

# Ball Splines - Overview

# Overview of Ball Spline Alterations / Grease Application Services

## Accuracy

**■ Spline Shaft: Raceway Twist Tolerance (Max.)**  
Unit:  $\mu\text{m}$

Material	Tolerance
EN 1.3505 Equiv.	13
EN 1.4125 Equiv.	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.

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

**■ Rotational Clearance** Unit:  $\mu\text{m}$

No.	Standard Preload	EN 1.3505 Equiv.	EN 1.4125 Equiv.
6	-2~+1	-	-1~+4
8	-	-3~+1	-
10	-	-	-2~+5
13	-	-	-
16	-	-	-
20	-	-	-
25	-4~+2	-	-
30	-	-	-

Ⓜ Values in ( ) are for EN 1.4125 Equiv.

**■ Tolerance (Max) of Accuracies against Spline Shaft Supporting Sections** Unit:  $\mu\text{m}$

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

Ⓜ Values in ( ) are for EN 1.4125 Equiv.

**③ Max. Runout of Spline Axis Line**

No.	-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 EN 1.4125 Equiv.

**④ Max. Runout of Spline Nut Outer Surface**

No.	11(27)	13(33)	16(39)	19
6	11(27)	-	-	-
8	-	13(33)	-	-
10	-	-	16(39)	-
13	-	-	-	19
16	-	-	-	-
20	-	-	-	-
25	-	-	-	-
30	-	-	-	-

Ⓜ Values in ( ) are for EN 1.4125 Equiv.

## Calculation of Life

### Running Life

**● Radial Load**

$$L = \left( \frac{ft \cdot fh \cdot fp \cdot C}{fw \cdot F} \right)^3 \cdot L_0$$

**● Torque Load**

$$L = \left( \frac{ft \cdot fh \cdot Ct}{fw \cdot T} \right)^3 \cdot L_0$$

**L: Running Life (km)**  
**ft: Temperature Factor**  
**fh: Hardness Factor**  
**fp: Ratio of Rated Load**  
**fw: Load Factor**  
**L0: 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)**

**Lh =  $\frac{106 \cdot L}{120 \cdot St \cdot n}$**   
**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)**

**Distributed Load**

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

**Direct Download**

No.	No.6, 8	No.10, 13	No.16, 20, 25, 30
fp	1	0.71	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		Basic Load Rating		Allowable Static Moment		Cross Sectional Moment of Inertia mm <sup>4</sup>
	Dynamic Ct N · m	Static Cot N · m	Dynamic C kN	Static Co kN	Mo1 N · m	Mo2 N · m	
6	3.8	7	1.2	2.1	5	36	6.2x10 <sup>3</sup>
8	4.8	8.7	1.2	2.1	5	36	1.97x10 <sup>4</sup>
10	19(11)	34(21)	3.8(2.4)	6.9(4.3)	26(15)	181(102)	5.57x10 <sup>4</sup>
13	28(20)	52(37)	4.6(3.3)	8.3(5.9)	36(22)	251(148)	1.55x10 <sup>5</sup>
16	51	93	6.2	11.1	56	386	3.61x10 <sup>5</sup>
20	85	154	8.5	15.3	83	611	8.74x10 <sup>5</sup>
25	193	348	15.4	27.7	173	1248	2.13x10 <sup>6</sup>
30	272	490	18.5	33.3	212	1581	4.37x10 <sup>6</sup>

Ⓜ Values in ( ) are for EN 1.4125 Equiv.

Ⓜ If the number of nuts is 1, check the Mo1 column; if the said number is 2, check the Mo2 column.

## Operating Temp.

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

## Alteration Overview

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

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

**■ Dimensions of the Retaining Ring Grooves 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	0.7	+0.1 0	3	0	JIS E Type 3
5	-0.012	0.9	0	4	+0.075 0	JIS E Type 4
6	0	1.15	0	5.05	0	JIS E Type 5
8	-0.015	1.35	0	6.05	0	JIS E Type 6
10	0	1.5	0	9.6	0 -0.09	JIS C Type 10
12	0	1.5	+0.14 0	11.5	0	JIS C Type 12
13	-0.018	1.5	0	12.4	-0.11	JIS C Type 13
15	0	1.5	0	14.3	0	JIS C Type 15
16	0	1.5	0	15.2	0	JIS C Type 16
20	0	1.5	0	19	0	JIS C Type 20
25	-0.021	1.5	0	23.9	-0.21	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. for a mileage of 100km.

## 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 on nuts and shafts. For performance of each grease, refer to the table below.

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

## Precautions for Use

- For Particle Generation Amount upon grease application, refer to the "Comparison of Particle Generation (Experimental Values)" section of "Linear Bushings." P304
- 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.

## Annealing Range

Spline Shafts are already hardened, and must be annealed before machining. Annealing may lower hardness on the machined area +10mm fore and aft. (See the examples below). Furthermore, the annealing portions are out of 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 sections:

- Threaded Ends
- Stepped Parts
- Tapped Ends
- Wrench flats, set screw flats, retaining ring grooves, tap alteration

**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.

Add the price in the table below to the unit price of applicable standard product.  
 <Price Calculation Example> BSSS8G-300 (Standard)  
 (Standard Type Unit Price) + (Unit Price in the Table Below) = (Total)

**■ 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: BSFS10G - L - M - (SC, FC...etc.)  
 BSFS10G - 350 - M5 - SC15

Confirm the details of alterations on each page.