Rotary Ball Spline

Geared Types: Model LBG and Model LBGT

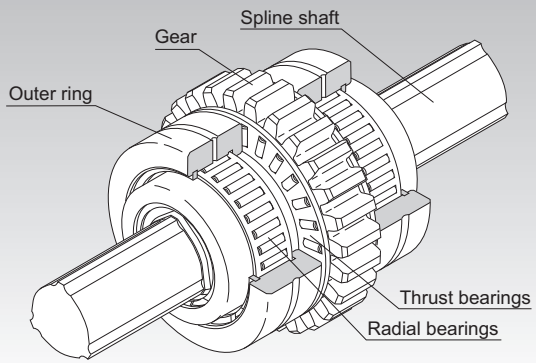


Fig. 1: Structure of Rotary Ball Spline Model LBG

Structure and Features

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°. 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° 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.

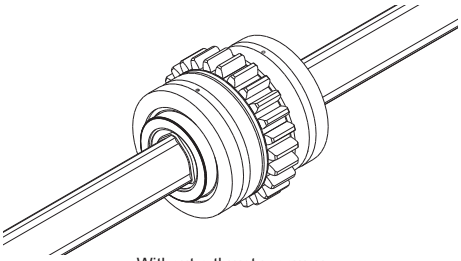
Types and Features

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.

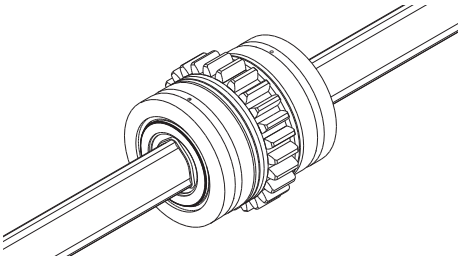


Without a thrust raceway

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.

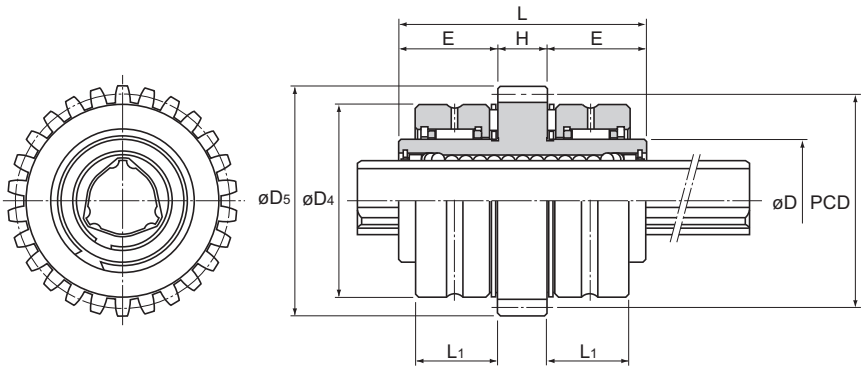
Housing Inner-Diameter Tolerance

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_4	Tolerance	L_1	Tolerance		
● LBG 20	30	0 −0.009	60	0 −0.2	47	0 −0.011	20	0 −0.16	12	24
● LBG 25	40	0 −0.011	70		60	0 −0.013	23	0 −0.19	14	28
● LBG 30	45		80		65		27		16	32
● LBG 40	60	0 −0.013	100		85	0 −0.015	31	0 −0.25	18	41
● LBG 50	75		112	0 −0.3	100		32		20	46
LBG 60	90	0 −0.015	127		120		38		22	52.5
● LBG 85	120		155		150	0 −0.025	40		26	64.5

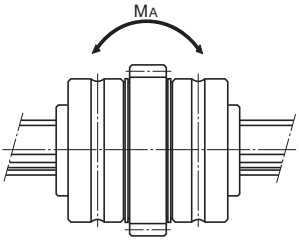
●: Indicates model numbers for which felt seals are available (see **A3-128**).

Model number coding

2 LBG50 UU CM +700L H K

- **2**: Number of spline nuts on one shaft (no symbol for one nut)
- **LBG50**: Model No.
- **UU**: Contamination protection accessory symbol [1]
- **CM**: Symbol for clearance in the rotational direction [2]
- **+700L**: Overall spline shaft length[5] (in mm)
- **H**: Accuracy symbol [3]
- **K**: Symbol for spline shaft[4]

[1] See **A3-128**. [2] See **A3-32**. [3] See **A3-37**. [4] See **A3-108**. [5] See **A3-123**.



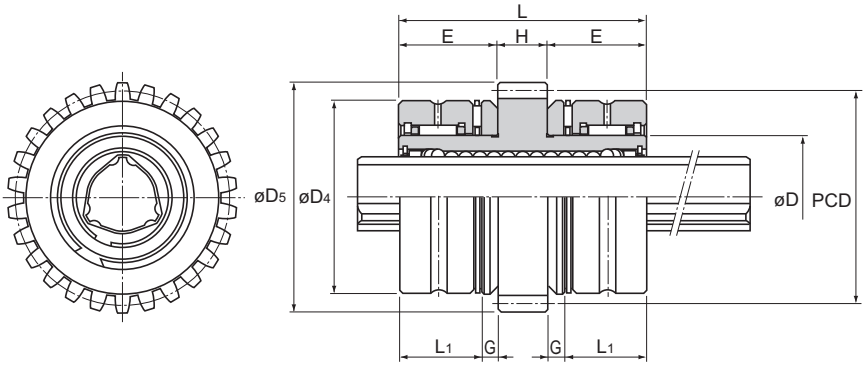
Unit: mm

	Gear specifications[1]				Basic torque rating		Basic load rating		Static permissible moment	Mass	
	Tip circle diameter D_5	Standard pitch diameter PCD	Module m	Number of teeth z	C_T N·m	C_{0T} 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

[1] 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.
[2] 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.

Options⇒A3-128

Model LBGT



Model No.	Spline nut dimensions										
	Spline nut outer diameter		Length		Outer diameter		Width		Thrust raceway width		
	D	Tolerance	L	Tolerance	D_4	Tolerance	L_1	Tolerance	G	H	E
● LBGT 20	30	0 −0.009	60	0 −0.2	47	0 −0.011	20	0 −0.16	4	12	24
● LBGT 25	40	0 −0.011	70		60	0 −0.013	23	0 −0.19	5	14	28
● LBGT 30	45		80		65		27		5	16	32
● LBGT 40	60	0 −0.013	100		85	0 −0.015	31	0 −0.25	8	18	41
● LBGT 50	75		112	0 −0.3	100		32		10	20	46
LBGT 60	90	0 −0.015	127		120		38		12	22	52.5
● LBGT 85	120		155		150	0 −0.025	40		16	26	64.5

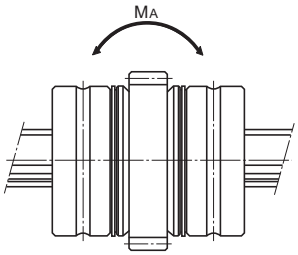
●: Indicates model numbers for which felt seals are available (see **A3-128**).

Model number coding

2 LBGT40 UU CL +700L P K

- 2: Number of spline nuts on one shaft (no symbol for one nut)
- LBGT40: Model No.
- UU: Contamination protection accessory symbol [1]
- CL: Symbol for clearance in the rotational direction [2]
- +700L: Overall spline shaft length[5] (in mm)
- P: Accuracy symbol [3]
- K: Symbol for spline shaft[4]

[1] See **A3-128**. [2] See **A3-32**. [3] See **A3-37**. [4] See **A3-108**. [5] See **A3-123**.



Unit: mm

	Gear specifications[1]				Basic torque rating		Basic load rating		Static permissible moment	Mass	
	Tip circle diameter D_5	Standard pitch diameter PCD	Module m	Number of teeth z	C_T N·m	C_{0T} 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

[1] 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.
[2] 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.

Options⇒A3-128

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 (ød) value of the shaft.

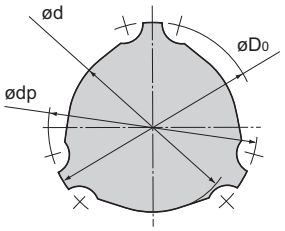


Table 2: Cross-Sectional Shape of the Spline Shaft

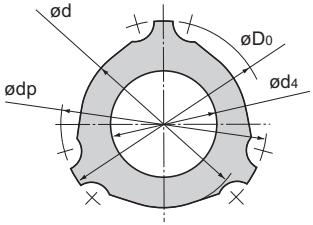
Unit: mm

Nominal shaft diameter	20	25	30	40	50	60	85
Minor diameter ød	15.3	19.5	22.5	31	39	46.5	67
Major diameter øD0	19.7	24.5	29.6	39.8	49.5	60	84
Ball center-to-center diameter ødp	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 ød 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 ød	15.3	19.5	22.5	31	39	46.5	67
Major diameter øD0	19.7	24.5	29.6	39.8	49.5	60	84
Ball center-to-center diameter ødp	20	25	30	40	50	60	85
Hole diameter ød4	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 ød 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.

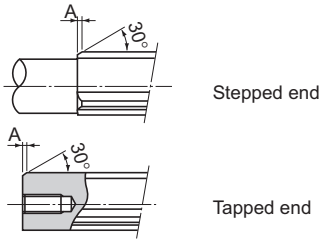


Fig. 2: Chamfer A

● 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.

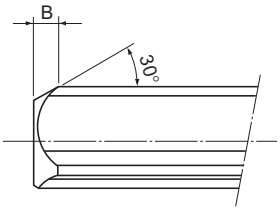


Fig. 3: Chamfer B

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

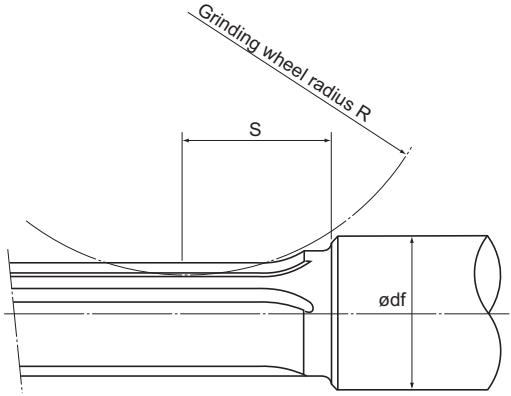


Table 5: Length of Incomplete Spline Area: S

Unit: mm

Flange diameter ødf / 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