

# Rotary Ball Spline

With Support Bearing Type Models LTR and LTR-A

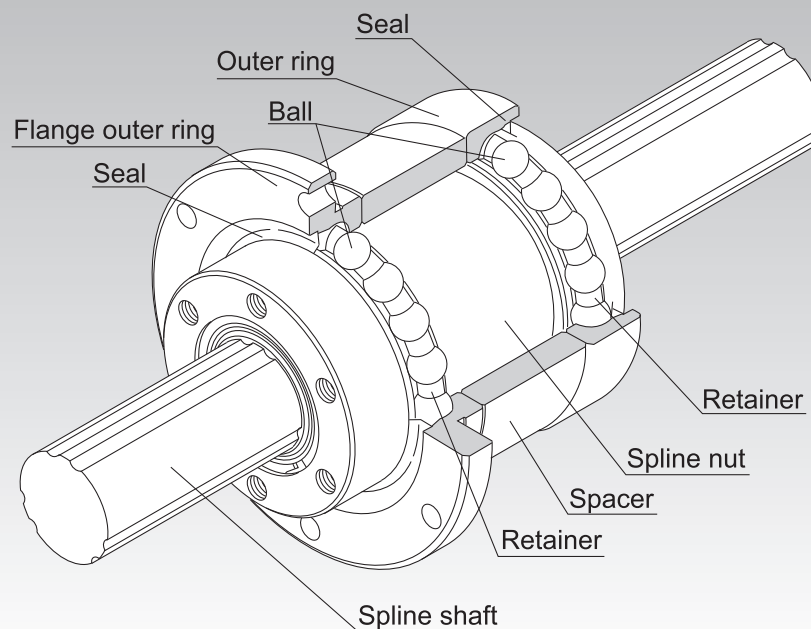


Fig.1 Structure of Rotary Ball Spline Model LTR

<b>Point of Selection</b>	<b>A3-6</b>
<b>Point of Design</b>	<b>A3-123</b>
<b>Options</b>	<b>A3-126</b>
<b>Model No.</b>	<b>A3-128</b>
<b>Precautions on Use</b>	<b>A3-129</b>
<b>Accessories for Lubrication</b>	<b>A24-1</b>
<b>Mounting Procedure and Maintenance</b>	<b>B3-31</b>
Cross-sectional Characteristics of the Spline Shaft	<b>A3-17</b>
Equivalent factor	<b>A3-27</b>
Clearance in the Rotation Direction	<b>A3-30</b>
Accuracy Standards	<b>A3-35</b>
Maximum Manufacturing Length by Accuracy	<b>A3-121</b>

**A3-110 THK**

## 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  $20^\circ$  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]

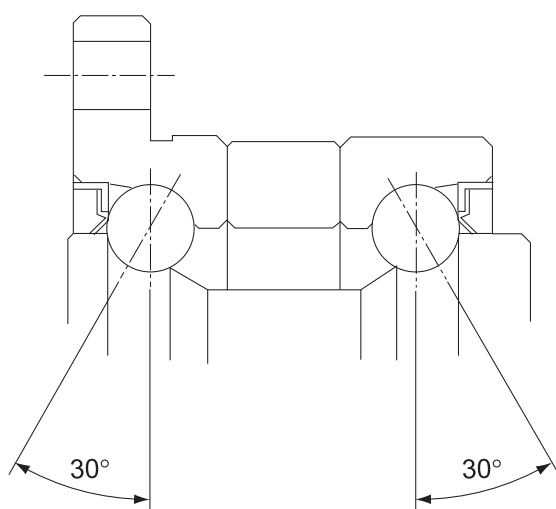
This ball spline can easily be installed by simply securing it to the housing using bolts.

### [High Rigidity]

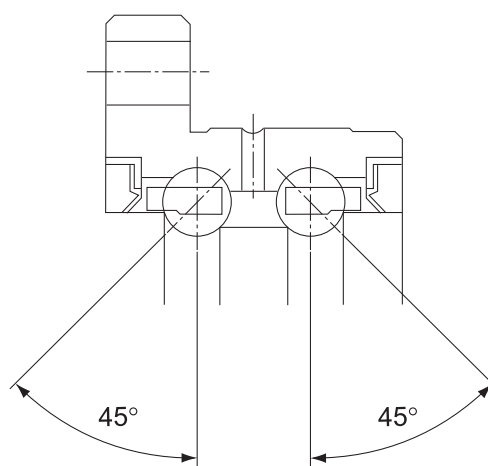
Since the contact angle is large and an appropriate preload is given, high rigidity against torque and moment is achieved.

The support bearing has a contact angle of  $30^\circ$  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  $45^\circ$ .



Model LTR



Model LTR-A

**THK** **A3-111**

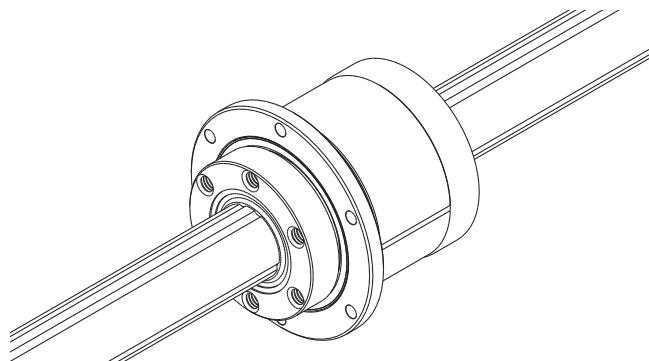
## Types and Features

### [Types of Spline Nuts]

#### Ball Spline Model LTR

Specification Table⇒ **A3-116**

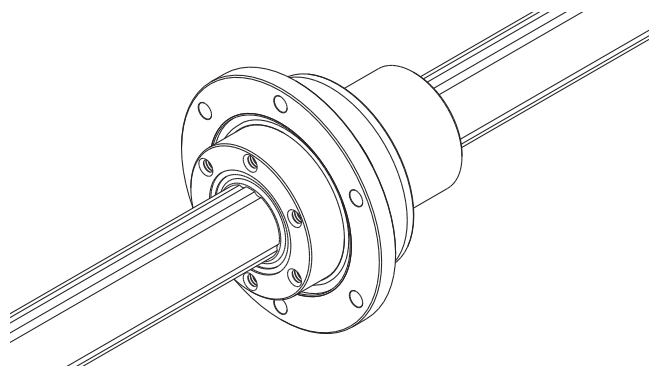
A compact unit type whose support bearings are directly integrated with the outer surface of the spline nut.



#### Ball Spline Model LTR-A

Specification Table⇒ **A3-114**

A compact type even smaller than LTR.



### [Types of Spline Shafts]

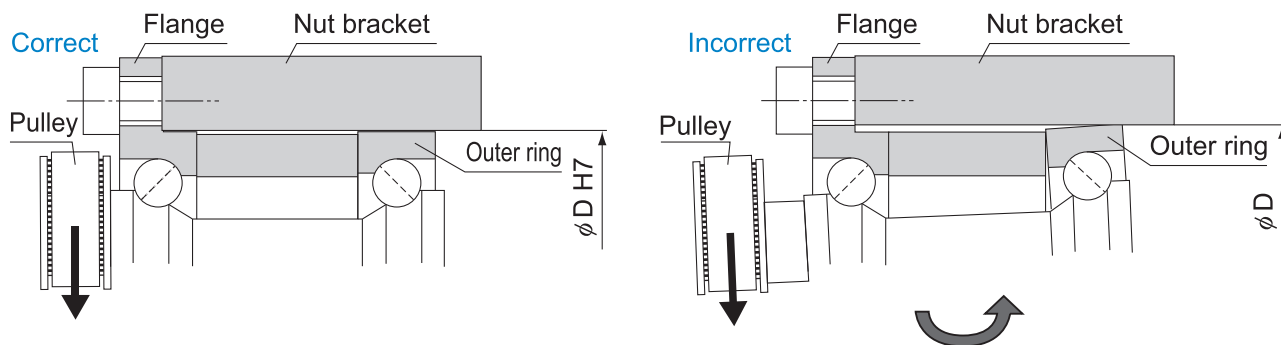
For details, see **A3-79**.

**A3-112** **THK**

## Housing Inner-diameter Tolerance

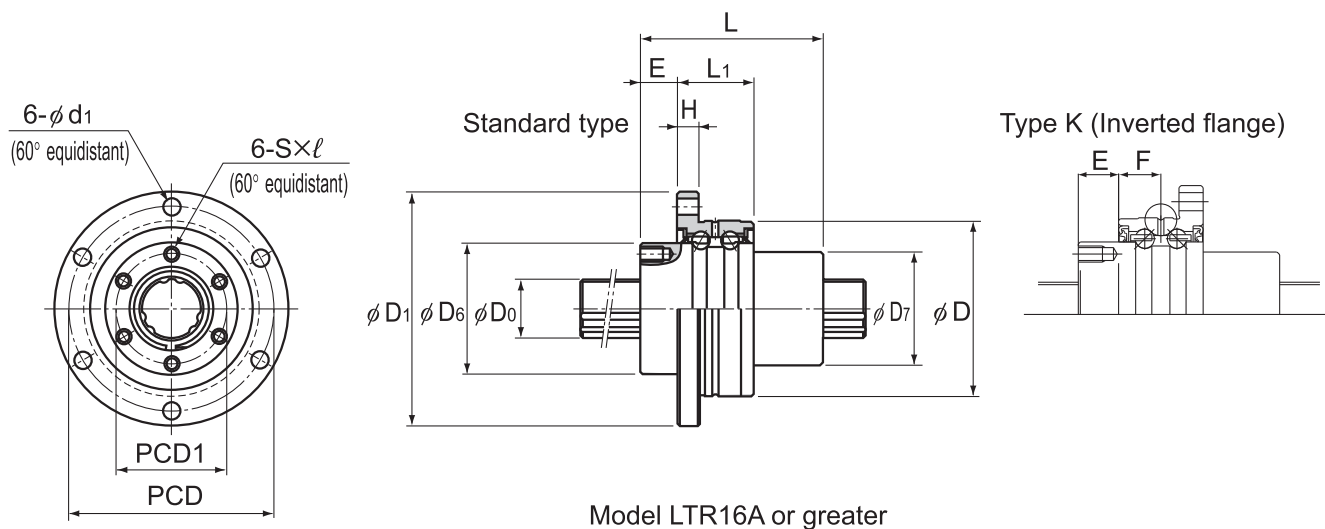
For the housing inner-diameter tolerance for model LTR, class H7 is recommended.

### [Important note concerning model LTR]



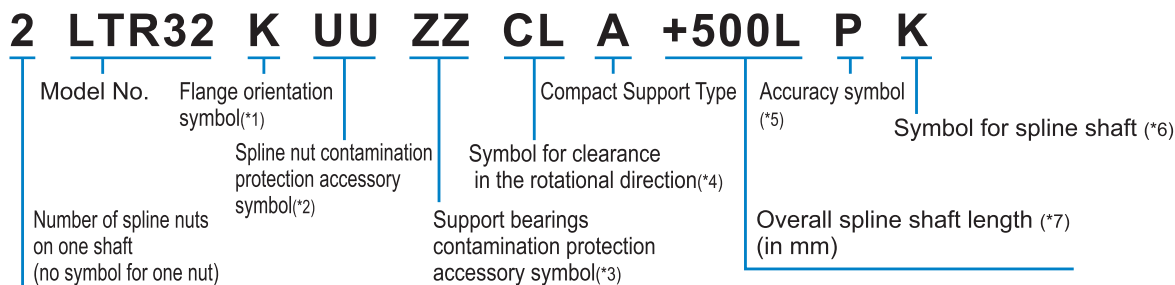
Note) Because of the divided outer ring, it is necessary to incorporate inner-diameter tolerance in the nut bracket (H7 is recommended) to prevent shifting of the outer ring on the side opposite the flange.

# Model LTR-A Compact Type



Model No.	Spline nut dimensions														
	Outer diameter		Length L	Flange diameter D <sub>1</sub>	D <sub>6</sub> h7	D <sub>7</sub>	H	L <sub>1</sub>	Standard type E	Type K E	Oil hole position F	E <sub>1</sub>	PCD	PCD1	S × l
	D	Tolerance													
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

## Model number coding



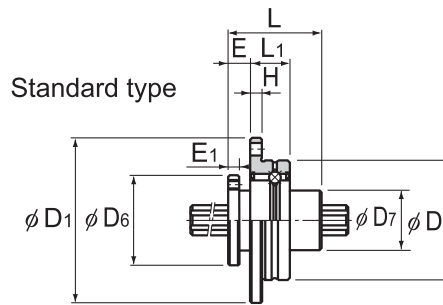
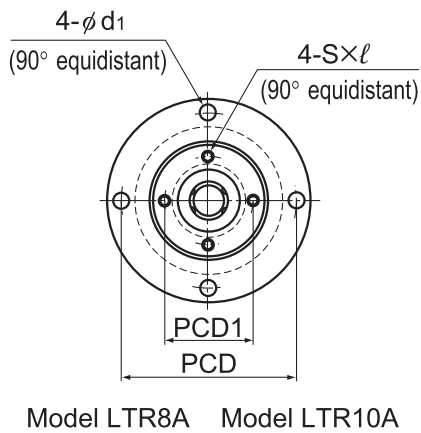
(\*2) See **A3-126**. (\*3) See **A3-126**. (\*4) See **A3-30**. (\*5) See **A3-35**. (\*6) See **A3-118**. (\*7) See **A3-121**.

(\*1) No Symbol: standard K: flange inverted

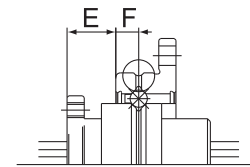
**A3-114 THK**

Download data by searching for the corresponding model number on the Technical Support site.

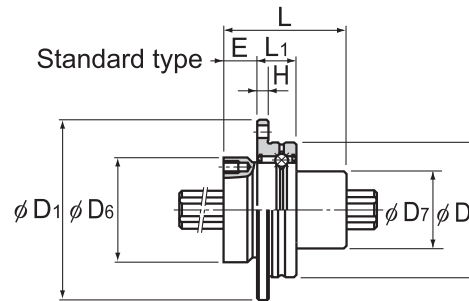
<https://tech.thk.com>



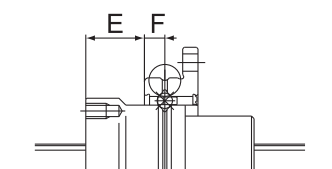
Type K (Inverted flange)



Model LTR8A



Type K (Inverted flange)



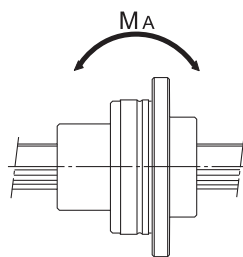
Model LTR10A

Unit: mm

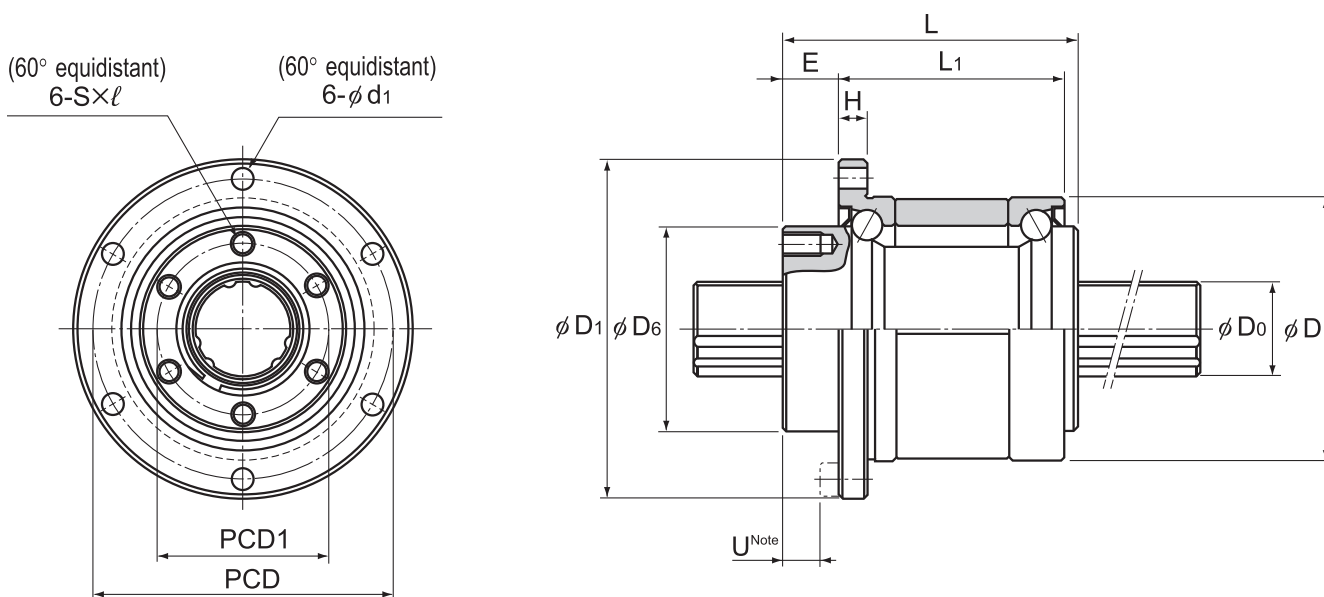
	Spline shaft diameter	Basic torque rating		Basic load rating		Static permissible moment	Support bearing basic load rating		Mass			
		$d_1$	$D_0$ h7	Rows of balls	$C_T$ N·m		$C_{0T}$ N·m	C kN	$C_0$ kN	$M_A^{**}$ N·m	C kN	$C_0$ kN
	3.4	8	4	1.96	2.94	1.47	2.55	5.9	0.69	0.24	0.08	0.4
	3.4	10	4	3.92	7.84	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 **A3-121**.

Options  $\Rightarrow$  **A3-126****THK A3-115**

## Model LTR



Model No.	Spline nut dimensions										
	Outer diameter		Length L	Flange diameter D <sub>1</sub>	D <sub>6</sub> h7	H	L <sub>1</sub>	E	PCD	PCD1	S × l
	D	Tolerance									
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**

Model No.	Flange orientation symbol(*1)	Symbol for clearance in the rotational direction(*4)	Accuracy symbol (*5)	Symbol for spline shaft (*6)
Number of spline nuts on one shaft (no symbol for one nut)	Spline nut contamination protection accessory symbol(*2)	Support bearings contamination protection accessory symbol(*3)	Overall spline shaft length (*7) (in mm)	

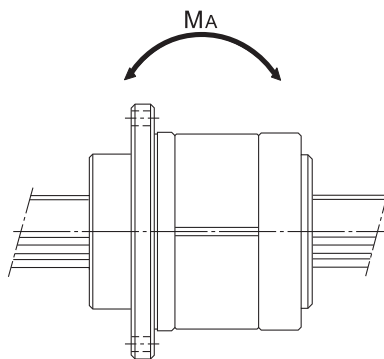
(\*2) See **A3-126**. (\*3) See **A3-126**. (\*4) See **A3-30**. (\*5) See **A3-35**. (\*6) See **A3-118**. (\*7) See **A3-121**.

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

**A3-116 THK**

Download data by searching for the corresponding model number on the Technical Support site.

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Unit: mm

			Spline shaft diameter $D_0$ h7	Rows of balls	Basic torque rating		Basic load rating		Static permissible moment	Support bearing basic load rating		Mass	
$d_1$	$U$ <sup>Note</sup>	$C_T$ 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 **A3-121**.

Options⇒ **A3-126****THK A3-117**



## 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 ( $\phi d$ ) value should not be exceeded if possible.

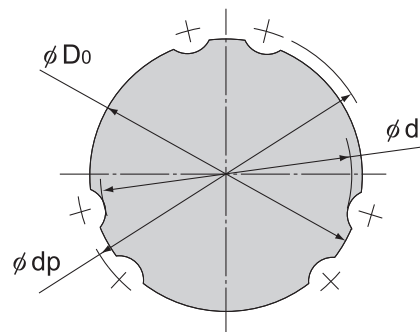


Table1 Sectional Shape of the Spline Shaft

Unit: mm

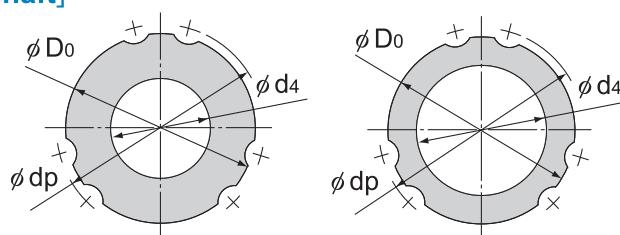
Nominal shaft diameter	8	10	16	20	25	32	40	50	60
Minor diameter $\phi d$	7	8.5	14.5	18.5	23	30	37.5	46.5	56.5
Major diameter $\phi D_0$ h7	8	10	16	20	25	32	40	50	60
Ball center-to-center diameter $\phi dp$	9.3	11.5	17.8	22.1	27.6	35.2	44.2	55.2	66.3
Mass (kg/m)	0.4	0.62	1.6	2.5	3.9	5.6	9.9	15.5	22.3

\*The minor diameter  $\phi d$  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 $\phi D_0$ h7	8	10	16	20	25	32	40	50	60	
Ball center-to-center diameter $\phi dp$	9.3	11.5	17.8	22.1	27.6	35.2	44.2	55.2	66.3	
Type K	Hole diameter $\phi d_4$	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 $\phi d_4$	—	—	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.

**A3-118** **THK**

### [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.

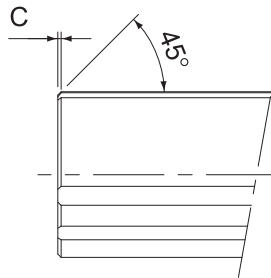


Table 3 Chamfer Dimensions of Model LTR-A and Model LTR Spline Shaft Ends

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 ( $\phi d$ ), an imperfect spline area is required to secure a recess for grinding. Table 4 shows the relationship between the length of the incomplete section (S) and the flange diameter ( $\phi df$ ).

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

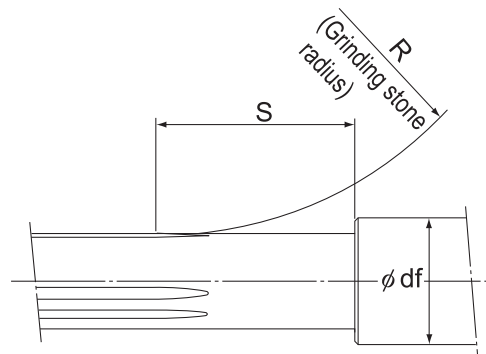


Table 4 Length of Incomplete Spline Area: S

Unit: mm

Flange diameter $\phi df$	6	8	10	13	16	20	25	30	40	50	60	80	100	120	140	160
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	—	—

THK A3-119

## 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<sup>-1</sup>

Model No.	Permissible Rotational Speed		
	Ball spline	Support bearing	
	Calculated using shaft length	Grease Lubrication	Oil Lubrication
LTR16	see <b>A3-16.</b>	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<sup>-1</sup>

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

**A3-120** **THK**