Rotary Ball Spline Type LTR

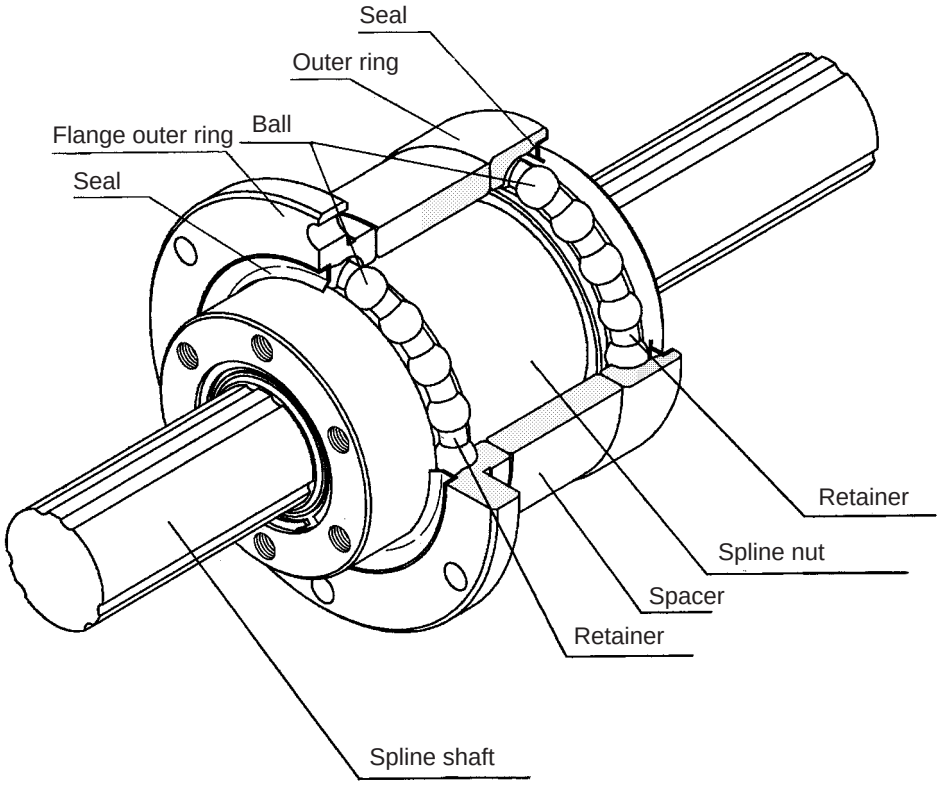


Fig. 1 Construction of Rotary Ball Spline Type LTR

Construction and Features

Rotary Ball Spline type LTR has six trains of load-bearing balls to hold three crests on the spline shaft from both sides, so that an appropriate preload is applied without trouble. Angular-contact raceways that constitute a support bearing are formed on the exterior of the spline nut, making this type compact and lightweight.

The support bearing is provided using specific seals, which prevent the entry of foreign matter. The balls are held in place by a retainer (made of special synthetic resin) that causes the balls to circulate in line and prevents them from falling off if the spline shaft is removed.

Lightweight and compact

The one-piece design integrating the spline nut and support bearing into one unit enables precise and compact design.
The compact spline nut is lightweight and therefore develops little inertia. A sensitive response can therefore be obtained.

Zero angular backlash

The preloaded angular-contact design, in which two trains of balls arranged opposite one another hold a crest on the spline shaft at a contact angle of 20°, reduces the angular backlash in the rotational direction to zero and increases rigidity.

Simple assembly

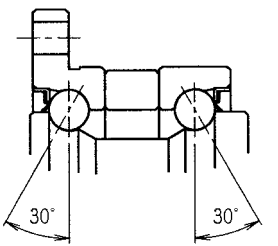
Just bolt the spline nut to the housing. It's that simple.

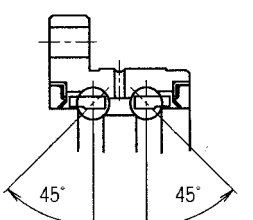
Major uses

- Scalar robot Z axis
- Wire winder
- Machine center ATC
- Assembling robots

High rigidity

A wide contact angle and appropriate level of preload combine to provide high torque and moment rigidity.
The support bearing, with a contact angle of 30°, is resistant to moment load and rigidly supports the shaft.
The contact angle for compact type LTR-A is 45°.





Clearance in the Rotational Direction

The clearance of the Ball Spline in the rotational direction significantly affects the rigidity and precision of the spline nut.
It is very important, therefore, to determine the appropriate clearance for the intended uses. As repeated swiveling and reciprocal linear motions cause heavy vibration and impact, preloading the system drastically improves its service life and accuracy.

We will determine the optimum clearance for your operating conditions. Please contact us.

Table 1 presents the clearances in the rotational direction for Ball Spline Type LTR.

Clearance in the rotational direction		Operating conditions
	CM	• High rigidity is required; vibration and impact are heavy. • Moment loads must be borne by a single spline nut.
	CL	• Overhang loads and moments are applied. • Highly reproducible accuracy is required. • Alternate loads are applied.
	Normal	• Smooth movement should be achieved with only a low magnitude of force. • Torque is continually applied in a given direction.

Table 1 Ball Spline Clearance in the Rotational Direction

Unit: μm

Nominal shaft diameter \ Symbol	Normal	Light preload	Medium preload
	No symbol	CL	CM
8 10	–2 ~ +1	–6 ~ -2	
16 20			–9 ~ –5
25 32	–3 ~ +2	–10 ~ –4	–14 ~ –8
40 50	–4 ~ +2	–16 ~ –8	–22 ~ –14
60	–5 ~ +2	–22 ~ –12	–30 ~ –20

Note: For normal clearance, do not append any symbol to a model number. For medium and light preloads, append “CM” or “CL”. (For model-number coding, see page B-95.)

Spline Shaft

Spline-shaft cross-sectional shape and outer-diameter tolerance

For Ball Spline type LTR, spline shafts can be provided upon request. When requesting an estimate or placing an order, specify the spline-shaft cross-sectional shape.

Table 2 presents the spline-shaft minor diameters and tolerances for the standard spline-shaft outer diameters.

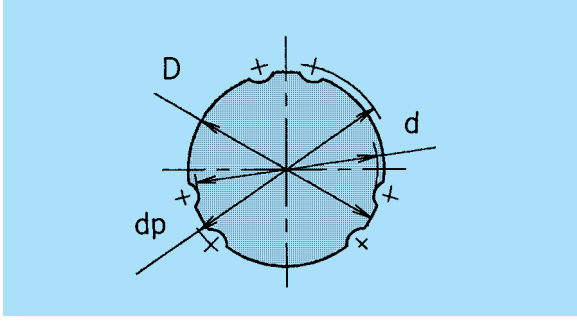


Table 2 Spline Shaft Cross-Sectional Shape

Unit: mm

Nominal shaft diameter	Minor diametr d	Outer diameter D	Outer-diameter tolerance
8	7.0	8	0 –0.015
10	8.5	10	
16	14.5	16	0 –0.018
20	18.5	20	0 –0.021
25	23.0	25	
32	30.0	32	
40	37.5	40	0 –0.025
50	46.5	50	
60	56.5	60	0 –0.030

Hollow-spline-shaft inner diameter

For Ball Spline type LTR, the hollow spline shafts shown in Table 4 are available as standard components. They are lightweight and can be used as a hydropneumatic passage.

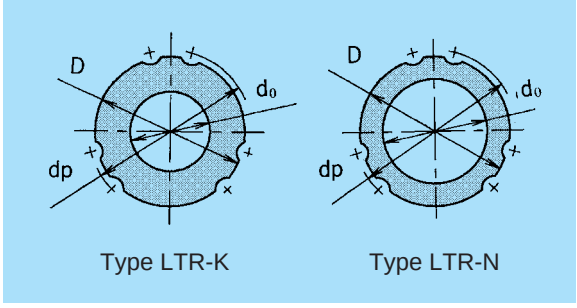


Table 4 Standard Hollow-Spline Shaft Dimensions

Unit: mm

Nominal shaft diameter	Outer diameter D	Type K		Type N	
		Hollow diameter d_0	Mass kg/m	Hollow diameter d_0	Mass kg/m
8	8	3.0	0.35	-	-
10	10	4.0	0.52	-	-
16	16	7	1.3	11	0.8
20	20	10	1.8	14	1.3
25	25	12	3.0	18	1.9
32	32	18	4.3	23	3.1
40	40	22	6.9	29	4.7
50	50	25	11.6	36	7.4
60	60	32	16.0	-	-

Note: The standard hollow spline shaft comes in two types, K and N. Specify the required type by appending “K” or “N” to the desired model number.

Table 3 Ball Center-to-Center Shaft Diameter

Unit: mm

Nominal shaft diameter	8	10	16	20	25	32	40	50	60
dp	9.3	11.5	17.8	22.1	27.6	35.2	44.2	55.2	66.3

Length of incomplete spline portion in special spline-shaft

To obtain a spline-shaft end or mid-point diameter greater than the minor diameter (d), an incomplete spline portion is required to provide a recess under the grinding wheel. Table 5 shows the relationship between the incomplete spline length (S) and the flange diameter (D_0). This, however, does not apply to spline shafts with an overall length of 1,500 mm or more. For spline shafts with an overall length greater than 1,500 mm, contact us.

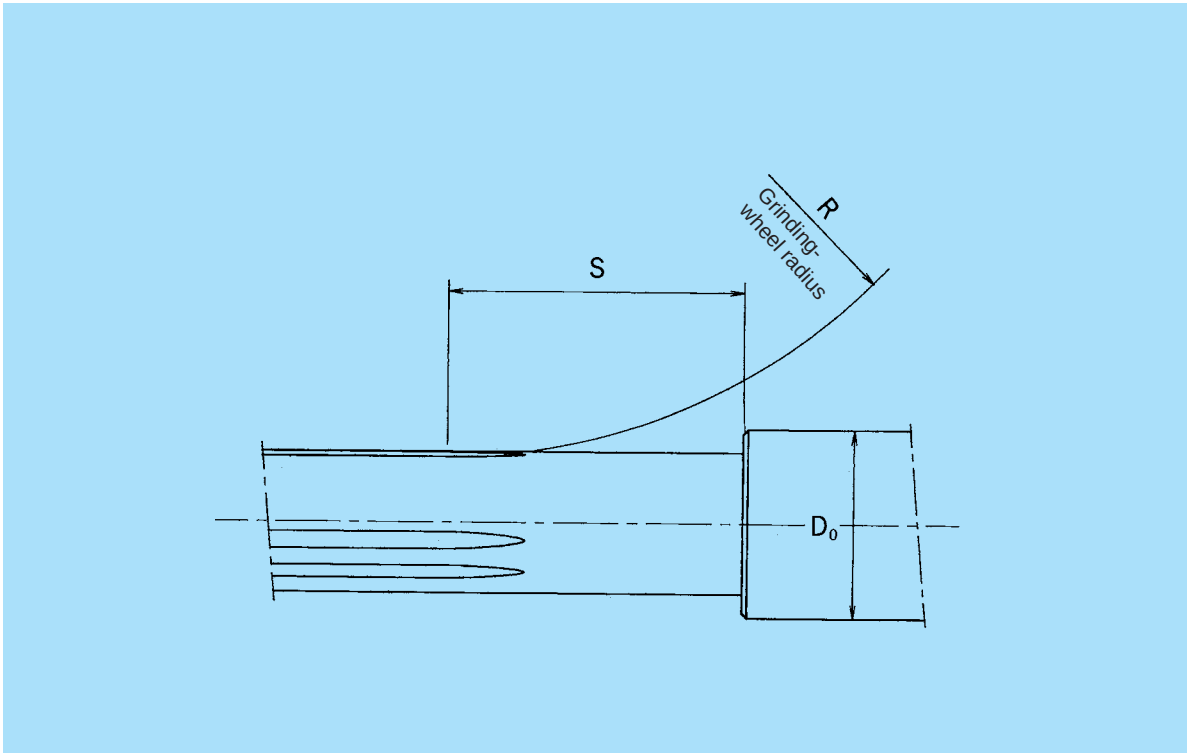
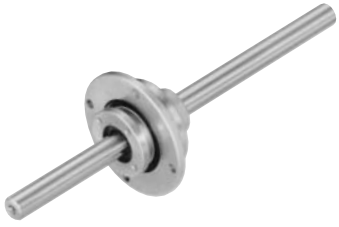


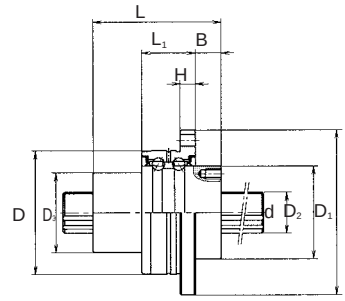
Table 5 Incomplete Spline Length S

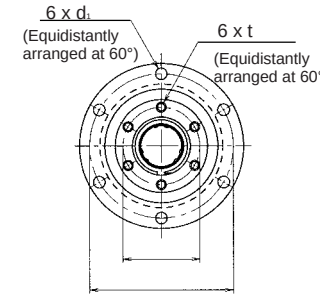
Unit: mm

Nominal shaft diameter \ Flange diameter D_0	6	8	10	13	16	20	25	30	40	50	60	80	100	120	140	160
8	-	16	24	30	35	-	-	-	-	-	-	-	-	-	-	-
10	-	-	17	27	32	37	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	21	36	46	54	-	-	-	-	-	-	-	-
20	-	-	-	-	-	21	38	48	62	-	-	-	-	-	-	-
25	-	-	-	-	-	-	23	39	56	67	-	-	-	-	-	-
32	-	-	-	-	-	-	-	24	49	62	72	-	-	-	-	-
40	-	-	-	-	-	-	-	-	27	50	63	81	-	-	-	-
50	-	-	-	-	-	-	-	-	-	29	51	74	89	-	-	-
60	-	-	-	-	-	-	-	-	-	-	28	56	71	82	-	-

Type LTR-A
(compact type)



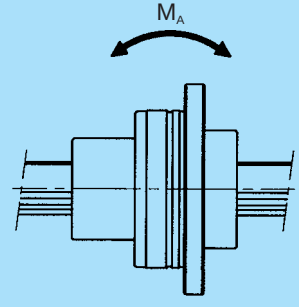


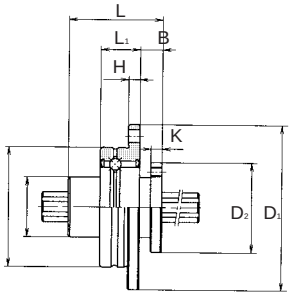


LT16A or over

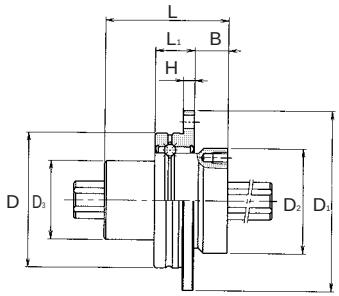
Model No.	Spline nut dimensions												
	Outer diameter D	Tolerance	Length L	Flange dimensions D_1	D_2^{h7}	D_3	H	L_1	B	K	P	P_1	m × t
LTR 8A	32	−0.009 −0.025	25	44	24	16	3	10.5	6	3	38	19	M2.6 × 3
LTR 10A	36		33	48	28	21	3	10.5	9	-	42	23	M3 × 0.5 × 4
LTR 16A	48		50	64	36	31	6	21	10	-	56	30	M4 × 0.7 × 6
LTR 20A	56	−0.010 −0.029	63	72	43.5	35	6	21	12	-	64	36	M5 × 8
LTR 25A	66		71	86	52	42	7	25	13	-	75	44	M5 × 8
LTR 32A	78		80	103	63	52	8	25	17	-	89	54	M6 × 10
LTR 40A	100	−0.012 −0.034	100	130	79.5	64	10	33	20	-	113	68	M6 × 10

Notes:
1) M_A represents the permissible moment in the axial direction when a single spline nut is used, as shown below.
- If a model with seals is required, please specify.
- For model-number coding, see page B-95.

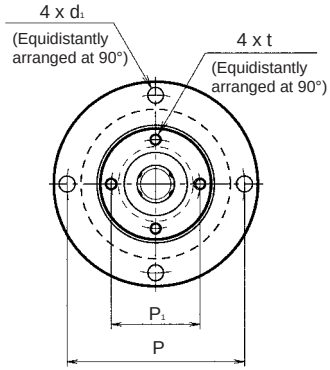




LTR8A



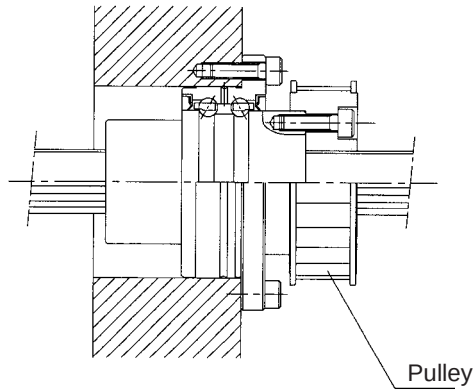
LTR10A



LTR8A LTR10A

Unit: mm

d_1	Shaft diameter d^{h7}	No. of trains of balls	Basic load rating C kN	Basic load rating C_0 kN	Basic torque rating C_T Nm	Basic torque rating C_{0T} Nm	Static permissible moment M_A 1) Nm	Support-bearing basic load rating C kN	Support-bearing basic load rating C_0 kN	Mass Spline nut kg	Mass Spline shaft kg/m
3.4	8	4	1.47	2.55	1.96	2.94	5.9	0.69	0.24	0.08	0.40
3.4	10	4	2.84	4.9	3.92	7.84	15.7	0.77	0.30	0.13	0.62
4.5	16	6	7.05	12.6	31.3	34.3	67.6	6.7	6.4	0.35	1.6
4.5	20	6	10.2	17.8	56.8	55.8	118	7.4	7.8	0.51	2.5
5.5	25	6	15.2	25.8	105	103	210	9.7	10.6	0.79	3.9
6.6	32	6	20.5	34.0	180	157	290	10.5	12.5	1.25	5.6
9.0	40	6	37.8	60.4	418	377	687	16.5	20.7	2.51	9.9



Type LTR

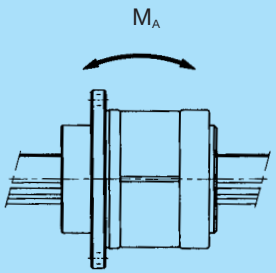
Model No.	Spline nut dimensions										
	Outer diameter D	Tolerance	Length L	Flange dimensions D_1	D_2^{h7}	H	L_1	B	P	P_1	m × t
LTR 16	52	0 –0.007	50	68	39.5	5	37	10	60	32	M 5 × 8
LTR 20	56		63	72	43.5	6	48	12	64	36	M 5 × 8
LTR 25	62		71	78	53	6	55	13	70	45	M 6 × 8
LTR 32	80		80	105	65.5	9	60	17	91	55	M 6 × 10
LTR 40	100	0 –0.008	100	130	79.5	11	74	23	113	68	M 6 × 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

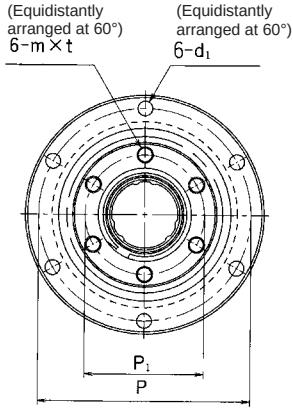
Notes:

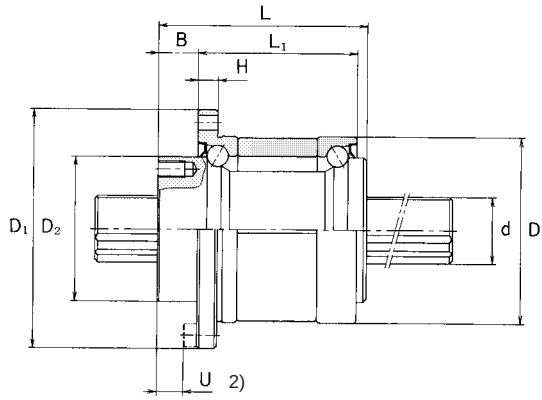
1) M_A represents the permissible moment in the axial direction when a single spline nut is used, as shown below.

2) Dimension U refers to the distance from the head of the hexagonal socket cap screw to the spline-nut end face.

- If a model with seals is required, please specify.
- For model-number coding, see page B-95.







Unit: mm

d_1	U 2)	Shaft diameter d h7	No. of trains of balls	Basic load rating C kN	Basic load rating C_0 kN	Basic torque rating C_T Nm	Basic torque rating C_{0T} Nm	Static permissible moment M_A 1) Nm	Support-bearing basic load rating C kN	Support-bearing basic load rating C_0 kN	Mass Spline nut kg	Mass Spline shaft kg/m
4.5	5	16	6	7.06	12.6	31.4	34.3	67.6	12.7	11.8	0.51	1.6
4.5	7	20	6	10.2	17.8	56.9	55.9	118	16.3	15.5	0.7	2.5
4.5	8	25	6	15.2	25.8	105	103	210	17.6	18.0	0.93	3.9
6.6	10	32	6	20.5	34.0	180	157	290	20.1	24.0	1.8	5.6
9	13	40	6	37.8	60.5	419	377	687	37.2	42.5	3.9	9.9
11	13	50	6	60.9	94.5	842	769	1340	41.7	54.1	6.7	15.5
11	13	60	6	73.5	111.7	1220	1040	1600	53.1	68.4	8.8	22.3