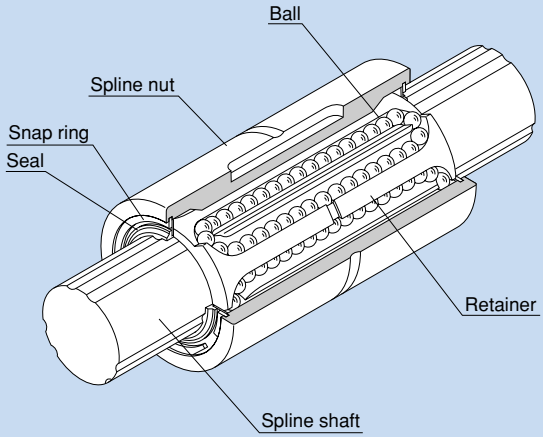


Fig. 1 Structure of Medium Torque Type Ball Spline Model LT

Structure and Features

With the medium torque type Ball Spline, the spline shaft has two to three crests on the circumference, and along both sides of each crest, two rows of balls (four or six rows in total) are arranged to hold the crest so that a reasonable preload is applied.
The rows of balls are held in a special resin retainer incorporated in the spline nut so that they smoothly roll and circulate. With this design, balls will not fall even if the nut is removed from the spline shaft.

●Large load capacity

The ball raceways are formed into circular-arc grooves approximate to the ball curvature and ensure angular contact. Thus, this model has a large load capacity in the radial and torque directions.

●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.

●High Rigidity

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

●Easy installation

Since the balls will not fall off even if the spline nut is removed from the spline shaft, thus, it is easy to install and maintain this model (except for models LT4 and 5).

Types and Features

●Types of Spline Nuts

Cylindrical Type Ball Spline Model LT

The most compact type with a straight cylindrical spline nut. When transmitting a torque, a key is driven into the body.

Flanged Type Ball Spline Model LF

The spline nut can be attached to the housing via the flange, making assembly simple. It is optimal for locations where the housing may be deformed if a keyway is machined on its surface, and where the housing width is small. Since it allows a knock pin to be driven into the flange, angular backlash occurring in the fitting can completely be eliminated.

●Types of Spline Shafts

Precision Solid Spline Shaft (Standard Type)

The raceway of the spline shaft is precision ground. It is used in combination with a spline nut.

Special Spine Shaft

THK manufactures a spline shaft with thicker ends or thicker middle area through special processing at your request.

Hollow Spline Shaft (Type K)

(Thick)

A drawn, hollow spline shaft is available for requirements such as piping, wiring, air-vent and weight reduction.

Hollow Spline Shaft (Type N)

(Thin)

A drawn, hollow spline shaft is available for requirements such as piping, wiring, air-vent and weight reduction.

Housing Inner-diameter Tolerance

When fitting the Ball Spline with the housing, tight fitting is normally recommended. If the accuracy of the Ball Spline does not need to be very high, clearance fitting is also acceptable.

Table 1 Housing Inner-diameter Tolerance

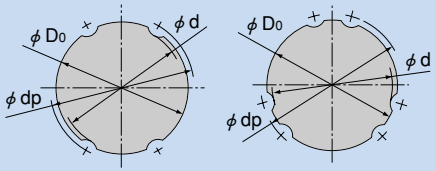
Housing inner-diameter tolerance	General service conditions	H7
	When clearance needs to be small	J6

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 page b-45.
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

Table 2 shows the sectional shape of a spline shaft. If the spline shaft ends need to be cylindrical, the minor diameter (d) value should not be exceeded if possible.



Model LT13 or smaller Model LT16 or greater

Table 2 Sectional Shape of the Spline Shaft

Unit: mm

Nominal shaft diameter	4	5	6	8	10	13	16	20	25	30	40	50	60	80	100
Minor diameter d	3.5	4.5	5	7	8.5	11.5	14.5	18.5	23	28	37.5	46.5	56.5	75.5	95
Major diameter D_0 h7	4	5	6	8	10	13	16	20	25	30	40	50	60	80	100
Ball center diameter dp	4.6	5.7	7	9.3	11.5	14.8	17.8	22.1	27.6	33.2	44.2	55.2	66.3	87.9	109.5
Mass (kg/m)	0.1	0.15	0.23	0.4	0.62	1.1	1.6	2.5	3.9	5.6	9.9	15.5	22.3	39.6	61.8

●Hole Shape of the Standard Hollow Type Spline Shaft

Table 3 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.

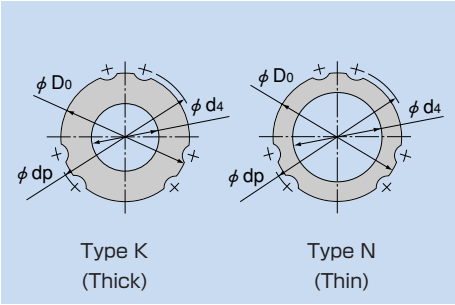


Table 3 Sectional Shape of the Standard Hollow Type Spline Shaft

Unit: mm

Nominal shaft diameter		6	8	10	13	16	20	25	30	40	50	60	80	100
Major diameter D_0		6	8	10	13	16	20	25	30	40	50	60	80	100
Ball center diameter dp		7	9.3	11.5	14.8	17.8	22.1	27.6	33.2	44.2	55.2	66.3	87.9	109.5
Type K	Hole diameter d_4	2.5	3	4	5	7	10	12	16	22	25	32	52.5	67.5
	Mass (kg/m)	0.2	0.35	0.52	0.95	1.3	1.8	3	4	6.9	11.6	16	22.6	33.7
Type N	Hole diameter d_4	—	—	—	—	11	14	18	21	29	36	—	—	—
	Mass (kg/m)	—	—	—	—	0.8	1.3	1.9	2.8	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

For details of chamfering of the spline nut ends, see page b-24.

●Length of Incomplete Section of a Special Spline Shaft

If the middle area or the end of a spline shaft is to be thicker than the minor diameter (d), an incomplete spline section 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 (df). (This table does not apply to overall length of 1,500 mm or greater. Contact THK for details.)

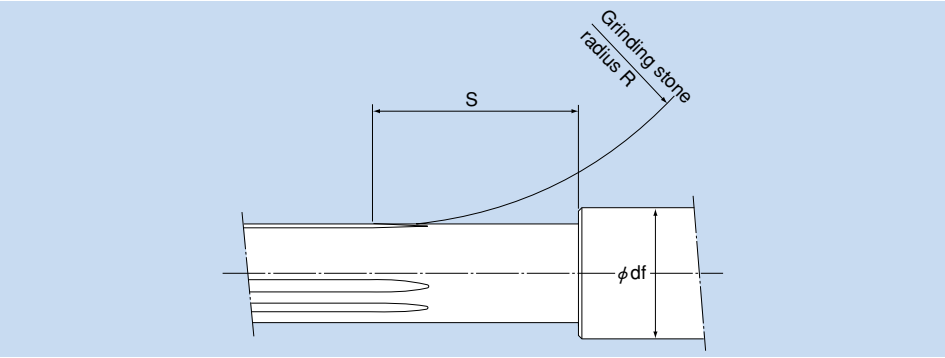


Table 4 Length of Incomplete Spline Section: S

Miniature type Unit: mm

Nominal shaft diameter \ Flange diameter df	4	5	6	8	10
4	13	20	24	31	—
5	—	14	21	28	33

Standard type: Unit: mm

Nominal shaft diameter \ Flange diameter df	6	8	10	13	16	20	25	30	40	50	60	80	100	120	140	160
6	16	24	28	33	—	—	—	—	—	—	—	—	—	—	—	—
8	—	16	24	30	35	—	—	—	—	—	—	—	—	—	—	—
10	—	—	17	27	32	37	—	—	—	—	—	—	—	—	—	—
13	—	—	—	17	27	34	40	—	—	—	—	—	—	—	—	—
16	—	—	—	—	21	36	46	54	—	—	—	—	—	—	—	—
20	—	—	—	—	—	21	38	48	62	—	—	—	—	—	—	—
25	—	—	—	—	—	—	23	39	56	67	—	—	—	—	—	—
30	—	—	—	—	—	—	—	24	49	62	72	—	—	—	—	—
40	—	—	—	—	—	—	—	—	27	50	63	81	—	—	—	—
50	—	—	—	—	—	—	—	—	—	29	51	74	89	—	—	—
60	—	—	—	—	—	—	—	—	—	—	28	56	71	82	—	—
80	—	—	—	—	—	—	—	—	—	—	—	31	57	72	83	—
100	—	—	—	—	—	—	—	—	—	—	—	—	33	58	73	83

Accessory

Ball Spline model LT is provided with a standard key as indicated in table 5.

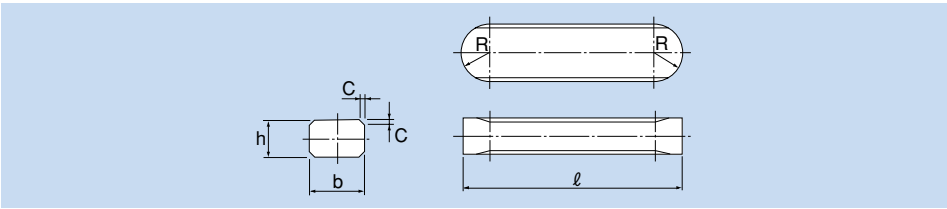


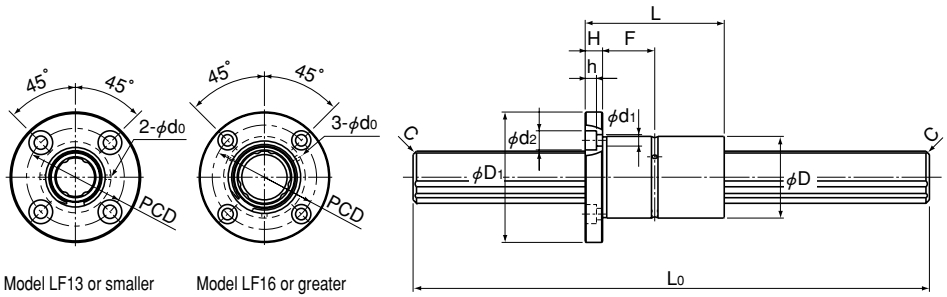
Table 5 Standard Key for Model LT

Unit: mm

Nominal shaft diameter	Width b	Tolerance (p7)	Height h	Tolerance (h9)	Length ℓ	Tolerance (h12)	R	C
LT 4	2	+0.016 +0.006	2	0 −0.025	6	0 −0.120	1	0.3
LT 5	2.5		2.5		8	0 −0.150	1.25	0.5
LT 6 LT 8	2.5		2.5		10.5	0 −0.180	1.25	0.5
LT 10	3		3		13		1.5	
LT 13	3		3		15		1.5	
LT 16	3.5	+0.024 +0.012	3.5	0 −0.030	17.5		1.75	
LT 20	4		4		29	0 −0.210	2	
LT 25	4		4		36	0 −0.250	2	
LT 30	4		4		42		2	
LT 40	6		6		52	0 −0.300	3	
LT 50	8	+0.030 +0.015	7	0 −0.036	58		4	
LT 60	12	+0.036 +0.018	8		67		6	0.8
LT 80	16		10		76		8	
LT 100	20	+0.043 +0.022	13	0 −0.043	110	0 −0.350	10	

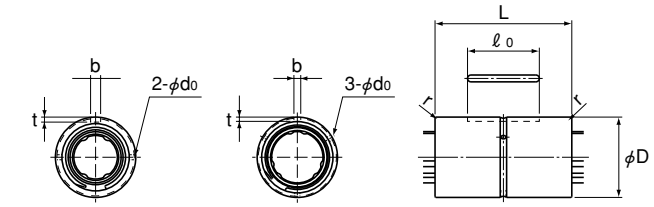
Standard Off-the-shelf Ball Spline Models LT / LF

Full spline



Model LF13 or smaller　Model LF16 or greater

Model LF



Model LT13 or smaller　Model LT16 or greater

Model LT

Unit: mm

Model No.	Spline nut dimensions															Spline shaft dimensions		Basic torque rating		Basic load rating (radial)	
	Outer diameter		Length		Flange diameter					Mounting hole	Keyway dimensions			Greasing hole	r	Length*	Chamfer				
	D	Tolerance	L	Tolerance	D1	Tolerance	H	F	PCD	d1×d2×h	b H8	t +0.05 0	ℓ0	d0		Lo	C	CT* N·m	CoT* N·m	C* kN	Co* kN
LT 6	14	0 −0.011	25	0 −0.2	—	0 −0.2	—	—	—	—	2.5	1.2	10.5	1	0.5	600	0.5	0.98	1.96	1.18	2.16
LF 6					30		5	7.5	22	3.4×6.5×3.3	—	—	—	1.5							
LT 8	16				—		—	—	—	—	2.5	1.2	10.5			1000		1.96	2.94	1.47	2.55
LF 8					32		5	7.5	24	3.4×6.5×3.3	—	—	—								
LT 10	21	0 −0.013	33		—		—	—	—	—	3	1.5	13					3.92	7.84	2.84	4.9
LF 10					42		6	10.5	32	4.5×8×4.4	—	—	—								
LT 13	24		36		—		—	—	—	—	3	1.5	15					5.88	10.8	3.53	5.78
LF 13					44		7	11	33	4.5×8×4.4	—	—	—								
LT 16	31		50		—		—	—	—	—	3.5	2	17.5	2		1500		31.4	34.3	7.06	12.6
LF 16					51	0 −0.2	7	18	40	4.5×8×4.4	—	—	—								
LT 20	35	0 −0.016	63		—		—	—	—	—	4	2.5	29			2000		56.9	55.9	10.2	17.8
LF 20					58		9	22.5	45	5.5×9.5×5.4	—	—	—								
LT 25	42		71	0 −0.3	—		—	—	—	—	4	2.5	36	3		3000		105	103	15.2	25.8
LF 25					65		9	26.5	52	5.5×9.5×5.4	—	—	—								
LT 30	47		80		—		—	—	—	—	4	2.5	42					171	148	20.5	34
LF 30					75		10	30	60	6.6×11×6.5	—	—	—								
LT 40	64	0 −0.019	100		—		—	—	—	—	6	3.5	52	4			1	419	377	37.8	60.5
LF 40					100		14	36	82	9×14×8.6	—	—	—								
LT 50	80		125		—		—	—	—	—	8	4	58		1			842	769	60.9	94.5
LF 50					124		16	46.5	102	11×17.5×11	—	—	—								

These standard off-the-shelf models are shipped in short delivery time.
You can also specify the number of spline nuts.

Note The values for the basic torque rating and basic load rating apply to single-nut configurations.
The clearance in the rotational direction is assumed to be normal clearance, and the accuracy to be normal grade.
If a greater length than the standard length is required, contact THK.

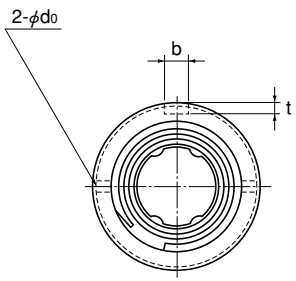
Model number coding

5 LT30 UU +3000L
1 2 3 4

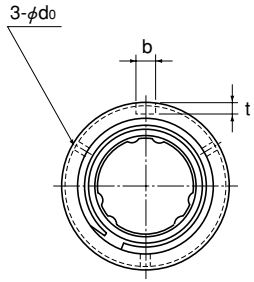
1 Number of spline nuts on one shaft (no symbol for one nut)
2 Model No.
3 Dust prevention accessory symbol - UU: rubber seal attached on both ends of spline nut
4 Overall spline shaft length (in mm)

Selecting a Model Number Refer to the "THK General Catalog - Technical Descriptions of the Products," provided separately

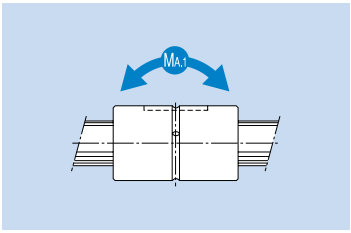
Model LT

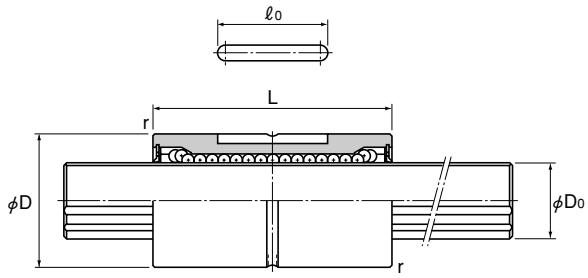


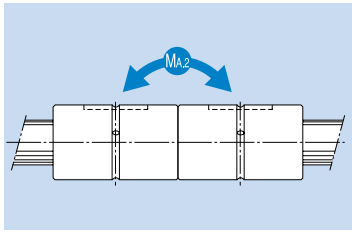
Model LT13 or smaller



Model LT16 or greater







Unit: mm

Model No.	Spline nut dimensions: Outer diameter D	Outer diameter Tolerance	Length L	Length Tolerance	Keyway dimensions: b H8	Keyway dimensions: t +0.05 0	Keyway dimensions: ℓ0	r	Greasing hole d0	Spline shaft diameter D0 h7	No. of rows of balls	Basic torque rating: CT N·m	Basic torque rating: COT N·m	Basic load rating (radial): C kN	Basic load rating (radial): C0 kN	Permissible static moment: MA.1** N·m	Permissible static moment: MA.2** N·m	Mass: Spline nut g	Mass: Spline shaft kg/m
*LT 4	10	0 −0.009	16	0 −0.2	2	1.2	6	0.5	—	4	4	0.59	0.78	0.44	0.61	0.88	6.4	5.2	0.1
*LT 5	12	0 −0.011	20		2.5	1.2	8	0.5	—	5	4	0.88	1.37	0.66	0.88	1.5	11.6	9.1	0.15
LT 6	14		25		2.5	1.2	10.5	0.5	1	6	4	0.98	1.96	1.18	2.16	4.9	36.3	17	0.23
LT 8	16		25		2.5	1.2	10.5	0.5	1.5	8	4	1.96	2.94	1.47	2.55	5.9	44.1	18	0.4
LT 10	21	0 −0.013	33		3	1.5	13	0.5	1.5	10	4	3.92	7.84	2.84	4.9	15.7	98	50	0.62
LT 13	24		36		3	1.5	15	0.5	1.5	13	4	5.88	10.8	3.53	5.78	19.6	138	55	1.1
○ LT 16	31		50		3.5	2	17.5	0.5	2	16	6	31.4	34.3	7.06	12.6	67.6	393	165	1.6
○ LT 20	35	0 −0.016	63		4	2.5	29	0.5	2	20	6	56.9	55.9	10.2	17.8	118	700	225	2.5
○ LT 25	42		71	0 −0.3	4	2.5	36	0.5	3	25	6	105	103	15.2	25.8	210	1140	335	3.9
○ LT 30	47		80		4	2.5	42	0.5	3	30	6	171	148	20.5	34	290	1710	375	5.6
○ LT 40	64	0 −0.019	100		6	3.5	52	0.5	4	40	6	419	377	37.8	60.5	687	3760	1000	9.9
○ LT 50	80		125		8	4	58	1	4	50	6	842	769	60.9	94.5	1340	7350	1950	15.5
○ LT 60	90	0 −0.022	140	0 −0.4	12	5	67	1	5	60	6	1220	1040	73.5	111.7	1600	9990	2500	22.3
○ LT 80	120		160		16	6	76	2	5	80	6	2310	1920	104.9	154.8	2510	16000	4680	39.6
○ LT 100	150	0 −0.025	185		20	7	110	2.5	5	100	6	3730	3010	136.2	195	3400	24000	9550	61.8

Note Models LT4 and 5 do not have a retainer. Do not remove the shaft from the spline nut (it will cause balls to fall off).
○ indicates model numbers for which high temperature types are available (with metal retainer; service temperature: up to 100℃).
(Example) LT20 A CL+500L H
└── High temperature type symbol

Note $M_{A.1}$ indicates the permissible moment value in the axial direction when a single spline nut is used, as shown in the figure above.
$M_{A.2}$ indicates the permissible moment value in the axial direction when two spline nuts in close contact with each other are used, as shown in the figure above.
(Single LT-unit configuration is not stable in accuracy. We recommend using two units in close contact with each other.)

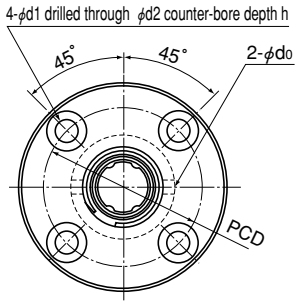
Model number coding

2 LT30 UU CL +500L H K
1 2 3 4 5 6 7

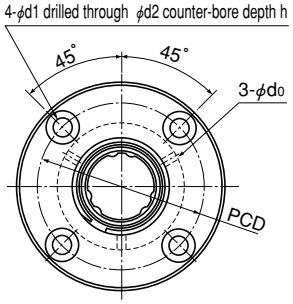
1 Number of spline nuts on one shaft (no symbol for one nut)
2 Model No.
3 Dust prevention accessory symbol - no symbol: without seal
UU: rubber seal attached on both ends of spline nut
U: rubber seal attached on either end of spline nut
4 Symbol for clearance in the rotational direction (see page b-4)
5 Overall spline shaft length (in mm)
6 Accuracy symbol (see page b-5)
7 Symbol for standard hollow spline shaft (see page b-47) (no symbol: solid spline shaft)

Selecting a Model Number | Refer to the "THK General Catalog - Technical Descriptions of the Products," provided separately

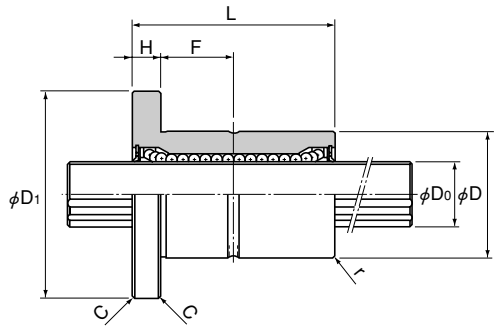
Model LF

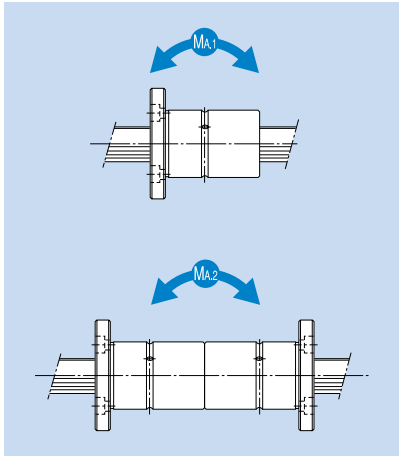


Model LF13 or smaller



Model LF16 or greater





Unit: mm

Model No.	Spline nut dimensions													Spline shaft diameter	No. of rows of balls	Basic torque rating		Basic load rating (radial)		Permissible static moment		Mass	
	Outer diameter		Length		Flange diameter						Greasing hole		Mounting hole										
	D	Tolerance	L	Tolerance	D1	Tolerance	H	F	C	r	d0	PCD	d1×d2×h	D0 h7		CT N·m	COT N·m	C kN	C0 kN	MA1* N·m	MA2* N·m	Spline nut g	Spline shaft kg/m
LF 6	14	0 −0.011	25	0 −0.2	30	0 −0.2	5	7.5	0.5	0.5	1.5	22	3.4×6.5×3.3	6	4	0.98	1.96	1.18	2.16	4.9	36.3	35	0.23
LF 8	16		25		32		5	7.5	0.5	0.5	1.5	24	3.4×6.5×3.3	8	4	1.96	2.94	1.47	2.55	5.9	44.1	37	0.4
LF 10	21	0 −0.013	33		42		6	10.5	0.5	0.5	1.5	32	4.5×8×4.4	10	4	3.92	7.84	2.84	4.9	15.7	98	90	0.62
LF 13	24		36		44		7	11	0.5	0.5	1.5	33	4.5×8×4.4	13	4	5.88	10.8	3.53	5.78	19.6	138	110	1.1
○ LF 16	31		50		51		7	18	0.5	0.5	2	40	4.5×8×4.4	16	6	31.4	34.3	7.06	12.6	67.6	393	230	1.6
○ LF 20	35	0 −0.016	63		58		9	22.5	0.5	0.5	2	45	5.5×9.5×5.4	20	6	56.9	55.9	10.2	17.8	118	700	330	2.5
○ LF 25	42		71	0 −0.3	65		9	26.5	0.5	0.5	3	52	5.5×9.5×5.4	25	6	105	103	15.2	25.8	210	1140	455	3.9
○ LF 30	47		80		75		10	30	0.5	0.5	3	60	6.6×11×6.5	30	6	171	148	20.5	34	290	1710	565	5.6
○ LF 40	64	0 −0.019	100		100		14	36	1	0.5	4	82	9×14×8.6	40	6	419	377	37.8	60.5	687	3760	1460	9.9
○ LF 50	80		125		124		16	46.5	1	1	4	102	11×17.5×11	50	6	842	769	60.9	94.5	1340	7350	2760	15.5

Note ○ indicates model numbers for which high temperature types are available (with metal retainer; service temperature: up to 100°C).
(Example) LF30 A CL+700L H
A: High temperature type symbol

***Note** M_{A1} indicates the permissible moment value in the axial direction when a single spline nut is used, as shown in the figure above.
M_{A2} indicates the permissible moment value in the axial direction when two spline nuts in close contact with each other are used, as shown in the figure above.
(Single LF-unit configuration is not stable in accuracy. We recommend using two units in close contact with each other.)

Model number coding

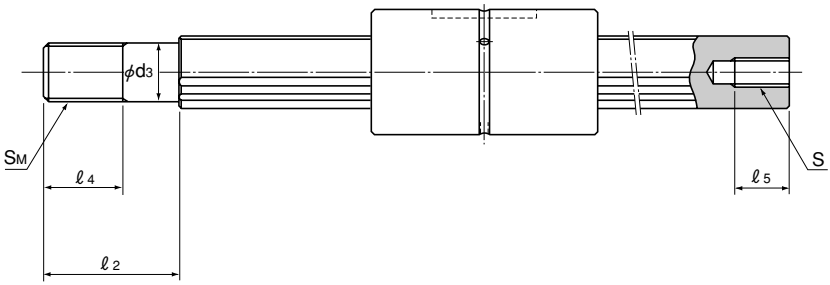
2 LF20 UU CM +400L P N
1 2 3 4 5 6 7

1 Number of spline nuts on one shaft (no symbol for one nut)
2 Model No.
3 Dust prevention accessory symbol - no symbol: without seal
UU: rubber seal attached on both ends of spline nut
U: rubber seal attached on either end of spline nut
4 Symbol for clearance in the rotational direction (see page b-4)
5 Overall spline shaft length (in mm)
6 Accuracy symbol (see page b-5)
7 Symbol for standard hollow spline shaft (see page b-47) (no symbol: solid spline shaft)

Selecting a Model Number | Refer to the "THK General Catalog - Technical Descriptions of the Products," provided separately

Model LT with Recommended Shaft End Shape

For support



Unit: mm

Model No.	d_3	Tolerance	ℓ_2	S_M	ℓ_4	S× ℓ_5
LT 6	5	0	12	M5×0.8	7	M2.5×4
LT 8	6	–0.012	14	M6×1	8	M3×5
LT 10	8	0	18	M8×1	11	M4×6
LT 13	10	–0.015	23	M10×1.25	14	M5× 8
LT 16	14	0	30	M14×1.5	18	M6×10
LT 20	16	–0.018	38	M16×1.5	22	M8×15
LT 25	22	0	50	M22×1.5	28	M10×18
LT 30	27	–0.021	60	M27×2	34	M14×25
LT 40	36	0	80	M36×3	45	M18×30
LT 50	45	–0.025	100	M45×4.5	58	M22×40