Rotary Ball Spline

With Support Bearing Type Models LTR and LTR-A

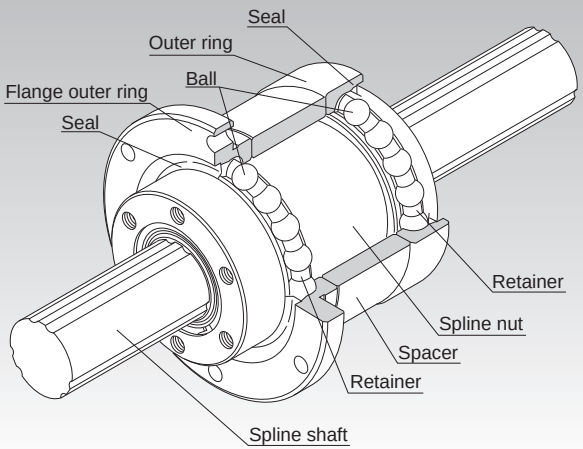

Fig.1 Structure of Rotary Ball Spline Model LTR

Point of Selection	**A3-6**
Point of Design	**A3-119**
Options	**A3-122**
Model No.	**A3-124**
Precautions on Use	**A3-125**
Accessories for Lubrication	**A24-1**
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Maximum Manufacturing Length by Accuracy	A3-117

Structure and Features

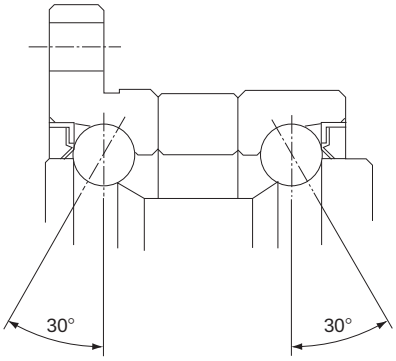
With the Rotary Ball Spline model LTR, the spline shaft has three crests on the circumference, and along both sides of each crest, two rows of balls (six rows in total) are arranged to hold the crest so that a reasonable preload is applied.
Angular-contact ball raceways are machined on the outer surface of the spline nut to constitute support bearings, allowing the whole body to be compactly and lightly designed.
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 even if the spline shaft is removed.
In addition, a dedicated seal for preventing foreign material from entering the support bearings is available.

[No Angular Backlash]
Two rows of balls facing one another hold a crest, formed on the circumference of the spline nut, at a contact angle of 20° to provide a preload in an angular-contact structure. This eliminates an angular backlash in the rotational direction and increases the rigidity.

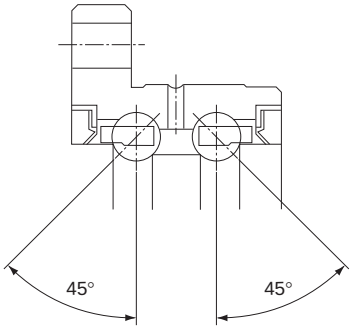
[Compact Design]
The spline nut is integrated with the support bearings, allowing highly accurate, compact design to be achieved.

[Easy Installation]
This ball spline can easily be installed by simply securing it to the housing using bolts.

[High Rigidity]
Since the contact angle is large and an appropriate preload is given, high rigidity against torque and moment is achieved.
The support bearing has a contact angle of 30° to secure high rigidity against a moment load, thus to achieve a rigid shaft support.
Model LTR-A, a compact type of LTR, has a contact angle of 45° .



Model LTR



Model LTR-A

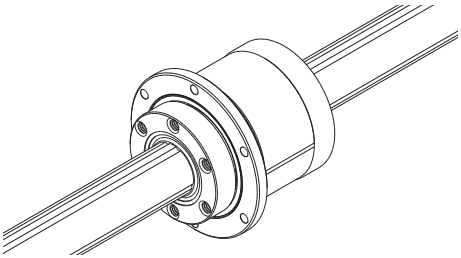
Types and Features

[Types of Spline Nuts]

Ball Spline Model LTR

Specification Table⇒A3-112

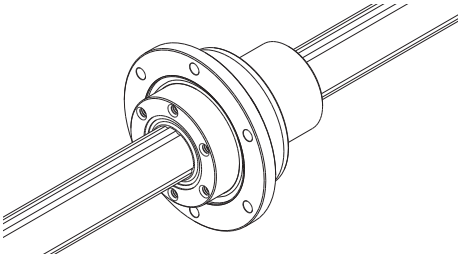
A compact unit type whose support bearings are directly integrated with the outer surface of the spline nut.



Ball Spline Model LTR-A

Specification Table⇒A3-110

A compact type even smaller than LTR.

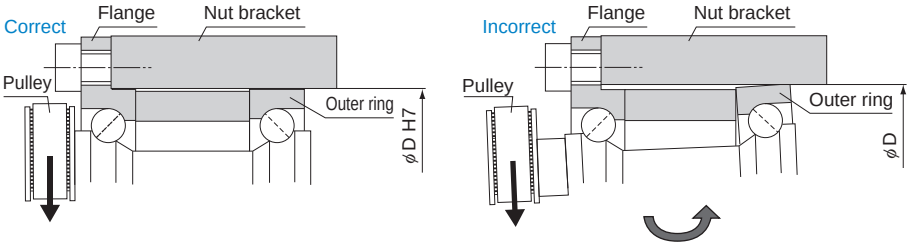


[Types of Spline Shafts]
For details,see A3-79.

Housing Inner-diameter Tolerance

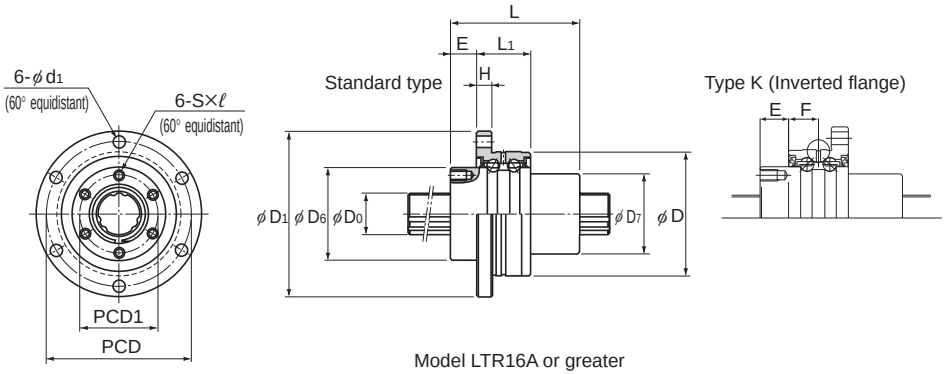
For the housing inner-diameter tolerance for model LTR, class H7 is recommended.

[Important note concerning model LTR]



Note) Because of the divided outer ring, it is necessary to incorporate inner-diameter tolerance in the nut bracket (H7 is recommended) to prevent shifting of the outer ring on the side opposite the flange.

Model LTR-A Compact Type



Model LTR16A or greater

Model No.	Spline nut dimensions															
	Outer diameter		Length	Flange diameter					Standard type	Type K	Oil hole position				
	D	Tolerance	L	D_1	D_6 h7	D_7	H	L_1	E	E	F	E_1	PCD	PCD1	S×ℓ
LTR8 A	32	–0.009 –0.025	25	44	24	16	3	10.5	6	8.5	4	3	38	19	M2.6×3
LTR10 A	36		33	48	28	21	3	10.5	9	11.5	4	—	42	23	M3×4
LTR16 A	48		50	64	36	31	6	21	10	10	10.5	—	56	30	M4×6
LTR20 A	56	–0.010 –0.029	63	72	43.5	35	6	21	12	12	10.5	—	64	36	M5×8
LTR25 A	66		71	86	52	42	7	25	13	13	12.5	—	75	44	M5×8
LTR32 A	78		80	103	63	52	8	25	17	17	12.5	—	89	54	M6×10
LTR40 A	100	–0.012 –0.034	100	130	79.5	64	10	33	20	20	16.5	—	113	68	M6×10

Model number coding

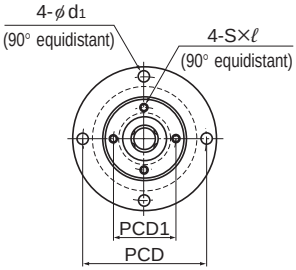
2 LTR32 K UU ZZ CL A +500L P K

- 2: Number of spline nuts on one shaft (no symbol for one nut)
- LTR32: Model No.
- K: Flange orientation symbol(*1)
- UU: Spline nut contamination protection accessory symbol(*2)
- ZZ: Support bearings contamination protection accessory symbol(*3)
- CL: Symbol for clearance in the rotational direction(*4)
- A: Compact Support Type
- +500L: Overall spline shaft length (*7) (in mm)
- P: Accuracy symbol (*5)
- K: Symbol for spline shaft (*6)

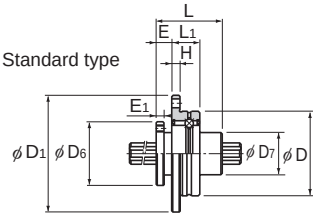
(*2) See A3-122. (*3) See A3-122. (*4) See A3-30. (*5) See A3-35. (*6) See A3-114. (*7) See A3-117.

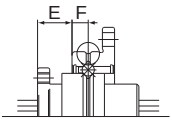
(*1) No Symbol: standard K: flange inversed

Download data by searching for the corresponding model number on the Technical Support site. https://tech.thk.com

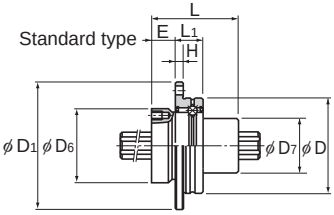


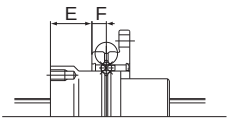
Model LTR8A Model LTR10A





Model LTR8A



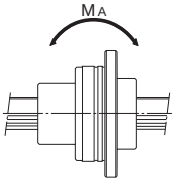


Model LTR10A

Unit: mm

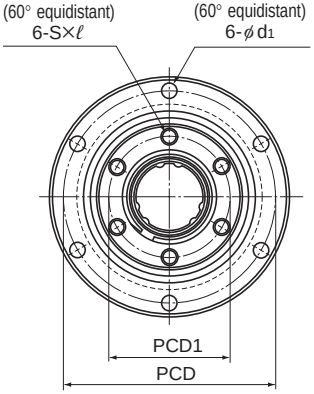
	d1	Spline shaft diameter D0 h7	Rows of balls	Basic torque rating CT N•m	Basic torque rating C0T N•m	Basic load rating C KN	Basic load rating C0 KN	Static permissible moment MA** N•m	Support bearing basic load rating C kN	Support bearing basic load rating C0 kN	Mass Spline Nut kg	Mass Spline shaft kg/m
	3.4	8	4	1.96	2.94	1.47	2.55	5.9	0.69	0.24	0.08	0.4
	3.4	10	4	3.92	7.84	2.84	4.9	15.7	0.77	0.3	0.13	0.62
	4.5	16	6	31.4	34.3	7.06	12.6	67.6	6.7	6.4	0.35	1.6
	4.5	20	6	56.9	55.9	10.2	17.8	118	7.4	7.8	0.51	2.5
	5.5	25	6	105	103	15.2	25.8	210	9.7	10.6	0.79	3.9
	6.6	32	6	180	157	20.5	34	290	10.5	12.5	1.25	5.6
	9	40	6	419	377	37.8	60.5	687	16.5	20.7	2.51	9.9

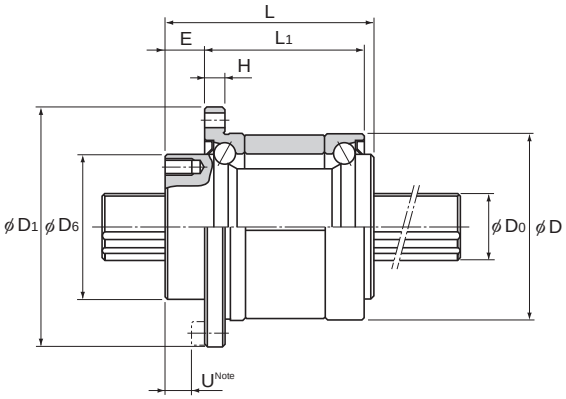
Note) **M_A indicates the permissible moment value in the axial direction when a single spline nut is used, as shown in the figure below.
For details on the maximum lengths of ball spline shafts by accuracy, please see A3-117.



Options⇒A3-122

Model LTR





Model No.	Spline nut dimensions										
	Outer diameter		Length	Flange diameter							
	D	Tolerance	L	D_1	D_6 h7	H	L_1	E	PCD	PCD1	S×ℓ
LTR 16	52	0 −0.007	50	68	39.5	5	37	10	60	32	M5×8
LTR 20	56		63	72	43.5	6	48	12	64	36	M5×8
LTR 25	62		71	78	53	6	55	13	70	45	M6×8
LTR 32	80		80	105	65.5	9	60	17	91	55	M6×10
LTR 40	100	0 −0.008	100	130	79.5	11	74	23	113	68	M6×10
LTR 50	120		125	156	99.5	12	97	25	136	85	M10×15
LTR 60	134	0 −0.009	140	170	115	12	112	25	150	100	M10×15

Model number coding

2 LTR50 K UU ZZ CM +1000L H K

- 2: Number of spline nuts on one shaft (no symbol for one nut)
- LTR50: Model No.
- K: Flange orientation symbol(*1)
- UU: Spline nut contamination protection accessory symbol(*2)
- ZZ: Support bearings contamination protection accessory symbol(*3)
- CM: Symbol for clearance in the rotational direction(*4)
- +1000L: Overall spline shaft length (*7) (in mm)
- H: Accuracy symbol (*5)
- K: Symbol for spline shaft (*6)

(*2) See A3-122. (*3) See A3-122. (*4) See A3-30. (*5) See A3-35. (*6) See A3-114. (*7) See A3-117.

(*1) No Symbol: standard K: flange inversed

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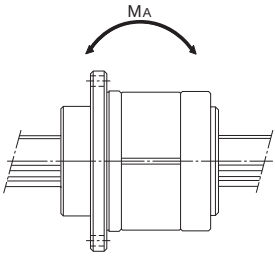


Unit: mm

			Spline shaft diameter		Basic torque rating		Basic load rating		Static permissible moment	Support bearing basic load rating		Mass	
	d_1	U Note	D_0 h7	Rows of balls	C_T N•m	C_{0T} N•m	C kN	C_0 kN	M_A** N•m	C kN	C_0 kN	Spline Nut kg	Spline shaft kg/m
	4.5	5	16	6	31.4	34.3	7.06	12.6	67.6	12.7	11.8	0.51	1.6
	4.5	7	20	6	56.9	55.9	10.2	17.8	118	16.3	15.5	0.7	2.5
	4.5	8	25	6	105	103	15.2	25.8	210	17.6	18	0.93	3.9
	6.6	10	32	6	180	157	20.5	34	290	20.1	24	1.8	5.6
	9	13	40	6	419	377	37.8	60.5	687	37.2	42.5	3.9	9.9
	11	13	50	6	842	769	60.9	94.5	1340	41.7	54.1	6.7	15.5
	11	13	60	6	1220	1040	73.5	111.7	1600	53.1	68.4	8.8	22.3

Note) **M_A indicates the permissible moment value in the axial direction when a single spline nut is used, as shown in the figure above.
Dimension U represents the dimension from the head of the hexagonal-socket-head type bolt to the spline nut end.
For details on the maximum lengths of ball spline shafts by accuracy, please see A3-117.

Options⇒A3-122

Spline Shaft

Spline shafts are divided in shape into precision solid spline shaft, special spline shaft and hollow spline shaft (types K and N), as described on A3-79.
Since production of a spline shaft with a specific shape is performed at your request, provide a drawing of the desired shaft shape when asking an estimate or placing an order.

[Sectional Shape of the Spline Shaft]

Table1 shows the sectional shape of a spline shaft. If the spline shaft ends need to be cylindrical, the minor diameter (ϕd) value should not be exceeded if possible.

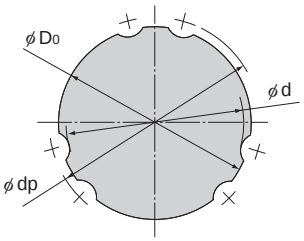


Table1 Sectional Shape of the Spline Shaft

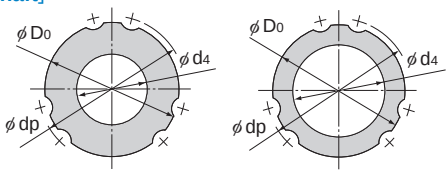
Unit: mm

Nominal shaft diameter	8	10	16	20	25	32	40	50	60
Minor diameter ϕd	7	8.5	14.5	18.5	23	30	37.5	46.5	56.5
Major diameter ϕD_0 h7	8	10	16	20	25	32	40	50	60
Ball center-to-center diameter ϕdp	9.3	11.5	17.8	22.1	27.6	35.2	44.2	55.2	66.3
Mass (kg/m)	0.4	0.62	1.6	2.5	3.9	5.6	9.9	15.5	22.3

*The minor diameter ϕd must be a value at which no groove is left after machining.

[Hole Shape of the Standard Hollow Type Spline Shaft]

Table2 shows the hole shape of the standard hollow type spline shaft (types K and N).
Use this table when a requirement such as piping, wiring, air-vent or weight reduction needs to be met.



Type K (Thick)

Type N (Thin)

Table2 Sectional Shape of the Standard Hollow Type Spline Shaft

Unit: mm

Nominal shaft diameter		8	10	16	20	25	32	40	50	60
Major diameter ϕD_0 h7		8	10	16	20	25	32	40	50	60
Ball center-to-center diameter ϕdp		9.3	11.5	17.8	22.1	27.6	35.2	44.2	55.2	66.3
Type K	Hole diameter ϕd_4	3	4	7	10	12	18	22	25	32
	Mass(kg/m)	0.35	0.52	1.3	1.8	3	4.3	6.9	11.6	16
Type N	Hole diameter ϕd_4	—	—	11	14	18	23	29	36	—
	Mass(kg/m)	—	—	0.8	1.3	1.9	3.1	4.7	7.4	—

Note) The standard hollow type Spline Shaft is divided into types K and N. Indicate “K” or “N” at the end of the model number to distinguish between them when placing an order.

[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.
The ends are chamfered whether they are used, such as with stepped, tapped, or drilled ends, or not used, such as with cantilevered supports.

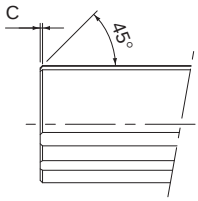


Table 3 Chamfer Dimensions of Model LTR-A and Model LTR Spline Shaft Ends

Unit: mm

Nominal shaft diameter	8	10	16	20	25	32	40	50	60
Chamfer C	0.5	0.5	0.5	0.5	0.5	0.5	1.0	1.0	2.0

[Length of Incomplete 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 (ϕd), an imperfect spline area is required to secure a recess for grinding. Table4 shows the relationship between the length of the incomplete section (S) and the flange diameter (ϕdf).
(This table does not apply to overall length of 1,500 mm or greater. Contact THK for details.)

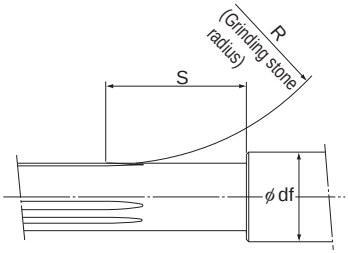


Table4 Length of Incomplete Spline Area: S

Unit: mm

Flange diameter ϕdf / Nominal shaft diameter	6	8	10	13	16	20	25	30	40	50	60	80	100	120	140	160
8	—	25	29	35	41	—	—	—	—	—	—	—	—	—	—	—
10	—	—	26	31	38	45	—	—	—	—	—	—	—	—	—	—
16	—	—	—	—	36	47	58	67	—	—	—	—	—	—	—	—
20	—	—	—	—	—	37	50	60	76	—	—	—	—	—	—	—
25	—	—	—	—	—	—	38	51	72	88	—	—	—	—	—	—
32	—	—	—	—	—	—	—	—	40	75	88	109	—	—	—	—
40	—	—	—	—	—	—	—	—	42	63	81	107	—	—	—	—
50	—	—	—	—	—	—	—	—	—	45	65	96	118	—	—	—
60	—	—	—	—	—	—	—	—	—	—	50	87	114	134	—	—

Permissible Rotational Speed for Rotary Ball Splines

For model LTR rotary ball splines, the speed is restricted by whichever is lower of the support bearing permissible rotational speed and the critical speed of the spline. When using the product, do not exceed the permissible rotational speed.

Table5 Model LTR permissible rotational speed

Unit:min^{-1}

Model No.	Permissible Rotational Speed		
	Ball spline	Support bearing	
	Calculated using shaft length	Grease Lubrication	Oil Lubrication
LTR16	see A3-16.	4000	5400
LTR20		3600	4900
LTR25		3200	4300
LTR32		2400	3300
LTR40		2000	2700
LTR50		1600	2200
LTR60		1400	2000

Table6 Model LTR-A permissible rotational speed

Unit:min^{-1}

Model No.	Permissible Rotational Speed		
	Ball spline	Support bearing	
	Calculated using shaft length	Grease Lubrication	Oil Lubrication
LTR8A	see A3-16.	6900	9300
LTR10A		5900	7900
LTR16A		4000	5400
LTR20A		3600	4900
LTR25A		3200	4300
LTR32A		2400	3300
LTR40A		2000	2700