

# Rotary Ball Spline

Geared Types: Model LBG and Model LBGT

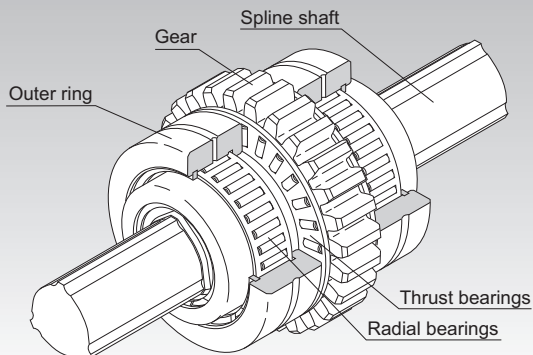


Fig. 1: Structure of Rotary Ball Spline Model LBG

<b>Selection Criteria</b>	<b>A3-6</b>
<b>Design Highlights</b>	<b>A3-125</b>
<b>Options</b>	<b>A3-128</b>
<b>Model No.</b>	<b>A3-130</b>
<b>Handling Precautions</b>	<b>A3-131</b>
<b>Lubrication Accessories</b>	<b>A24-1</b>
<b>Mounting Procedure and Maintenance</b>	<b>B3-32</b>
Cross-Sectional Characteristics of the Spline Shaft	<b>A3-17</b>
Equivalent Factor	<b>A3-29</b>
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Maximum Manufacturing Lengths by Accuracy	<b>A3-123</b>

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## Structure and Features

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With the rotary ball spline, the spline shaft has three crests on its circumference. Along both sides of each crest, two rows of balls (six rows in total) are arranged to hold the crest so that a reasonable preload is applied.

These models are unit types based on model LBR, but they have gear teeth machined on the flange circumference and radial and thrust bearings integrated compactly into the spline nut.

The rows of balls are held in a special resin retainer so that they smoothly roll and circulate. With this design, balls will not fall out even if the spline shaft is removed.

### No Angular Backlash

The spline shaft has three crests positioned equidistantly every  $120^\circ$ . Along both sides of each crest, two rows of balls (six rows in total) are arranged so as to hold the crest at a contact angle of  $45^\circ$  and provide a preload. As a result, backlash in the rotational direction is eliminated and the rigidity is increased.

### Compact Design

The spline nut achieves space-saving design thanks to its compactly integrated radial and thrust bearings.

### High Rigidity

Since the contact angle is large and an appropriate preload is applied, high rigidity against torque and moment is achieved.

Use of needle bearings in the support unit achieves a rigid nut support strong against a radial load.

### Optimal for Torque Transmission with Spline Nut Drive

Since the support bearings allow a rigid nut support, these models are optimal for torque transmission with spline nut drive.

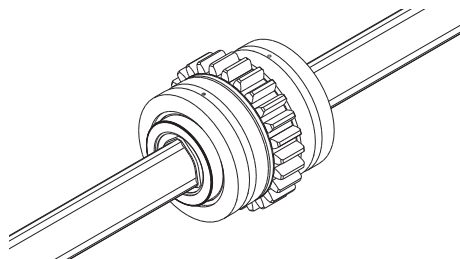
## Types and Features

### Types of Spline Nuts

#### Ball Spline with Gears Model LBG

Dimensional Table⇒ [A3-104](#)

This model is a unit type based on model LBR, but it has gear teeth machined on the flange circumference and radial and thrust bearings compactly integrated in the spline nut. It is optimal for a torque transmission mechanism with spline nut drive.

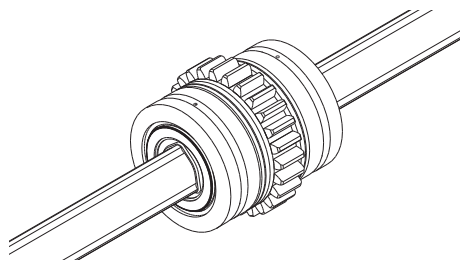


Without a thrust raceway

#### Ball Spline with Gears Model LBGT

Dimensional Table⇒ [A3-106](#)

This model is a unit type based on model LBR, but it has gear teeth machined on the flange circumference and radial and thrust bearings compactly integrated in the spline nut. It is optimal for a torque transmission mechanism with spline nut drive.



With a thrust raceway

### Types of Spline Shafts

For details, see [A3-59](#).

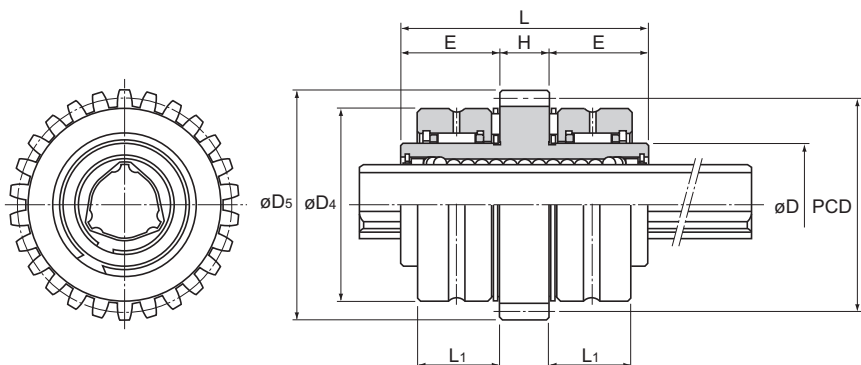
## Housing Inner-Diameter Tolerance

Table 1 shows housing inner-diameter tolerance for models LBG and LBGT.

Table 1: Housing Inner-Diameter Tolerance

Housing inner-diameter tolerance	General conditions	H7
	When clearance needs to be small	J6

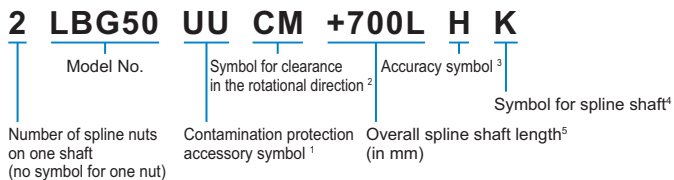
# Model LBG



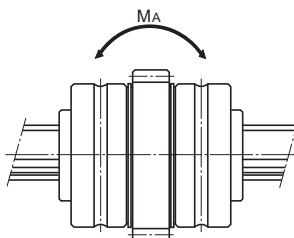
Model No.	Spline nut dimensions									
	Spline nut outer diameter		Length		Outer diameter		Width		H	E
	D	Tolerance	L	Tolerance	D <sub>4</sub>	Tolerance	L <sub>1</sub>	Tolerance		
● LBG 20	30	$\begin{matrix} 0 \\ -0.009 \end{matrix}$	60	$\begin{matrix} 0 \\ -0.2 \end{matrix}$	47	$\begin{matrix} 0 \\ -0.011 \end{matrix}$	20	$\begin{matrix} 0 \\ -0.16 \end{matrix}$	12	24
● LBG 25	40	$\begin{matrix} 0 \\ -0.011 \end{matrix}$	70		60	$\begin{matrix} 0 \\ -0.013 \end{matrix}$	23	$\begin{matrix} 0 \\ -0.19 \end{matrix}$	14	28
● LBG 30	45		80		65	27	16		32	
● LBG 40	60	$\begin{matrix} 0 \\ -0.013 \end{matrix}$	100	$\begin{matrix} 0 \\ -0.3 \end{matrix}$	85	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	31	$\begin{matrix} 0 \\ -0.25 \end{matrix}$	18	41
● LBG 50	75		112		100		32		20	46
● LBG 60	90	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	127		120		38		22	52.5
● LBG 85	120		155		150	$\begin{matrix} 0 \\ -0.025 \end{matrix}$	40		26	64.5

●: Indicates model numbers for which felt seals are available (see **A3-128**).

## Model number coding



<sup>1</sup> See **A3-128**. <sup>2</sup> See **A3-32**. <sup>3</sup> See **A3-37**. <sup>4</sup> See **A3-108**. <sup>5</sup> See **A3-123**.



Unit: mm

	Gear specifications <sup>1</sup>				Basic torque rating		Basic load rating		Static permissible moment	Mass	
	Tip circle diameter $D_s$	Standard pitch diameter PCD	Module $m$	Number of teeth $z$	$C_T$ N·m	$C_{OT}$ N·m	$C$ kN	$C_0$ kN	$M_A^2$ N·m	Spline nut unit kg	Spline shaft kg/m
	56	52	2	26	90.2	213	9.4	20.1	103	0.61	1.8
	70	65	2.5	26	176	381	14.9	28.7	171	1.4	2.7
	75	70	2.5	28	312	657	22.5	41.4	295	2.1	3.8
	96	90	3	30	696	1,420	37.1	66.9	586	3	6.8
	111	105	3	35	1,290	2,500	55.1	94.1	941	4.1	10.6
	133	126	3.5	36	1,870	3,830	66.2	121	1,300	6.3	15.6
	168	160	4	40	4,740	9,550	119	213	3,180	11.8	32

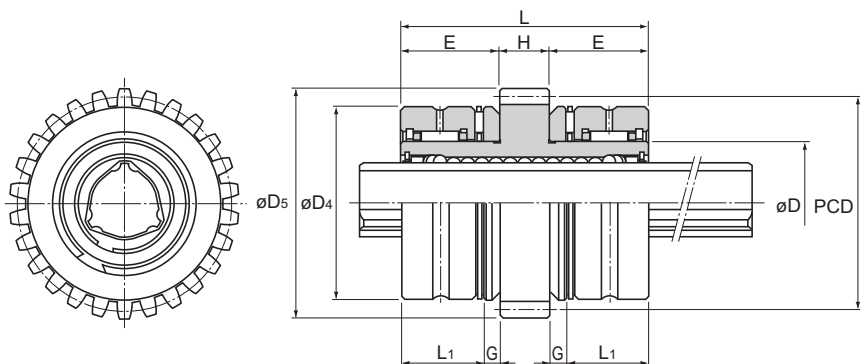
<sup>1</sup> The gear specifications in the table represent the dimensions with the highest possible module value.

Special gear types such as a helical gear and a worm gear can also be manufactured at your request.

<sup>2</sup>  $M_A$  indicates the permissible moment value in the axial direction when a single spline nut is used, as shown in the figure above.

Note: For details on the maximum lengths of ball spline shafts by accuracy, please see **A3-123**.

# Model LBGT



Model No.	Spline nut dimensions										
	Spline nut outer diameter		Length		Outer diameter		Width		Thrust raceway width	H	E
	D	Tolerance	L	Tolerance	D <sub>4</sub>	Tolerance	L <sub>1</sub>	Tolerance			
● LBGT 20	30	<sup>0</sup> <sub>-0.009</sub>	60	0 -0.2	47	<sup>0</sup> <sub>-0.011</sub>	20	<sup>0</sup> <sub>-0.16</sub>	4	12	24
● LBGT 25	40	<sup>0</sup> <sub>-0.011</sub>	70		60	<sup>0</sup> <sub>-0.013</sub>	23	<sup>0</sup> <sub>-0.19</sub>	5	14	28
● LBGT 30	45	<sup>0</sup> <sub>-0.011</sub>	80		65	<sup>0</sup> <sub>-0.015</sub>	27	<sup>0</sup> <sub>-0.25</sub>	5	16	32
● LBGT 40	60	<sup>0</sup> <sub>-0.013</sub>	100	0 -0.3	85	<sup>0</sup> <sub>-0.025</sub>	31	0 -0.25	8	18	41
● LBGT 50	75	<sup>0</sup> <sub>-0.015</sub>	112		100	<sup>0</sup> <sub>-0.025</sub>	32		10	20	46
LBGT 60	90	<sup>0</sup> <sub>-0.015</sub>	127		120	<sup>0</sup> <sub>-0.025</sub>	38		12	22	52.5
● LBGT 85	120	<sup>0</sup> <sub>-0.015</sub>	155		150	<sup>0</sup> <sub>-0.025</sub>	40		16	26	64.5

● : Indicates model numbers for which felt seals are available (see **A3-128**).

## Model number coding

**2 LBGT40 UU CL +700L P K**

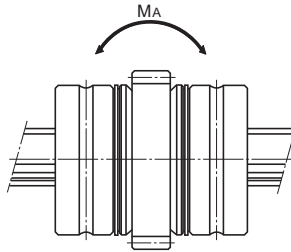
Model No.  
Number of spline nuts on one shaft (no symbol for one nut)

Symbol for clearance in the rotational direction<sup>2</sup>  
Contamination protection accessory symbol<sup>1</sup>

Accuracy symbol<sup>3</sup>  
Overall spline shaft length<sup>5</sup> (in mm)

Symbol for spline shaft<sup>4</sup>

<sup>1</sup> See **A3-128**. <sup>2</sup> See **A3-32**. <sup>3</sup> See **A3-37**. <sup>4</sup> See **A3-108**. <sup>5</sup> See **A3-123**.



Unit: mm

	Gear specifications <sup>1</sup>				Basic torque rating		Basic load rating		Static permissible moment	Mass	
	Tip circle diameter $D_s$	Standard pitch diameter PCD	Module $m$	Number of teeth $z$	$C_T$ N·m	$C_{OT}$ N·m	$C$ kN	$C_0$ kN	$M_A^2$ N·m	Spline nut unit kg	Spline shaft kg/m
	56	52	2	26	90.2	213	9.4	20.1	103	0.67	1.8
	70	65	2.5	26	176	381	14.9	28.7	171	1.5	2.7
	75	70	2.5	28	312	657	22.5	41.4	295	2.2	3.8
	96	90	3	30	696	1,420	37.1	66.9	586	3.3	6.8
	111	105	3	35	1,290	2,500	55.1	94.1	941	4.8	10.6
	133	126	3.5	36	1,870	3,830	66.2	121	1,300	7.2	15.6
	168	160	4	40	4,740	9,550	119	213	3,180	13.4	32

<sup>1</sup> The gear specifications in the table represent the dimensions with the highest possible module value.

Special gear types such as a helical gear and a worm gear can also be manufactured at your request.

<sup>2</sup>  $M_A$  indicates the permissible moment value in the axial direction when a single spline nut is used, as shown in the figure above.

Note: For details on the maximum lengths of ball spline shafts by accuracy, please see **A3-123**.

## Spline Shaft

Spline shafts are divided by shape into precision solid spline shafts, special spline shafts, and hollow spline shafts (type K), as described on **A3-59**.

Spline shafts can be produced with various shapes according to customer requests. Please provide a drawing of the desired shaft shape when asking for an estimate or placing an order.

### Cross-Sectional Shape of the Spline Shaft

Table 2 shows the cross-sectional shape of a spline shaft. When the spline shaft ends need to be cylindrical, if possible, the width should not exceed the minor diameter ( $\phi d$ ) value of the shaft.

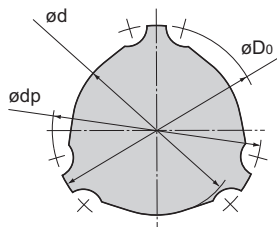


Table 2: Cross-Sectional Shape of the Spline Shaft

Unit: mm

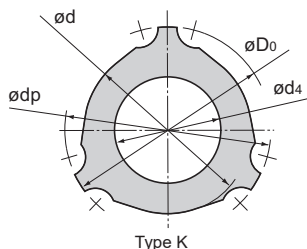
Nominal shaft diameter	20	25	30	40	50	60	85
Minor diameter $\phi d$	15.3	19.5	22.5	31	39	46.5	67
Major diameter $\phi D_0$	19.7	24.5	29.6	39.8	49.5	60	84
Ball center-to-center diameter $\phi dp$	20	25	30	40	50	60	85
Mass (kg/m)	1.8	2.7	3.8	6.8	10.6	15.6	32

Note: The minor diameter  $\phi d$  must be a value at which no groove is left after machining.

### Hole Shape of the Standard Hollow Spline Shaft

Table 3 shows the hole shape of the standard hollow spline shaft (type K) for models LBG and LBGT.

Use this table when a requirement such as piping, wiring, air ventilation, or weight reduction needs to be met.



Type K

Table 3: Cross-Sectional Shape of the Standard Hollow Spline Shaft

Unit: mm

Nominal shaft diameter	20	25	30	40	50	60	85
Minor diameter $\phi d$	15.3	19.5	22.5	31	39	46.5	67
Major diameter $\phi D_0$	19.7	24.5	29.6	39.8	49.5	60	84
Ball center-to-center diameter $\phi dp$	20	25	30	40	50	60	85
Hole diameter $\phi d_1$	6	8	12	18	24	30	45
Mass (kg/m)	1.6	2.3	2.9	4.9	7	10	19.5

Note: The minor diameter  $\phi d$  must be a value at which no groove is left after machining.

### Chamfering of the Spline Shaft Ends

To facilitate the insertion of the spline shaft into a spline nut, the shaft ends are normally chamfered with the dimensions indicated below unless otherwise specified.

#### ● Chamfer A

If the spline shaft ends are stepped, tapped, or drilled as in Fig. 2, they are machined with the Chamfer A dimensions indicated in Table 4.

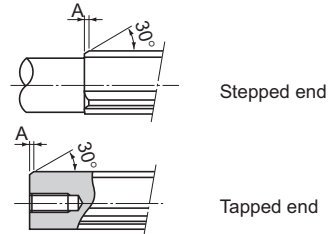


Fig. 2: Chamfer A

#### ● Chamfer B

If either end of the spline shaft is not used, such as for cantilever support, it is machined with the Chamfer B dimensions indicated in Table 4.

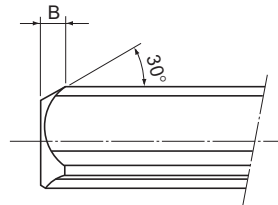


Fig. 3: Chamfer B

Table 4: Chamfer Dimensions of Spline Shaft Ends

Unit: mm

Nominal shaft diameter	20	25	30	40	50	60	85
Chamfer A	1	1.5	2.5	3	3.5	5	7
Chamfer B	4.5	5.5	7	8.5	10	13	16

Note: Spline shafts with nominal diameters 6, 8, and 10 are chamfered to C0.5.

### Length of the Incompletely Ground Area of a Special Spline Shaft

If the middle area or the end of a spline shaft is to be thicker than the minor diameter ( $\phi d$ ), an imperfect spline area is required to secure a recess for grinding. Table 5 shows the relationship between the length of the incomplete section ( $S$ ) and the flange diameter ( $\phi df$ ).

(This table does not apply to overall lengths of 1,500 mm or greater. Contact THK for details.)

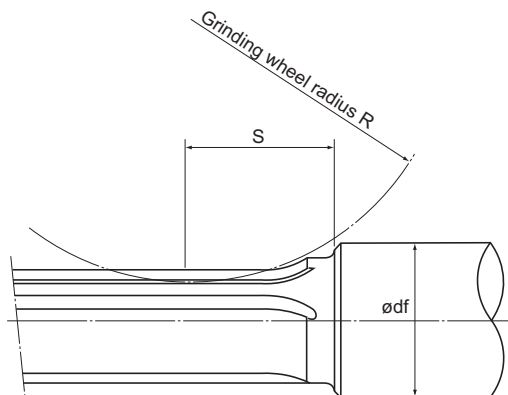


Table 5: Length of Incomplete Spline Area: S

Unit: mm

Flange diameter $\phi df$	20	25	30	35	40	50	60	80	100	120	140
Nominal shaft diameter	20	25	30	35	40	50	60	80	100	120	140
20	35	43	51	57	62	—	—	—	—	—	—
25	—	51	64	74	82	97	—	—	—	—	—
30	—	—	54	67	76	92	105	—	—	—	—
40	—	—	—	—	59	80	95	119	—	—	—
50	—	—	—	—	—	63	83	110	131	—	—
60	—	—	—	—	—	—	66	100	123	140	—
85	—	—	—	—	—	—	—	61	98	122	140

