1



Note : Retainer for N S B economy ball spline is made of synthetic resin, thus there is a limit for operating temperature. Please use it under the operating temperature below 80 °C.

Load factor (fw)

Higher load than calculated value may be acting during vibration or impact. Load factor shown in the Table 1-2 should be adopted according to the condition applied.

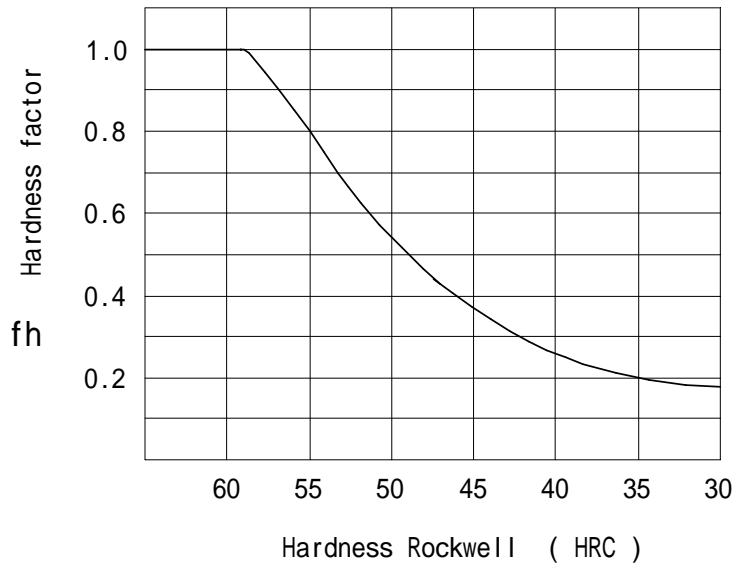
Table 1-2

Condition of operation	fw
Operation scarcely with vibration or shock Low speed driving .Less than 15 m/min	1.0 ~ 1.2
Operation with some vibration or shock Medium speed driving .Less than 60 m/min	1.2 ~ 2.0
Operation with severe vibration or shock High speed driving .More than 60 m/min	2.0 ~ 3.5

Hardness factor (fh)

The basic rating load can only be applied for rolling surfaces with hardness of HRC 58 or more. When using rolling surfaces with hardness of less than this value, multiplication of the hardness factor is necessary.

Fig 1-2



Ratio of rated load (fp)

Basic rated radial loads are adopted only for balanced loads as shown in Fig.1-3(a). Please multiply ratio of rated load (fp) in the case when load is applied directly above, as shown in Fig.1-3(b).

Fig 1-3 (a)

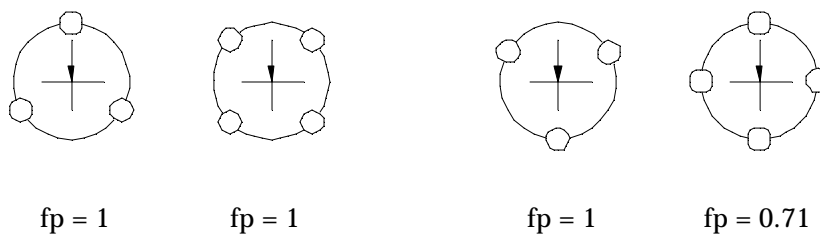
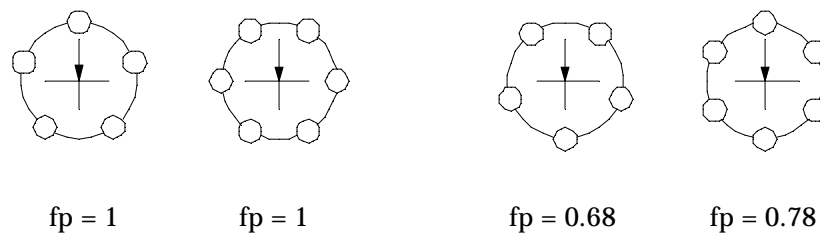


Fig 1-3 (b)



Composite load factor (fs)

The composite load factor is applied when both the radial load and the torque are applied simultaneously. Adopt composite load factor in the Table I-3 for the equation I-4.

• **Precision Ball Spline (fs)**

Table I-3

Shaft diameter (mm)	R · FR MR · MFR · KR H · FH		SR FSR KSR	
	A	C	A	C
6	0.009	-	0.011	-
8 (6.9)	0.013	-	0.015	-
10 (8.9)	0.016	-	0.018	-
12 (10.9)	0.019	-	0.021	-
16 (14.5)	0.024	-	0.027	-
20 (18.5)	0.031	-	0.033	-
25 (23.5)	0.039	-	0.041	-
30 (28.0)	0.046	0.092	0.050	0.100
40 (36.5)	0.060	0.120	0.066	0.132
50 (46.5)	0.075	0.150	0.082	0.164
60 (55.0)	0.091	0.182	0.096	0.192
80 (74.5)	0.122	0.244	-	-
100 (92.0)	0.152	0.304	-	-

Note 1. Dimensions in parentheses indicate axes diameters of FH and H type.

2. "A" indicates three grooves, while "C" is for six grooves.

• **Economy ball spline . Rotary ball spline. Super spline bush (fs)**

Table I-4

Type	LSK LS-R	LSF LS-RY	LST LK-R	LSKL LSFL LSTW	LSKW LSFW SSB
6	0.011			-	
8	0.014			-	
10	0.020				
13	0.032				
16	0.057				
20	0.068				
25	0.073				
30	0.085				

Lubrication

In NSB ball spline, bearing balls rotate along with the stroking of the shaft, thus this bearing will not seize even if the bearg is used without any lubricant. This is one of the excellent features of this bearing. It is recommended, however, to apply the lubricants as shown in the Table 1-5, in order to reduce wear, improve life and suppress noise during operation. Rough idea for lubricating interval may be for each 100 km of normal usage.

Table 1-5

Lubricants	Kind	Brand name	Maker
Grease	Lithium Soap Group Grease	Alvania No.2	Shell Oil
Oil	Spindle oil # 60 Turbine # 90 ~ 180	Teresso 52	Esso

Frictional resistance

NSB rolling linearly guided bearing can move axes linearly with less power by using a number of steel balls. Frictional resistance of the bearing can be expressed by formula 1-6, though the resistance may vary according to the type of the bearing , type of the load application , stroking velocity , lubricant and amount of preloading.

Table 1-6

Bearing type	Coefficient of friction μ
R . FR . MR . MFR KR . H . FH SR . FSR . KSR	0.002 ~ 0.004
LSK . LSF . LST LSKL . LSFL LSKW . LSFW . LSTW LS-R. LS-RY. LK-R SSB	0.004 ~ 0.006

$F = \mu W$ ----- (formula 1-6)

F : Frictional resistance ----- (N)

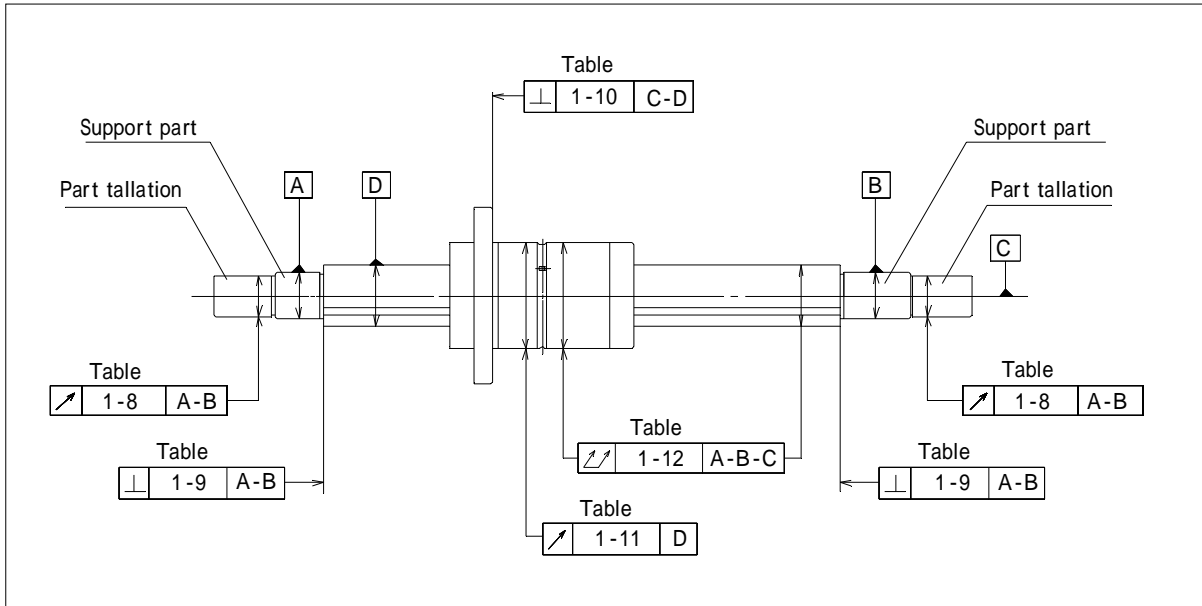
μ : Coefficient of friction ----- (Table 1-6)

W : Load acting on the bearing ----- (N)

When seal is adopted, its friction should be added. The seal presses axes by about 0.1N, seal resistance will reach up to about ten times compared with the case where no seal is adopted.

Accuracy Standard

NSB Ball splines are ranked Normal grade, high grade (H) and precision grade (P).



Tolerance of twist of groove in reference to effective length of spline

Tolerance of twist of groove in spline is expressed for arbitrary chosen 100 mm effective length of spline portion of spline shaft. See Table 1-7.

If relative movement between sleeve and spline shaft exceeds 100 mm, correct the tolerance shown in Table 1-7, in proportion to the stroke.

Table 1-7 (Unit: μm)

Tolerance of twist		
Normal grade	High grade (H)	Precision grade (P)
33	13	6

Radial .Circumferential run out of installed position of part to supporting axis of spline shaft

Note. Dimension in parentheses indicate axes diameters of H and FH types.

Table 1-8

(Unit: μm)

	Run-out (Max)		
	Normal grade	High grade (H)	Precision grade (P)
6 8 (6.9)	33	14	8
10 (8.90) 12 (10.9)	41	17	10
13 16 (14.5) 20 (18.5)	46	19	12
25 (23.5) 30 (28.0)	53	22	13
40 (36.5) 50 (46.5)	62	25	15
60 (55.0) 80 (74.5)	73	29	17
100 (92.0)	86	34	20

Squareness of end face of spline portion to supporting axis of spline shaft.

Note. Dimension in parentheses indicate axes diameters of H and FH types.

Table 1-9

(Unet: μm)

Type	Squareness (Max)		
	Normal grade	High grade (H)	Precision grade (P)
6 8 (6.9)	22	9	6
10 (8.90) 12 (10.9)	22	9	6
13 16 (14.5) 20 (18.5)	27	11	8
25 (23.5) 30 (28.0)	33	13	9
40 (36.5) 50 (46.5)	39	16	11
60 (55.0) 80 (74.5)	46	19	13
100 (92.0)	54	22	15

Squareness of reference end face of sleeve or flange mating surface to center line of spline axis.

Note. Dimension in parentheses indicate axes diameters of H and FH types.

Table 1-10

(Unet: μm)

Type	Squareness (Max)		
	Normal grade	High grade (H)	Precision grade (P)
6 8 (6.9)	27	11	8
10 (8.90) 12 (10.9)	33	13	9
13 16 (14.5) 20 (18.5)	39	16	11
25 (23.5) 30 (28.0)	46	19	13
40 (36.5) 50 (46.5)	54	22	15
60 (55.0) 80 (74.5)	63	25	18
100 (92.0)	72	29	20

Radial ,circumferential run out of sleeve outer surface to center line of spline shaft.

Note. Dimension in parentheses indicate axes diameters of H and FH types.

Table 1-11

(Unet: μm)

Type	Run-out (Max)		
	Normal grade	High grade (H)	Precision grade (P)
6 8 (6.9)	27	11	5
10 (8.90) 12 (10.9)	33	13	6
13 16 (14.5) 20 (18.5)	39	16	7
25 (23.5) 30 (28.0)	46	19	8
40 (36.5) 50 (46.5)	54	22	10
60 (55.0) 80 (74.5)	63	25	12
100 (92.0)	72	29	14

Total radial run out of center line of spline Shaft.

Note. Dimension in parentheses indicate axes diameters of H and FH types.

Table 1-12

(Unet: μm)

Total shaft diameter (mm)	Normal grade Run-out (Max)						
	Shaft diameter (mm)						
	6	10 (8.9)	13 16 (14.5)	25 (23.5)	40 (36.5)	60 (55.0)	100 (92.0)
Over ~ Incl	8 (6.9)	12 (10.9)	20 (18.5)	30 (28.0)	50 (46.5)	80 (74.5)	
~ 200	72	59	56	53	53	51	51
200 ~ 315	133	83	71	58	58	55	53
315 ~ 400		103	83	70	63	58	55
400 ~ 500		123	95	78	68	61	57
500 ~ 630			112	88	74	65	60
630 ~ 800			137	103	84	71	64
800 ~ 1000			170	124	97	79	69
1000 ~ 1250				151	114	90	76
1250 ~ 1600				190	139	106	86
1600 ~ 2000					173	128	99
2000 ~ 2500						156	117

Table 1-12

(Unet: μm)

Total shaft diameter (mm)	High grade (H) Run-out (Max)						
	Shaft diameter (mm)						
	6	10 (8.9)	13 16 (14.5)	25 (23.5)	40 (36.5)	60 (55.0)	100 (92.0)
Over ~ Incl	8 (6.9)	12 (10.9)	20 (18.5)	30 (28.0)	50 (46.5)	80 (74.5)	
~ 200	46	36	34	32	32	30	30
200 ~ 315	89	54	45	39	36	34	32
315 ~ 400		68	53	44	39	36	34
400 ~ 500		82	62	50	43	38	35
500 ~ 630			75	57	47	41	37
630 ~ 800			92	68	54	45	40
800 ~ 1000			115	83	63	51	43
1000 ~ 1250				102	76	59	48
1250 ~ 1600				130	93	70	55
1600 ~ 2000					118	86	65
2000 ~ 2500						106	78

Table 1-12

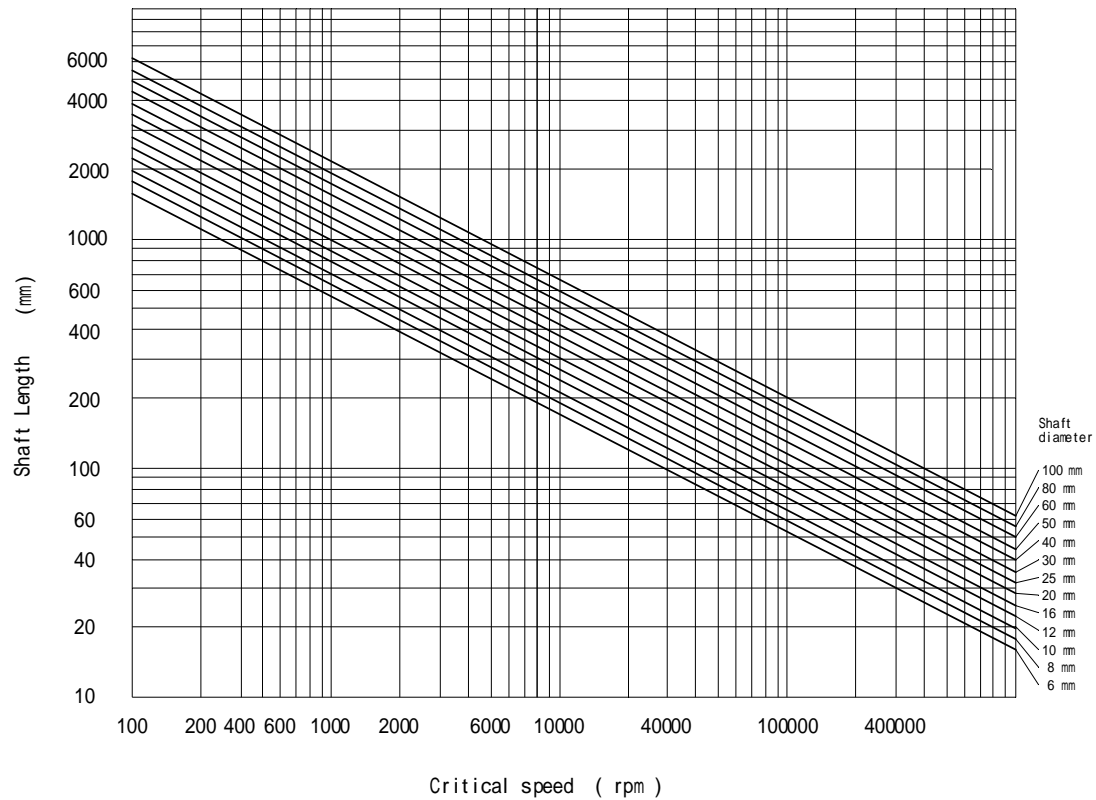
(Unet: μm)

Total shaft diameter (mm)	Precision grade (P) Run-out (Max)						
	Shaft diameter (mm)						
	6 (6.9)	10 (8.9) 12 (10.9)	13 16 (14.5) 20 (18.5)	25 (23.5) 30 (28.0)	40 (36.5) 50 (46.5)	60 (55.0) 80 (74.5)	100 (92.0)
Over ~ Incl							
~ 200	26	20	18	18	16	16	16
200 ~ 315	57	32	25	21	19	17	17
315 ~ 400		41	31	25	21	19	17
400 ~ 500		51	38	29	24	21	19
500 ~ 630			46	34	27	23	20
630 ~ 800			58	42	32	26	22
800 ~ 1000			75	52	38	30	24
1000 ~ 1250				65	47	35	28
1250 ~ 1600				85	59	43	33
1600 ~ 2000					77	54	40
2000 ~ 2500						68	49

Critical Speed

For high speed revolution application of spline shaft, shaft length and diameter should be selected considering strength ,rigidity and above all ,critical speed .Fig.1-4 shows critical speed of ball spline shafts .In selecting shaft diameter of the ball spline ,operating rotational speed should be at least 20% higher or lower than the critical speed.

Fig.1-4



Strength of the shaft

Change in geometrical moment of inertia and polar moment of inertia

Geometrical moment of inertia (second moment of area) I_z and polar moment of inertia I_p are shown in Table 1-13

Please refer these values when examination of bending rigidity or torsional rigidity of the shaft is necessary from standpoint of design.

Table 1-13 (a)

(mm)

Precision ball spline				
Shaft dia	Geometrical moment of inertia		Polar moment of inertia	
	($\times 10^4 \text{ mm}^4$)			
	I_z		I_p	
	A	C	A	C
	(3grooves)	(6grooves)	(3grooves)	(6grooves)
6	0.0052	-	0.0104	-
8	0.0175	-	0.0349	-
10	0.0433	-	0.087	-
12	0.0935	-	0.1871	-
16	0.2854	-	0.5707	-
20	0.7265	-	1.453	-
25	1.8235	-	3.6471	-
30	3.7654	3.5546	7.5307	7.1092
40	12.0261	11.4857	24.0521	22.9713
50	29.207	27.7344	58.414	55.5915
60	60.4364	57.1919	120.8728	114.5111
80	192.6173	184.1728	385.6368	368.7476
100	467.8028	444.7317	935.6056	889.4634

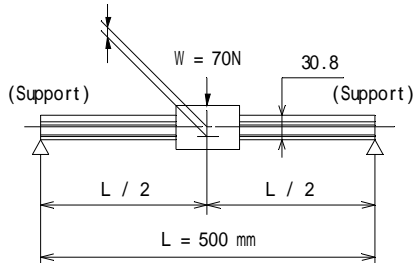
Table 1-13 (b)

(mm)

Economy ball spline Rotary ball spline Super spline bush		
Shaft dia	Geometrical moment of inertia	Polar moment of inertia
	($\times 10^4 \text{ mm}^4$)	
	I_z	I_p
6	0.0062	0.0124
8	0.0197	0.0394
10.4	0.0557	0.1114
13.4	0.1551	0.3102
16.6	0.3616	0.7232
20.6	0.8742	1.7484
25.8	2.1314	4.2628
30.8	4.3733	8.7466

Example of calculation

- (1) Calculate the deflection of spline shaft of the type LSK30 ball spline, shown in the following figure.



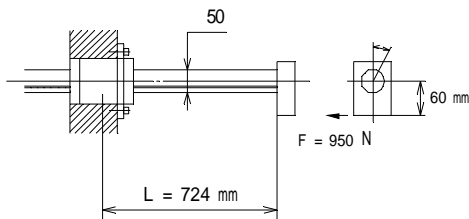
$$\begin{aligned} \text{Deflection} &= \frac{W L^3}{48 E \cdot I z} \quad (\text{mm}) \\ &= \frac{70 \times 500^3}{48 \times 21.56 \times 10^4 \times 4.3733 \times 10^4} \\ &= 0.019 \text{ mm} \end{aligned}$$

Modulus of longitudinal elasticity $E = 21.56^4 \times 10^2 \text{ N/mm}$

Geometrical moment of inertia $I z = 4.3733^4 \times 10^4 \text{ mm}$

(See table 1-13 (b) Page 13)

- (2) Calculate the twist angle of spline shaft alone for the FR50C ball spline.



$$\begin{aligned} \text{Twist angle} &= \frac{F \cdot h \cdot L}{G \cdot I p} \times \frac{180}{\pi} \quad (^\circ) \\ &= \frac{950 \times 60 \times 724}{8.33 \times 10^4 \times 55.5915 \times 10^4} \times \frac{180}{3.14} \\ &= 0.05^\circ = 3 \end{aligned}$$

Modulus of transverse elasticity $G = 8.33^4 \times 10^2 \text{ N/mm}$

Polar moment of inertia $I p = 55.5915^4 \times 10^4 \text{ mm}$

(See table 2-15 (a) Page 13)

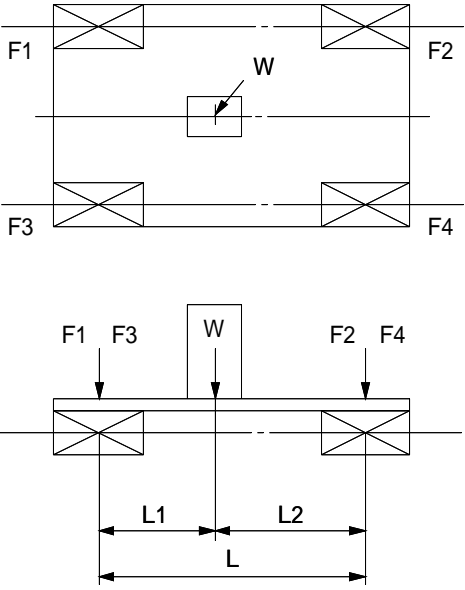
Acting load

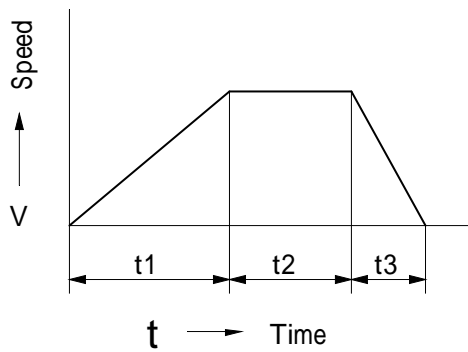
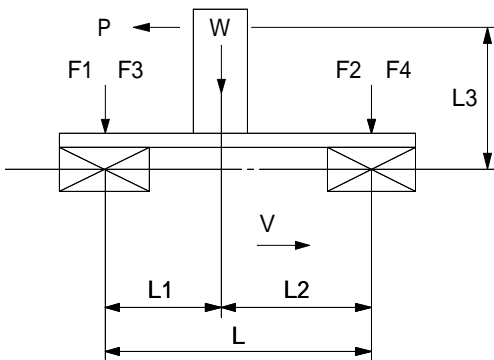
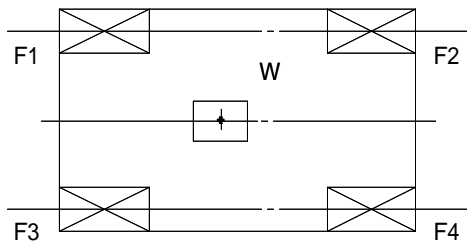
Load distribution

Load distribution to the linearly guided bearing varies according to bearing arrangement and position of load application. Load distribution for conventional two parallel axes arrangement is as shown in Fig.1-5.

- W : Load weight ----- (N)
 P : Thrust ----- (N)
 Fn: Bearing load ----- (N)
 V : Speed ----- (mm/sec)
 t : Time ----- (sec)
 L n : Arm length ----- (mm)
 g : Gravitational acceleration ----- ($9.8 \times 10^3 \text{ mm / sec}^2$)

Fig.1-5

Bearing arrange	Gravitational Load on One Slide Bearing
	$F_1 = F_3 = \frac{W L_2}{2 L}$ $F_2 = F_4 = \frac{W L_1}{2 L}$



(1) In motion at a constnt speed

$$F_1 = F_3 = \frac{W L_2}{2 L}$$

$$F_2 = F_4 = \frac{W L_1}{2 L}$$

(2) On accelerating

$$P = \frac{W}{g} \cdot \frac{V}{t_1}$$

$$F_1 = F_3 = \frac{W}{2 L} \left(L_2 + \frac{V L_3}{g t_1} \right)$$

$$F_2 = F_4 = \frac{W}{2 L} \left(L_1 - \frac{V L_3}{g t_1} \right)$$

(3) On decelerating

$$P = \frac{W}{g} \cdot \frac{V}{t_3}$$

$$F_1 = F_3 = \frac{W}{2 L} \left(L_2 - \frac{V L_3}{g t_3} \right)$$

$$F_2 = F_4 = \frac{W}{2 L} \left(L_1 + \frac{V L_3}{g t_3} \right)$$

Mean load

When load imposed on the bearing varies, find out mean load which is equivalent to varied load, in order to calculate the life of lineary guided bearing.

$$F_m = \sqrt[3]{\frac{1}{L_s} \int \cdot F_n^3 \cdot L_n}$$

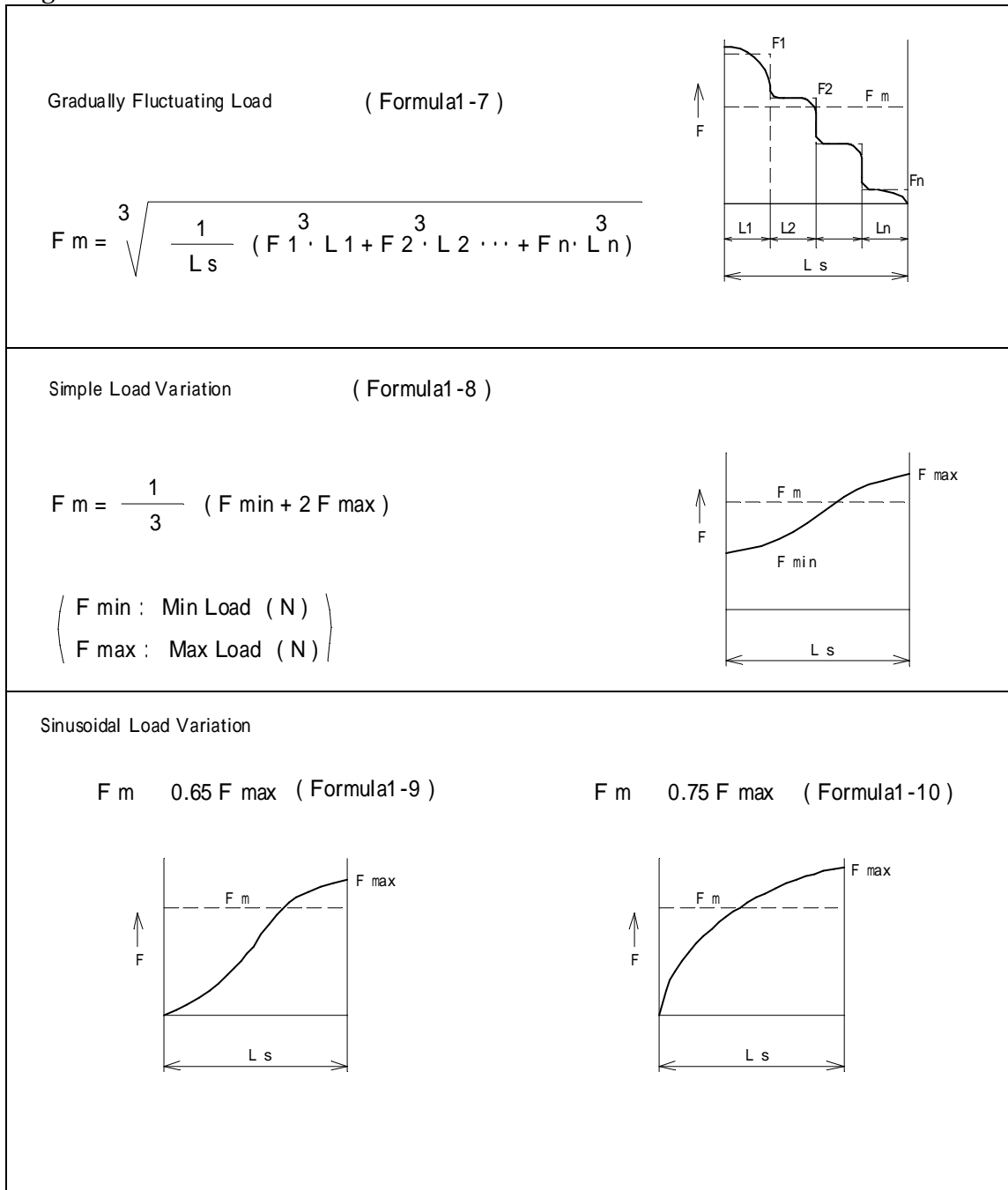
F_m : Mean Load ----- (N)

F_n : Fluctuating Load ----- (N)

L_s : Total travel distance ----- (m)

L_n : Travel distance under F_n ----- (m)

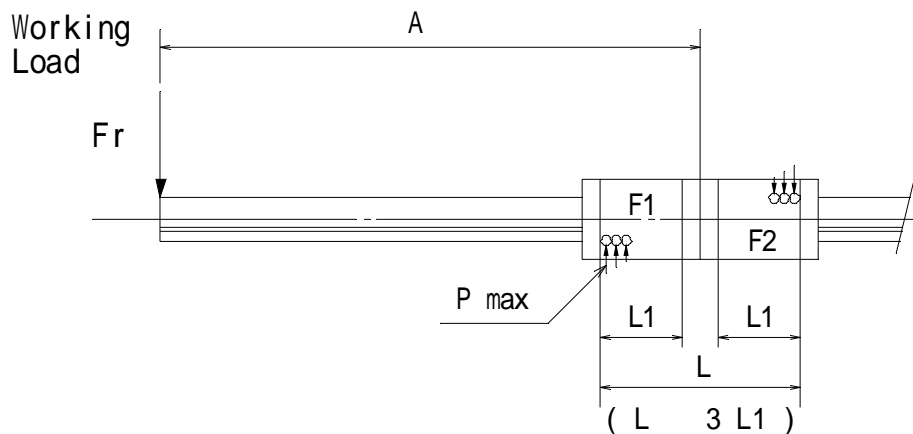
Fig 1-6



Moment load

When NSB ball spline is used in the manner as shown in Fig. 1-7 and Fig.1-9, moment load is acting on the sleeve. The steel balls installed in the sleeve sustain uneven loads. However, if the distance between sleeves is large, loads are assumed to be uniformly distributed as approximation. Therefore, operational life can be calculated by one of the methods shown in Fig. 1-7 or Fig. 1-9, according to the sleeve distance. In the case only one sleeve is used, operational life and maintenance of accuracy will be excessively diminished. Adoption of two sleeves is strongly recommended.

Fig. 1-7



When sleeves are installed closely as shown in Fig.1-7, or installation interval is less than three times of sleeve body length, find out the maximum distributed load \$P_{max}\$, which is the maximum value of unevenly distributed load. This value can be obtained from Fig.1-8

That is, \$K\$ value in the ordinate of Fig.1-8 indicates ratio of maximum distributed load acting on steel ball \$P_{max}\$, to mean load \$F_r / i \cdot z\$

$$K = \frac{P_{max}}{F_r / i \cdot z} \quad (\text{Formula 1-11})$$

Where

\$i\$: Number of sleeves

\$z\$: Number of actually load carrying ball in a row of a sleeve

Type of the sleeve	\$z\$
R . FR . KR . H . FH	15
MR . MFR	10
SR . FSR . KSR	3
LSK . LSF . LST . LS-R . LS-RY . LK-R . SSB	6
LSKL . LSFL	9
LSKW . LSFW . LSTW	12

Thus Pmax can be calculated as $P_{max} = K \cdot Fr / i \cdot z$. To calculate operational life of ball spline, we assume Pmax is acting on all load carrying ball in a row, and radial load F is being applied:

$$F = P_{max} \cdot i \cdot z = K \cdot Fr \quad \text{----- (Formula 1-12)}$$

Length of steel ball rolling portion sustaining load (L1)

Item		L1
Precision ball spline	Circulating ball type	Length of sleeve = 1
	Non- circulating ball type	Length of sleeve = 1 / 4
Economy ball spline	LSK . LSF . LST	Length of sleeve = 1 / 2
	LS-R. LS-RY.LK-R. SSB	
Rotary ball spline	LSKL . LSFL	Length of sleeve = 2 / 3
Super spline bush	LSKW . LSFW . LSTW	Length of sleeve = 3 / 4

Fig.1-8

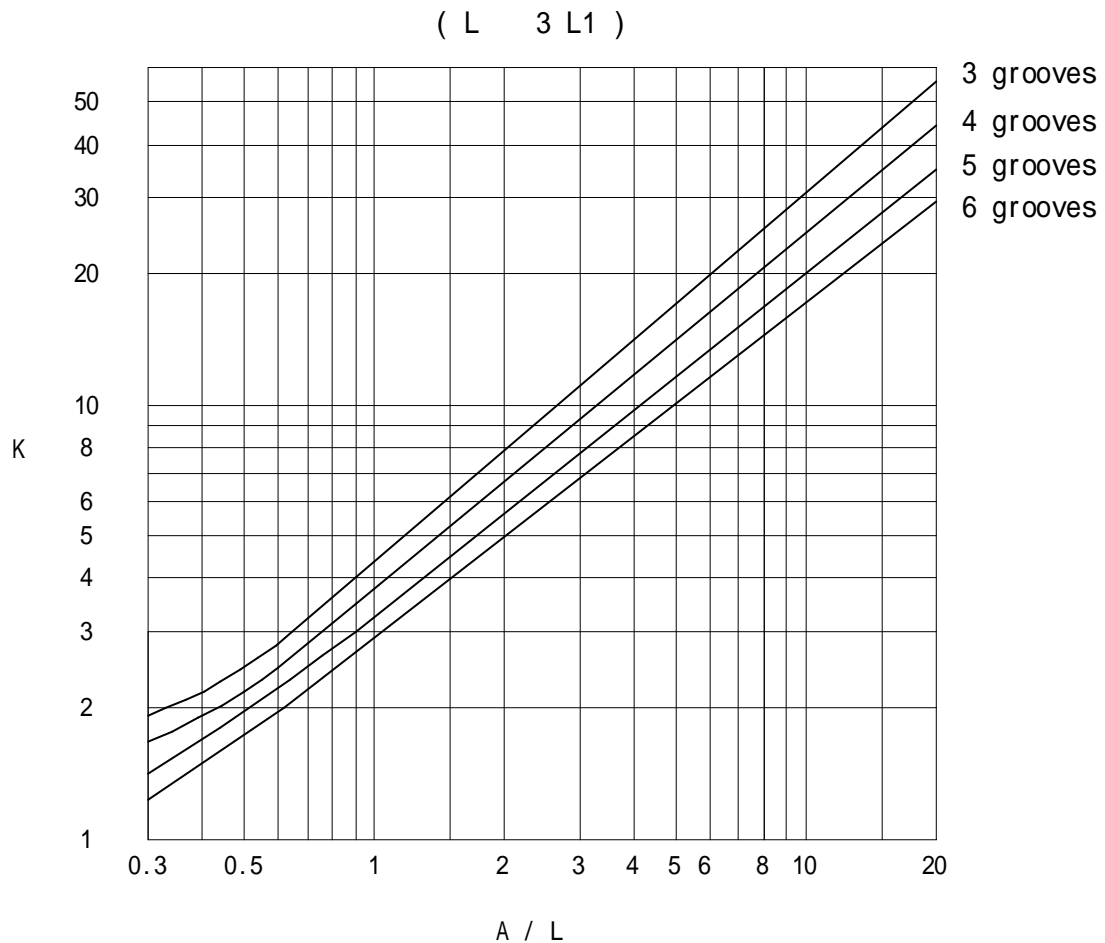
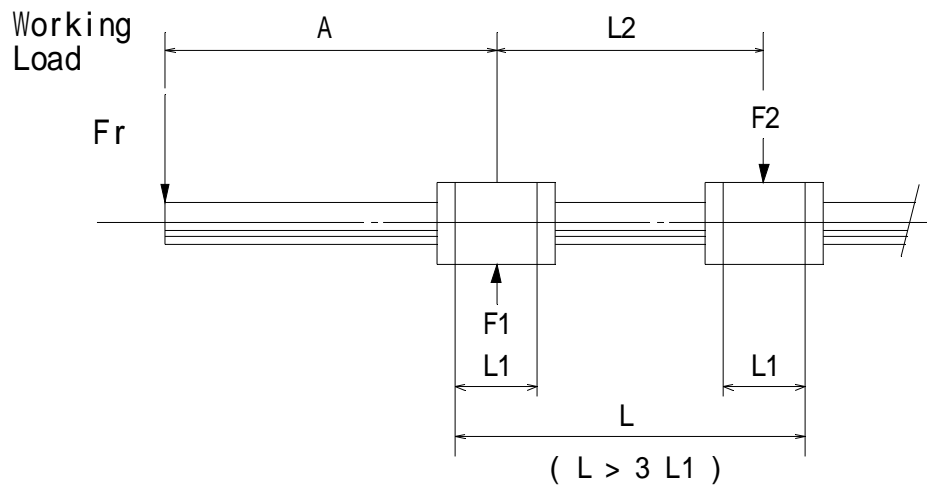


Fig.1-9



When the installation interval of sleeve exceeds three times of sleeve body length $L1$, radial load acting on sleeve may be calculated, assuming uniform load is applied to steel balls in the sleeve.

$$F1 = \frac{(L2+A) Fr}{L2} \quad (\text{Formula 1-13})$$

$$F2 = \frac{A \cdot Fr}{L2} \quad (\text{Formula 1-14})$$

Precision Ball spline

Feather key or spline with square section are often used as mechanical element to transfer torque and stroking axially simultaneously. These elements, however, have various problems concerning tribology features such as friction, too much wear, and method of lubrication.

Ball spline, on the other hand, differs radically from above mentioned mechanisms, in that it uses steel balls between spline shaft and sleeve. These balls rotate and circulate, allowing the shaft to move smoothly in axial direction for both short and long strokes. Coefficient of friction of the ball spline is less than 0.004, which is about 1/40 of the square spline. Therefore, only small force is necessary to move shaft axially while transmitting large torque. Also change in coefficient of friction is very small, thus no stick-slip phenomenon will occur. Repeated positioning with high accuracy is possible.

NSB Precision ball spline was developed in 1968. We have ample know-how on machining this spline, such as development of our original grinding machine for spline groove inside the sleeve. Performances of ball spline are studied for a long time, thus our products have high accuracy and excellent performance, which will satisfy all customers. We recommend our NSB ball spline with utmost confidence.

Features

Rolling surfaces of balls under load have semicircular grooves. This portion is ground with high accuracy after heat treatment, then finished by lapping. Thus this mechanism has high load carrying capacity, and smooth and stable starting action is possible.

As frictional resistance is very small, big power saving can be expected. Also very accurate positioning is possible.

Man-hour can be saved, because frequent oiling or lubrication is not necessary. Failure such as seizure is prevented.

Two kinds of ball grooves, i.e. three and six (for shaft with 30 mm diameter or bigger) grooves are available. Please select one of them according to the load.

For circulating ball type, balls travel smoothly by the end-cap system adopted specially for NSB splines.

Backlash can be eliminated due to the fact that pre-load is applicable. This also results in enhancing rigidity against torsional moment.

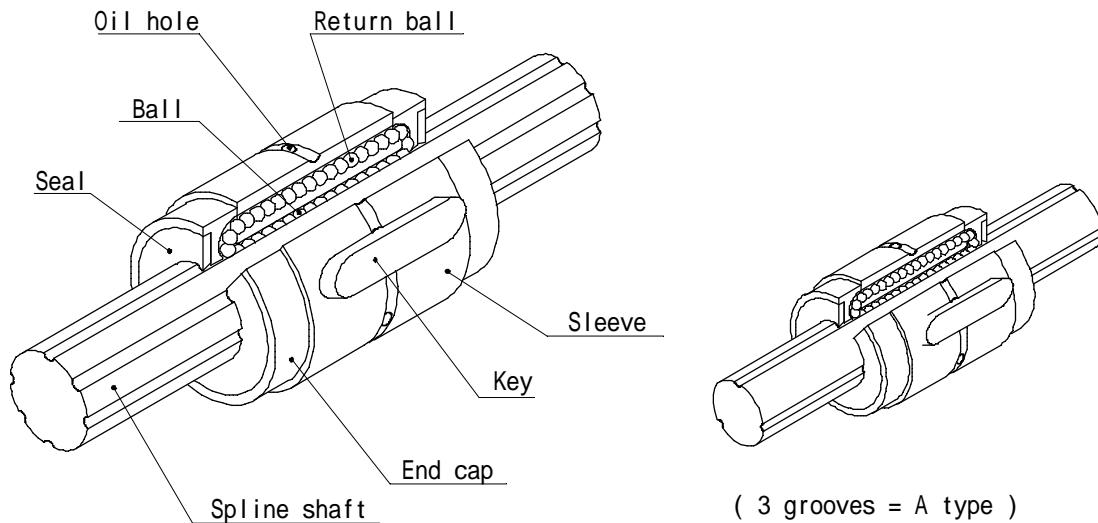
Applications

- Industrial robots
- Robots for taking out products
- Coil winding machines
- Inserting machines for electronic parts
- Paper cylinder formers
- Electric terminal crimping machines
- Honing machines
- Robots for welding
- Semiconductor producing machines
- Glass forming machines
- etc.

Configuration

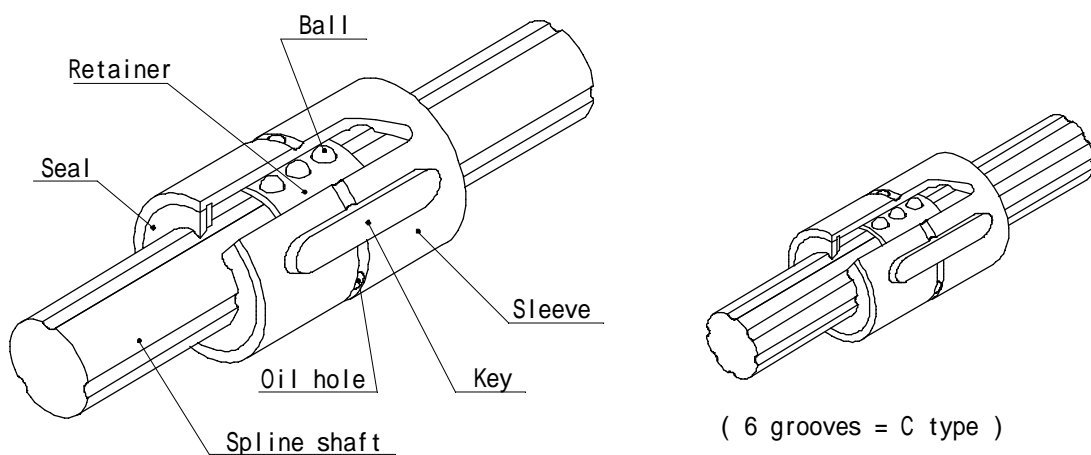
Circulating ball type NSB precision ball spline consists of spline shaft and sleeve moving on it ,as shown in Fig.2-1. The sleeve consists of sleeve body, end-cap and steel balls. Steel balls roll in the groove machined on the sleeve body and the spline shaft. This is limitless stroke type, in which balls circulate through return hole provided in sleeve body. (Please refer figure in the dimension table in H type and FH type)

Fig 2-1










Non- Circulating ball type NSB precision ball spline consists of spline shaft and sleeve moving on it, as shown in Fig.2-2. The sleeve consists of steel balls and retainer. Contrary to circulating type , sleeve is not provided with return hole for steel balls ,thus steel ball do not circulate .Movement of sleeve on spline shaft , therefore , it limited depending upon the shaft diameter . This non- circulating type is to be used for a limited stroke .




Fig 2-2



Kind of the sleeve (Circulating ball type)

Standard type		
	R-A (3 grooves) R-C (6 grooves)	Has high load carrying capacity for radial load. Fitted for transmission of the torque. Has high strength for moment load. This is a typical ball spline bearing.
	FR-A (3 grooves) FR-C (6 grooves)	
Medium-sized type		
	MR-A (3 grooves) MR-C (6 grooves)	Only small installation space is necessary, due to short overall length. This is a compact type bearing. Best fitted for applying pre-load or when weight reduction is necessary.
	MFR-A (3 grooves) MFR-C (6 grooves)	
Setting radial bearing type		
	KR-A (3 grooves) KR-C (6 grooves)	This is a bearing which allows direct installation of rotary bearing at outer surface of the sleeve.
Retainer type		
	H-A (3 grooves) H-C (6 grooves)	Handling is easy because the retainer prevents balls from falling off when sleeve is extracted from the spline shaft. (Sizes and performances of the sleeve is the same as R,FR types.)
	FH-A (3 grooves) FH-C (6 grooves)	

Kind of the sleeve (None-circulating ball type)

Standard type		
	SR-A (3 grooves) SR-C (6 grooves)	This is a non-circulating ball type bearing with a sleeve of small diameter. Particularly fitted for limited stroke application.
	FSR-A (3 grooves) FSR-C (6 grooves)	
Setting radial bearing type		
	KSR-A (3 grooves) KSR-C (6 grooves)	This is a non-circulating ball type bearing which allows direct installation of rotary bearing at outer surface of the sleeve.

Material . Heat treatment . Hardness . Surface finish

Table 2-1

Item	Material	Heat treatment	Hardness	Surface finish
Spline shaft	SUJ 2	Induction hardening	HRC 58 up	-
Sleeve	SUJ 2	Hardening	HRC 58 up	-
Steel ball	SUJ 2	Hardening	HRC 60 up	-
End cap	S50C	-	-	Phosphate coating
Retainer	Al . BC	-	-	-

Note. Retainers are using for type H . FH. SR. FSR. KSR.

Designation

NSB precision ball splines are manufactured as set of sleeve and shaft, and are sold with sleeve installed on the shaft. When you issue an order, please use the following form.

FR40 C UU - 2 - E - P - 1280 T M

Table 2-2

Type of sleeve	FR40 (Flange type. Shaft outer diameter = 40 mm)
Symbol for the number of grooves	C = 6 grooves (A = 3 grooves)
Seal	UU (Symbol for the ball spline with seals at both ends)
Number of sleeves per shaft	2
Clearance	E (See page A10 Table 2-6)
Symbol for accuracy levels	P (See page 8 Table 1-7 ~ 1-12)
Total length of shaft	1280 mm
Other than standard stock	T = with additional machining
	L = without additional machining
Symbol for hollow shaft No symbol = Solid shaft	M (See page 8 Table 2-4)

Standard stock for shafts ("J" mark). See page A17 ~ A19. Table 2-9 (a) and (b)

Spline shaft (special design shaft)

Maximum length of the shafts

Maximum length of the spline shafts we manufacture is shown in Table 2-3. Longer shafts can be manufactured to order .Please contact NSB.

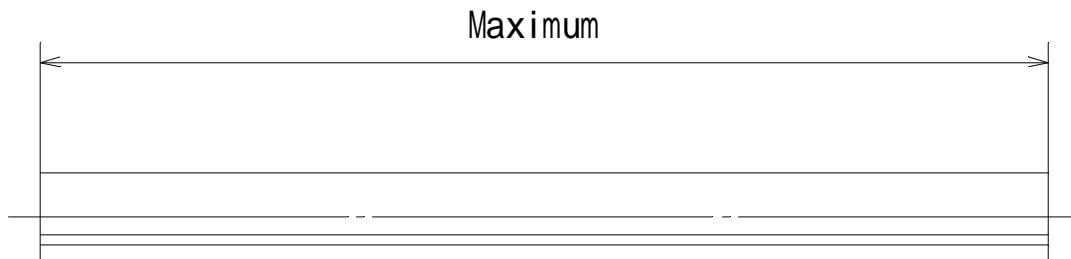


Table 2-3

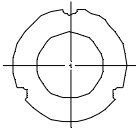
Shaft diameter (mm)	Maximum length of the spline shaft (mm)
6	200
8 (6.9)	300
10 (8.9)	400
12 (10.9)	500
16 (14.5)	800
20 (18.5)	1200
25 (23.5)	1500
30 (28.0)	2000
40 (36.5)	3000
50 (46.5)	3000
60 (55.0)	3000
80 (74.5)	2500
100 (92.0)	1300

Note. Dimension in parentheses indicate axes diameters of H and FH types.

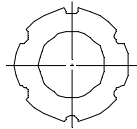
Hollow shaft (M-mark)

We can supply hollow shafts as shown in Table 2-4, when reduction of spline shaft weight or air passage through the shaft is necessary.

A = 3 grooves



C = 6 grooves



(Up to 30 mm)

Table 2-4

Shaft diameter (mm)	Hollow diameter (mm)
6	2
8 (6.9)	3
10 (8.9)	3
12 (10.9)	4
16 (14.5)	6
20 (18.5)	8
25 (23.5)	12
30 (28.0)	17
40 (36.5)	21
50 (46.5)	28
60 (55.0)	33
80 (74.5)	52
100 (92.0)	68

Note. Dimension in parentheses indicate axes diameters of H and FH types.

Incomplete length of the groove

When stepped machining is necessary, use incomplete length L_t of spline shaft indicated in Table 2-5.

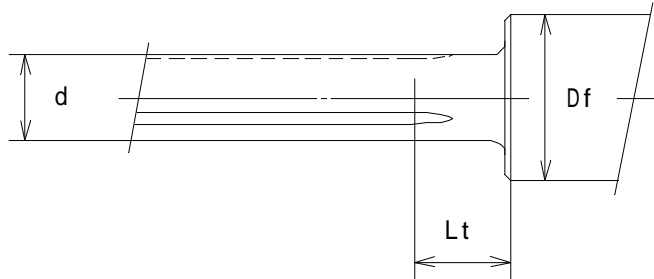


Table 2-5

d (mm)	Df (mm)															
	6	8	10	12	16	20	25	30	40	50	60	80	100	120	140	160
6	8	13	16	18	-	-	-	-	-	-	-	-	-	-	-	-
8 (6.9)	-	9	13	16	21	-	-	-	-	-	-	-	-	-	-	-
10 (8.9)	-	-	8	12	18	22	-	-	-	-	-	-	-	-	-	-
12 (10.9)	-	-	-	9	16	21	25	-	-	-	-	-	-	-	-	-
16 (14.5)	-	-	-	-	11	17	22	26	-	-	-	-	-	-	-	-
20 (18.5)	-	-	-	-	-	11	19	23	30	-	-	-	-	-	-	-
25 (23.5)	-	-	-	-	-	-	11	18	27	33	-	-	-	-	-	-
30 (28.0)	-	-	-	-	-	-	-	12	24	32	35	-	-	-	-	-
40 (36.5)	-	-	-	-	-	-	-	-	16	25	31	39	-	-	-	-
50 (46.5)	-	-	-	-	-	-	-	-	-	16	26	36	42	-	-	-
60 (55.0)	-	-	-	-	-	-	-	-	-	-	18	33	40	44	-	-
80 (74.5)	-	-	-	-	-	-	-	-	-	-	-	19	33	40	44	-
100 (92.0)	-	-	-	-	-	-	-	-	-	-	-	-	23	35	41	44

Note. Dimension in parentheses indicate axes diameters of H and FH types.

Clearance

For NSB precision ball splines , appropriate clearance adapted to usage is necessary in order to obtain long life and high accuracy. Please select correct clearance for the application.

Table 2-6

(Unit:mm)

Shaft diameter (mm)	E0	E	Normal (No symbol)	E1
6		0.006	0.001	+0.004
8 (6.9)		~	~	~
10 (8.90)		0.001	+0.004	+0.010
12 (10.9)	0.012	0.008	0.002	+0.005
16 (14.5)	~	~	~	~
20 (18.5)	0.006	0.002	+0.005	+0.012
25 (23.5)	0.014	0.008	0.002	+0.006
30 (28.0)	~	~	~	~
	0.006	0.002	+0.006	+0.015
40 (36.5)	0.020	0.012	0.004	+0.008
50 (46.5)	~	~	~	~
60 (55.0)	0.012	0.004	+0.008	+0.020
80 (74.5)	0.025	0.016	0.006	+0.010
100 (92.0)	~	~	~	~
	0.016	0.006	+0.010	+0.030
Condition of operation	<ul style="list-style-type: none"> • Receiving severe vibration or shock. • Receiving overhanged load. • Places requiring high stiffness and exposed. 	<ul style="list-style-type: none"> • Receiving weak vibration or shock. • Places with alternating loads. 	<ul style="list-style-type: none"> • When smooth driving with mall power is necessary. • Receiving load in one direction only. 	<ul style="list-style-type: none"> • For very long shaft. • Where tempreat-ure change is expected.

Note

1. Dimensions in parentheses indicate outer diameter of shafts for H and FH types.

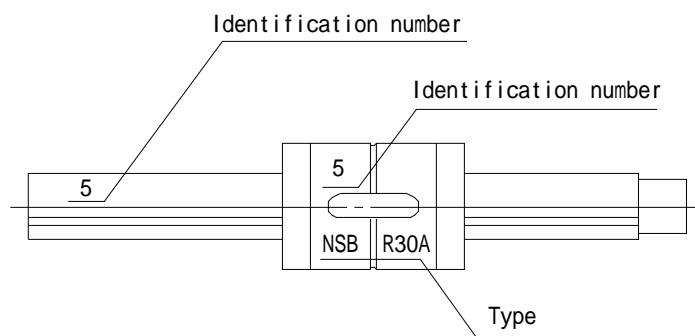
Remarks for application

NSB precision ball splines are very precisely machined parts. If handled improperly ,the accuracy may be wasted .During operation please take care of the following instructions.

For installing sleeve into housing box do not knock end caps at both ends of sleeve ,directly. Also ,do not use outer surface of end cap to guide the sleeve into housing box.

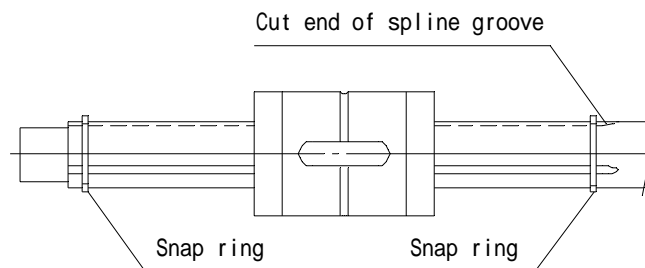
Sleeve and spline shaft have identification numbers as shown in Fig.2-3. When disassembled using special tools ,please confirm identification number, direction of characters ,and relative position ,be fore re-assembling.

Fig.2-3



For spline shaft ,use of locating snap ring is recommended to prevent falling off of the sleeve and to protect the damage of the end cap from the attack of cut end of spline groove.

Fig.2-4

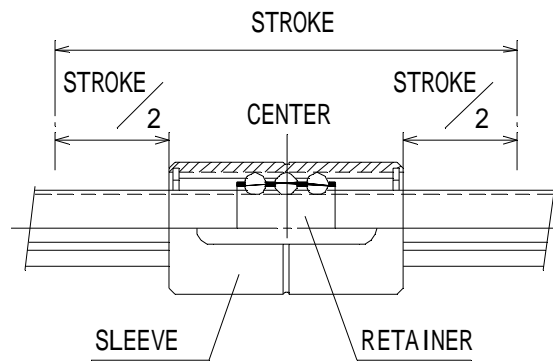


SR, FSR, and KSR types are ball spline with non-circulating retainer, having limited strokes. When removing the sleeve from the shaft, or installing sleeve to desired position, steel balls sustain first rolling condition and then slide without rolling. So during-in action, cares should be taken not to give shocks to the balls.

The retainer should be located in the center. (Fig2-5)

Available stroke should be limited to 80% of the maximum stroke indicated in the Table.

Fig2-5

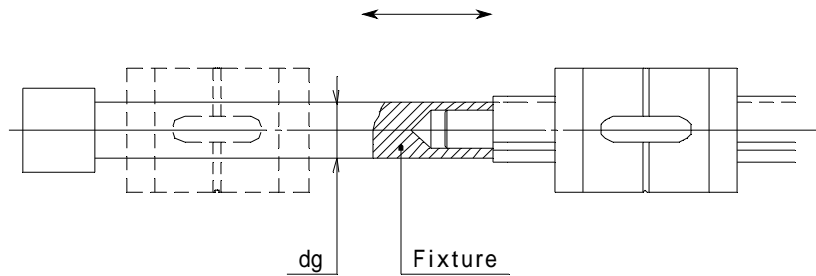


Use of dis-assembling fixture

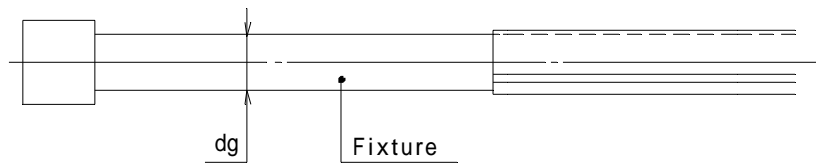
In NSB precision ball spline ,steel balls will fall off if the sleeve is moved beyond the end of the spline shaft .Use sleeve disassembling fixture to remove the sleeve from spline shaft ,in assembling.(Sec Fig.2-6) For fabrication of the fixture and reassembling of the ball spline When steel balls have fallen off, please contact NSB.

(H , FH , types have retainers ,thus no disassembling fixture is necessary.)

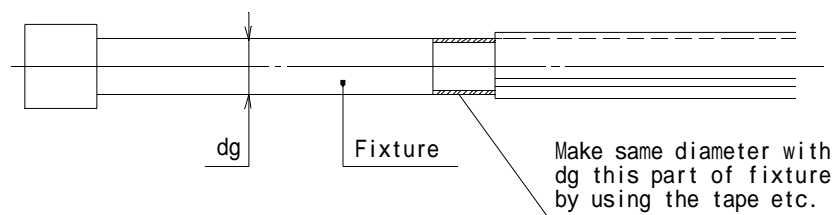
Fig.2-6



- The case without machining of end face .



- The case without machining diameter is ca.1 mm smaller than minor diameter .



Note. Outer diameter of the fixture dg should be ca. 0.1 mm smaller than the minor diameter do which is shown in dimension table for each types.

Fit

For the fit value in installing NSB precision ball spline into housing box, We recommend the figure in Table 2-7.

For the tolerance of key groove in installing ball spline with key into housing box, please use the figures expressed in Table 2-8.

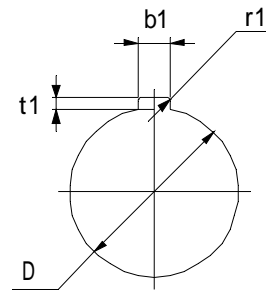


Table 2-7 (mm)

D Over ~ Upto	Fit	
	Loose fit (H7)	Tight fit (J7)
10 ~ 18	+0.018 0	+0.010 -0.008
18 ~ 30	+0.021 0	+0.012 -0.009
30 ~ 50	+0.025 0	+0.014 -0.011
50 ~ 80	+0.03 0	+0.018 -0.012
80 ~ 120	+0.035 0	+0.022 -0.013
120 ~ 180	+0.040 0	+0.026 -0.014
180 ~ 250	+0.046 0	+0.030 -0.016

Table 2-8 (mm)

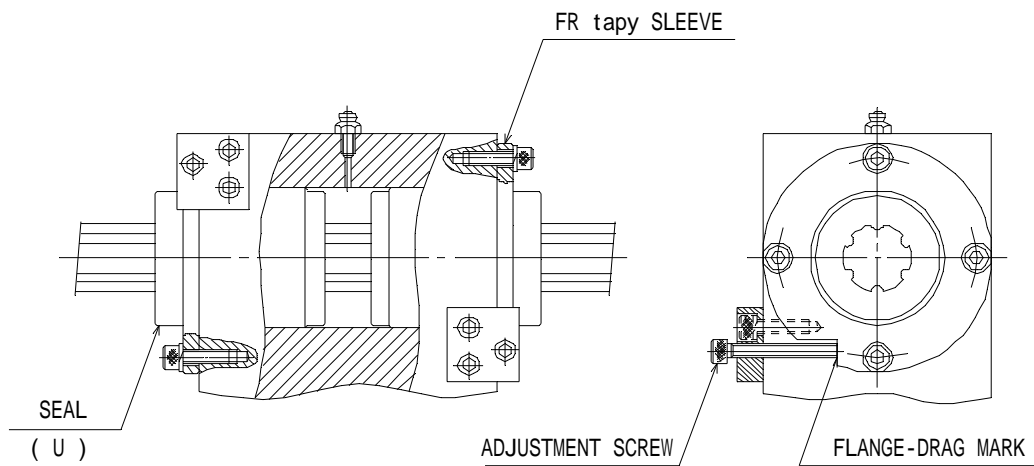
D Over ~ Upto	Key groove				
	b1	Tol.	t1	Tol.	r1
10 ~ 13	4	+0.030	1.8	+0.1 0	0.1
13 ~ 20	5	0	2.3	+0.2 0	0.16
20 ~ 30	7	+0.036	3.3		
30 ~ 40	10	0	3.8		0.25
40 ~ 50	12	+0.043	3.8		
50 ~ 60	15	0	5.4	+0.3 0	0.4
60 ~ 70	18		6.4		
70 ~ 80	20	+0.052	6.4		
80 ~ 95	24	0	8.4		0.7
95 ~ 110	28		9.4		
125 ~ 140	35	+0.062	11.4		
140 ~ 180	42	0	13.4		

How to apply pre-load

NSB precision ball splinc can apply pre-load. It is effective in enhancing rigidity ,elimination of backlash or extension of service life.

In order to apply pre-load,two sleeves with flange are installed to housing in the manner shown in Fig.2-7,and manipulate adjusting screw.Optimum quantity of pre-load is about one third of transmitting torque.

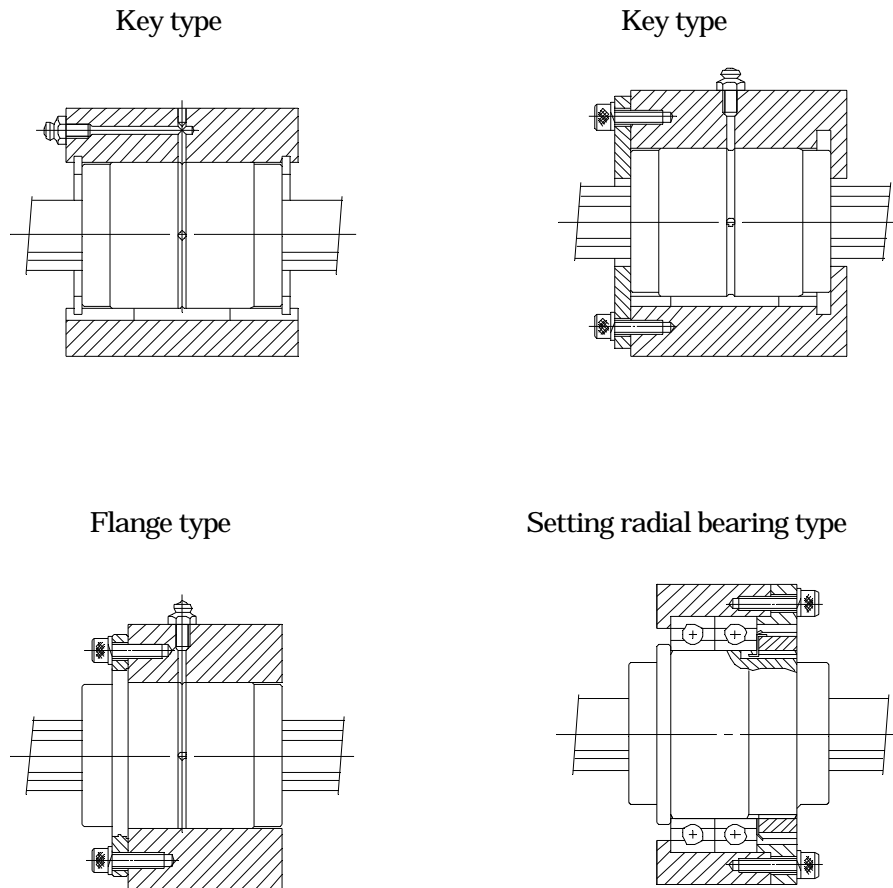
Fig.2-7



Example of installation of the sleeve

The method shown in Fig.2-8 is generally adopted for installing NSB precision ball spline into the housing box.

Fig.2-8

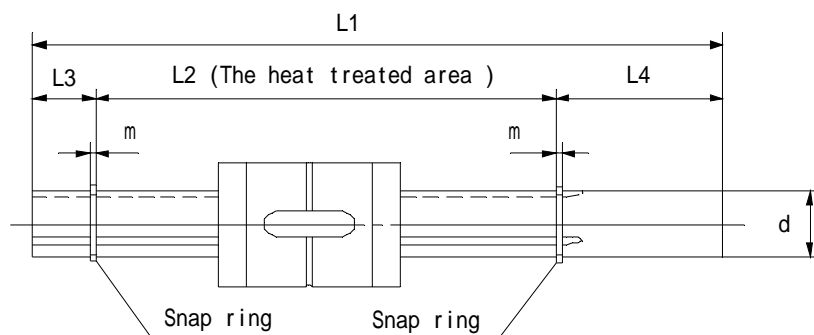


Some sleeve type has one row of revolving bearing.

Standard stock for shafts (J - mark)

For NSB precision ball spline ,we keep in stock circulating type standard shaft of up to 30 mm diameter , as shown in Table 2-9(a) Key type and 2-9(b) Flange type release make use of them.

Key type



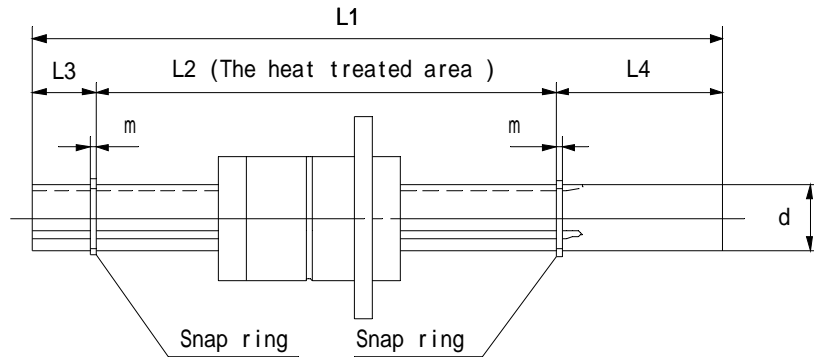
【Standard shaft designation】 R8AUU H 250J

Table2-9(a) (mm)

Key type	L1	L2	L3	L4	m	do	d (h7)
R6AUU H 150 J	150	90	10	50	0.8	4.6	6
R8AUU H 150 J	150	105	10	35	0.8	6.3	8
R8AUU H 250 J	250	205	10	35	0.8	6.3	8
R10AUU H 200 J	200	145	10	45	1	8.3	10
R10AUU H 300 J	300	245	10	45	1	8.3	10
R12AUU H 250 J	250	195	10	45	1	10.2	12
R12AUU H 400 J	400	345	10	45	1	10.2	12
R16AUU H 300 J	300	235	15	50	1	13.5	16
R16AUU H 600 J	600	535	15	50	1	13.5	16
R20AUU H 350 J	350	285	15	50	1.2	17.2	20
R20AUU H 800 J	800	735	15	50	1.2	17.2	20
R25AUU H 400 J	400	335	15	50	1.2	22.5	25
R25AUU H 1000 J	1000	935	15	50	1.2	22.5	25
R30AUU H 450 J	450	380	20	50	1.5	26.7	30
R30AUU H 1000 J	1000	930	20	50	1.5	26.7	30

• For dismantling sleeve from spline shaft ,special fixture for extraction is necessary .Please refer Page A13.

Flange type



【Standard shaft designation】 **FR8AUU H 250J**

Table2-9(b)

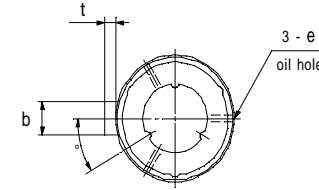
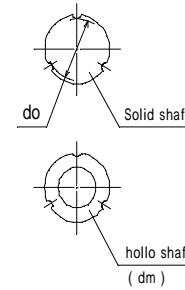
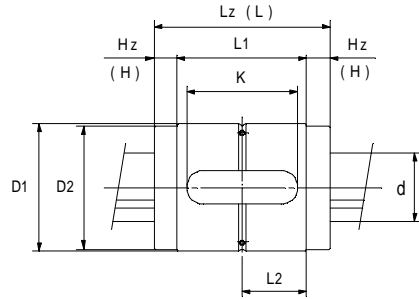
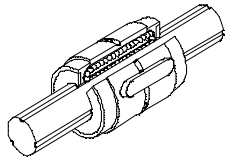
(mm)

Flange type	L1	L2	L3	L4	m	do	d (h7)
FR6AUU H 150 J	150	90	10	50	0.8	4.6	6
FR8AUU H 150 J	150	105	10	35	0.8	6.3	8
FR8AUU - H - 250 J	250	205	10	35	0.8	6.3	8
FR10AUU H 200 J	200	145	10	45	1	8.3	10
FR10AUU H 300 J	300	245	10	45	1	8.3	10
FR12AUU H 250 J	250	195	10	45	1	10.2	12
FR12AUU H 400 J	400	345	10	45	1	10.2	12
FR16AUU H 300 J	300	235	15	50	1	13.5	16
FR16AUU H 600 J	600	535	15	50	1	13.5	16
FR20AUU H 350 J	350	285	15	50	1.2	17.2	20
FR20AUU H 800 J	800	735	15	50	1.2	17.2	20
FR25AUU H 400 J	400	335	15	50	1.2	22.5	25
FR25AUU H 1000 J	1000	935	15	50	1.2	22.5	25
FR30AUU H 450 J	450	380	20	50	1.5	26.7	30
FR30AUU H 1000 J	1000	930	20	50	1.5	26.7	30

- For dismantling sleeve from spline shaft ,special fixture for extraction is necessary .Please refer Page A13.

Note.

1. One sleeve is supplied with a shaft.(If you need more than one sleeve ,please indicate in your order.)
2. Type of sleeve is both ended seal (UU type). both for attached key type and attached flange type.
3. Standard Clearance is “normal” (without any symbol.) High precision class is designated “upper” class (symbol H).
4. Number of spline groove is three, and the groove is A type.
5. For locating snap ring ,use JIS B2804. (JIS stands for Japanese Industrial Standard available from Japan Standard Assn.)



(Unit : mm)

Type of sleeve	Outer diameter	Total length of sleeve				Dimension of Key				Oil hole	hollow shaft	Minor diameter	Number of grooves	Basic rated radial load (k N)		Basic rated torque (N · m)		Static rated moment (N · m)		Weight (kg)		Dia (h7)			
		With seal	Without seal	Lz	Hz	L	H	D2	b					(h8)	t	K	L1	L2	Dynamic rating Cr	Static rating Cor	Dynamic rating Ct		Static rating Cot	Mpo-	Mpo-
R6AUU	16			27	5	23	3	15.4	4	1.5	13	17	8.5	1	2	4.6	1.5	1.9	6.1	14.2	7.5	35.9	0.23	0.03	6
R8AUU	20			32	6	28	4	19.6	5	2	16	20	10	1	3	6.3	2.4	3.0	13.2	30.3	13.4	65.8	0.39	0.07	8
R10AUU	24			36	7	32	5	23	5	2	19	22	11	2	3	8.3	2.6	3.3	18.0	41.4	15.8	82.1	0.61	0.09	10
R12AUU	28			38	7	34	5	27	7	3	20	24	12	2	4	10.2	2.9	3.6	23.3	53.6	18.5	94.2	0.88	0.15	12
R16AUU	36			57	9	52	6.5	35	10	3.5	33	39	19.5	2	6	13.5	5.7	7.2	63.4	145	60.9	290	1.56	0.34	16
R20AUU	42			58	9	53	6.5	40.5	12	3.5	34	40	20	2	8	17.2	5.7	7.2	77.4	178	63.7	301	2.45	0.45	20
R25AUU	47			69	9.5	64	7	45	12	3.5	40	50	25	2.5	12	22.5	7.2	9.0	122	280	95.1	446	3.83	0.61	25
R30AUU	55			82	11	76	8	53.5	15	5	51	60	30	2.5	17	26.7	14.3	18.0	289	665	153	712	5.52	1.00	30
R40AUU	72			105	12.5	98	9	71	20	6	72	80	40	3	21	35.1	33.7	42.6	887	2039	353	1591	9.82	2.18	40
R50AUU	90			137	18.5	130	15	88	24	8	80	100	50	3.5	28	44.6	56.2	71.0	1890	4343	742	3540	15.4	4.58	50
R60AUU	110			158	19	150	15	108	28	9	98	120	60	3.5	33	52.8	57.2	72.3	2295	5274	878	4013	22.1	8.20	60
R80AUU	140			215	25.5	200	18	138	35	11	135	164	82	4	52	71.9	93.4	118	5023	11540	1928	8677	39.3	16.1	80
R100AUU	180			265	33.5	250	26	178	42	13	148	198	99	4	68	88.2	146	185	9764	22431	3802	17586	61.4	35.7	100

1 k N 102kgf 1 N · m 0.102 kgf · m

[Designation]

R16 A UU - 2 - E - H - 680 I M

See page A6

Note. NSB Precision ball spline are manufactured as set of sleeve and shaft, and are sold with sleeve installed on the shaft.

Type of sleeve

Symbol for the number of grooves

With saels at both ends

Number of sleeve per shaft

Clearance (See page A10)

Symbol for accuracy levels (See page 8)

Shaft length [mm]

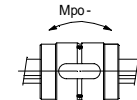
Outer then standard stock

T = With additional machining

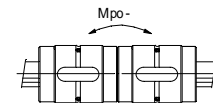
L = Without additional machining

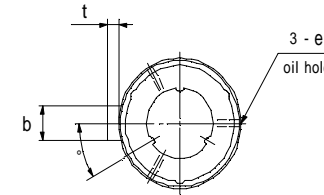
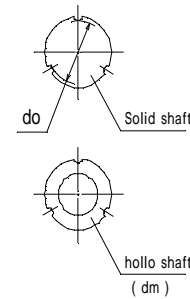
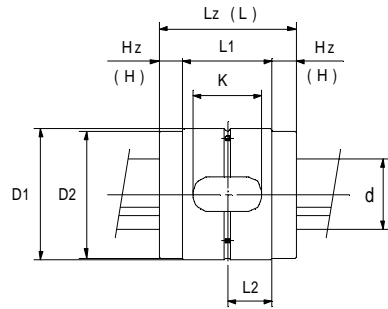
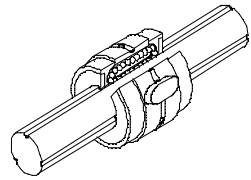
Symbol for hollow shaft (No symbol = Solid shaft)

· Static rated moment load Mpo- applies when one sleeve is positioned closely together. (See upper figure)



· Static rated moment load Mpo- applies when two sleeves are positioned closely together. (See lower figure)





(Unit : mm)

Type of sleeve	Outer diameter		Total length of sleeve				Dimension of Key						Oil hole	hollo w shaft	Minor diameter	Number of grooves	Basic rated radial load		Basic rated torque		Static rated moment		Weight		Dia (h7)		
	With seal	Without seal	Lz	Hz	L	H	D2	b	(h8)	t	K	L1					L2	°	e	dm	do	Dynamic rating	Static rating	Dynamic rating		Static rating	Mpo-
MR10AUU <small>CAD DATA</small> MR10A	24	0	28	7	24	5	23	5	0	2	11	14	7	30°	2	3	8.3	3	1.6	2.1	11.0	26.3	7.2	41.7	0.61	0.06	10
MR12AUU <small>CAD DATA</small> MR12A	28	-0.013	30	7	26	5	27	7	0	3	12	16	8		2	4	10.2		1.9	2.4	15.0	35.6	9.1	50.6	0.88	0.07	12
MR16AUU <small>CAD DATA</small> MR16A	36	0	41	9	36	6.5	35	10	-0.022	3.5	17	23	11.5		2	6	13.5		3.3	4.2	35.6	84.9	24.0	126	1.56	0.22	16
MR20AUU <small>CAD DATA</small> MR20A	42	-0.016	41	9	36	6.5	40.5	12	0	3.5	17	23	11.5		2	8	17.2		3.3	4.2	43.5	103	24.0	126	2.45	0.30	20
MR25AUU <small>CAD DATA</small> MR25A	47		49	9.5	44	7	45	12	-0.027	3.5	20	30	15		2.5	12	22.5		4.3	5.4	70.9	168	38.0	194	3.83	0.40	25
MR30AUU <small>CAD DATA</small> MR30A	55	0	58	11	52	8	53.5	15		5	27	36	18		2.5	17	26.7		8.5	10.8	168	399	61.8	309	5.52	0.66	30
MR40AUU <small>CAD DATA</small> MR40A	72	-0.019	73	12.5	66	9	71	20	0	6	40	48	24		3	21	35.1		21.0	26.6	537	1274	141	678	9.82	1.37	40
MR50AUU <small>CAD DATA</small> MR50A	90	0	97	18.5	90	15	88	24	-0.033	8	40	60	30		3.5	28	44.6		33.7	42.6	1099	2606	296	1551	15.4	3.02	50
MR60AUU <small>CAD DATA</small> MR60A	110	-0.022	110	19	102	15	108	28		9	50	72	36		3.5	33	52.8		34.3	43.4	1334	3164	353	1733	22.1	5.46	60
MR80AUU <small>CAD DATA</small> MR80A	140	0	147	25.5	132	18	138	35	0	11	67	96	48		4	52	71.9		54.9	69.4	2863	6787	737	3540	39.3	10.45	80
MR100AUU <small>CAD DATA</small> MR100A	180	-0.025	183	33.5	168	26	178	42	-0.039	13	66	116	58	4	68	88.2	87.9	111	5677	13458	1464	7352	61.4	24.03	100		

1 k N 102kgf 1 N·m 0.102 kgf·m

[Designation]

MR20 A UU - 2 - E - H - 680 I M

See page A6

Note. NSB Precision ball spline are manufactured as set of sleeve and shaft, and are sold with sleeve installed on the shaft.

Type of sleeve

Symbol for the number of grooves

With saels at both ends

Number of sleeve per shaft

Clearance (See page A10)

Symbol for accuracy levels (See page 8)

Shaft length [mm]

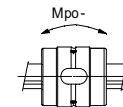
Outer then standard stock

T = With additional machining

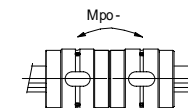
L = Without additional machining

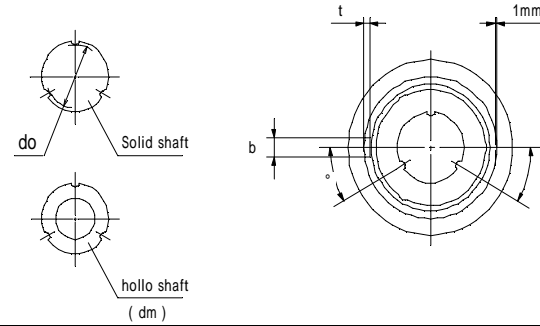
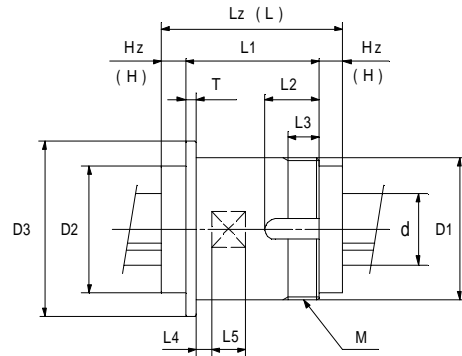
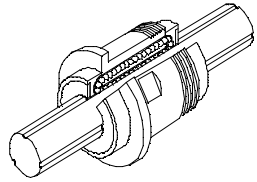
Symbol for hollow shaft (No symbol = Solid shaft)

• Static rated moment load Mpo- applies when one sleeve is positioned closely together. (See upper figure)



• Static rated moment load Mpo- applies when two sleeves are positioned closely together. (See lower figure)





(Unit : mm)

Type of sleeve	Outer diameter		Total length of sleeve				D2	M	L1	D3	T	L2	L3	L4	L5	b	t	°	hollow shaft	Minor diameter	Number of grooves	Basic rated radial load		Basic rated torque		Static rated moment		Weight		Dia (h7)		
	With seal	Without seal	Lz	Hz	L	H																Dynamic rating	Static rating	Dynamic rating	Static rating	Mpo-	Mpo-	Shaft/m	Sleeve			
		D1	(h6)															30 °	dm	do	(k N)		(N · m)		(N · m)		(kg)		d			
																					Cr	Cor	Ct	Cot	Mpo-	Mpo-	Shaft/m	Sleeve	d			
KR8AUU		KR8A	25	0	32	6	28	4	19.6	M25 × 1.5	20	33	2	15	9	2	5	5.5	2.1		3	6.3	3	2.4	3.0	13.2	30.3	13.4	65.8	0.39	0.10	8
KR10AUU		KR10A	30	-0.013	36	7	32	5	23	M30 × 1.5	22	38	2	15	9	2	7	5.5	2.6		3	8.3	3	2.6	3.3	18.0	41.4	15.8	82.1	0.61	0.13	10
KR12AUU		KR12A	35	0	38	7	34	5	27	M35 × 1.5	24	45	2	17	10	2	8	6.5	2.6		4	10.2	3	2.9	3.6	23.3	53.6	18.5	94.2	0.88	0.21	12
KR16AUU		KR16A	40	-0.016	57	9	52	6.5	35	M40 × 1.5	39	50	4	19	12	5	12	6.5	2.6		6	13.5	3	5.7	7.2	63.4	145	60.9	290	1.56	0.40	16
KR20AUU		KR20A	50		58	9	53	6.5	40.5	M50 × 1.5	40	62	4	22	14	5	12	6.5	2.6		8	17.2	3	5.7	7.2	77.4	178	63.7	301	2.45	0.86	20
KR25AUU		KR25A	55	0	69	9.5	64	7	45	M55 × 2	50	67	5	24	14	7	15	8.5	2.6		12	22.5	3	7.2	9.0	122	280	95.1	446	3.83	1.00	25
KR30AUU		KR30A	60	-0.019	82	11	76	8	53.5	M60 × 2	60	74	5	24	14	7	15	8.5	2.6		17	26.7	3	14.3	18.0	289	665	153	712	5.52	1.18	30
KR40AUU		KR40A	80		105	12.5	98	9	71	M80 × 2	80	94	6	31	20	10	28	11	3.6		21	35.1	3	33.7	42.6	887	2039	353	1591	9.82	2.66	40
KR50AUU		KR50A	95	⁰ / _{-0.022}	137	18.5	130	15	88	M95 × 2	100	111	8	35	22	10	35	11	3.6		28	44.6	3	56.2	71.0	1890	4343	742	3540	15.4	4.89	50

1 k N 102kgf 1 N · m 0.102 kgf · m

[Designation]

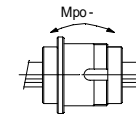
KR20 A UU - 2 - E - H - 680 I M

See page A6

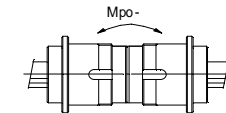
Note. NSB Precision ball spline are manufactured as set of sleeve and shaft, and are sold with sleeve installed on the shaft.

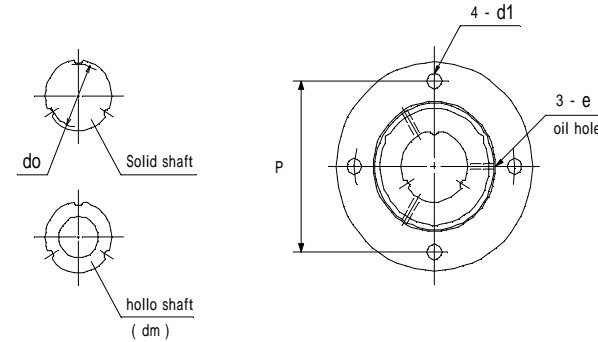
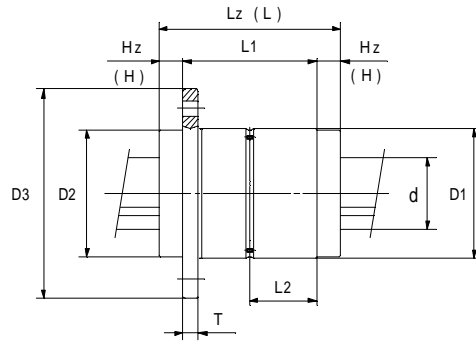
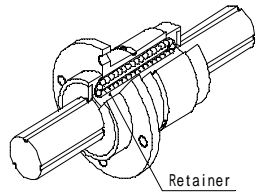
- Type of sleeve
- Symbol for the number of grooves
- With saels at both ends
- Number of sleeve per shaft
- Clearance (See page A10)
- Symbol for accuracy levels (See page 8)
- Shaft length [mm]
- Outer then standard stock T = With additional machining
- L = Without additional machining
- Symbol for hollow shaft (No symbol = Solid shaft)

· Static rated moment load Mpo- applies when one sleeve is positioned closely together. (See upper figure)



· Static rated moment load Mpo- applies when two sleeves are positioned closely together. (See lower figure)





(Unit : mm)

Type of sleeve	Outer diameter		Total length of sleeve				Dimension of flange					oil hole	hollow shaft	Minor diameter	Number of grooves	Basic rated radial load (k N)		Basic rated torque (N · m)		Static rated moment (N · m)		Weight (kg)		Dia (h7)		
	With seal	Without seal	with seal		without seal		D2	D3	T	P	d1					L1	L2	e	dm	do	Dynamic rating	Static rating	Dynamic rating		Static rating	Mpo-
FH069AUU <small>CAD DATA</small> FH069A	20	0	32	6	28	4	19.6	40	4	30	4.5	20	10	1	3	6.3	3	2.4	3.0	13.2	30.3	13.4	65.8	0.28	0.10	6.9
FH089AUU <small>CAD DATA</small> FH089A	24	-0.013	36	7	32	5	23	44	4	34	4.5	22	11	2	3	8.3		2.6	3.3	18.0	41.4	15.8	82.1	0.52	0.14	8.9
FH109AUU <small>CAD DATA</small> FH109A	28		38	7	34	5	27	48	4	38	4.5	24	12	2	4	10.2		2.9	3.6	23.3	53.6	18.5	94.2	0.66	0.19	10.9
FH145AUU <small>CAD DATA</small> FH145A	36	0	57	9	52	6.5	35	60	5	48	5.5	39	19.5	2	6	13.5		5.7	7.2	63.4	145	60.9	290	1.28	0.38	14.5
FH185AUU <small>CAD DATA</small> FH185A	42	-0.016	58	9	53	6.5	40.5	66	5	54	5.5	40	20	2	8	17.2		5.7	7.2	77.4	178	63.7	301	2.09	0.49	18.5
FH235AUU <small>CAD DATA</small> FH235A	47		69	9.5	64	7	45	72	6	60	5.5	50	25	2.5	12	22.5		7.2	9.0	122	280	95.1	446	3.39	0.69	23.5
FH280AUU <small>CAD DATA</small> FH280A	55	0	82	11	76	8	53.5	88	7	72	6.5	60	30	2.5	17	26.7		14.3	18.0	289	665	153	712	4.80	1.18	28.0
FH365AUU <small>CAD DATA</small> FH365A	72	-0.019	105	12.5	98	9	71	112	10	92	8.5	80	40	3	21	35.1		33.7	42.6	887	2039	353	1591	8.14	2.50	36.5
FH465AUU <small>CAD DATA</small> FH465A	90	0	137	18.5	130	15	88	134	12	112	10.5	100	50	3.5	28	44.6		56.2	71.0	1890	4343	742	3540	13.24	4.73	46.5
FH550AUU <small>CAD DATA</small> FH550A	110	-0.022	158	19	150	15	108	154	12	132	10.5	120	60	3.5	33	52.8		57.2	72.3	2295	5274	878	4013	18.51	8.45	55.0

1k N 102kgf 1N · m 0.102 kgf · m

[Designation]

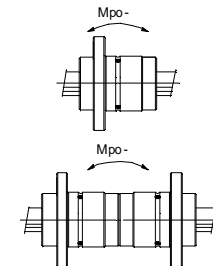
FH185 A UU - 2 - E - H - 680 I M

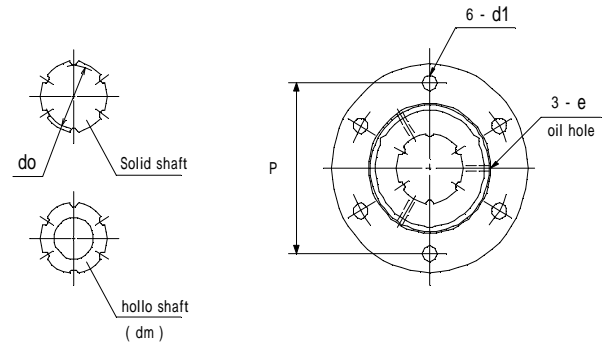
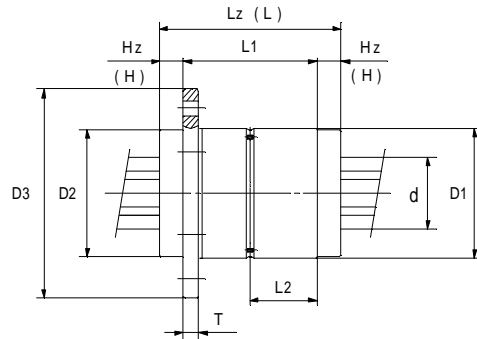
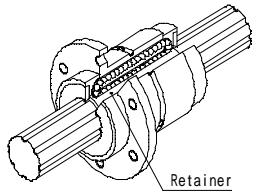
See page A6

Note. NSB Precision ball spline are manufactured as set of sleeve and shaft, and are sold with sleeve installed on the shaft.

Type of sleeve
 Symbol for the number of grooves
 With seals at both ends
 Number of sleeve per shaft
 Clearance (See page A10)
 Symbol for accuracy levels (See page 8)
 Shaft length [mm]
 Outer then standard stock T = With additional machining
 L = Without additional machining
 Symbol for hollow shaft (No symbol = Solid shaft)

- Static rated moment load Mpo- applies when one sleeve is positioned closely together. (See upper figure)
- Static rated moment load Mpo- applies when two sleeves are positioned closely together. (See lower figure)





(Unit : mm)

Type of sleeve	Outer diameter		Total length of sleeve				Dimension of flange					oil hole	hollow shaft	Minor diameter	Number of grooves	Basic rated radial load (k N)		Basic rated torque (N · m)		Static rated moment (N · m)		Weight (kg)		Dia (h7)		
	With seal	Without seal	with seal		without seal		D2	D3	T	P	d1					L1	L2	e	dm	do	Dynamic rating	Static rating	Dynamic rating		Static rating	Mpo-
FH280CUU <small>CAD DATA</small> FH280C	55	0	82	11	76	8	53.5	88	7	72	6.5	60	30	2.5	17	26.7	6	24.7	31.3	579	1331	266	1233	4.80	1.18	28.0
FH365CUU <small>CAD DATA</small> FH365C	72	-0.019	105	12.5	98	9	71	112	10	92	8.5	80	40	3	21	35.1		58.4	73.8	1775	4078	612	2755	8.14	2.50	36.5
FH465CUU <small>CAD DATA</small> FH465C	90	0	137	18.5	130	15	88	134	12	112	10.5	100	50	3.5	28	44.6		97.3	123	3781	8687	1286	6132	13.24	4.73	46.5
FH550CUU <small>CAD DATA</small> FH550C	110	-0.022	158	19	150	15	108	154	12	132	10.5	120	60	3.5	33	52.8		99.2	125	4591	10548	1522	6951	18.51	8.45	55.0
																1k N	102kgf	1N · m	0.102 kgf · m							

[Designation]

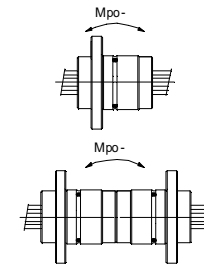
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See page A6

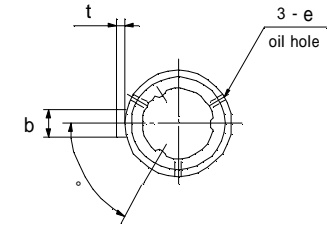
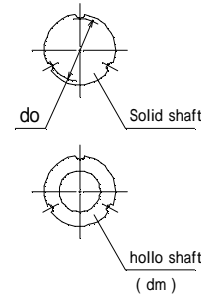
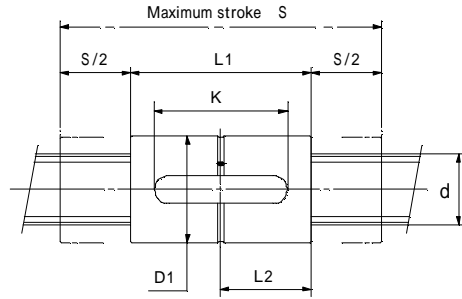
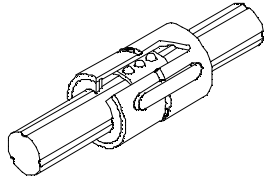
Note. NSB Precision ball spline are manufactured as set of sleeve and shaft, and are sold with sleeve installed on the shaft.

- Type of sleeve
- Symbol for the number of grooves
- With saels at both ends
- Number of sleeve per shaft
- Clearance (See page A10)
- Symbol for accuracy levels (See page 8)
- Shaft length [mm]
- Outer then standard stock T = With additional machining
- L = Without additional machining
- Symbol for hollow shaft (No symbol = Solid shaft)

- Static rated moment load Mpo- applies when one sleeve is positioned closely together. (See upper figure)
- Static rated moment load Mpo- applies when two sleeves are positioned closely together. (See lower figure)



Non-circulating ball type (Limited stroke)



(Unit : mm)

Type of sleeve	Maximum stroke	Outer diameter		Total length	Dimension of Key					Oil hole	hollow shaft	Minor diameter	Number of grooves	Basic rated radial load		Basic rated torque		Static rated moment	Weight		Dia	
		With seal	Without seal		D1	(h6)	L1	b	(h8)					t	K	L2	(°)		e	dm		do
		S												Dynamic rating	Static rating	Dynamic rating	Static rating	Mpo-	Shaft/m	Sleeve	d	
														Cr	Cor	Ct	Cot					
SR6AUU	SR6A	22	12	0	29	4	0	1.5	19	14.5	60°	1	2	5.1	0.8	1.0	3.9	9.1	2.5	0.23	0.01	6
SR8AUU	SR8A	26	16	-0.011	34	5	-0.018	2	24	17	60°	1	3	6.8	1.8	2.3	11.9	27.6	6.9	0.39	0.03	8
SR10AUU	SR10A	30	20	0	40	5	0	2	30	20	60°	2	3	8	2.8	3.6	22.5	51.8	14.4	0.61	0.08	10
SR12AUU	SR12A	32	24	-0.013	41	7	0	3	31	20.5	60°	2	4	10	2.8	3.6	26.3	60.5	14.4	0.88	0.10	12
SR16AUU	SR16A	40	28	0	48	7	0	3	38	24	60°	2	6	13.5	4.1	5.2	49.6	114	23.4	1.56	0.12	16
SR20AUU	SR20A	50	32	0	53	10	-0.022	3.5	40	26.5	60°	2	8	17.5	4.1	5.2	60.4	139	23.4	2.45	0.15	20
SR25AUU	SR25A	50	40	-0.016	56	10	0	3.5	40	28	60°	2.5	12	22	5.6	7.0	101	234	34.7	3.83	0.27	25
SR30AUU	SR30A	80	45	0	76	12	0	3.5	56	38	60°	2.5	17	26.8	7.3	9.2	160	368	36.7	5.52	0.54	30
SR40AUU	SR40A	100	62	0	95	18	-0.027	6	75	47.5	30°	3	21	36	11.4	14.4	332	762	52.1	9.82	1.01	40
SR50AUU	SR50A	130	76	-0.019	116	20	0	6	86	58	30°	3.5	28	45.2	16.4	20.38	595	1368	86.8	15.4	1.81	50
SR60AUU	SR60A	130	85	0	121	24	-0.033	8	91	60.5	30°	3.5	33	55.2	16.4	20.8	704	1618	95.8	22.1	2.16	60

[Designation]

SR20 A UU - 1 - E - H - 170 I M

See page A6

Type of sleeve

Symbol for the number of grooves

With seals at both ends

Number of sleeve per shaft

Clearance (See page A10)

Symbol for accuracy levels (See page 8)

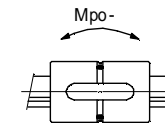
Shaft length [mm]

Outer then standard stock T = With additional machining

L = Without additional machining

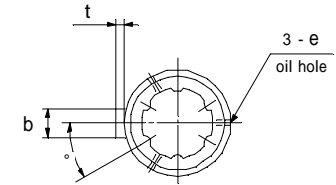
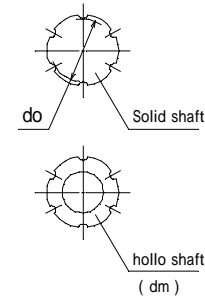
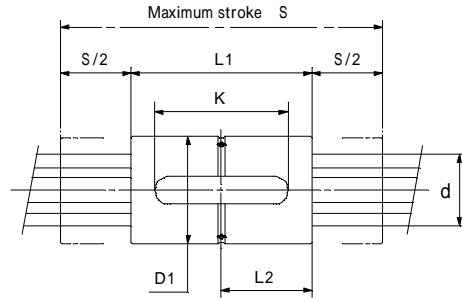
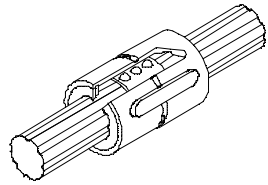
Symbol for hollow shaft (No symbol = Solid shaft)

· Static rated moment load Mpo- applies when one sleeve is positioned closely together. (See upper figure)



Note. NSB Precision ball spline are manufactured as set of sleeve and shaft, and are sold with sleeve installed on the shaft.

Non-circulating ball type (Limited stroke)



(Unit : mm)

Type of sleeve	Maximum stroke	Outer diameter		Total length	Dimension of Key					Oil hole	hollow shaft	Minor diameter	Number of grooves	Basic rated radial load (k N)		Basic rated torque (N · m)		Static rated moment (N · m)	Weight (kg)		Dia (h7)		
		With seal	Without seal		D1	(h6)	L1	b	(h8)					t	K	L2	°		e	dm		do	Dynamic rating Cr
SR30CUU <small>CAD DATA</small> SR30C	80	45	⁰ / _{-0.016}	76	12	0	3.5	56	38	30°	2.5	17	26.8	6	12.6	16	320	736	63.6	5.52	0.54	30	
SR40CUU <small>CAD DATA</small> SR40C	100	62	⁰ / _{-0.019}	95	18	-0.027	6	75	47.5		3	21	36		19.8	25	664	1525	90.2	9.82	1.01	40	
SR50CUU <small>CAD DATA</small> SR50C	130	76	⁰ / _{-0.019}	116	20	0	6	86	58		3.5	28	45.2		28.5	36	1191	2736	150	15.4	1.81	50	
SR60CUU <small>CAD DATA</small> SR60C	130	85	⁰ / _{-0.022}	121	24	-0.033	8	91	60.5		3.5	33	55.2		28.5	36	1408	3236	166	22.1	2.16	60	
														1 k N	102kgf	1 N·m	0.102 kgf·m						

[Designation]

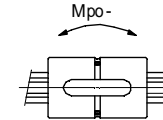
SR40 C UU - 1 - E - H - 280 I M

See page A6

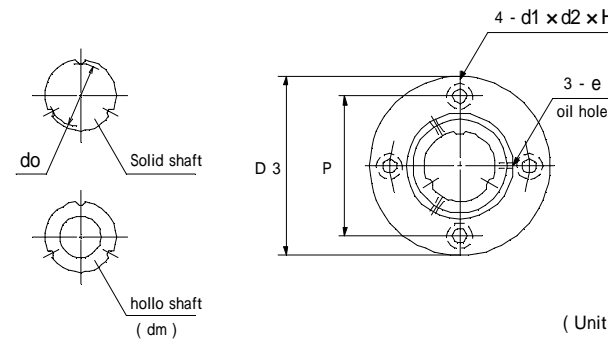
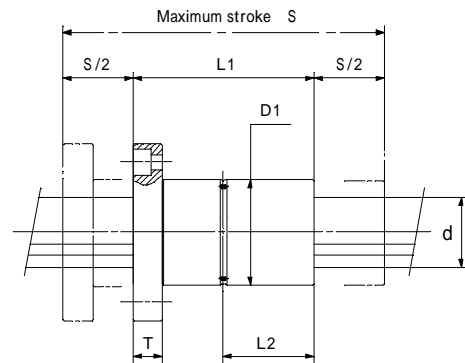
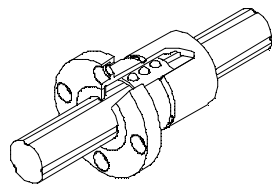
Note. NSB Precision ball spline are manufactured as set of sleeve and shaft, and are sold with sleeve installed on the shaft.

- Type of sleeve
- Symbol for the number of grooves
- With saels at both ends
- Number of sleeve per shaft
- Clearance (See page A10)
- Symbol for accuracy levels (See page 8)
- Shaft length [mm]
- Outer then standard stock T = With additional machining
L = Without additional machining
- Symbol for hollow shaft (No symbol = Solid shaft)

· Static rated moment load Mpo- applies when one sleeve is positioned closely together. (See upper figure)



Non-circulating ball type (Limited stroke)



(Unit : mm)

Type of sleeve	Maximum stroke	Outer diameter		Total length	Dimension of Flange							Oil hole	hollow shaft	Minor diameter	Number of grooves	Basic rated radial load (k N)		Basic rated torque (N · m)		Static rated moment (N · m)	Weight (kg)		Dia (h7)
		With seal	Without seal		S	D1 (h6)	L1	D3	T	P	d1					d2	H	L2	e		dm	do	
FSR6AUU <small>CAD DATA</small> FSR6A	22	12	0	29	27	6	18	3.4	6.5	3.3	14.5	1	2	5.1	3	0.8	1.0	3.9	9.1	2.5	0.23	0.02	6
FSR8AUU <small>CAD DATA</small> FSR8A	26	16	-0.011	34	34	7	25	4.5	7.5	4	17	1	3	6.8		1.8	2.3	11.9	27.6	6.9	0.39	0.06	8
FSR10AUU <small>CAD DATA</small> FSR10A	30	20	0	40	38	7	29	4.5	7.5	4	20	2	3	8		2.8	3.6	22.5	51.8	14.4	0.61	0.10	10
FSR12AUU <small>CAD DATA</small> FSR12A	32	24	-0.013	41	42	7	33	4.5	7.5	4	20.5	2	4	10		2.8	3.6	26.3	60.5	14.4	0.88	0.14	12
FSR16AUU <small>CAD DATA</small> FSR16A	40	28	0	48	49	8	38	5.5	9	5	24	2	6	13.5		4.1	5.2	49.6	114	23.4	1.56	0.19	16
FSR20AUU <small>CAD DATA</small> FSR20A	50	32		53	56	9	43	6.5	10.5	6	26.5	2	8	17.5		4.1	5.2	60.4	139	23.4	2.45	0.25	20
FSR25AUU <small>CAD DATA</small> FSR25A	50	40	-0.016	56	64	9	51	6.5	10.5	6	28	2.5	12	22		5.6	7.0	101	234	34.7	3.83	0.37	25
FSR30AUU <small>CAD DATA</small> FSR30A	80	45	0	76	75	12	59	8.5	14	8	38	2.5	17	26.8		7.3	9.2	160	368	36.7	5.52	0.66	30
FSR40AUU <small>CAD DATA</small> FSR40A	100	62		95	92	12	76	8.5	14	8	47.5	3	21	36		11.4	14.4	332	762	52.1	9.82	1.34	40
FSR50AUU <small>CAD DATA</small> FSR50A	130	76	-0.019	116	112	14	92	10.5	17	10	58	3.5	28	45.2		16.4	20.8	595	1368	86.8	15.4	2.13	50
FSR60AUU <small>CAD DATA</small> FSR60A	130	85	0 -0.022	121	121	14	101	10.5	17	10	60.5	3.5	33	55.2		16.4	20.8	704	1618	95.8	22.1	2.37	60

1 k N 102kgf 1 N · m 0.102 kgf · m

[Designation]

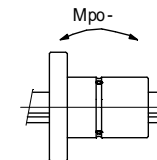
FSR20 A UU - 1 - E - H - 170 I M

See page A6

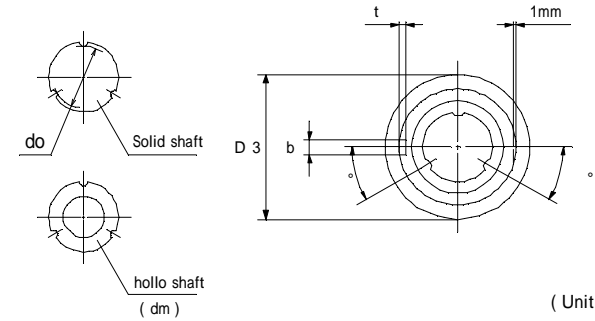
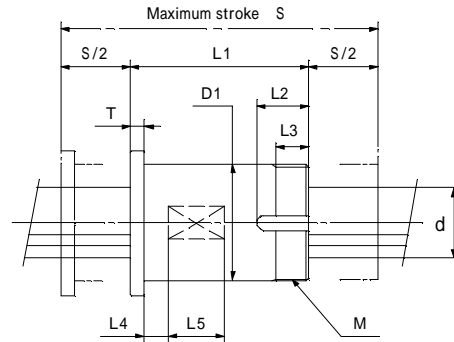
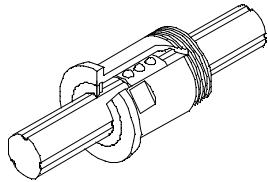
Note. NSB Precision ball spline are manufactured as set of sleeve and shaft, and are sold with sleeve installed on the shaft.

- Type of sleeve
- Symbol for the number of grooves
- With seals at both ends
- Number of sleeve per shaft
- Clearance (See page A10)
- Symbol for accuracy levels (See page 8)
- Shaft length [mm]
- Outer than standard stock T = With additional machining
- L = Without additional machining
- Symbol for hollow shaft (No symbol = Solid shaft)

· Static rated moment load Mpo- applies when one sleeve is positioned closely together. (See upper figure)



Non-circulating ball type (Limited stroke)



(Unit : mm)

Type of sleeve	Maximum stroke	Outer diameter		Total length											hollow shaft	Minor diameter	Number of grooves	Basic rated radial load		Basic rated torque		Static rated moment	Weight		Dia	
		With seal	Without seal		S	D1	(h6)	L1	M	D3	T	L2	L3	L4				L5	b	t	°		dm	do		Dynamic rating
KSR8AUU <small>CAD DATA</small> KSR8A	26		20	0	34	M20 × 1	27	3	13	8	5	10	4.5	1.6	30°	3	6.8	3	1.8	2.3	11.9	27.6	6.9	0.37	0.07	8
KSR10AUU <small>CAD DATA</small> KSR10A	30		25	0	40	M25 × 1.5	33	3	15	9	5	10	5.5	2.1	3	8	8	2.8	3.6	22.5	51.8	14.4	0.58	0.14	10	
KSR12AUU <small>CAD DATA</small> KSR12A	32		30	-0.013	41	M30 × 1.5	38	3	15	9	5	10	5.5	2.6	4	10	10	2.8	3.6	26.3	60.5	14.4	0.85	0.18	12	
KSR16AUU <small>CAD DATA</small> KSR16A	40		35	0	48	M35 × 1.5	45	5	17	10	7	12	6.5	2.6	6	13.5	13.5	4.1	5.2	49.6	114	23.4	1.52	0.26	16	
KSR20AUU <small>CAD DATA</small> KSR20A	50		40	0	53	M40 × 1.5	50	5	19	12	7	15	6.5	2.6	8	17.5	17.5	4.1	5.2	60.4	139	23.4	2.41	0.35	20	
KSR25AUU <small>CAD DATA</small> KSR25A	50		45	-0.016	56	M45 × 1.5	56	5	19	12	7	15	6.5	2.6	12	22	22	5.6	7.0	101	234	34.7	3.78	0.43	25	
KSR30AUU <small>CAD DATA</small> KSR30A	80		50	0	76	M50 × 1.5	62	6	22	14	10	24	6.5	2.6	17	26.8	26.8	7.3	9.2	160	368	36.7	5.45	0.77	30	
KSR40AUU <small>CAD DATA</small> KSR40A	100		65	0	95	M65 × 2	79	6	26	16	10	28	8.5	2.6	21	36	36	11.4	14.4	332	762	52.1	9.71	1.20	40	
KSR50AUU <small>CAD DATA</small> KSR50A	130		80	-0.019	116	M80 × 2	94	8	31	20	10	35	11	3.6	28	45.2	45.2	16.4	20.8	595	1368	86.8	15.2	2.22	50	
																	1 k N	102kgf	1 N · m		0.102 kgf · m					

[Designation]

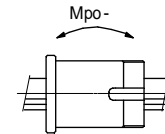
KSR20 A UU - 1 - E - H - 170 I M

See page A6

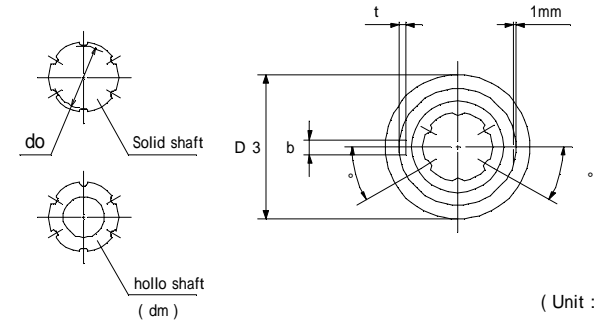
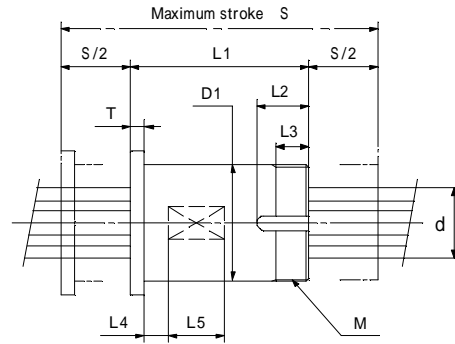
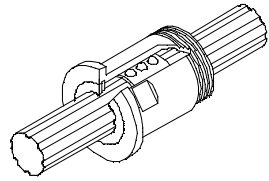
Note. NSB Precision ball spline are manufactured as set of sleeve and shaft, and are sold with sleeve installed on the shaft.

Type of sleeve
 Symbol for the number of grooves
 With saels at both ends
 Number of sleeve per shaft
 Clearance (See page A10)
 Symbol for accuracy levels (See page 8)
 Shaft length [mm]
 Outer then standard stock T = With additional machining
 L = Without additional machining
 Symbol for hollow shaft (No symbol = Solid shaft)

· Static rated moment load Mpo- applies when one sleeve is positioned closely together. (See upper figure)



Non-circulating ball type (Limited stroke)



(Unit : mm)

Type of sleeve	Maximum stroke	Outer diameter		Total length											hollow shaft	Minor diameter	Number of grooves	Basic rated radial load (k N)		Basic rated torque (N · m)		Static rated moment (N · m)		Weight (kg)		Dia (h7)
		With seal	Without seal		D1	(h6)	L1	M	D3	T	L2	L3	L4	L5				b	t	°	dm	do	Dynamic rating Cr	Static rating Cor	Dynamic rating Ct	
KSR30CUU <small>CAD DATA</small> KSR30C	80		50	⁰ / _{-0.016}	76	M50 × 1.5	62	6	22	14	10	24	6.5	2.6	30 °	17	26.8	6	12.6	16	320	736	63.6	5.45	0.77	30
KSR40CUU <small>CAD DATA</small> KSR40C	100		65	⁰ / _{-0.019}	95	M65 × 2	79	6	26	16	10	28	8.5	2.6		21	36		19.8	25	664	1525	90.2	9.71	1.20	40
KSR50CUU <small>CAD DATA</small> KSR50C	130		80	⁰ / _{-0.019}	116	M80 × 2	94	8	31	20	10	35	11	3.6		28	45.2		28.5	36	1191	2736	150	15.2	2.22	50

1 k N 102kgf 1 N · m 0.102 kgf · m

[Designation]

KSR40 C UU - 1 - E - H - 280 I M

See page A6

Note. NSB Precision ball spline are manufactured as set of sleeve and shaft, and are sold with sleeve installed on the shaft.

Type of sleeve

Symbol for the number of grooves

With saels at both ends

Number of sleeve per shaft

Clearance (See page A10)

Symbol for accuracy levels (See page 8)

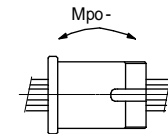
Shaft length [mm]

Outer then standard stock T = With additional machining

L = Without additional machining

Symbol for hollow shaft (No symbol = Solid shaft)

· Static rated moment load Mpo- applies when one sleeve is positioned closely together. (See upper figure)



Economy Ball splines

Preface

NSB economy ball splines are ball circulating type spline bearing which are cheap and compact configuration . They have semicircular ball grooves on the shaft and on the sleeve . By installing steel balls between grooves , linear and rotary motion is possible.

Features

Semi-circular grooves , serving as rolling surface for load carrying steel balls, furnish high loading capacity and long service life as ball splines.

Circulating steel balls in the grooves enable torque transmission and linear motion of the shaft simultaneously.

Ample sleeve types and standard stock of spline shafts are always available for various applications.

Space saving type bearing consisting of two bearings within a sleeve is also available . This type has a high moment load capacity and is able to transmit big torque.

Handling is simple because this bearing is constructed in the way that steel balls do not fall off.

Applications

- Industrial robots
- Robots for taking out products
- Coil winding machines
- Inserting machines for electronic parts
- Semiconductor producing machines
- Electric terminal crimping machines
- Honing machines
- Robots for welding

Configuration

NSB economy ball spline consists of a spline shaft and a sleeve moving on the shaft. Steel balls circulate in the sleeve, help in place by a retainer integrally formed.

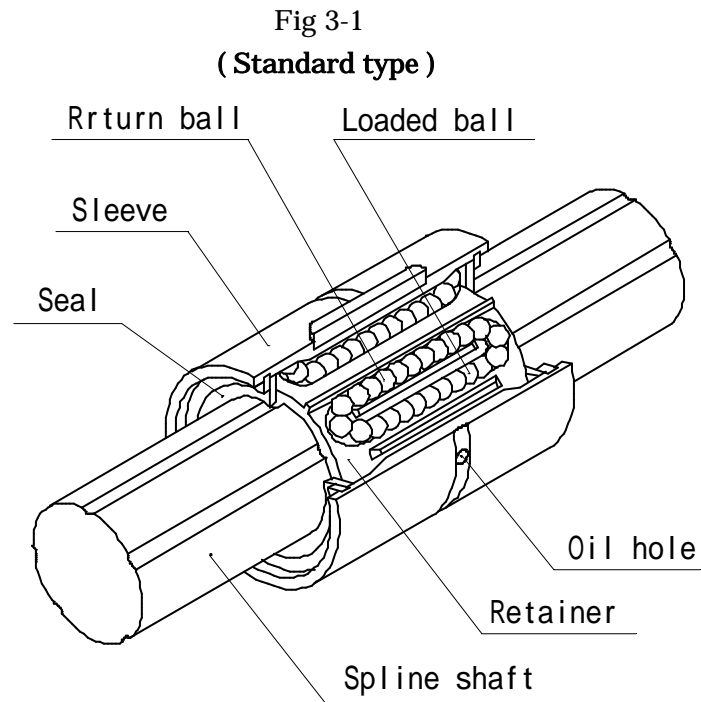
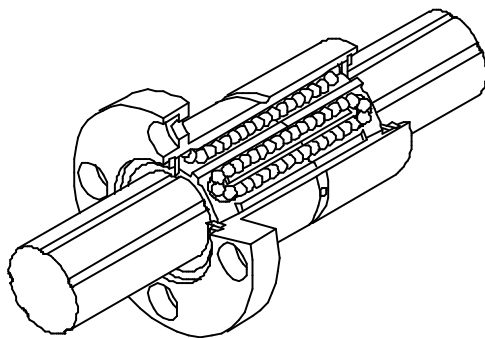
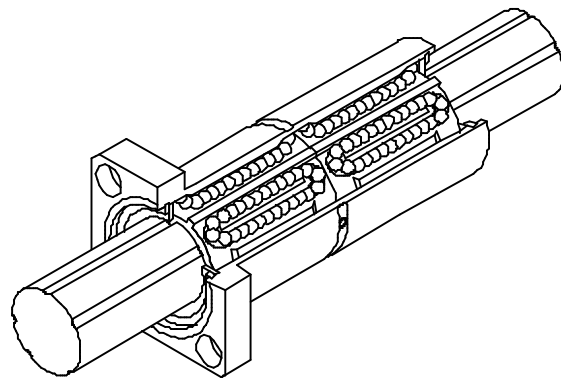


Fig 3-2
(Long type)






The sleeve is made longer to enable it bear high load



Fig 3-3
(Double type)






Single sleeve consists of two sleeve has high strength for moment load

Kind of the sleeve

Standard type		
		
LSK	LSF	LST
Single sleeve		

Long type	
	
LSKL	LSFL
The sleeve is made longer to enable it bear high load	

Double type		
		
LSKW	LSFW	LSTW
Single sleeve consists of two sleeves has high strength for moment load		

Material . Heat treatment . Hardness

Table 3-1

Item	Material	Heat treatment	Hardness
Spline shaft	SUJ 2	Induction hardening	HRC 58 up
Sleeve	SCM415	Carburizing hardening	HRC 58 up
Steel ball	SUJ 2	Hardening	HRC 60 up
Retainer	Synthetic resin	-	-

Designation

NSB Economy ball splines are manufactured as set of sleeve and shaft ,and are sold with sleeve installed on the shaft .When you issue an order ,please use the following form.

LSFL20 UU - 2 - E - H - 680 T M

Table 3-2

Type of sleeve	LSFL20 (Flange long type)
Seal	UU (Symbol for the ball spline with seals at both ends)
Number of sleeves per shaft	2
Clearance	E (See page B8 Table 3-6)
Symbol for accuracy levels	H (See page 8 Table 1-7 ~ 1-12)
Total length of shaft	680 mm
Other than standard stocks	T = with additional machining L = without additional machining
Symbol for hollow shaft No symbol = Solid shaft	M (See page B6 Table 3-4)

Standard stock items for See page B12

Spline shaft (special design shaft)

Maximum length of the shafts

Maximum length of the spline shafts we manufacture is shown in Table 3-3. Longer shafts can be manufactured to order .Please contact NSB

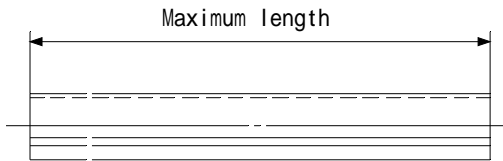


Table 3-3

Type	Maximum length of the spline shaft (mm)
6	250
8	350
10	500
13	800
16	1000
20	1500
25	2000
30	2400

Hollow shaft (M-mark)

We will supply hollow shafts as shown in Table 3-4, when reduction of spline shaft weight or air passage through the shaft is necessary.

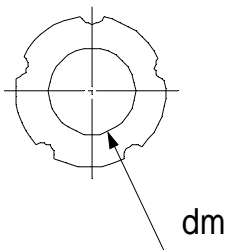


Table 3-4

Type	Reduction of weight dm (mm)
6	2
8	3
10	4
13	4
16	6
20	8
25	12
30	17

Incomplete length of the groove

When stepped machining is necessary ,use incomplete length L_t of spline shaft indicated in Table 3-5.

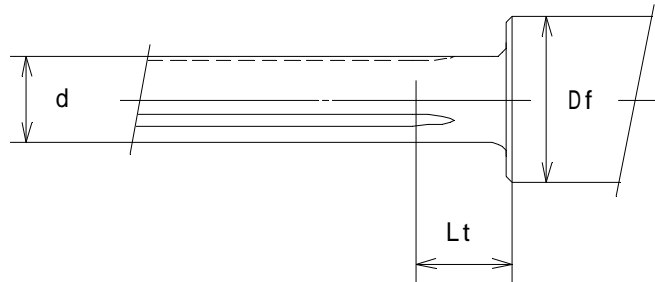


Table3-5

(Unit:mm)

Shaft dia	D f												
	6	8	10	13	16	20	25	30	35	40	50	60	80
6	5	11	14	18	21	25	-	-	-	-	-	-	-
8	-	5	11	16	19	23	27	30	-	-	-	-	-
10.4	-	-	-	12	17	21	25	29	-	-	-	-	-
13.4	-	-	-	-	12	18	23	27	30	-	-	-	-
16.6	-	-	-	-	-	14	20	25	28	31	-	-	-
20.6	-	-	-	-	-	-	15	21	25	29	34	-	-
25.8	-	-	-	-	-	-	-	15	21	25	32	36	-
30.8	-	-	-	-	-	-	-	-	15	21	29	34	41

Clearance

For NSB economy ball splines , appropriate clearance adapted to usage is necessary in order to obtain long life and high accuracy. Please select correct clearance for the application.

Table 3-6

(Unit:mm)

Type	E0	E	Normal (No symbol)	E1
6		0.006	0.001	+0.004
8		~	~	~
10		0.001	+0.004	+0.010
13	0.012	0.008	0.002	+0.005
16	~	~	~	~
20	0.006	0.002	+0.005	+0.012
25	0.014	0.008	0.002	+0.006
30	~	~	~	~
	0.006	0.002	+0.006	+0.015
Condition of operation	<ul style="list-style-type: none"> • eceiving severe vibration or shock. • eceiving overhanged load. • Places requiring high stiffness and exposed. 	<ul style="list-style-type: none"> • Receiving weak vibration or shock. • Places with alternating loads. 	<ul style="list-style-type: none"> • When smooth driving with small power is necessary. • Receiving load in one direction only. 	<ul style="list-style-type: none"> • For very long shaft. • Where temperature change is expected.

Remarks for application

In installing the sleeve to the housing ,care should be taken not to afford shock to the sleeve.

For assembling sleeve to spline shaft ,insert gently keeping sleeve axis parallel to the shaft .Do not pry.

This type is easy to handle ,because it has a retainer .The retainer ,however ,is made of synthetic resin ,thus it can not bear high temperature. Operating temperature should be between - 40 to + 80 .

Relative location of spline grooves ,key groove on the outer surface of sleeve ,and mounting holes for the flange are shown in the drawing indicating dimensions for each types.

If additional machining of spline shaft is necessary ,chamfering of shaft end face should be more than C0.5 .(more than 0.5 mm chamfer)

Fit

For the fit value in installing NSB economy ball spline into housing box , we recommend the figure in Table 3-7.

Table 3-7 (Unit : mm)

Type	Loose fit (H 7)	Tight fit (J 7)
6	+0.018	+0.010
8	0	-0.008
10	+0.021	+0.012
13	0	-0.009
16		
20	+0.025	+0.014
25	0	-0.011
30		

Dimension of key way and key

For inserting NSB economy ball spline with key way (LSK LSKL LSKW) ,into housing box ,refer Table 3-8 for key way tolerances ,and Table 3-9 for key dimensions.

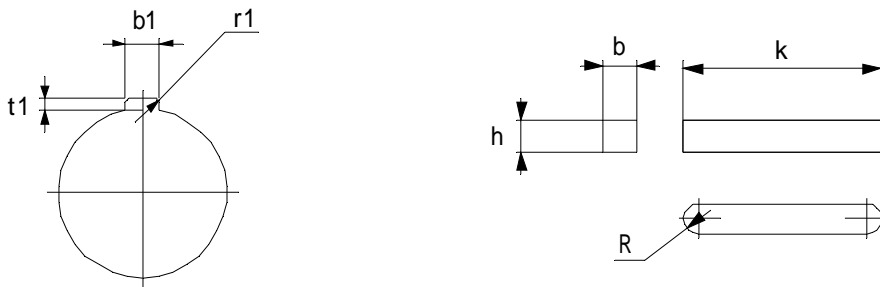


Table 3-8 (Unit : mm)

Type	Key way				
	b1	Tol.	t1	Tol.	r1
6	2.5	±0.013	1.5	+0.1	0.4
8			1.7		
10	3	±0.013	1.7	+0.1	0.4
13					
16	3.5			0	
20	4	±0.015	1.8		
25					
30					

Table 3-9 (Unit : mm)

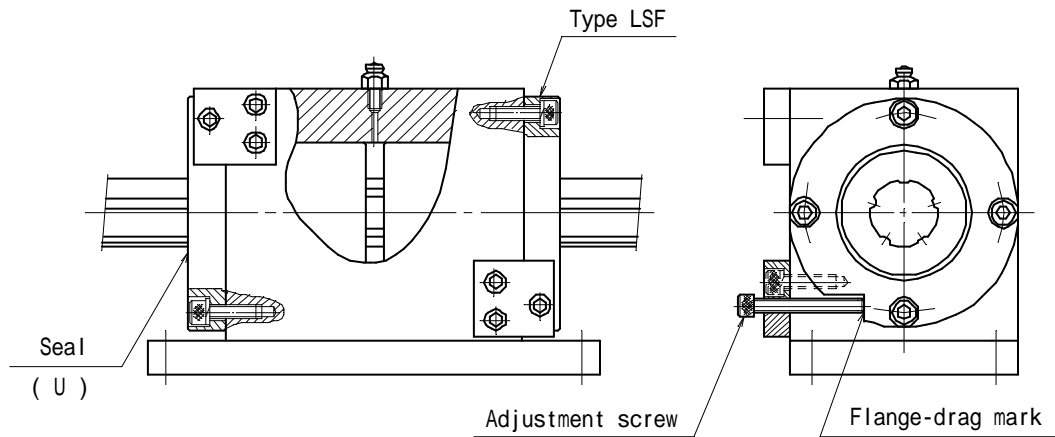
Type	Key							
	b	Tol.	h	Tol.	k (LSK) (LSKW)	k (LSKL)	Tol.	R
6	2.5	+0.016	2.5	0	10.5	-	0	1.25
8			3					-0.025
10	3	+0.006	3		14	17	0	
13								
16	3.5		3.5		18	18	-0.2	1.75
20	4	+0.024		0	20	29		
25								
30		+0.012	4		33	42		

How to apply pre-load

NSB economy ball spline can apply pre-load. It is effective in enhancing rigidity ,elimination of backlash or extension of service life..

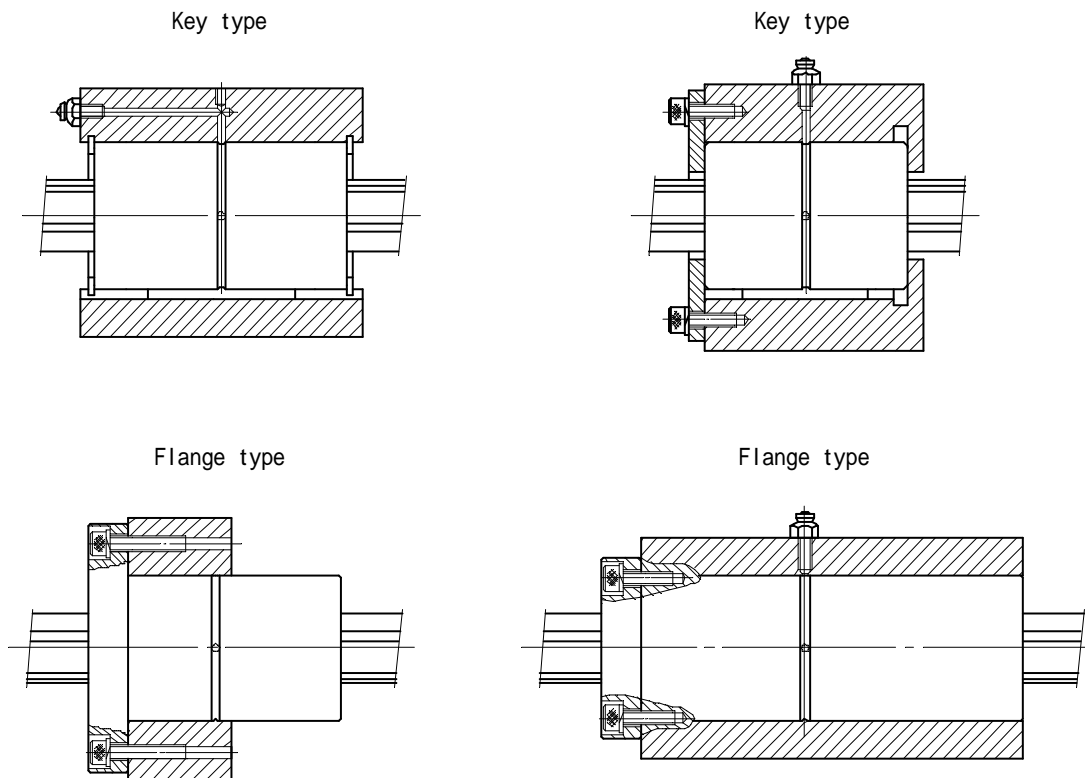
In order to apply pre-load ,two sleeves with flange are installed to housing in the manner shown in Fig.3-4, and manipulate adjusting screw. Optimum quantity of pre-load is about one third of transmitting torque.

Fig.3-4



Example of installation of the sleeve

Fig.3-5



Standard stocks

NSB' Economy Ball spline, as illustrated below, provides standard stock of full spline shaft with one sleeve or two sleeves installed on the shaft for short time delivery

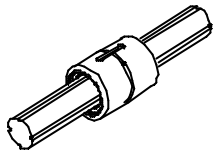
(Example)

One sleeve

LSK16 - 1 - 300 S

Type of sleeve (all seal type)
 Number of one sleeve per shaft
 Standard Shaft length [mm]
 Standard stock mark = "S"

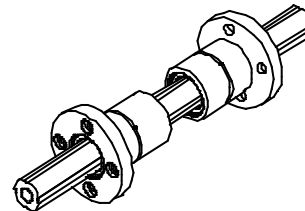
No symbol = Solid shaft
 (Symbol for hollow shaft mark = "M")



Two sleeve

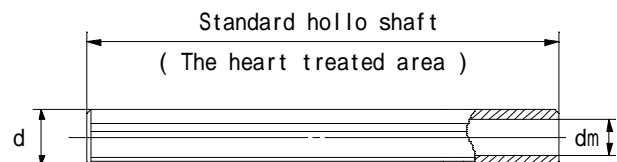
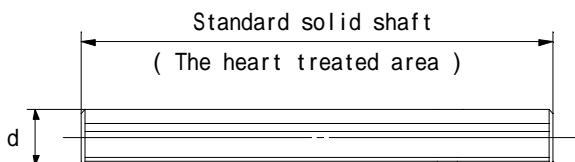
LSFL20 - 2 - 500 S M

Type of sleeve (all seal type)
 Number of two sleeve per shaft
 Standard Shaft length [mm]
 Standard stock mark = "S"
 Symbol for hollow shaft mark = "M"
 (No symbol = Solid shaft)



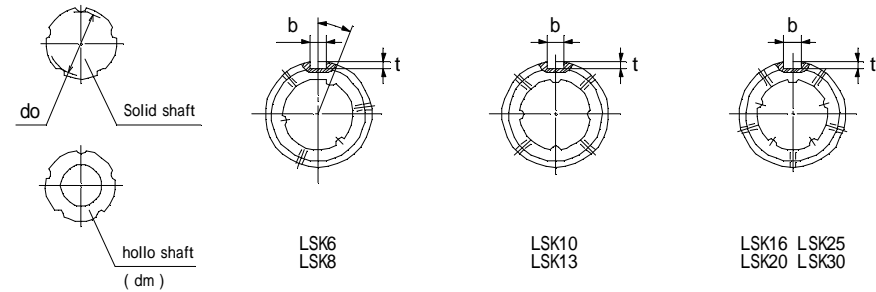
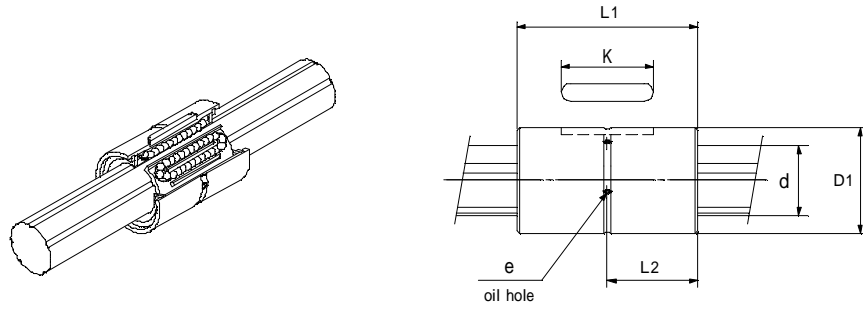
Note : (1) Clearance is normal clearance.(with no symbol)

(2) Grade of accuracy is standard class.



(Unit : mm)

Spline Shaft dia d (h7)	Shaft length of standard stock [full spline]						Hollow shaft (Mark "M") dm
	100	150	200	300	400	500	
6	100	150	200				2
8	100	150	200				3
10.4	100	200	300	400			4
13.4	200	300	400	500			4
16.6	200	300	400	500	600		6
20.6	300	400	500	600	700		8
25.8	400	500	600	700	800	1000	12
30.8	400	500	600	700	800	1000	17



(Unit : mm)

CAD DATA	Type of sleeve		Outer Diameter		Total length L1	Key way				Oil hole e	Minor dia do	Number of grooves	°	Basic rated radial load (k N)		Basic rated torque (N·m)		Static rated moment (N·m)		Weight (kg)		Dia (h7) d																
	With seal	Without seal	D1	(h6)		b	(H8)	t	K					L2	Dynamic Cr	Static Cor	Dynamic Ct	Static Cot	Mpo-	Mpo-	Shaft/m		Sleeve															
LSK6UU	LSK6	14	0	25	2.5	+0.014	1.2	10.5	12.5	1.5	2	5.6	3	15 °	1.2	2.1	3.8	7.0	5	36	0.23	0.012	6															
LSK8UU	LSK8	16	-0.011	25	2.5		1.2																	10.5	12.5	1.5	3	7.6	25 °	1.2	2.1	4.8	8.7	5	36	0.39	0.013	8
LSK10UU	LSK10	21	0	33	3	+0.014	1.5	14	16.5	1.5	4	10	4	-	2.4	4.3	11	21	15	102	0.65	0.04	10.4															
LSK13UU	LSK13	24	-0.013	36	3		1.5																	14	18	1.5	4	13	-	3.3	5.9	20	37	22	148	1.11	0.05	13.4
LSK16UU	LSK16	31	0	41	3.5	+0.018	2	18	20.5	1.5	6	16	5	-	3.8	6.9	32	58	32	216	1.65	0.12	16.6															
LSK20UU	LSK20	35		46	4		2.5																	20	23	2	8	20	-	4.6	8.3	46	84	42	276	2.57	0.14	20.6
LSK25UU	LSK25	42		60	4		2.5																	29	30	2	12	25	-	10.8	19.4	135	244	113	773	4.04	0.23	25.8
LSK30UU	LSK30	47		66	4		2.5																	33	33	2.5	17	30	-	12.3	22.2	181	327	136	937	5.85	0.29	30.8

1 k N 102kgf 1 N·m 0.102 kgf·m

[Designation]

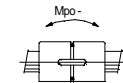
LSK20 UU - 2 - E - H - 680 I M

See page B5

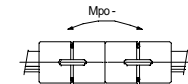
Note.1 NSB Economy ball spline are manufactured as set of sleeve and shaft , and are sold with sleeve installed on the shaft .

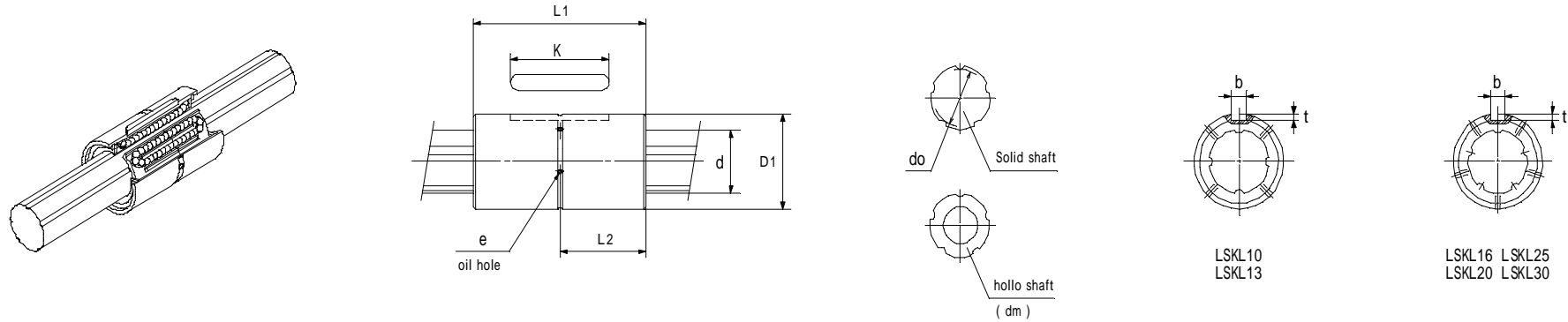
Type of sleeve
 With saels at both ends
 Number of sleeve per shaft
 Clearance (See page B8)
 Symbol for accuracy levels (See page 8)
 Shaft length [mm]
 Outer then standard stock T = With additional machining
 L = Without additional machining
 Symbol for hollow shaft (No symbol = Solid shaft)

Note.2 Static rated moment load Mpo- applies when one sleeve is positioned closely together. (See upper figure)



Note.3 Static rated moment load Mpo- applies when two sleeves are positioned closely together. (See lower figure)





(Unit : mm)

Type of sleeve	Outer Diameter		Total length	Key way					Oil hole	Minor dia	Number of grooves	Basic rated radial load (k N)		Basic rated torque (N · m)		Static rated moment (N · m)		Weight (kg)		Dia (h7)			
	With seal	Without seal		D1	(h6)	L1	b (H8)	t				K	L2	e	dm	do	Dynamic Cr	Static Cor	Dynamic Ct		Static Cot	Mpo-	Mpo-
CAD DATA LSKL10UU	LSKL10	21	0	40	3	+0.014	1.5	+0.05	17	20	1.5	4	10	4	3.8	6.9	19	34	26	181	0.65	0.06	10.4
CAD DATA LSKL13UU	LSKL13	24	-0.013	44	3	0	1.5		17	22	1.5	4	13		4.6	8.3	28	52	36	251	1.11	0.07	13.4
CAD DATA LSKL16UU	LSKL16	31	0	50	3.5	+0.018	2	0	18	25	1.5	6	16	5	6.2	11.1	51	93	56	386	1.65	0.15	16.6
CAD DATA LSKL20UU	LSKL20	35		63	4		2.5		29	31.5	2	8	20		8.5	15.3	85	154	83	611	2.57	0.20	20.6
CAD DATA LSKL25UU	LSKL25	42		71	4		2.5		33	35.5	2	12	25		15.4	27.7	193	348	173	1248	4.04	0.29	25.8
CAD DATA LSKL30UU	LSKL30	47		80	4		2.5		42	40	2.5	17	30		18.5	33.3	272	490	212	1581	5.85	0.37	30.8
												1 k N	102kgf	1 N · m	0.102 kgf · m								

[Designation]

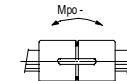
LSKL20 UU - 2 - E - H - 680 T M

See page B5

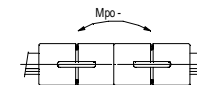
Note.1 NSB Economy ball spline are manufactured as set of sleeve and shaft , and are sold with sleeve installed on the shaft .

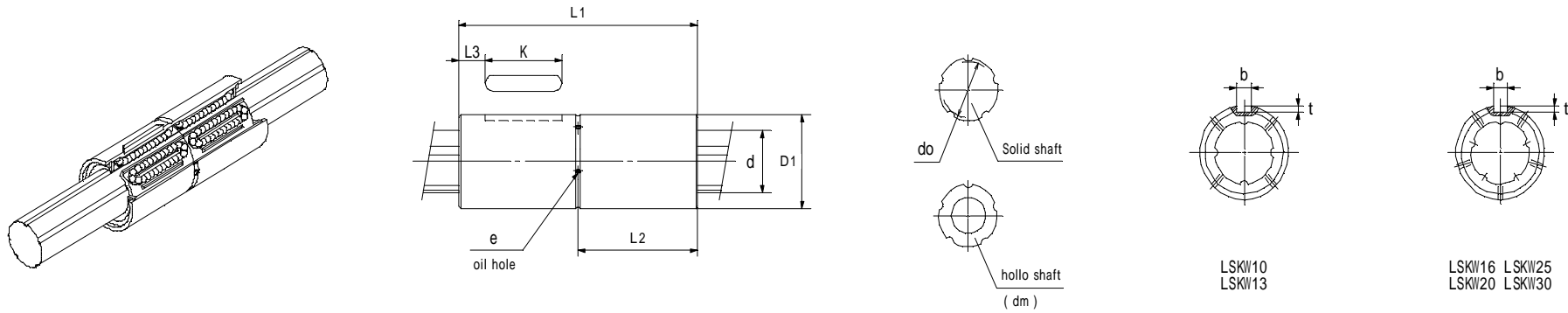
Type of sleeve
 With saels at both ends
 Number of sleeve per shaft
 Clearance (See page B8)
 Symbol for accuracy levels (See page 8)
 Shaft length [mm]
 Outer then standard stock T = With additional machining
 L = Without additional machining
 Symbol for hollow shaft (No symbol = Solid shaft)

Note.2 Static rated moment load Mpo- applies when one sleeve is positioned closely together. (See upper figure)



Note.3 Static rated moment load Mpo- applies when two sleeves are positioned closely together. (See lower figure)





(Unit : mm)

Type of sleeve	Outer Diameter		Total length	Key way				Oil hole	dm	Minor dia do	Number of grooves	Basic rated radial load (k N)		Basic rated torque (N · m)		Static rated moment (N · m)	Weight (kg)		Dia (h7) d												
	With seal	Without seal		D1	(h6)	L1	b (H8)					t	K	L2	L3		e	Dynamic Cr		Static Cor	Dynamic Ct	Static Cot	Mpo-	Shaft/m	Sleeve						
CAD DATA LSKW10UU	LSKW10	21	0	59	3	+0.014	1.5	+0.05	0	14	29.5	9.5	1.5	4	10	4	4.8	8.7	23	43	82	0.65	0.07	10.4							
CAD DATA LSKW13UU	LSKW13	24	-0.013	64	3	0	1.5										14	32	11	1.5	4	13	6.6	11.8	41	74	116	1.11	0.09	13.4	
CAD DATA LSKW16UU	LSKW16	31	0	74	3.5	+0.018	2	0	0	18	37	11.5	1.5	6	16	5	7.7	13.9	64	116	176	1.65	0.19	16.6							
CAD DATA LSKW20UU	LSKW20	35		84	4		2.5										20	42	13	2	8	20	9.3	16.7	93	168	228	2.57	0.23	20.6	
CAD DATA LSKW25UU	LSKW25	42		-0.016	110		4										2.5	29	55	15.5	2	12	25	21.6	38.9	271	488	640	4.04	0.37	25.8
CAD DATA LSKW30UU	LSKW30	47		122	4		2.5										33	61	16.5	2.5	17	30	24.7	44.4	363	653	787	5.85	0.50	30.8	
												1 k N	102kgf	1 N · m	0.102 kgf · m																

[Designation]

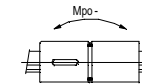
LSKW20 UU - 2 - E - H - 680 I M

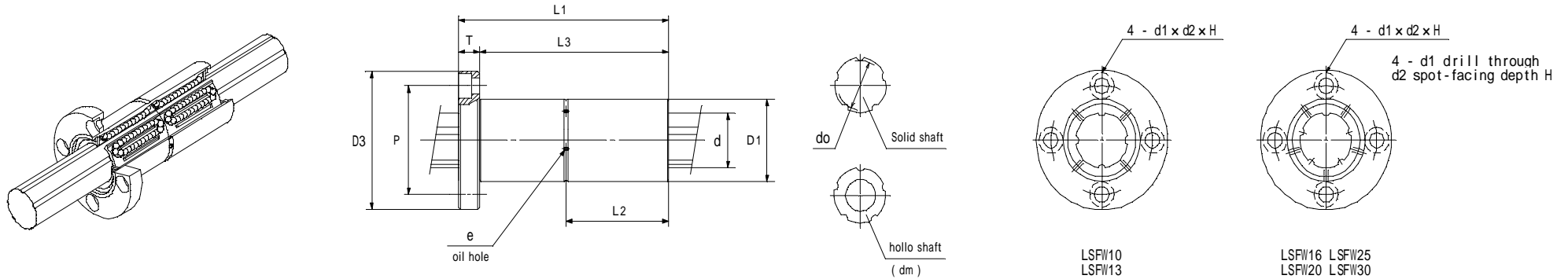
See page B5

Note.1 NSB Economy ball spline are manufactured as set of sleeve and shaft , and are sold with sleeve installed on the shaft .

Type of sleeve
 With saels at both ends
 Number of sleeve per shaft
 Clearance (See page B8)
 Symbol for accuracy levels (See page 8)
 Shaft length [mm]
 Outer then standard sto T = With additional machining
 L = Without additional machining
 Symbol for hollow shaft (No symbol = Solid shaft)

Note.2 Static rated moment load Mpo- applies when one sleeves are positioned closely together.





(Unit : mm)

Type of sleeve		Outer Diameter		Total length	Dimension of flange							Oil hole	Minor dia	Number of grooves	Basic rated radial load (k N)		Basic rated torque (N · m)		Static rated moment (N · m)	Weight (kg)		Dia (h7)				
With seal	Without seal	D1	(h6)		D3	T	P	d1	d2	H	L2				L3	e	dm	do		Dynamic Cr	Static Cor		Dynamic Ct	Static Cot	Mpo-	Shaft/m
CAD DATA	LSFW10UU	LSFW10	21	0	59	41	8	30	4.5	8	5.3	29.5	51	1.5	4	10	4	4.8	8.7	23	43	82	0.65	0.13	10.4	
CAD DATA	LSFW13UU	LSFW13	24	-0.013	64	45	8	34	4.5	8	5.3	32	56	1.5	4	13		6.6	11.8	41	74	116	1.11	0.15	13.4	
CAD DATA	LSFW16UU	LSFW16	31	0	74	52	8	40	4.5	8	5.3	37	66	1.5	6	16	5	7.7	13.9	64	116	176	1.65	0.27	16.6	
CAD DATA	LSFW20UU	LSFW20	35		84	60	10	46	5.5	9.5	6.3	42	74	2	8	20		9.3	16.7	93	168	228	2.57	0.40	20.6	
CAD DATA	LSFW25UU	LSFW25	42		-0.016	110	68	10	54	5.5	9.5	6.3	55	100	2	12		25	21.6	38.9	271	488	640	4.04	0.57	25.8
CAD DATA	LSFW30UU	LSFW30	47		122	77	12	60	6.6	12.5	7.6	61	110	2.5	17	30		24.7	44.4	363	653	787	5.85	0.72	30.8	
																		1 k N	102kgf	1 N · m	0.102 kgf · m					

[Designation]

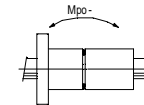
LSFW20 UU - 2 - E - H - 680 I M

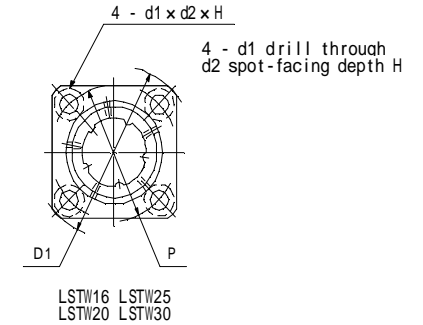
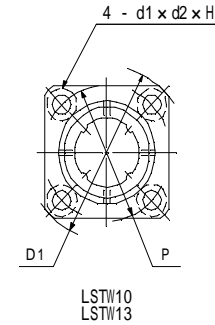
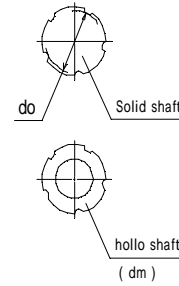
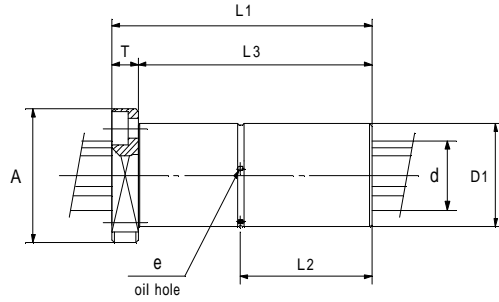
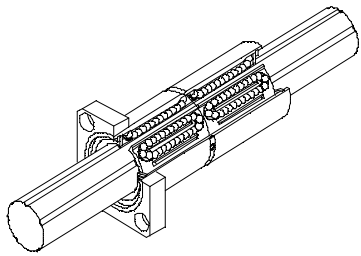
See page B5

Note.1 NSB Economy ball spline are manufactured as set of sleeve and shaft , and are sold with sleeve installed on the shaft .

Type of sleeve
 With saels at both ends
 Number of sleeve per shaft
 Clearance (See page B8)
 Symbol for accuracy levels (See page 8)
 Shaft length [mm]
 Outer then standard stock T = With additional machining
 L = Without additional machining
 Symbol for hollow shaft (No symbol = Solid shaft)

Note.2 Static rated moment load Mpo- applies when one sleeves are positioned closely together.





(Unit : mm)

CAD DATA	Type of sleeve		Outer Diameter		Total length	Dimension of flange							Oil hole	Minor dia	Number of grooves	Basic rated radial load (k N)		Basic rated torque (N·m)		Static rated moment (N·m)	Weight (kg)		Dia (h7)			
	With seal	Without seal	D1	(h6)		D3	T	P	d1	d2	H	L2				L3	e	dm	do		Dynamic Cr	Static Cor		Dynamic Ct	Static Cot	Mpo-
CAD DATA	LSTW10UU	LSTW10	21	0	59	32	41	8	30	4.5	8	5.3	29.5	51	1.5	4	10	4	4.8	8.7	23	43	82	0.65	0.12	10.4
CAD DATA	LSTW13UU	LSTW13	24	-0.013	64	35	45	8	34	4.5	8	5.3	32	56	1.5	4	13	4	6.6	11.8	41	74	116	1.11	0.13	13.4
CAD DATA	LSTW16UU	LSTW16	31	0 -0.016	74	39	52	8	40	4.5	8	5.3	37	66	1.5	6	16	5	7.7	13.9	64	116	176	1.65	0.22	16.6
CAD DATA	LSTW20UU	LSTW20	35		84	45	60	10	46	5.5	9.5	6.3	42	74	2	8	20	5	9.3	16.7	93	168	228	2.57	0.33	20.6
CAD DATA	LSTW25UU	LSTW25	42		110	51	68	10	54	5.5	9.5	6.3	55	100	2	12	25	5	21.6	38.9	271	488	640	4.04	0.47	25.8
CAD DATA	LSTW30UU	LSTW30	47		122	59	77	12	60	6.6	12.5	7.6	61	110	2.5	17	30	5	24.7	44.4	363	653	787	5.85	0.60	30.8
																			1 k N	102kgf	1 N·m	0.102 kgf·m				

[Designation]

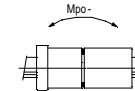
LSTW20 UU - 2 - E - H - 680 I M

See page B5

Note.1 NSB Economy ball spline are manufactured as set of sleeve and shaft , and are sold with sleeve installed on the shaft .

Type of sleeve
 With saels at both ends
 Number of sleeve per shaft
 Clearance (See page B8)
 Symbol for accuracy levels (See page 8)
 Shaft length [mm]
 Outer then standard stock T = With additional machining
 L = Without additional machining
 Symbol for hollow shaft (No symbol = Solid shaft)

Note.2 Static rated moment load Mpo- applies when one sleeves are positioned closely together.



Rotary Ball splines

Preface

NSB rotary ball splines of LS-R / LS-RY type are light weight, Compact and complex spline bearings which have been provided for both Functions of linear guide and rotary motion constructing precision-class deep groove ball bearings (ZZ type) on the spline sleeves of NSB Economy type ball splines and assembling in the spline housings directory as one unit.

NSB LK-R type Rotary ball spline is the space saving and low Price simple construction which has been installed precision-class deep groove ball bearings in the flange and on the spline sleeve. When LK-R type is used together with LS-R type or LS-RY type as one unit, it is best suited for the case of large torque condition and Non-angular-rash.

Features

Handling is simple because this bearing is constructed in the way that steel balls do not fall off.

The high precision ball bearing have been installed with appropriate adjustment, then exact rotary motion can be obtained.

The unit construction is able to easy installation, so you can use it instantly by means of fix it on your equipments.

Because of nickel non-electrolysis plating upon spline housing and flange, so it is excellent to damage and rust on the surfaces.

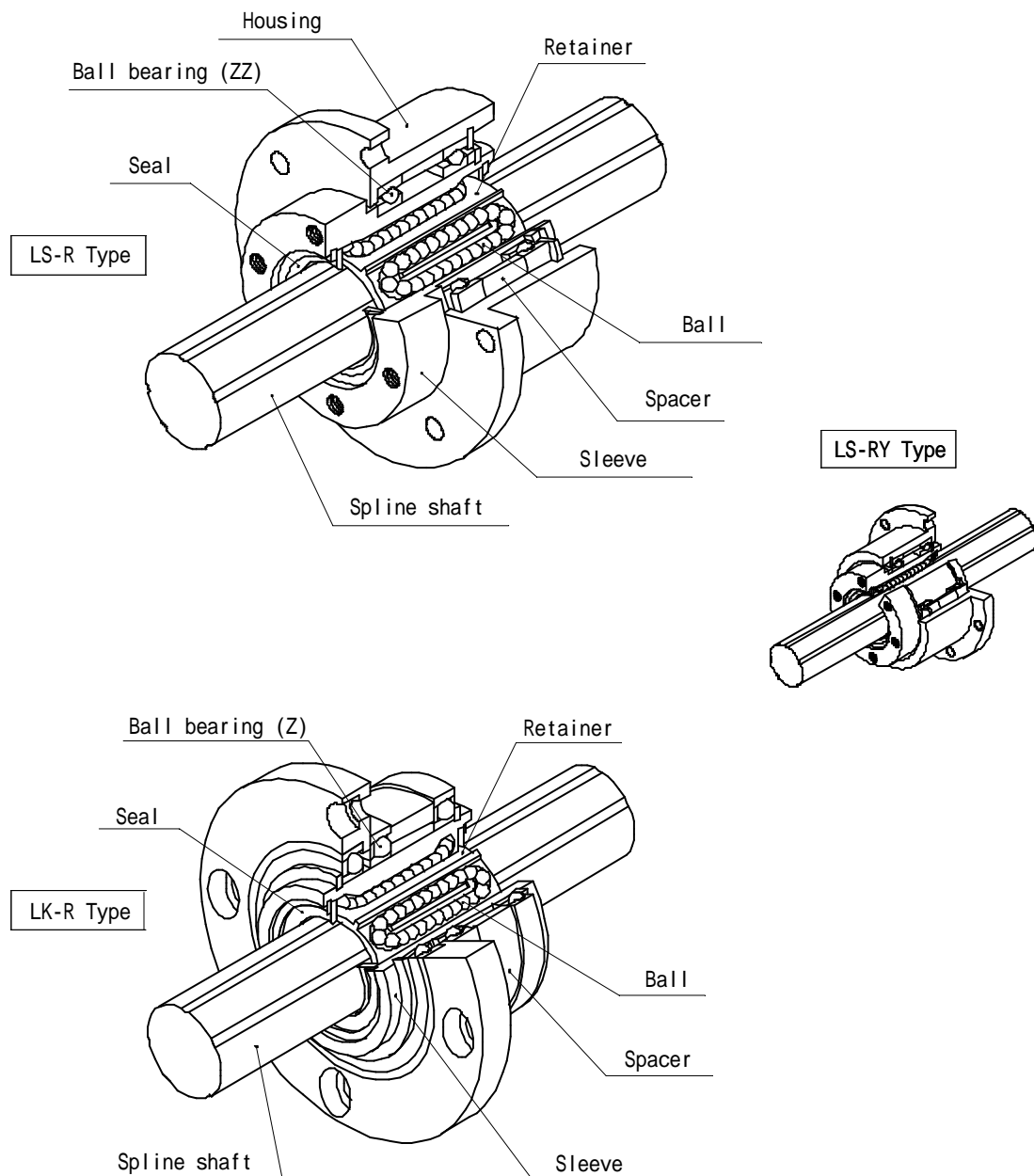
Applications

- Industrial robots
- Robots for taking out products
- Coil winding machines
- Inserting machines for electronic parts
- Semiconductor producing machines
- Electric terminal crimping machines
- Honing machines
- Robots for welding

Configuration

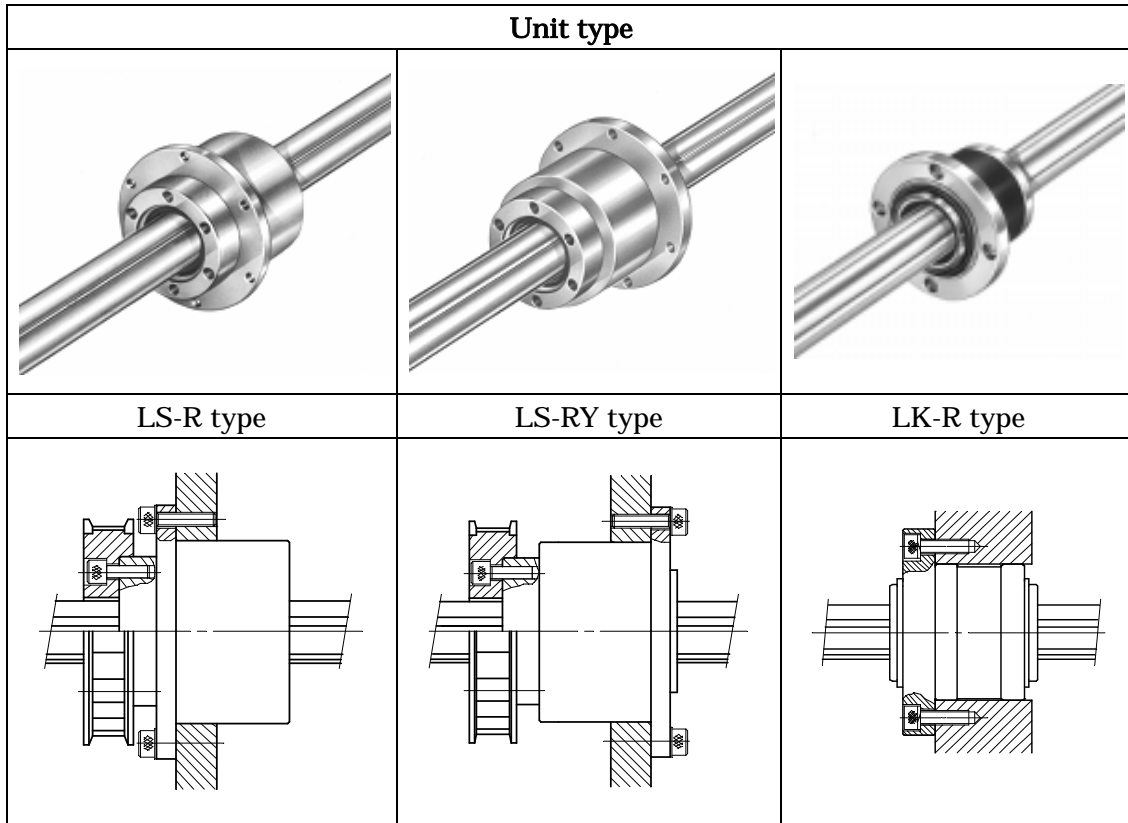
NSB rotary ball spline of LS-R / LS-RY type are composed of the spline shaft and moving unit on the shaft, as shown in Fig.4 - 1, the unit has been installed inside precision-class deep groove ball bearings and composed the retainer and balls in the spline sleeve in order to roll the unit freely at the longitudinal direction. This type ball spline can be consistent with both rotary and linear Motions.

Fig 4-1



LK-R simple type rotary ball spline, as shown in Fig.4 - 1 (a), has been installed precision-class deep groove ball bearings in the flange and on the sleeve, and it can be assembled in the housing of most equipment directly.

Kind of the sleeve



Material . Heat treatment . Hardness

Table 4-1

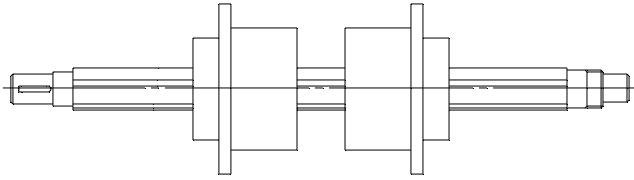
Item	Material	Heat treatment	Hardness
Spline shaft	SUJ 2	Induction hardening	HRC 58 up
Sleeve	SCM415	Carburizing hardening	HRC 58 up
Steel ball	SUJ 2	Hardening	HRC 60 up
Retainer	Synthetic resin	-	-
Housing	S45C	-	-

Designation

NSB Rotary ball splines are manufactured as set of unit and shaft ,and are sold with unit installed on the shaft .When you issue an order ,please use the following form.

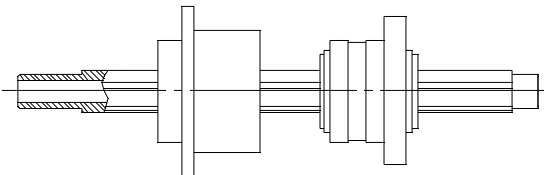
Table 4-2

LS20R - 2 - E - H - 680 T



Type of unit	LS20R
Number of unit per shaft	2
Clearance	E (Table 4-7 See page C8)
Symbol for accuracy levels	H (Table 4-6 See page C7 and See page 8)
Total length of shaft	680 mm
Other then standard stocks	T = with additional machining L = without additional machining

LS20R+LK20R - E - H - 450 T M



Type of unit	LS20R + LK20R
Clearance	E (Table 4-7 See page C8)
Symbol for accuracy levels	H (Table 4-6 See page C7 and See page 8)
Total length of shaft	450 mm
Other then standard stocks	T = with additional machining L = without additional machining
Symbol for hollow shaft No symbol = Solid shaft	M (Table 4-4 See page C5)

Spline shaft (Special design shaft)

Maximum length of the shafts

Maximum length of the spline shafts we manufacture is shown in Table 4-3. Longer shafts can be manufactured to order .Please contact NSB

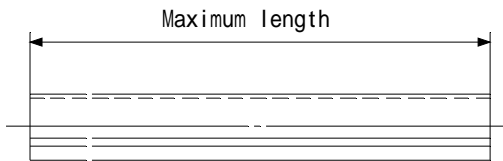


Table 4-3

Unit	Maximum length of the spline shaft (mm)
6	250
8	350
10	500
13	800
16	1000
20	1500
25	2000
30	2400

Hollow shaft (M-mark)

We will supply hollow shafts as shown in Table 4-4, when reduction of spline shaft weight or air passage through the shaft is necessary.

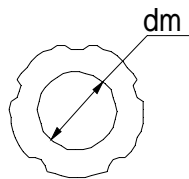


Table 4-4

Unit	Reduction of weight dm (mm)
6	2
8	3
10	4
13	4
16	6
20	8
25	12
30	17

Incomplete length of the groove

When stepped machining is necessary ,use incomplete length L_t of spline shaft indicated in Table 4-5.

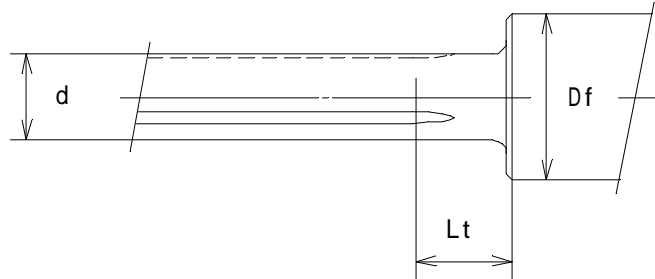


Table4-5

(mm)

Shaft dia d	D f												
	6	8	10	13	16	20	25	30	35	40	50	60	80
6	5	11	14	18	21	25	-	-	-	-	-	-	-
8	-	5	11	16	19	23	27	30	-	-	-	-	-
10.4	-	-	-	12	17	21	25	29	-	-	-	-	-
13.4	-	-	-	-	12	18	23	27	30	-	-	-	-
16.6	-	-	-	-	-	14	20	25	28	31	-	-	-
20.6	-	-	-	-	-	-	15	21	25	29	34	-	-
25.8	-	-	-	-	-	-	-	15	21	25	32	36	-
30.8	-	-	-	-	-	-	-	-	15	21	29	34	41

Accuracy Standard

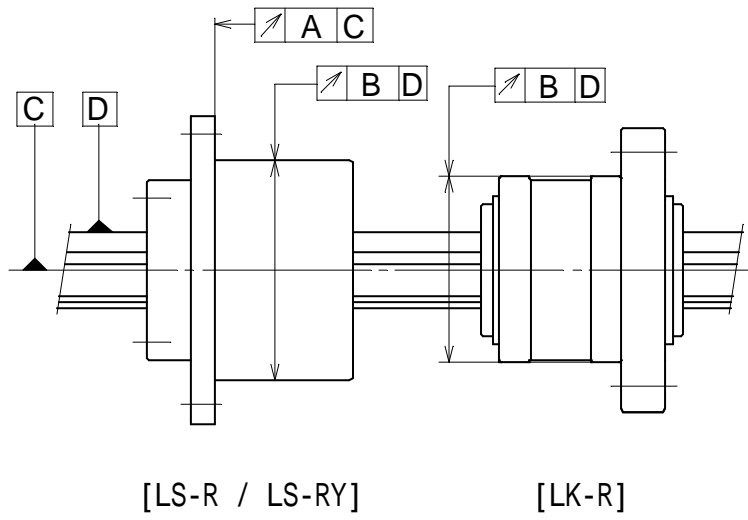


Table4-6

(Unit:mm)

Unit	Grade (H)	
	A	B
6	0.016	0.021
8		
10	0.018	
13		
16	0.021	
20		
25		
30		

Clearance

For NSB Rotary ball splines , appropriate clearance adapted to usage is necessary in order to obtain long life and high accuracy. Please select correct clearance for the application.

Table 4-7 (Unit:mm)

Shaft diameter (mm)	E0	E	Normal (No symbol)
6		0.006	0.001
8		~	~
10.4		0.001	+0.004
13.4	0.012	0.008	0.002
16.6	~	~	~
20.6	0.006	0.002	+0.005
25.8	0.014	0.008	0.002
30.8	~	~	~
	0.006	0.002	+0.006
Condition of operation	<ul style="list-style-type: none"> • Receiving severe vibration or shock. • Receiving overhanded load. • Places requiring high stiffness and exposed. 	<ul style="list-style-type: none"> • Receiving weak vibration or shock. • Places with alternating loads. 	<ul style="list-style-type: none"> • When smooth driving with small power is necessary. • Receiving load in one direction only.

Remarks for application

In installing the sleeve to the housing ,care should be taken not to afford shock to the sleeve.

For assembling sleeve to spline shaft ,insert gently keeping sleeve axis parallel to the shaft .Do not pry.

This type is easy to handle ,because it has a retainer .The retainer ,however ,is made of synthetic resin ,thus it can not bear high temperature. Operating temperature should be between - 40 to + 80 .

Relative location of spline grooves ,key groove on the outer surface of sleeve ,and mounting holes for the flange are shown in the drawing indicating dimensions for each types.

If additional machining of spline shaft is necessary ,chamfering of shaft end face should be more than C0.5 .(more than 0.5 mm chamfer)

Fit

For the fit value in installing NSB Rotary ball spline into housing box , we recommend the figure in Table 4-8.

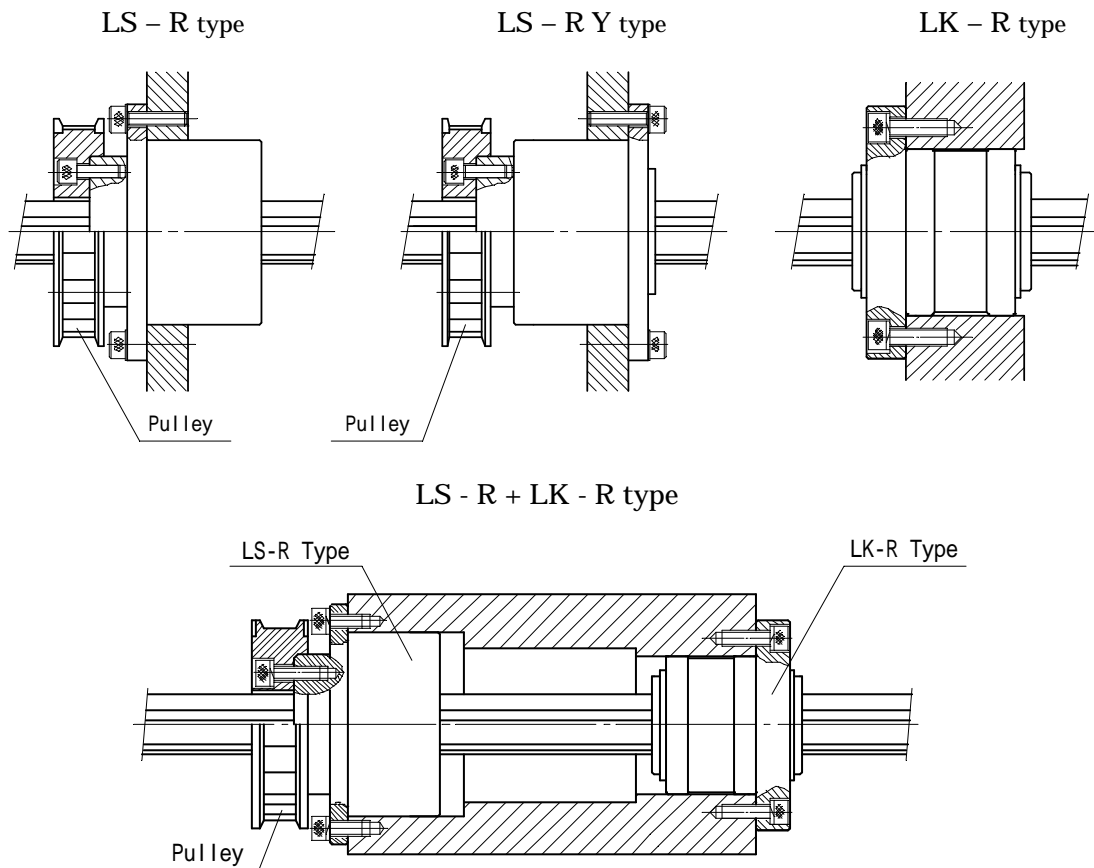
Table 4-8

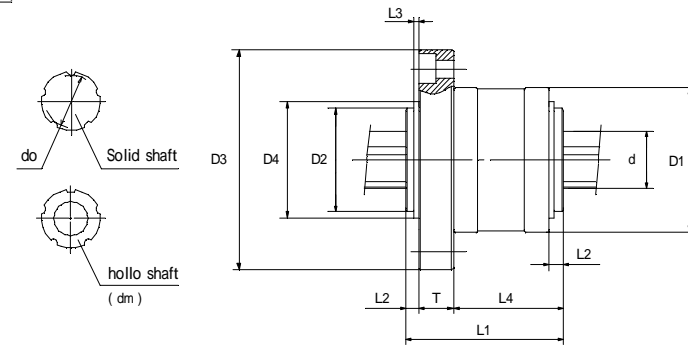
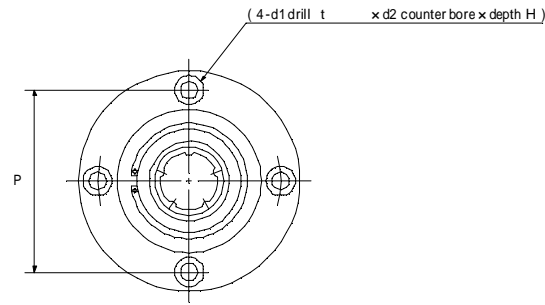
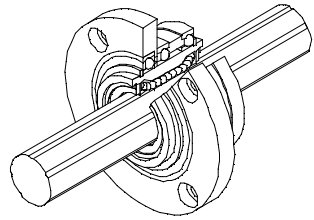
(Unit : mm)

Type	Loose fit (H 7)	Type	Tol.
LS6R LS6RY	+0.018	LK6R	+0.016
LS8R LS8RY	0	LK8R	+0.003
LS10R LS10RY	+0.021	LK10R	+0.020
LS13R LS13RY	0	LK13R	+0.020
LS16R LS16RY	+0.025	LK16R	+0.004
LS20R LS20RY	+0.025	LK20R	+0.004
LS25R LS25RY	0	LK25R	+0.025
LS30R LS30RY	0	LK30R	+0.005

Example of installation of the sleeve

Fig 4-2





(Unit : mm)

Unit type (With seal)	Outer diameter				Length					P	d1	d2	H	dm	Minor dia do	Number of grooves	Basic rated radial load (k N)		Static rated moment (N·m)		Unit radial ball bearings (k N)		Weight (kg)		Dia (h7) d	
	D1	(h5)	D2	D3	D4	L1	L2	L3	L4								T	Dynamic Cr	Static Cor	Mpo-	Mpo-	Dynamic Ca	Static Coa	Shaft/m		Unit
CAD DATA LK6R	24	⁰ / _{-0.009}	15	38	19.2	25	3	1	16	6	31	2.4	4.8	3.0	2	5.6	3	1.2	2.1	5	36	5.2	3.2	0.23	0.08	6
CAD DATA LK8R	26	⁰ / _{-0.011}	17	40	21.5	25	3	1	16	6	33	2.4	4.8	3.0	3	7.6		1.2	2.1	5	36	5.6	3.7	0.39	0.09	8
CAD DATA LK10R	32		20	50	25.0	33	3.5	1.2	21	8.5	41	3.4	6.5	4.5	4	10	4	2.4	4.3	15	102	10.0	6.2	0.65	0.17	10.4
CAD DATA LK13R	37	25	55	30.6	36	3.5	1.2	24	8.5	46	3.4	6.5	4.5	4	13	3.3		5.9	22	148	10.8	7.4	1.11	0.23	13.4	
CAD DATA LK16R	42	⁰ / _{-0.013}	30	64	36.1	41	4.5	1.5	28	8.5	53	4.5	8.0	5.5	6	16	5	3.8	6.9	32	216	11.8	9.1	1.65	0.33	16.6
CAD DATA LK20R	47		35	69	41.5	46	4.5	1.5	33	8.5	58	4.5	8.0	5.5	8	20		4.6	8.3	42	276	12.3	10.1	2.57	0.42	20.6
CAD DATA LK25R	52		40	74	47.8	60	6	1.75	45	9	63	4.5	8.0	5.5	12	25		10.8	19.4	113	773	12.8	11.0	4.04	0.53	25.8
CAD DATA LK30R	58		45	84	53.2	66	7	1.75	50	9	71	5.5	9.5	6.5	17	30		12.3	22.2	136	937	13.4	12.4	5.85	0.68	30.8
																			1 k N	102kgf						

[Designation]

LK20R - 2 - E - H - 680 T M

See page C4

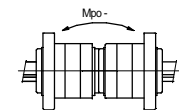
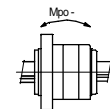
Note.1 NSB Rotary ball spline are manufactured as set of unit and shaft , and are sold with unit installed on the shaft .

Type of unit
 Number of sleeve per shaft
 Clearance (See page C8)
 Symbol for accuracy levels (See page C7)
 Shaft length [mm]
 Outer then standard stock
 T = With additional machining
 L = Without additional machining

Symbol for hollow shaft (No symbol = Solid shaft)

Note.2 Static rated moment load Mpo- applies when one unit is positioned closely together. (See upper figure)

Note.3 Static rated moment load Mpo- applies when two unit are positioned closely together. (See lower figure)



Super spline Bush

Super spline bush (SSB) is the unique and space-saving linear bearing for wide range use to both spline shaft or round shaft, when you use it as the ball spline, you can transmit some torque under low longitudinal friction, and otherwise you can it as the linear ball guide.

Features

In case of use SSB on the spline shaft, SSB is able to work as the ball spline transmitting some torque under low friction. otherwise use SSB on the round shaft, SSB can operate as the linear ball bearing (ball bush)

Circular groove has been manufactured as each race ways. consequently SSB has 3~4 times loading capacity and 30~50 times operating life longer than usual linear ball bearing.

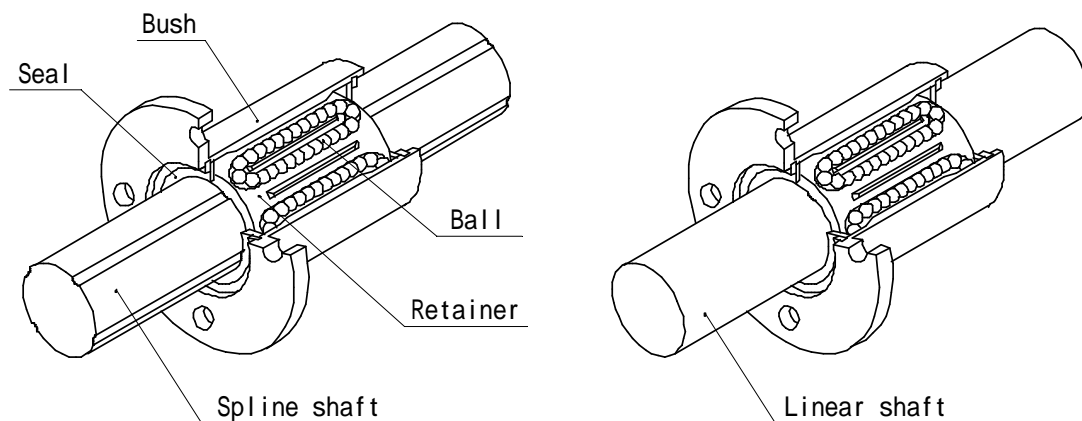
Outer diameters of SSB are equal to usual ball bushes. so you exchange them easily when larger loading capacities than the ball bushes are required.

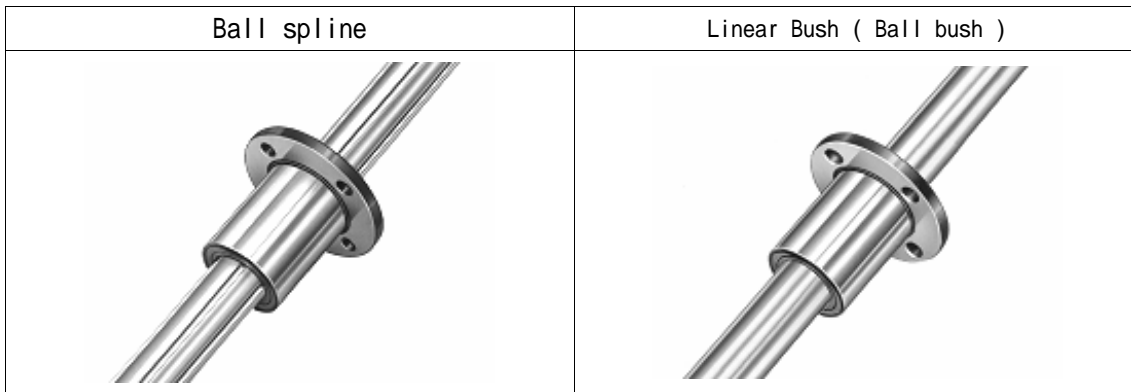
SSB is the compact, low price and long life bearing, so it is effective to reduce the final total working cost of the equipment.

Handling is simple because this bearing is constructed in the way that steel balls do not fall off.

Configuration

Fig 5-1





Material . Heat treatment . Hardness

Table 5-1

Item	Material	Heat treatment	Hardness
Spline shaft	SUJ 2	Induction hardening	HRC 58 up
Bush	SCM415	Carburizing hardening	HRC 58 up
Steel ball	SUJ 2	Hardening	HRC 60 up
Retainer	Synthetic resin	-	-

Accuracy standard

NSB Super spline Bush arc ranked Normal grade. high grade (H)
 .(Please refer page 8 of the Accuracy standard)

Fit

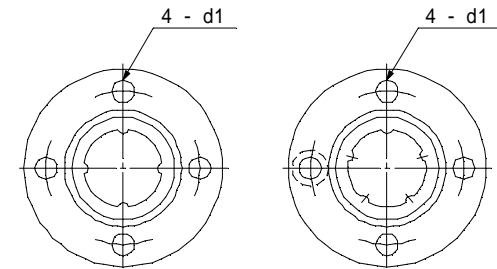
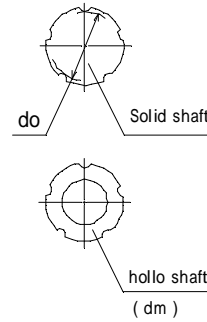
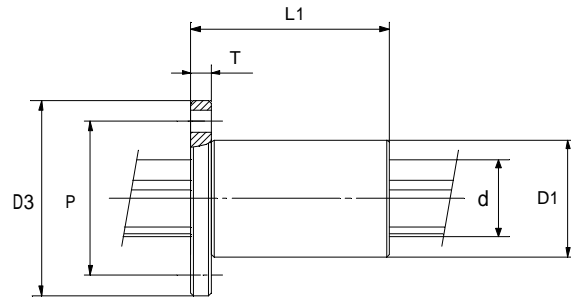
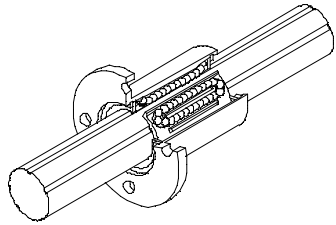
For the fit value in installing NSB Super spline bush into housing box, we recommend the figure in See B10 Table 3-7 (Loose fit (H 7)).

Clearance

For NSB Super spline bush , appropriate clearance adapted to usage is necessary in order to obtain long life and high accuracy. Please select correct clearance for the application. (Please refer page B8 of the clearance)

Remarks for application

Please see B9 of the Economy ball spline contents, regarding Cautions for application of SSB.



SSB10F
SSB13F

SSB16F SSB25F
SSB20F SSB30F

(Unit : mm)

CAD DATA	Type of bush		Outer Diameter		Total length L1	Dimension of flange				Minor dia do	Number of grooves	Basic rated radial load (k N)		Basic rated torque (N · m)		Static rated moment (N · m)		Weight (kg)		Maximum length of the shaft	Dia (h7) d	
	With seal	Without seal	D1	(h6)		D3	T	P	d1			dm	Dynamic Cr	Static Cor	Dynamic Ct	Static Cot	Mpo-	Mpo-	Shaft/m			Bush
CAD DATA	SSB10FUU	SSB10F	19	0 -0.013	32	38	4	28	4.5	4	10	4	0.74	2.04	10	18	7.6	50.8	0.65	0.05	400	10.4
CAD DATA	SSB13FUU	SSB13F	23		35	42	4	32	4.5	4	13		1.01	2.79	17	31	11.1	73.6	1.11	0.07	600	13.4
CAD DATA	SSB16FUU	SSB16F	28		40	48	4	38	4.5	6	16		1.19	3.28	27	49	16.6	109	1.65	0.98	800	16.6
CAD DATA	SSB20FUU	SSB20F	32	0 -0.016	45	56	5	44	5.5	8	20	5	1.43	3.94	40	72	21.8	140	2.57	0.14	1000	20.6
CAD DATA	SSB25FUU	SSB25F	40		58	64	5	52	5.5	12	25		3.33	9.14	116	208	56.8	386	4.04	0.25	1200	25.8
CAD DATA	SSB30FUU	SSB30F	45		64	72	6	58	6.5	17	30		3.80	10.45	155	280	68.2	469	5.85	0.32	1500	30.8

1 k N 102kgf 1 N · m 0.102 kgf · m

[Designation]

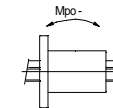
SSB20F UU - 2 - E - H - 680 I M

Note.1 NSB Super spline bush are manufactured as set of bush and shaft , and are sold with bush installed on the shaft .

Type of bush
With saels at both ends
Number of bush per shaft
Clearance (See page B8)
Symbol for accuracy levels (See page 8)
Shaft length [mm]
Outer then standard stock
T = With additional machining
L = Without additional machining

Symbol for hollow shaft (No symbol = Solid shaft)

Note.2 Static rated moment load Mpo- applies when one bush is positioned closely together. (See upper figure)



Note.3 Static rated moment load Mpo- applies when two bush are positioned closely together. (See lower figure)

