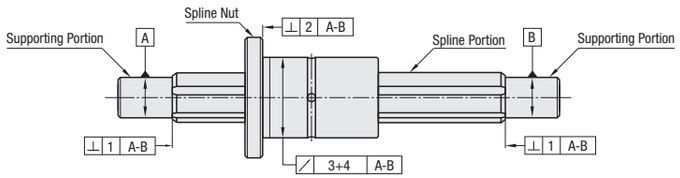
Ball Splines - Overview

Accuracy



Note: Supporting portion is the part to mount the bearing and support the spline shaft.

■**Spline Shaft: Raceway Twist Tolerance (Max.)** Unit: μm

Material	Tolerance
52100 Bearing Steel	13
440C Stainless Steel	33

Spline groove twist is measured at an arbitrary 100mm section of the effective shaft length. If the length to be evaluated is longer or shorter than 100mm, proportionally add or subtract from the standard values in the table.

■**Rotational Clearance** Unit: μm

No.	Standard Preload	
	52100 Bearing Steel	440C Stainless Steel
6	-2~+1	-1~+4
8		
10	-3~+1	-2~+5
13		
16		
20	-4~+2	-
25		
30		

■**Tolerance (Max) of Accuracies against Spline Shaft Supporting Portions** Unit: μm

No.	①Spline Portion Perpendicularity of End Face of the Shafts	②Flange Mounting Surface Perpendicularity
6	9 (22)	11 (27)
8		
10		13 (33)
13	11 (27)	16 (39)
16		
20		
25	13	19
30		

Values in ( ) are for 440C Stainless Steel.

No.	③Max. Runout of Spline Axis Line							
	~200	201~	316~	401~	501~	631~	801~	1001~
6	46 (72)	89	126	163	-	-	-	-
8								
10	36 (59)	54 (83)	68 (103)	82	102	-	-	-
13								
16	34 (56)	45 (71)	53 (83)	62	75	-	-	-
20								
25	32	39	44	50	57	68	83	102
30								

Values in ( ) are for 440C Stainless Steel.

No.	④Max. Runout of Spline Nut Outer Surface
6	11 (27)
8	
10	13 (33)
13	
16	16 (39)
20	
25	19
30	

Values in ( ) are for 440C Stainless Steel.

Calculation of Life

Running Life

· Radial Load

$$L=\left(\frac{ft\cdot fh\cdot fp}{fw}\cdot\frac{C}{F}\right)^3\cdot Lo$$

· Torque Load

$$L=\left(\frac{ft\cdot fh}{fw}\cdot\frac{Ct}{T}\right)^3\cdot Lo$$

L: Running Life (Km)
ft: Temperature Factor
fh: Hardness Factor
fp: Ratio of Rated Load
fw: Load Factor
Lo: Rated Life (50km)
C: Basic Dynamic Load Rating (N)
F: Applied Radial Load (N)
Ct: Basic Dynamic Torque (N·m)
T: Applied Torque (N·m)

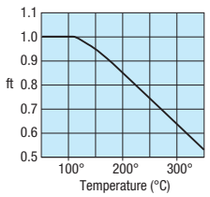
Life Hours

$$Lh=\frac{10^6\cdot L}{120\cdot St\cdot n}$$

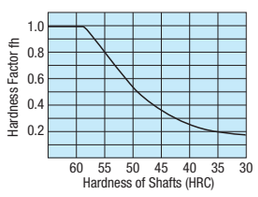
Lh: Running Time (hr)
L: Running Life (km)
St: Stroke Length (mm)
n: Reciprocating Cycles per Minute (cpm)

For values and factors, see below.

■**Temperature Factor (ft)**

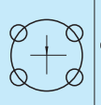
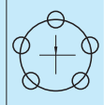


■**Hardness Factor (fh)**

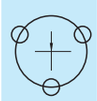
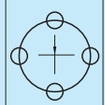
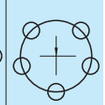


■**Ratio of Rated Load (fp)**

Load Fivided

No. 6, 8	No. 10, 13	No. 16, 20, 25, 30
		
fp=1	fp=1	fp=1

Direct Download

No. 6, 8	No. 10, 13	No. 16, 20, 25, 30
		
fp=1	fp=0.71	fp=0.68

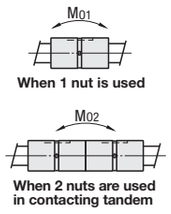
■**Load Factor (fw)**

Conditions of Use	Load Factor (fw)
Minimal vibrations / shocks (Low speed 15m/min or less)	1~2
Some vibrations / shocks (Medium speed 60m/min or less)	2~3
Significant vibrations / shocks (High speed over 60m/min.)	3 or more

■**Load Rating**

No.	Basic Rated Torque Dynamic Ct N·m	Basic Rated Torque Static Cot N·m	Basic Load Rating Dynamic C kN	Basic Load Rating Static Co kN	Allowable Static Moment M01 N·m	Allowable Static Moment M02 N·m	Sectional Moment of Inertia mm⁴
6	3.8	7	1.2	2.1	5	36	6.2x10
8	4.8	8.7	1.2	2.1	5	36	$1.97x10^2$
10	19 (11)	34 (21)	3.8 (2.4)	6.9 (4.3)	26 (15)	181 (102)	$5.57x10^2$
13	28 (20)	52 (37)	4.6 (3.3)	8.3 (5.9)	36 (22)	251 (148)	$1.55x10^3$
16	51	93	6.2	11.1	56	386	$3.61x10^3$
20	85	154	8.5	15.3	83	611	$8.74x10^3$
25	193	348	15.4	27.7	173	1248	$2.13x10^4$
30	272	490	18.5	33.3	212	1581	$4.373x10^4$

Values in ( ) are for 440C Stainless Steel.



If the number of nuts is 1, check the M_{01} column; and if the said number is 2, check the M_{02} column.

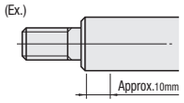
Operating Temp.

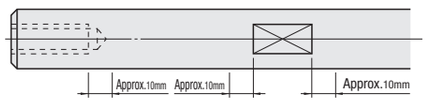
Plastic components are used in ball spline assemblies. Avoid using in high temperature environments, keep below 80°C.

Annealing Range

Spline Shafts are already hardened, and are to be annealed upon machining.
Annealing may lower hardness on the machined area +10mm fore and aft. (See the examples below). Furthermore, the annealing portions are out the guaranteed range of O.D. Tolerance.
When calculating stroke, count out the dimensions of annealing portions.

(Ex.)



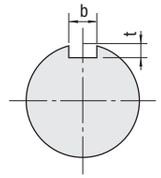


Annealing may lower hardness of the following parts:
· Threaded Ends
· Stepped Parts
· Tapped Ends
· Wrench flats, set screw flats, retaining ring grooves, tap alteration

Overview of Ball Spline Alteration / Grease Application Services

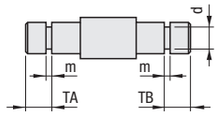
Alteration Overview

■**Dimensions of Key Grooves on the Shaft Ends (P and Q)**



P, Q	b	Tolerance (N9)	t	Tolerance
8, 10	3	-0.004 -0.029	1.8	+0.1 0
12	4	0 -0.030	2.5	
13~16	5		3.0	
20	6		3.5	
25	8	0 -0.036	4.0	+0.2 0

■**Dimensions of the Retaining Ring Groove on the Shaft Ends (P and Q)**



P, Q	Tolerance	m	Tolerance	d	Tolerance	Applicable Retaining Ring
3	0 -0.010	0.5	+0.05 0	2	+0.06 0	JIS E Type 2
4	0 -0.012	0.7	+0.1 0	3		JIS E Type 3
5				4	+0.075 0	JIS E Type 4
6				5.05		JIS E Type 5
8	0 -0.015	0.9		6.05		JIS E Type 6
10		1.15	+0.14 0	9.6	0 -0.09	JIS C Type 10
12	0 -0.018			11.5	0 -0.11	JIS C Type 12
13				12.4		JIS C Type 13
15				14.3		JIS C Type 15
16				15.2		JIS C Type 16
20	0 -0.021	1.35		19	0 -0.21	JIS C Type 20
25				23.9		JIS C Type 25

Lubrication

Ball splines are shipped greased.
Administer lubrication maintenance with Lithium soap based grease (Alvania Grease S2 by Showa Shell Sekiyu K.K), etc. as needed.

Various Grease Application Services

The Lubricant used for Ball Splines can be changed to any of the following Special Greases.
Service is provided to apply grease onto nuts and shafts. For performance of each grease, refer to the table below.

Type	Grease Product Name	Main Feature
L Type	ET–100K (Made by Kyodo Yushi)	High heat resistance and oxidation stability. Also high adhesion and cohesion with limited splash or leakage.
G Type	LG2 (Made by NSK Ltd.)	Suitable for clean environment due to low particle generation grease. Highly resistant to corrosion.

■**Grease Performance**

Item		Conditions	Unit	Measurement Method	L Type	G Type
Grease Performance	Thickener	-	-	-	Aromatic Diurea	Lithium Type
	Base Oil	-	-	-	Ether Synthetic Oil	Mineral Oil + Synthetic Hydrocarbon Oil
	Base Oil Kinetic Viscosity	40°C	mm²/s	JIS K2220 5.19	103	30
		100°C			12.8	-
	Miscible Consistency	-	-	JIS K2220 5.3	280	207
	Dropping Point	-	°C	JIS K2220 5.4	<260	200
	Evaporation Amount	99°C x 22hr	wt%	-	0.15%	1.40%
	Oil Separation	100°C x 24hr	wt%	JIS K2220 514	1.2%	0.8%
	Operating Temp.	In Air	°C	-	-40~200	-10~80

■**Precautions for Use**
For Particle Generation Amount upon grease application, refer to the "Comparison of Particle Generation (Experimental Values)" section on **P.266**, "Linear Bushings."
If G Type grease, Low Miscible Consistency grease, is applied onto the small dia. portion (No. 6, 8, or 10), resistance may be increased, and thus, sliding motion may be degraded.

Ordering Example — Part Number
BSSS8L-300 (L Type Greased)
BSSS8G-300 (G Type Greased)
Please add L or G after part number of Regular Type when placing an order.

Price: Configure Online

Days to Ship: Configure Online

■**Grease Application Service Charges Table**

Part Number (No.)	Unit Price (Add to the price of Standard Type) Nut 1 pc.	Nut 2 pcs.
6≤No.≤13		
16≤No.≤30		

Alterations: Part Number - L - M - (SC, FC ··· etc.)
BSFS10G - 350 - M5 - SC15
Confirm the details of alterations from each page.