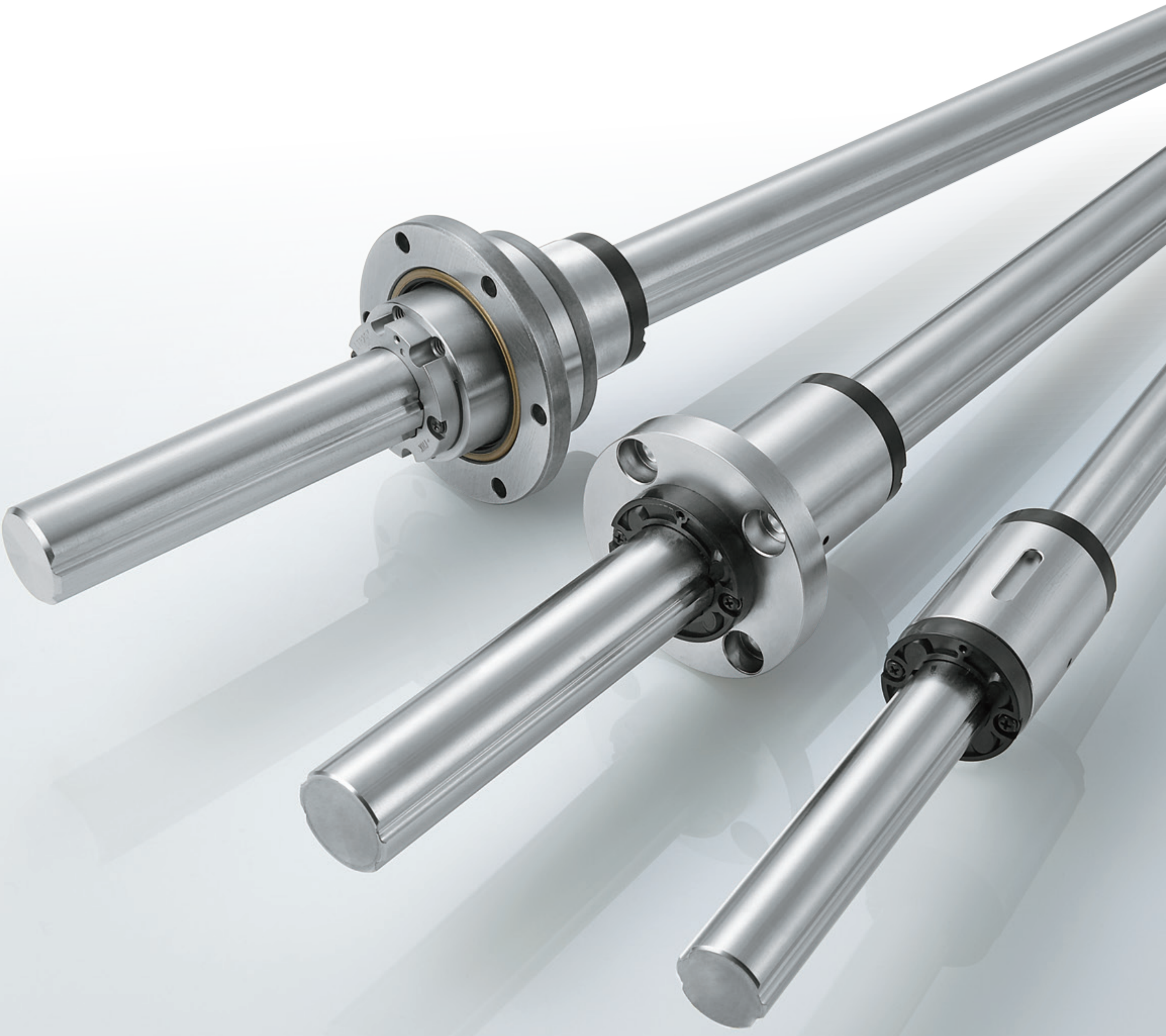
THK

Compact Ball Spline

LT-X／LF-X／LTR-V



Compact, High-Speed Performance via a New Circulation Method

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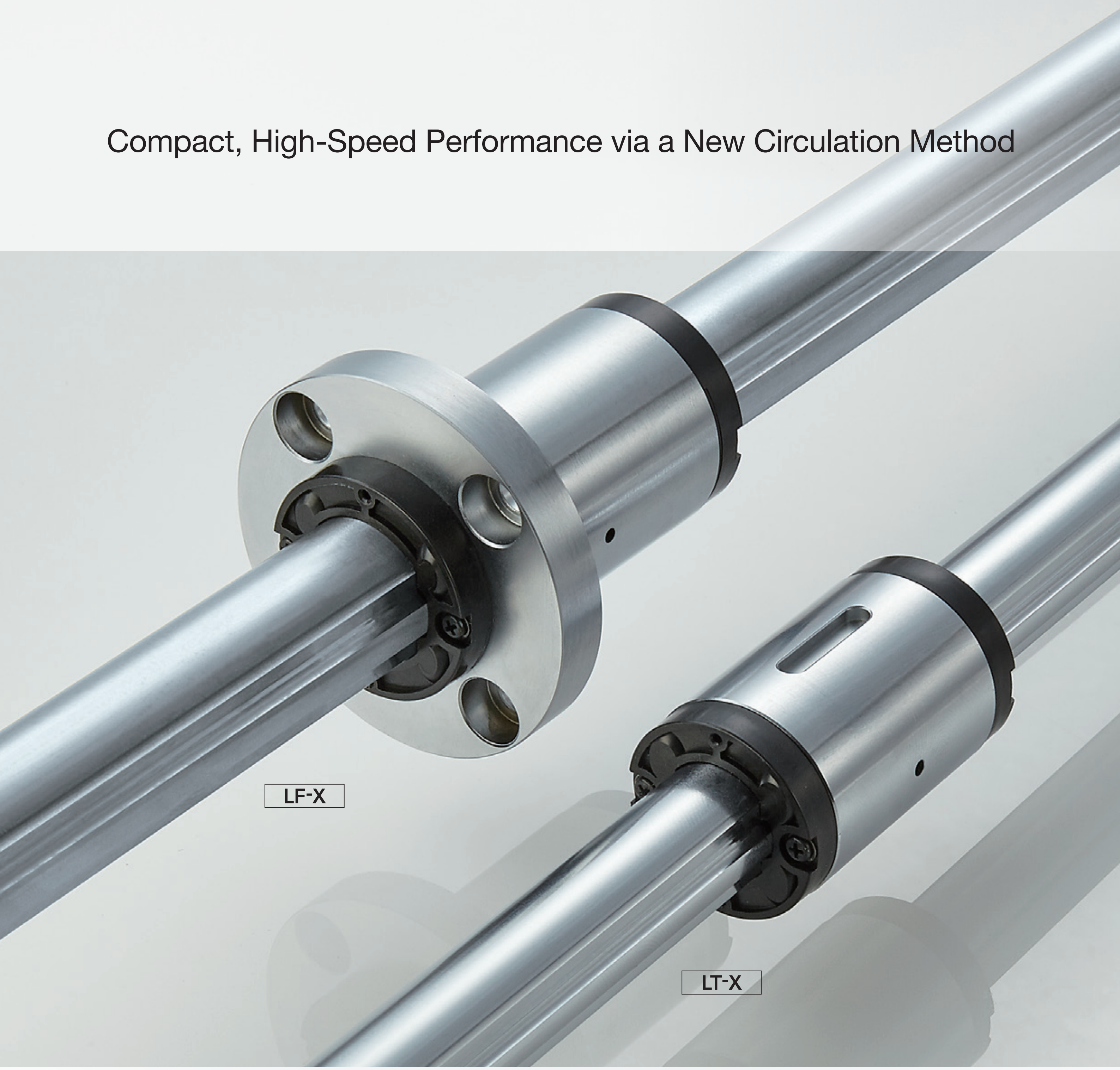
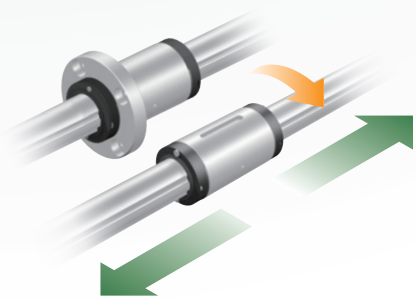


Compact Ball Spline

LT-X／LF-X

This compact ball spline's new circulation structure enables it to feature a compact outer diameter and handle high-speed operations.



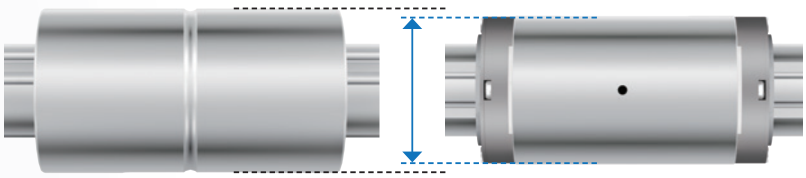
Product Features

Feature 1 Compact Outer Diameter

The outer diameter is more compact than the previous Model LT/LF thanks to the new circulation structure.

The outer diameter is up to 20% more compact

Comparison of Spline Nut Outer Diameter Dimensions (LT and LT-X)



The outer diameter is up to 20% more compact than previous THK products. This makes it possible to design a more compact machine core.

Unit: mm

Shaft diameter	Nut outer diameter	
	Model LT	Model LT-X
3(3D)	–	6(7)
4	10	8
5	12	10
6	14	12
8	16	15
10	21	19
13	24	23
16	31	28
20	35	32
25	42	40
30	47	45

Feature 2 High-Speed Performance

The new circulation structure optimizes ball circulation, enabling high-speed operations.

Test result: **Runs 10,000 km without abnormalities**

High-Speed Durability Test Conditions

Item	Description
Model No.	LT20X
Speed	2 m/s
Acceleration	49 m/s^2
Lubricant	Lithium soap-based grease (AFB-LF Grease)
Stroke	650 mm
Orientation	Horizontal

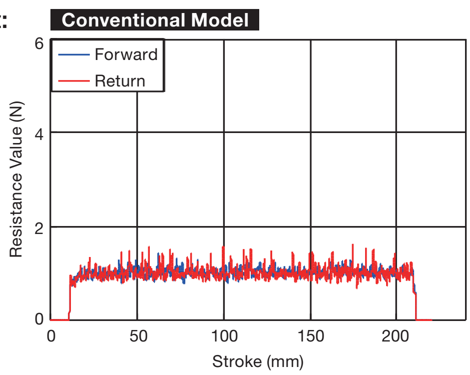
Feature 3 Smooth Motion

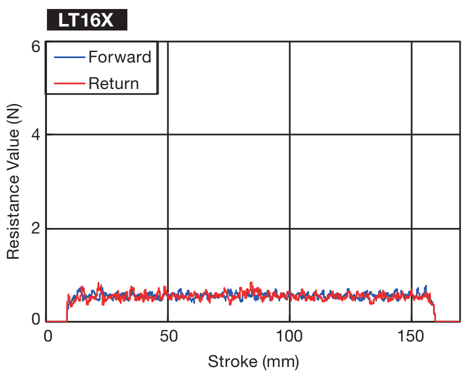
Sliding resistance fluctuates less than that of the previous Model LT/LF.

Rolling Resistance Test Conditions

Item	Description
Speed	10 mm/s
Lubricant	Lithium soap-based grease (AFB-LF Grease)
Orientation	Horizontal

Test result:

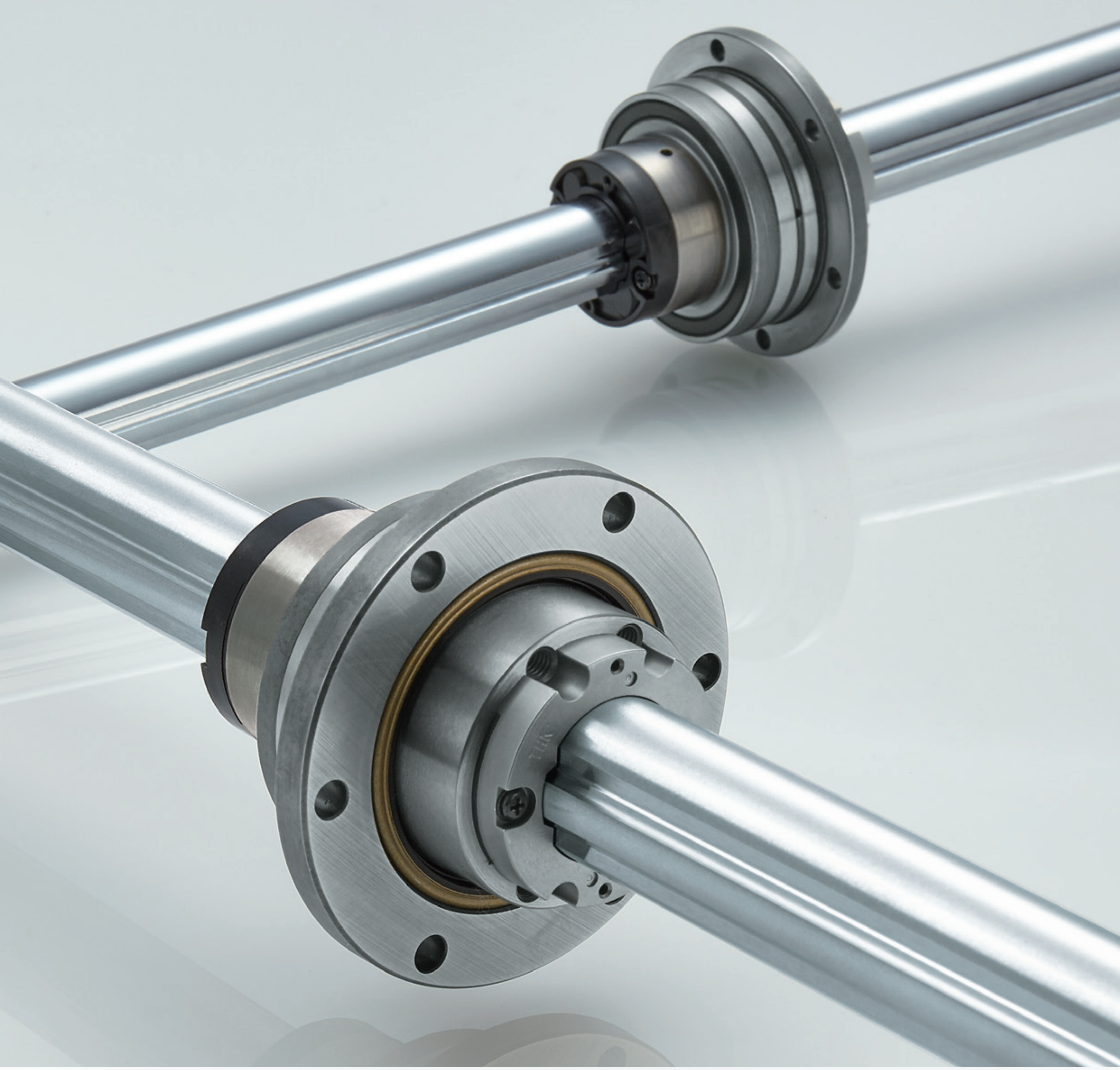




Feature 4 Option: QZ Lubricator

See page 10 for details.

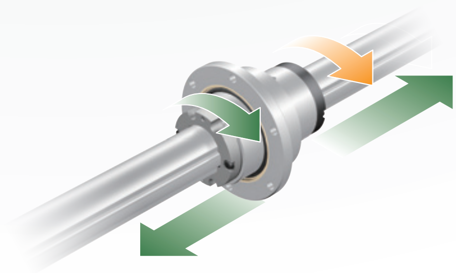
The QZ Lubricator is a lubricator attached to both ends of the spline nut. The QZ Lubricator feeds the right amount of lubricant to the raceway on the spline shaft. This allows an oil film to be continuously formed between the rolling element and the raceway, and it drastically extends the lubrication maintenance interval.



Rotary Ball Spline

LTR-V

This lightweight, compact unit-type ball spline features support bearings that are directly integrated with the outer surface of the LT-X spline nut.



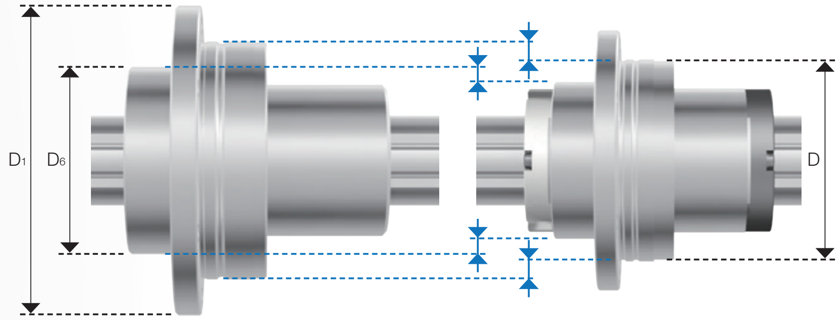
Product Features

Feature 1 Compact Outer Diameter

The Model LTR-V is more compact than the previous Model LTR-A because it uses a Model LT-X for the ball spline.

The outer diameter is up to 17% more compact

Spline Nut Dimension Comparison (LTR-A and LTR-V)



Unit: mm

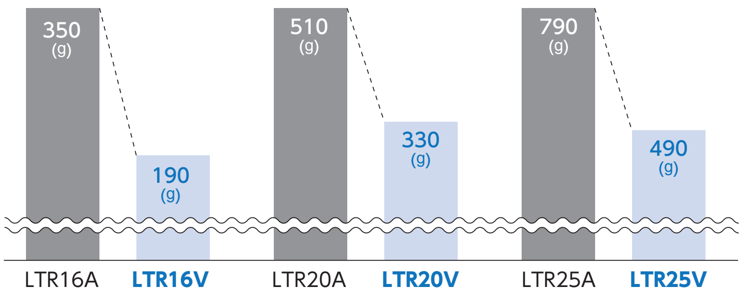
Model No.	Outer diameter of support bearing (D)		Outer diameter of flange (D1)		Pulley mount (D6)	
		Compared to the previous product		Compared to the previous product		Compared to the previous product
LTR 16A	48	13% smaller	64	16% smaller	36	10% smaller
LTR 16V	42		54		32.5	
LTR 20A	56	14% smaller	72	11% smaller	43.5	17% smaller
LTR 20V	48		64		36	
LTR 25A	66	15% smaller	86	16% smaller	52	16% smaller
LTR 25V	56		72		43.5	

Feature 2 Lightweight

The Model LTR-V is more lightweight than the previous Model LTR-A because it uses a Model LT-X for the ball spline.

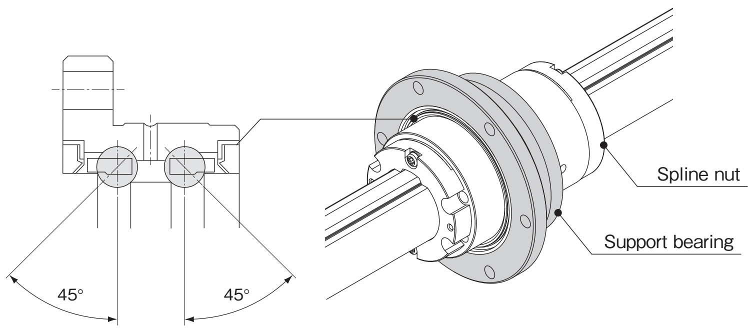
Up to 46% lighter

Mass Comparison with Conventional Models



Feature 3 High Rigidity

The support bearing uses a 45° contact angle that is resistant to moment loads.

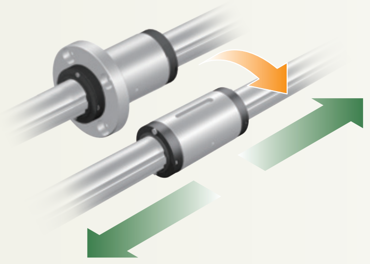


What is a ball spline?

Ball splines are linear motion guides that transmit torque while the nut moves with smooth linear motion caused by balls rolling along raceways precisely ground into the spline shaft.

LT-X／LF-X

Linear motion and torque transmission

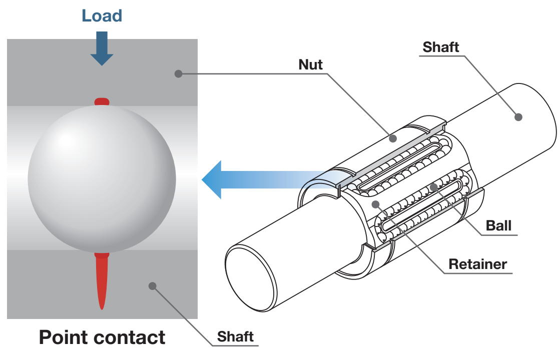


Three advantages of the ball spline

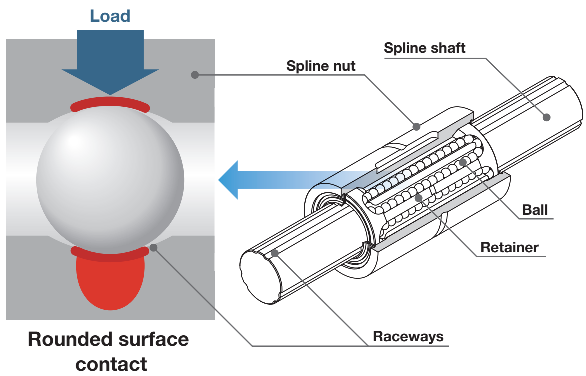
1 High load capacity and long service life

Unlike linear bushings, ball splines possess raceways. The rounded shape of these raceways closely resembles that of the balls, significantly increasing the load the ball spline can handle and enabling a high load capacity and long service life. Compared to linear bushings, the permissible load is 13 times greater, and the service life is 2,200 times greater.

Linear Bushing

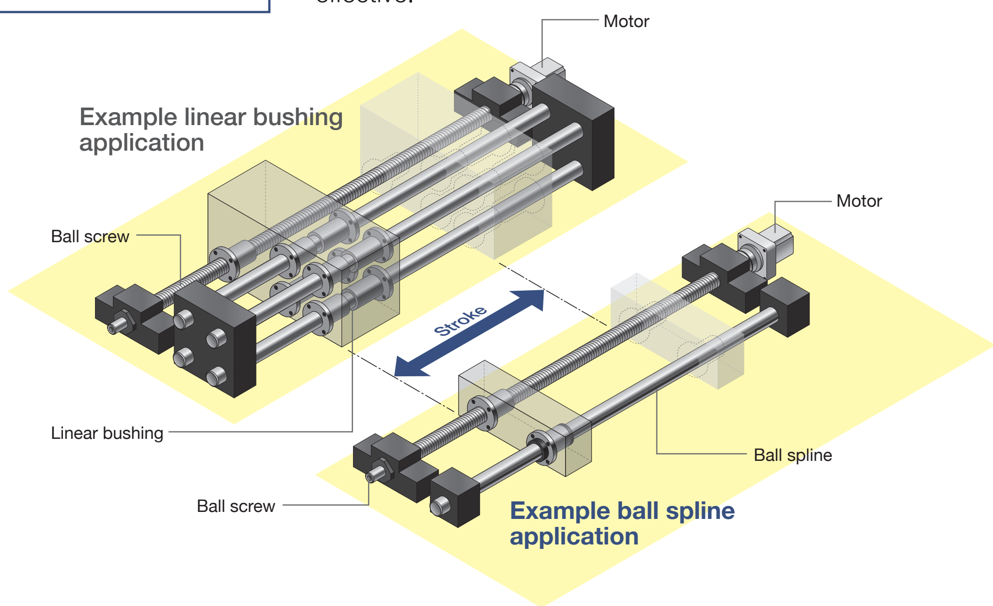


Ball Spline



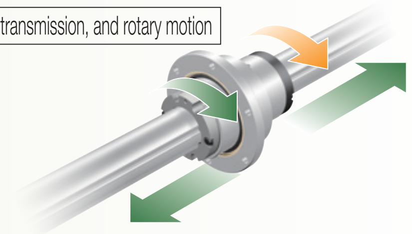
2 Lightweight and compact

Ball splines can handle torque with one shaft, requiring fewer and smaller peripheral components than linear bushings and enabling machine cores to be made lighter and more cost-effective.



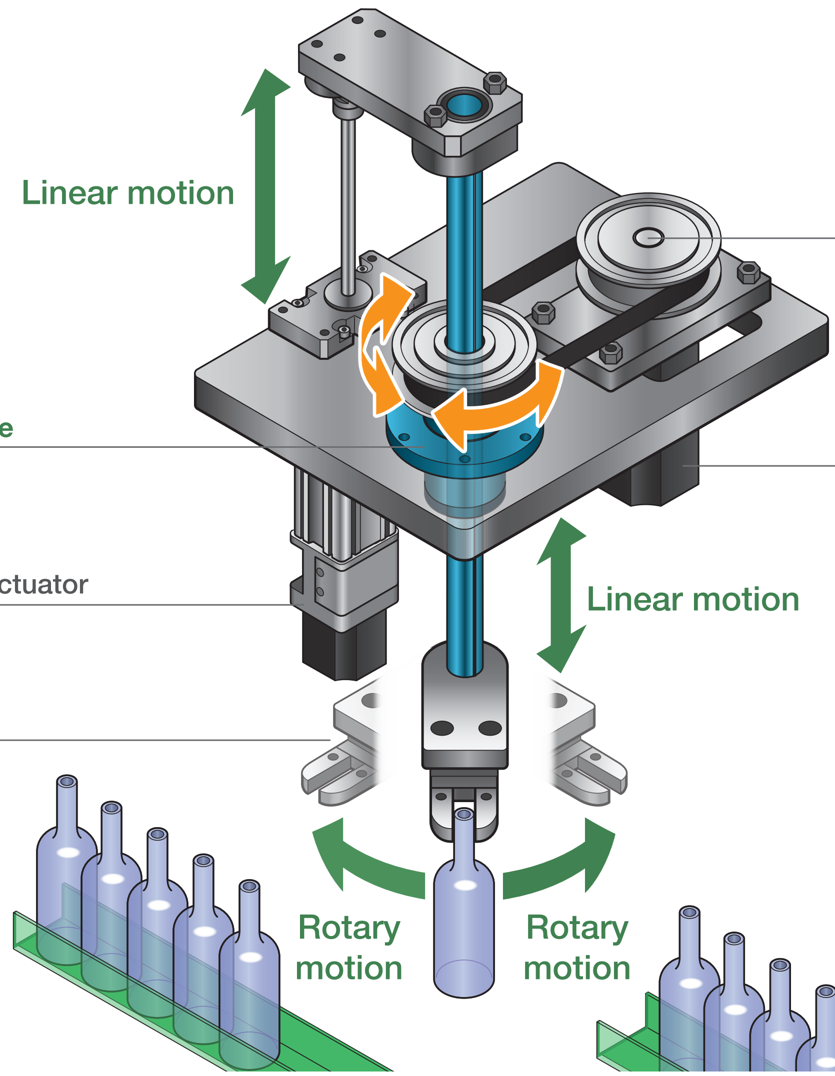
LTR-V

Linear motion, torque transmission, and rotary motion



3 Linear and rotary mechanisms

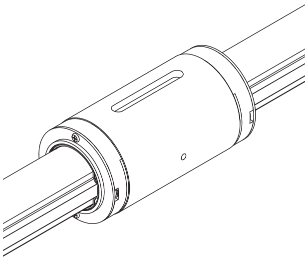
Ball splines can transmit torque with one shaft, enabling operations that combine linear motion and rotation.



Lineup

LT-X

Cylindrical



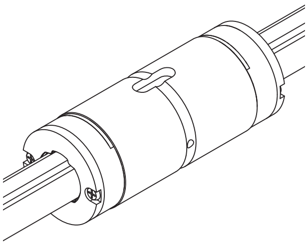
This type has a straight, cylindrical spline nut. A keyway* can be used to affix to the housing and transmit torque.

Models LT3X to LT6X are made of stainless steel, which has high corrosion resistance.

* LT3X, LT3XD, and LT4X are countersunk.

LT-XL

Long cylindrical type



This type uses an elongated nut with the same outer diameter as the Model LT-X.

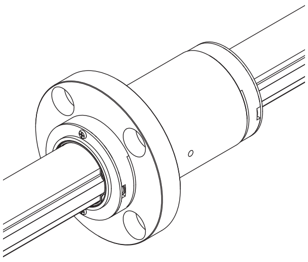
It is suitable for moment loads or torque and overhang loads that exceed those tolerated by the Model LT-X.

Models LT5XL and LT6XL are made of stainless steel, which has high corrosion resistance.

Models: LT5XL, LT6XL, LT8XL

LF-X

Flanged

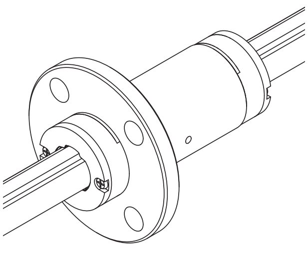


The spline nut can be bolted to the housing via the flange, making assembly simple. It is suited for locations where the housing may be deformed if a keyway is machined on its surface, and where the housing is narrow.

Models LF3X to LF6X are made of stainless steel, which has high corrosion resistance.

LF-XL

Long flanged type



This type uses an elongated nut with the same outer diameter as the Model LF-X.

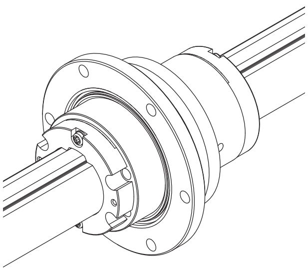
It is suitable for moment loads or torque and overhang loads that exceed those tolerated by the Model LF-X.

Models LF5XL and LF6XL are made of stainless steel, which has high corrosion resistance.

Models: LF5XL, LF6XL, LF8XL

LTR-V

Support bearing type

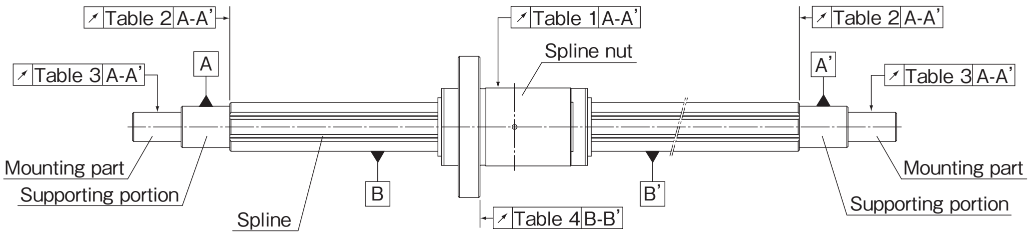


This ball spline is a lightweight and compact type featuring the same outer diameter of the nut as the Model LT-X and ball raceways that use angular contact to accommodate support bearings.

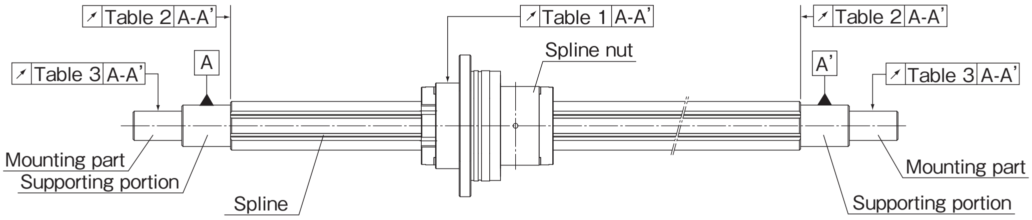
Accuracy Standards

The accuracy of a ball spline is categorized as Normal Grade (no symbol), High Accuracy Grade (H), or Precision Grade (P) based on the radial runout of the spline nut's outer diameter in relation to the spline shaft's support. Measurement areas are shown in the below drawings.

■ LT-X/LT-XL, LF-X/LF-XL



■ LTR-V



Ball Spline Accuracy Measurements

Table 1 Radial Runout of the Spline Nut Diameter in Relation to the Spline Shaft

Accuracy		Radial runout (max)														
Nominal shaft diameter		3(3D), 4, 5			6, 8			10			13, 16, 20			25, 30		
Overall spline shaft length (mm)		Normal grade (No symbol)	High accuracy grade (H)	Precision grade (P)	Normal grade (No symbol)	High accuracy grade (H)	Precision grade (P)	Normal grade (No symbol)	High accuracy grade (H)	Precision grade (P)	Normal grade (No symbol)	High accuracy grade (H)	Precision grade (P)	Normal grade (No symbol)	High accuracy grade (H)	Precision grade (P)
Above	Or less															
—	150	72[1]	46[1]	26[1]	—	—	—	—	—	—	—	—	—	—	—	—
150	200	72[2]	46[2]	26[2]	72	46	26	59	36	20	56	34	18	53	32	18
200	315	133[3]	—	—	133	89[4]	57[5]	83	54	32	71	45	25	58	39	21
315	400	—	—	—	171[5]	114	—	103	68	41	83	53	31	70	44	25
400	500	—	—	—	214[5]	—	—	123	82	51	95	62	38	78	50	29
500	630	—	—	—	—	—	—	151	102	—	112	75	46	88	57	34
630	800	—	—	—	—	—	—	190	—	—	137	92	58[6]	103	68	42
800	1000	—	—	—	—	—	—	260	—	—	170	115[6]	75[6]	124	83	52
1000	1250	—	—	—	—	—	—	—	—	—	222[6]	153[7]	—	151	102	65[9]
1250	1600	—	—	—	—	—	—	—	—	—	284[6]	196[8]	—	190	130[10]	—
1600	2000	—	—	—	—	—	—	—	—	—	356[6]	—	—	240	—	—
2000	2500	—	—	—	—	—	—	—	—	—	—	—	—	300	—	—
2500	3000	—	—	—	—	—	—	—	—	—	—	—	—	360	—	—

[1]Only applies to #3(3D). [2]Only applies to #4 and #5. [3]Only applies to #5. Applies to #5 only up to 250 mm. [4]Only applies to #6 up to 250 mm. [5]Only applies to #8.
[6]Only applies to #16 and #20. [7]Only applies to #20. [8]Only applies to #20. Applies to #20 only up to 1500 mm. [9]Only applies to #30. [10]Only applies to #25 up to 1500 mm.

Table 2 Axial Runout of the Spline Shaft End Face in Relation to the Spline Shaft Support

Accuracy	Axial runout (max) (μm)		
Nominal shaft diameter	Normal grade (No symbol)	High accuracy grade (H)	Precision grade (P)
3, 4, 5, 6, 8, 10	22	9	6
13, 16, 20	27	11	8
25, 30	33	13	9

Table 4 Axial Runout of the Spline Nut Flange Mounting Surface in Relation to the Spline Shaft Support

Accuracy	Axial runout (max) (μm)		
Nominal shaft diameter	Normal grade (No symbol)	High accuracy grade (H)	Precision grade (P)
3(3D), 4, 5, 6, 8	27	11	8
10, 13	33	13	9
16, 20, 25, 30	39	16	11

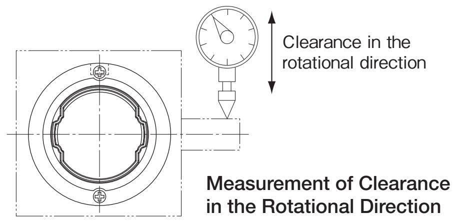
Note: Applies to Model LF-X only.

Table 3 Radial Runout of the Part Mounting Surface in Relation to the Spline Shaft Support

Accuracy	Radial runout (max) (μm)		
Nominal shaft diameter	Normal grade (No symbol)	High accuracy grade (H)	Precision grade (P)
3, 4, 5, 6, 8	33	14	8
10	41	17	10
13, 16, 20	46	19	12
25, 30	53	22	13

Clearance in the Rotational Direction

With the Model LT-X/LT-XL, LF-X/LF-XL, and LTR-V, the sum of clearances in the circumferential direction is standardized as the clearance in the rotational direction.



Measurement of Clearance in the Rotational Direction

Table 5 Clearance in the Rotational Direction

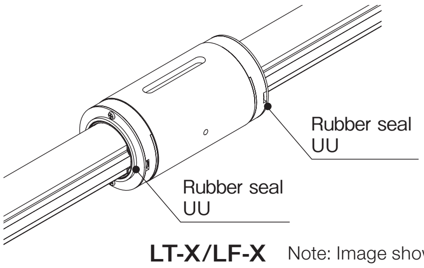
Unit: μm

Nominal shaft diameter	Clearance in the rotational direction		
	Normal	CL clearance	CM clearance
3(3D)	0 to +2	-2 to 0	—
4, 5, 6, 8	-2 to +1	-6 to -2	—
10, 13	-2 to +1	-4 to -2	—
16, 20	-2 to +1	-5 to -2	-8 to -5
25, 30	-3 to +1	-7 to -3	-11 to -7

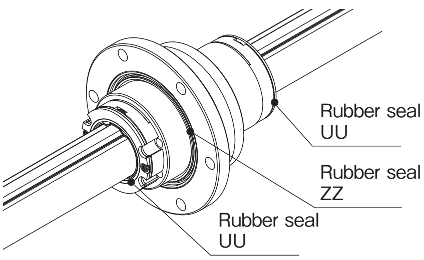
Contamination Protection

Contamination protection options for ball splines include special synthetic rubber seals with superior wear resistance. It is necessary to prevent harmful foreign materials from getting inside the spline nut or support bearing, as that could cause abnormal wear or shorten the product's service life.

Note: Models LT3X, LT3XD, LF3X, and LF3XD do not feature contamination seals.



LT-X/LF-X Note: Image shows LT-X.



LTR-V

Model LT-X/LF-X Max Seal Resistance

Unit: N

Nominal shaft diameter	Seal resistance (Max/2 seals)
4	0.13
5	0.15
6	0.17
8	0.21
10	0.8
13	1.0
16	1.3
20	1.6
25	2.0
30	2.4

Note: These specifications are for ball splines with one nut (two end seals). They are also based on using THK AFF Grease at the lips.

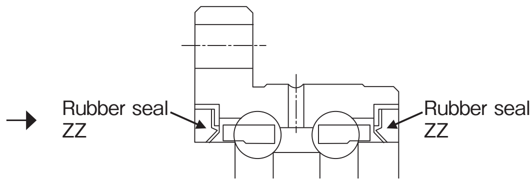
Model LTR-V Max Support Bearing Seal Torque Resistance

Unit: N·m

Nominal shaft diameter	Seal resistance (Max/2 seals)
16	0.04
20	0.06
25	0.06

Note: These values were measured when using two ZZ seals and THK AFB-LF Grease.

Support Bearing Cross-Section



Standard Grease

THK Original Grease AFF

AFF is a grease using a high-grade synthetic oil, lithium-based consistency enhancer, and special additives. It provides stable rolling resistance and superior fretting resistance.

Used for: LT3X to LT8X
LF3X to LF8X

Representative Physical Properties

Item		Physical property	Testing method
Consistency enhancer		Lithium-based	
Base oil		High-grade synthetic oil	
Base oil kinematic viscosity mm²/s (40℃)		100	JIS K 2220 23
Worked penetration (25°C, 60 W)		315	JIS K 2220 7
Mixing stability (100,000 W)		345	JIS K 2220 15
Dropping point: °C		220	JIS K 2220 8
Evaporation volume: mass% (99°C, 22 h)		0.7	JIS K 2220 10
Oil separation rate: mass% (100°C, 24 h)		2.6	JIS K 2220 11
Copper plate corrosion (B method, 100°C, 24 h)		Accepted	JIS K 2220 9
Low-temperature torque: mN·m (−20°C)	Starting	220	JIS K 2220 18
	Rotational	60	
4-ball testing (welding load): N		1236	ASTM D2596
Operating temperature range: °C		-40 to 120	
Color		Reddish brown	

THK Original Grease AFB-LF

AFB-LF is a general-purpose grease using a lithium-based consistency enhancer with refined mineral oil as the base oil. It excels in extreme pressure resistance and mechanical stability.

Used for: LT10X to 30X
LF10X to 30X
LTR16V, 20V, 25V

Note: Greases other than the standard greases may also be used. Contact THK for details.

Representative Physical Properties

Item		Physical property	Testing method
Consistency enhancer		Lithium-based	
Base oil		Refined mineral oil	
Base oil kinematic viscosity mm²/s (40℃)		170	JIS K 2220 23
Worked penetration (25°C, 60 W)		275	JIS K 2220 7
Mixing stability (100,000 W)		345	JIS K 2220 15
Dropping point: °C		193	JIS K 2220 8
Evaporation volume: mass% (99°C, 22 h)		0.4	JIS K 2220 10
Oil separation rate: mass% (100°C, 24 h)		0.6	JIS K 2220 11
Copper plate corrosion (B method, 100°C, 24 h)		Accepted	JIS K 2220 9
Low-temperature torque: mN·m (−20°C)	Starting	130	JIS K 2220 18
	Rotational	51	
4-ball testing (welding load): N		3089	ASTM D2596
Operating temperature range: °C		-15 to 100	
Color		Yellowish brown	

Option: QZ Lubricator

The QZ Lubricator is a lubricator attached to both ends of the spline nut. This component directly feeds the right amount of lubricant to the raceways in the spline shaft. This allows an oil film to be constantly formed between the balls and the raceway, and it significantly extends the lubrication maintenance interval.

In addition, this lubrication system is environmentally friendly because it does not make the ball spline's surroundings dirty. The QZ Lubricator is made primarily of three components, and lubricant is supplied to the spline's raceways from within the QZ Lubricator using the basic principle of capillary action, as used in felt-tip pens.

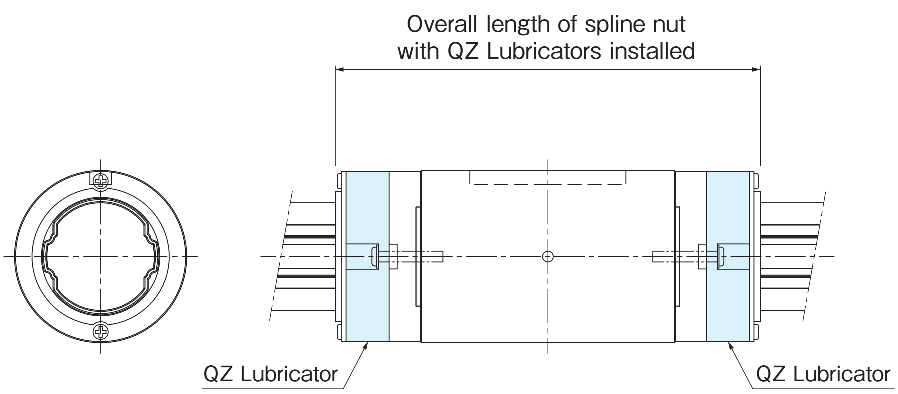
Note: Using the QZ Lubricator will increase the overall length of the spline nut.

Features

- Since it compensates for oil loss, the lubrication maintenance interval can be significantly extended.
- It is an eco-friendly lubrication system that does not contaminate the surrounding area, since it feeds the right amount of lubricant to the raceway.

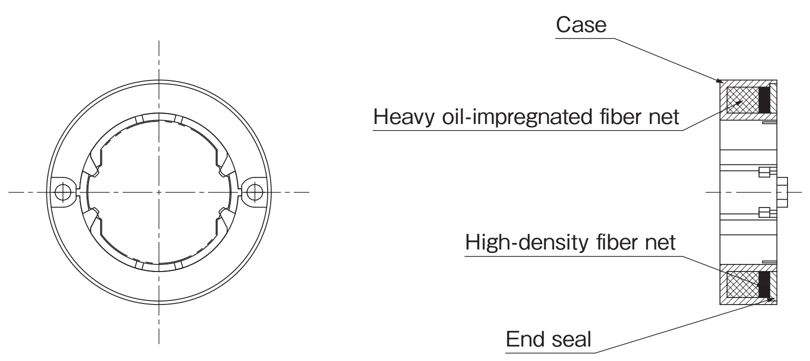
Overall Length of QZ-Compatible Spline Nuts Unit: mm

Model	LT-X / LF-X				
Nominal shaft diameter	#10	#13	#16	#20	#25
No seals or QZ	30.8	32.4	46.4	59	67
UU	33	36	50	63	71
QZUU	49	52	66	79	87



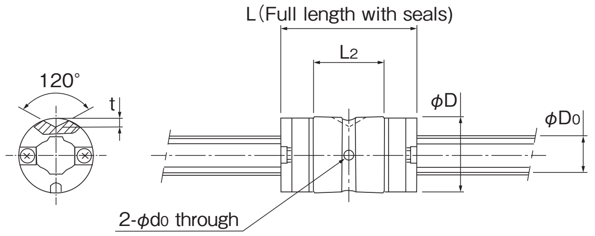
Note: See above table for each spline nut model's overall length

Structure of QZ Lubricator

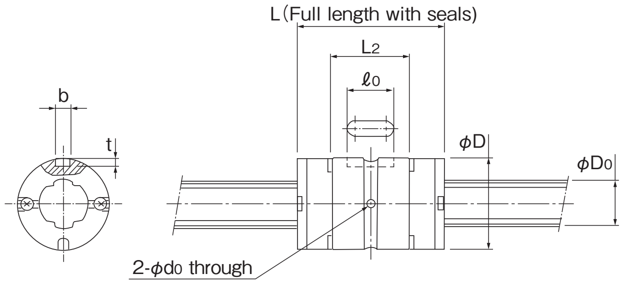


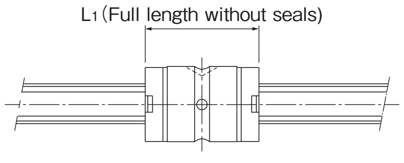
Specification Table

LT-X / LT-XL

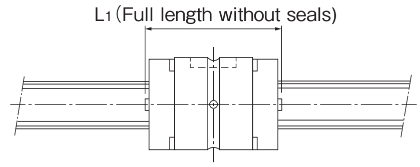


LT4X





LT3X, LT3XD, LT4X



LT5X, LT5XL, LT6X, LT6XL, LT8X, LT8XL

Model No.	Spline shaft diameter	Spline nut dimensions								
		Outer diameter		Length			Keyway dimensions			Greasing hole
	D_0 h7	D	Tolerance	L (With seals)	L_1 (Without seals)	L_2	b H8	t	ℓ_0	d_0
LT3X	3	6	0 -0.008	—	10	6.5	—	0.7	—	—
LT3XD	3	7	0 -0.009	—	10	6.5	—	0.8	—	—
LT4X	4	8	0 -0.009	14.4	12	7.5	—	1	—	
LT5X	5	10	0 -0.009	15	13.6	7.3	2	1.2	4.7	1
LT5XL				26	24.6	18.3				
LT6X	6	12	0 -0.011	19	17.6	10.2	2	1.2	6	
LT6XL				30	28.6	21.2				
LT8X	8	15	0 -0.011	25	23.8	14.6	2.5	1.2	8	1.5
LT8XL				40	38.8	29.6				
LT10X	10	19	0 -0.013	33	30.8	23.9	3	1.5	13	1.5
LT13X	13	23	0 -0.013	36	32.4	24	3	1.5	15	1.5
LT16X	16	28	0 -0.013	50	46.4	35.5	3.5	2	17.5	2
LT20X	20	32	0 -0.016	63	59	47.4	4	2.5	29	2
LT25X	25	40	0 -0.016	71	67	52.6	4	2.5	36	3
LT30X	30	45	0 -0.016	80	75.6	59.6	4	2.5	42	3

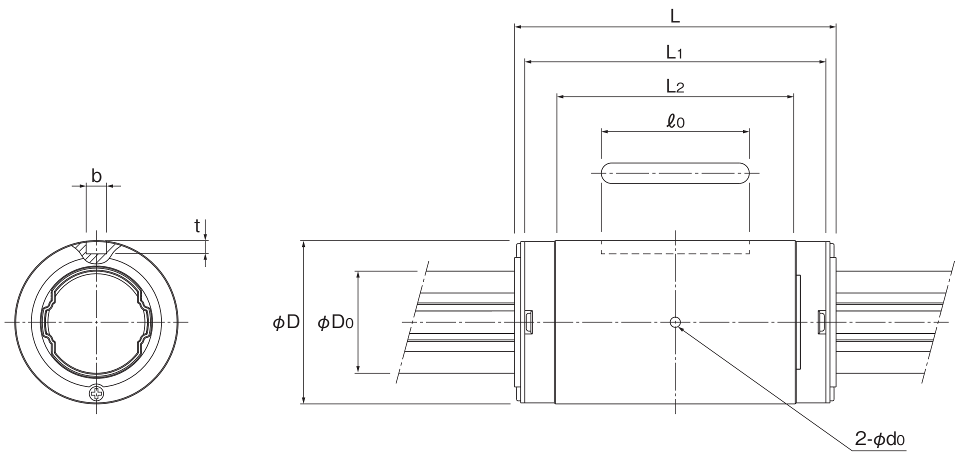
Note: Models LT3X and LT3XD do not feature contamination seals. They do not feature lubrication holes, either.

Model Number Coding

Specify the highlighted codes. Note: Specify each item for the models in the catalog.

2 LT20X QZ UU CL +700L P K

- **2** — Number of spline nuts on one shaft (No symbol for one nut)
- **LT20X** — Model number
- **QZ** — With QZ Lubricator (See p. 10)
  - No symbol: Without QZ Lubricator
  - QZ: With QZ Lubricator
- **UU** — Contamination protection accessory symbol (See p. 9)
  - No symbol: Without seals
  - UU: Seal on both ends
  - U: Seal on one end
- **CL** — Symbol for clearance in the rotational direction (See p. 8)
  - No symbol: Normal clearance
  - CL: CL clearance
  - CM: CM clearance
- **+700L** — Overall spline shaft length (in mm)
- **P** — Accuracy symbol (See p. 8)
  - No symbol: Normal grade
  - H: High accuracy grade
  - P: Precision grade
- **K** — Symbol for standard hollow spline shaft (See p. 17)
  - No symbol: Solid shaft
  - K: Hollow shaft Type K (Thick)
  - N: Hollow shaft Type N (Thin)



LT10X to 30X

Unit: mm

Basic torque rating		Basic load rating		Static permissible moment			Mass
C_T (N·m)	C_{0T} (N·m)	C (kN)	C_0 (kN)	M_{A1} (N·m)	M_{A2} (With seals) (N·m)	M_{A2} (Without seals) (N·m)	Spline nut symbol* (g)
0.23	0.42	0.26	0.48	0.52	—	3.1	1.1
0.23	0.42	0.26	0.48	0.52	—	3.1	1.6
0.49	0.82	0.42	0.70	0.84	6.2	5.0	2.2
0.82	1.25	0.56	0.85	1.04	8.2	6.6	3.3
1.59	3.20	1.09	2.19	6.11	35.5	28.4	8
1.73	2.77	0.98	1.58	2.85	19.0	15.2	6.6
2.81	5.54	1.60	3.15	10.6	59.8	47.8	13.3
6.00	9.23	1.39	2.15	5.13	34.3	27.4	14.3
10.10	19.5	2.35	4.53	21.1	110.9	88.7	24.3
9.41	17.3	2.94	5.40	21.5	114	104	30
17.1	28.7	4.16	6.96	28.9	164	149	40
42.9	68.6	8.40	13.4	77.4	419	381	81
66.4	117	10.5	18.6	144	735	669	130
125	207	15.9	26.2	230	1183	1077	235
196	319	20.8	34.0	335	1714	1560	295

*The mass of the spline nut is the mass without seals.

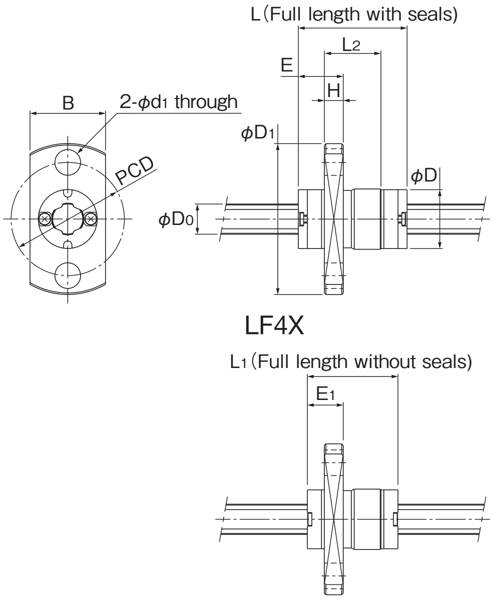
Maximum Spline Shaft Manufacturing Length

Unit: mm

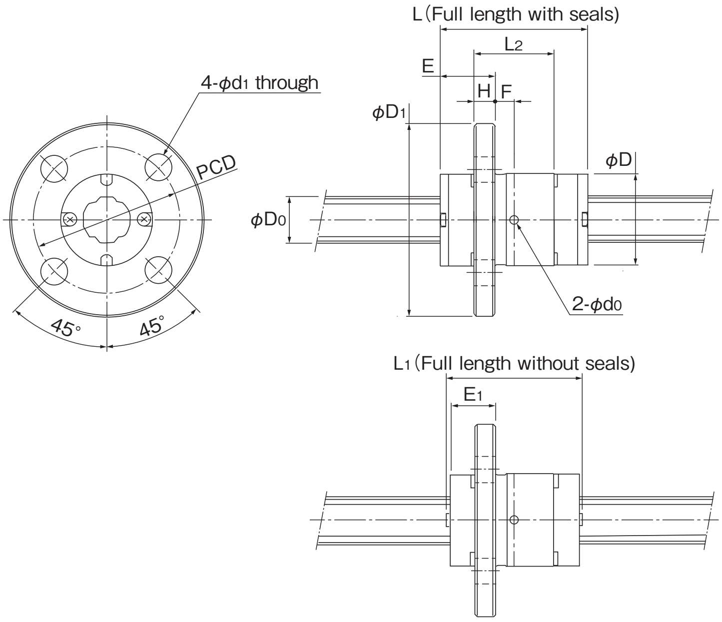
Nominal shaft diameter	Accuracy		
	Normal grade (No symbol)	High accuracy grade (H)	Precision grade (P)
3	150	150	150
4	200	200	200
5	250	200	200
6	315	250	200
8	500	400	315
10	1000	630	500
13	1000	800	630
16	2000	1000	1000
20	2000	1500	1000
25	3000	1500	1000
30	3000	1600	1250

Specification Table

LF-X / LF-XL



LF3X, LF3XD, LF4X



LF5X, LF5XL, LF6X, LF6XL, LF8X, LF8XL

Model No.	Spline shaft diameter	Spline nut dimensions													
		Outer diameter		Length			Flange outer diameter						Greasing hole		Mounting hole
	D_0 h7	D	Tolerance	L (With seals)	L_1 (Without seals)	L_2	D_1	B	H	F	E (With seals)	E_1 (Without seals)	d_0	PCD	d_1×d_2×h
LF3X	3	6	0 -0.008	—	10	6.5	15.5	8	1.5	—	—	3.25	—	11	2.4 drilled through
LF3XD	3	7	0 -0.009	—	10	6.5	18	9	1.9	—	—	3.65	—	13	2.9 drilled through
LF4X	4	8	0 -0.009	14.4	12	7.5	20	10	2.5	—	5.95	4.75	—	15	3.4 drilled through
LF5X	5	10	0 -0.009	15	13.6	7.3	23	—	2.7	—	6.55	5.35	—	17	3.4 drilled through
LF5XL	5	10	0 -0.009	26	24.6	18.3	23	—	2.7	6.5	6.55	5.35	1	17	3.4 drilled through
LF6X	6	12	0 -0.011	19	17.6	10.2	25	—	2.7	2.4	7.1	5.9	1	19	3.4 drilled through
LF6XL	6	12	0 -0.011	30	28.6	21.2	25	—	2.7	7.9	7.1	5.9	1	19	3.4 drilled through
LF8X	8	15	0 -0.011	25	23.8	14.6	28	—	3.8	3.5	9	7.5	1.5	22	3.4 drilled through
LF8XL	8	15	0 -0.011	40	38.8	29.6	28	—	3.8	11	9	7.5	1.5	22	3.4 drilled through
LF10X	10	19	0 -0.013	33	30.8	23.9	38	—	6	5.95	10.55	9.45	1.5	28	4.5×8×4.4
LF13X	13	23	0 -0.013	36	32.4	24	43	—	6	6	12	10.2	1.5	33	4.5×8×4.4
LF16X	16	28	0 -0.013	50	46.4	35.5	48	—	6	11.7	13.3	11.5	2	38	4.5×8×4.4
LF20X	20	32	0 -0.016	63	59	47.4	54	—	8	15.7	15.8	13.8	2	43	5.5×9.5×5.4
LF25X	25	40	0 -0.016	71	67	52.6	62	—	8	18.3	17.2	15.2	3	51	5.5×9.5×5.4
LF30X	30	45	0 -0.016	80	75.6	59.6	74	—	10	19.8	20.2	18	3	60	6.6×11×6.5

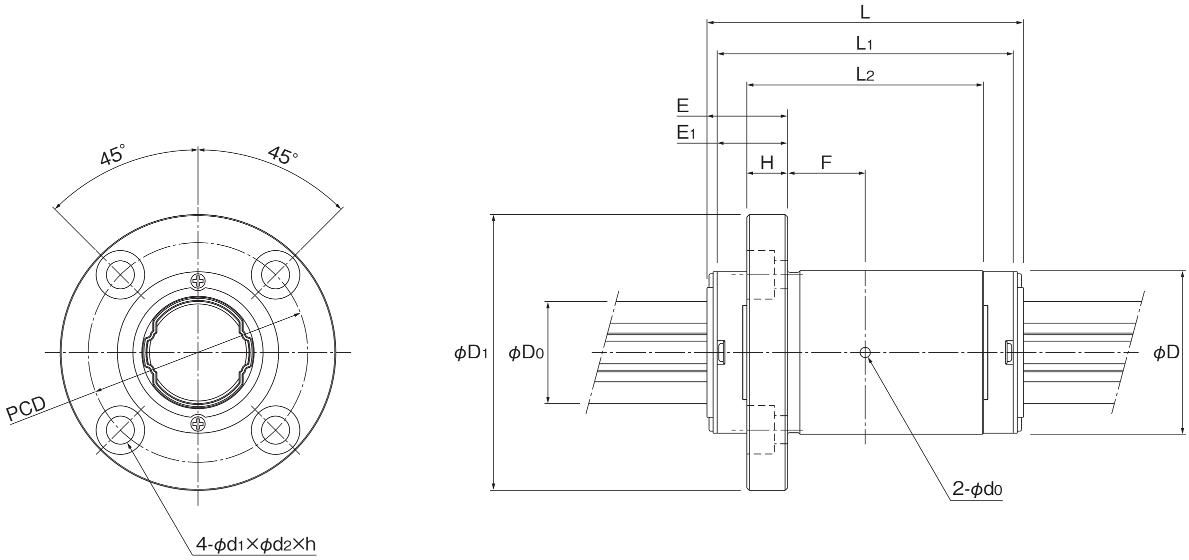
Note: Models LF3X and LF3XD do not feature contamination seals. Models LF3X, LF3XD, LF4X, and LF5X do not feature lubrication holes.

Model Number Coding

Specify the highlighted codes. Note: Specify each item for the models in the catalog.

2 LF20X QZ UU CL +700L P K

- **2** — Number of spline nuts on one shaft (No symbol for one nut)
- **LF20X** — Model number
- **QZ** — With QZ Lubricator (See p. 10)
  - No symbol: Without QZ Lubricator
  - QZ: With QZ Lubricator
- **UU** — Contamination protection accessory symbol (See p. 9)
  - No symbol: Without seals
  - UU: Seal on both ends
  - U: Seal on one end
- **CL** — Symbol for clearance in the rotational direction (See p. 8)
  - No symbol: Normal clearance
  - CL: CL clearance
  - CM: CM clearance
- **+700L** — Overall spline shaft length (in mm)
- **P** — Accuracy symbol (See p. 8)
  - No symbol: Normal grade
  - H: High accuracy grade
  - P: Precision grade
- **K** — Symbol for standard hollow spline shaft (See p. 17)
  - No symbol: Solid shaft
  - K: Hollow shaft Type K (Thick)
  - N: Hollow shaft Type N (Thin)



LF10X to 30X

Unit: mm

Basic torque rating		Basic load rating		Static permissible moment			Mass
C_T (N·m)	C_{0T} (N·m)	C (kN)	C_0 (kN)	M_{A1} (N·m)	M_{A2} (With seals) (N·m)	M_{A2} (Without seals) (N·m)	Spline nut symbol* (g)
0.23	0.42	0.26	0.48	0.52	—	3.1	2.1
0.23	0.42	0.26	0.48	0.52	—	3.1	3.2
0.49	0.82	0.42	0.70	0.84	6.2	5.0	4.7
0.82	1.25	0.56	0.85	1.04	8.2	6.6	9.9
1.59	3.20	1.09	2.19	6.11	35.5	28.4	14.6
1.73	2.77	0.98	1.58	2.85	19.0	15.2	13.8
2.81	5.54	1.60	3.15	10.6	59.8	47.8	20.5
6.00	9.23	1.39	2.15	5.13	34.3	27.4	26.5
10.10	19.5	2.35	4.53	21.1	110.9	88.7	36.5
9.41	17.3	2.94	5.40	21.5	114	104	66
17.1	28.7	4.16	6.96	28.9	164	149	82
42.9	68.6	8.40	13.4	77.4	419	381	131
66.4	117	10.5	18.6	144	735	669	212
125	207	15.9	26.2	230	1183	1077	335
196	319	20.8	34.0	335	1714	1560	489

*The mass of the spline nut is the mass without seals.

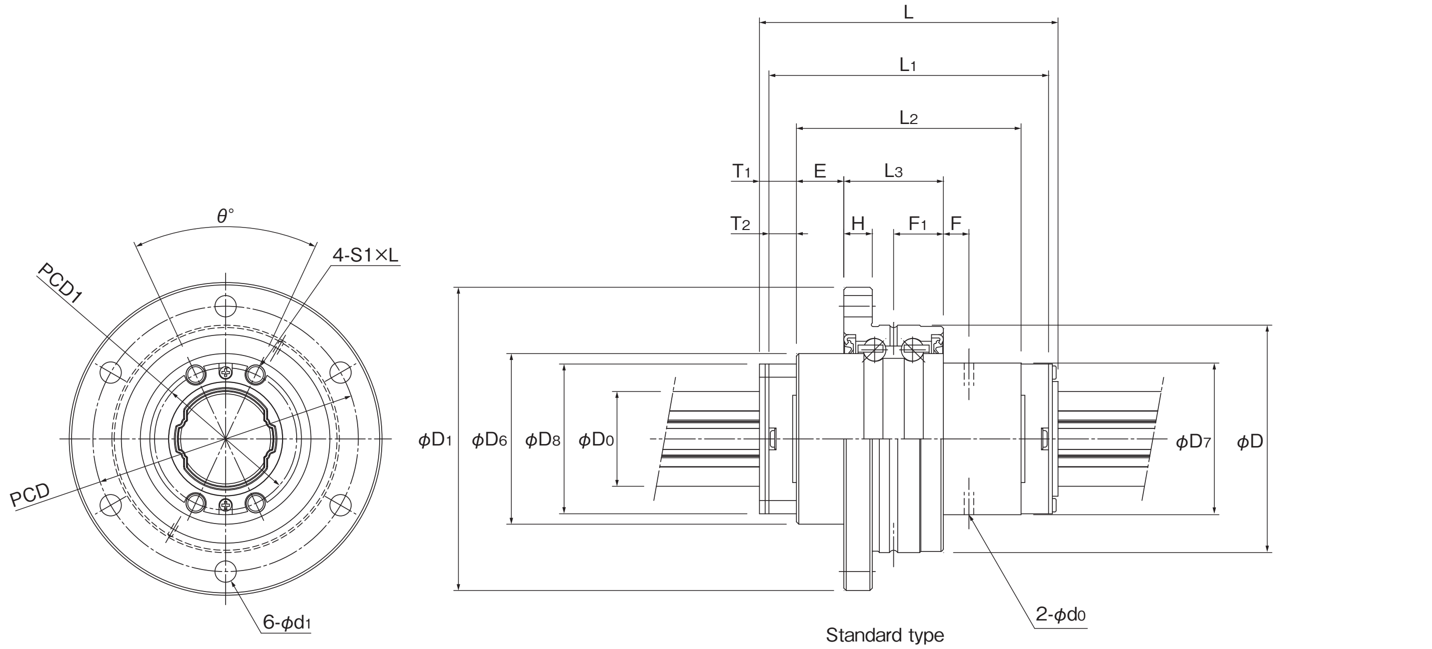
Maximum Spline Shaft Manufacturing Length

Unit: mm

Nominal shaft diameter	Accuracy		
	Normal grade (No symbol)	High accuracy grade (H)	Precision grade (P)
3	150	150	150
4	200	200	200
5	250	200	200
6	315	250	200
8	500	400	315
10	1000	630	500
13	1000	800	630
16	2000	1000	1000
20	2000	1500	1000
25	3000	1500	1000
30	3000	1600	1250

Specification Table

LTR-V



Standard type

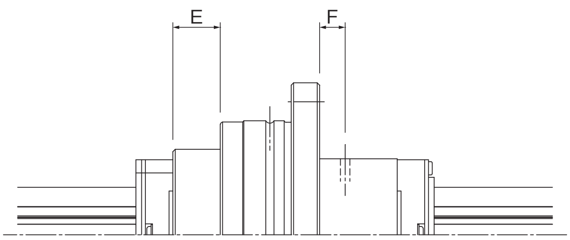
Model No.	Spline shaft diameter	Spline nut dimensions																			
		Outer diameter		Length			Flange outer diameter														
	D_0 h7	D	Tolerance	L (With seals)	L_1 (Without seals)	L_2	D_1	D_6 h7	D_7	D_8	H	L_3	F_1	d_0	T_1	T_2	PCD	PCD_1	θ	S1×L	d_1
LTR16V	16	42	-0.009 -0.025	50	46.4	35.5	54	32.5	28	27.6	4	18	9	2	7.3	5.5	48	25	40	M3x6	3.4
LTR20V	20	48		63	59	47.4	64	36	32	31.6	6	21	10.5	2	7.8	5.8	56	30	50	M4x6	4.5
LTR25V	25	56	-0.010 -0.029	71	67	52.6	72	43.5	40	39.6	6	21	10.5	3	9.2	7.2	64	36	50	M5x8	5.5

Model Number Coding

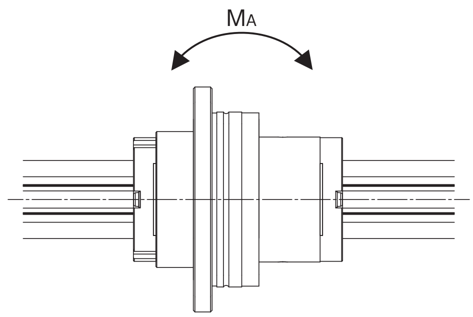
Specify the highlighted codes. Note: Specify each item for the models in the catalog.

2 LTR20V K UU ZZ CL +500L P K

- **2** — Number of spline nuts on one shaft (No symbol for one nut)
- **LTR20V** — Model number
- **K** — Flange orientation symbol
  - No symbol: Standard
  - K: Inverted flange
- **UU** — Spline nut contamination protection accessory symbol (See p. 9)
  - No symbol: Without seals
  - UU: Seal on both ends
  - U: Seal on one end
- **ZZ** — Support bearings contamination protection accessory symbol (See p. 9)
  - No symbol: Without seals
  - ZZ: With end seals
- **CL** — Symbol for clearance in the rotational direction (See p. 8)
  - No symbol: Normal clearance
  - CL: CL clearance
  - CM: CM clearance
- **+500L** — Overall spline shaft length (in mm)
- **P** — Accuracy symbol (See p. 8)
  - No symbol: Normal grade
  - H: High accuracy grade
  - P: Precision grade
- **K** — Symbol for standard hollow spline shaft (See p. 17)
  - No symbol: Solid shaft
  - K: Hollow shaft Type K (Thick)
  - N: Hollow shaft Type N (Thin)



Type K (Inverted flange)



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.

Unit: mm

Standard type		K Type		Basic torque rating		Basic load rating		Static permissible moment	Support bearing basic load rating		Mass	
								M_A*			Spline nut (With seals) (g)	Spline nut (Without seals) (g)
E	F	E	F	C_T (N·m)	C_{0T} (N·m)	C (kN)	C_0 (kN)	(N·m)	C (kN)	C_0 (kN)		
7.5	5	7.5	5	42.9	68.6	8.4	13.4	77.4	5.2	5.1	196	190
10	5.4	10	5.4	66.4	117	10.5	18.6	144	6.7	6.4	338	330
12	7.6	12	7.6	125	207	15.9	26.2	230	7.4	7.8	502	490

Maximum Spline Shaft Manufacturing Length

Unit: mm

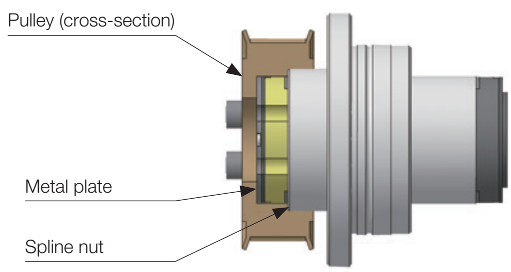
Model No.	Accuracy		
	Normal grade (No symbol)	High accuracy grade (H)	Precision grade (P)
LTR16V	2000	1000	1000
LTR20V	2000	1500	1000
LTR25V	3000	1500	1000

Support Bearing Permissible Rpm

Unit: min^{-1}

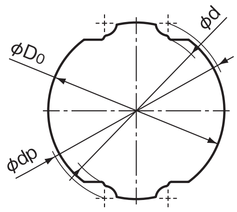
Model No.	Grease lubrication	Oil lubrication
LTR16V	4400	6100
LTR20V	4000	5400
LTR25V	3500	4700

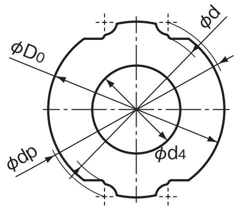
Mounting a Pulley (Recommended)



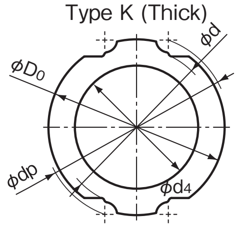
When mounting a pulley, make sure it is touching either the end face of the metal plate or the end face of the spline nut before use.

Cross-Sectional Shape of the Spline Shaft





Type K (Thick)



Type N (Thin)

Cross-Sectional Shapes of Spline Shafts

Cross-Sectional Shape of the Spline Shaft

Unit: mm

Nominal shaft diameter		3	4	5	6	8	10	13	16	20	25	30
Minor diameter	ϕd	2.7	3.6	4.5	5.4	7	8.6	11.3	13.9	17.9	22.4	27
Major diameter	ϕD_0	3	4	5	6	8	10	13	16	20	25	30
Ball center-to-center diameter	ϕdp	3.3	4.4	5.5	6.6	8.6	10.7	13.8	17.1	21.1	26.4	31.6
Mass (g/m)		50	100	150	210	380	590	1010	1520	2410	3710	5370

Hollow Spline Shaft Cross-Sectional Shape (K Type)

Unit: mm

Nominal shaft diameter		3	4	5	6	8	10	13	16	20	25	30
Minor diameter	ϕd	2.7	3.6	4.5	5.4	7	8.6	11.3	13.9	17.9	22.4	27
Major diameter	ϕD_0	3	4	5	6	8	10	13	16	20	25	30
Ball center-to-center diameter	ϕdp	3.3	4.4	5.5	6.6	8.6	10.7	13.8	17.1	21.1	26.4	31.6
Hole diameter	ϕd_4	—	—	—	2.5	3	4	5	7	10	12	16
Mass (g/m)		—	—	—	170	320	490	850	1220	1790	2820	3780

Note: The material used for the hollow spline axis of Models LT6X, LF6X, LFK6X, and LFH6X is carbon steel.

Hollow Spline Shaft Cross-Sectional Shape (N Type)

Unit: mm

Nominal shaft diameter		3	4	5	6	8	10	13	16	20	25	30
Minor diameter	ϕd	2.7	3.6	4.5	5.4	7	8.6	11.3	13.9	17.9	22.4	27
Major diameter	ϕD_0	3	4	5	6	8	10	13	16	20	25	30
Ball center-to-center diameter	ϕdp	3.3	4.4	5.5	6.6	8.6	10.7	13.8	17.1	21.1	26.4	31.6
Hole diameter	ϕd_4	—	—	—	—	—	—	—	11	14	18	21
Mass (g/m)		—	—	—	—	—	—	—	770	1190	1700	2630

Spline Shaft Strength Design

The spline shaft is a compound shaft capable of receiving a radial load and torque. When the load and torque are large, the spline shaft strength must be taken into account.

Spline Shaft Receiving a Bending Load

When a bending load is applied to the spline shaft, obtain the spline shaft diameter using formula (1) below.

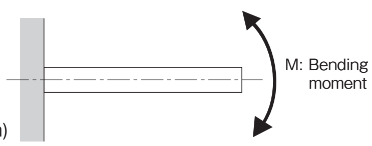
$$M = \sigma \cdot Z \text{ and } Z = \frac{M}{\sigma} \quad \cdots\cdots(1)$$

M: Maximum bending moment acting on the spline shaft (N·mm)
σ: Permissible bending stress of the spline shaft (98 N/mm²)
Z: Section modulus of the spline shaft (see Table 6 on p. 19) (mm³)

Reference: Section Modulus (Solid Circle)

$$Z = \frac{\pi \cdot d^3}{32}$$

Z: Section modulus (mm³)
d: Shaft outer diameter (mm)



Spline Shaft Receiving a Torsion Load

When a torsion load is applied to the spline shaft, obtain the spline shaft diameter using formula (2) below.

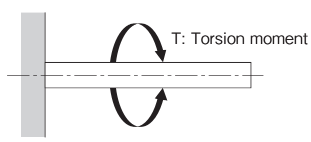
$$T = \tau_a \cdot Z_P \text{ and } Z_P = \frac{T}{\tau_a} \quad \cdots\cdots(2)$$

T: Maximum torsion moment (N·mm)
τ_a: Permissible torsion stress of the spline shaft (49 N/mm²)
Z_P: Polar section modulus of the spline shaft (see Table 6 on p. 19) (mm³)

Reference: Polar Section Modulus (Solid Circle)

$$Z_P = \frac{\pi \cdot d^3}{16}$$

Z_P: Polar modulus section (mm³)
d: Shaft outer diameter (mm)



Spline Shaft Simultaneously Receiving a Bending Load and a Torsion Load

When the spline shaft receives a bending load and a torsion load simultaneously, calculate two separate spline shaft diameters: one for the equivalent bending moment (M_e) and the other for the equivalent torsion moment (T_e). Then, use the greater value as the spline shaft diameter.

■ **Equivalent Torsion Moment**

$$M_e = \frac{M + \sqrt{M^2 + T^2}}{2} = \frac{M}{2}\left\{1 + \sqrt{1 + \left(\frac{T}{M}\right)^2}\right\} \quad \cdots\cdots(3)$$

$M_e = \sigma \cdot Z$

■ Equivalent Torsion Moment

$$T_e = \sqrt{M^2 + T^2} = M \cdot \sqrt{1 + \left(\frac{T}{M}\right)^2} \quad \cdots\cdots(4)$$

$$T_e = \tau_a \cdot Z_P$$

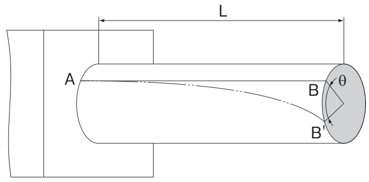
Torsional Rigidity of the Spline Shaft

The torsional rigidity of the spline shaft is expressed as a torsion angle per meter of shaft length. Its value should be limited within 1°/4.

$$\theta = 57.3 \times \frac{T \cdot L}{G \cdot I_P} \quad \cdots\cdots\cdots\cdots\cdots(5)$$

$$\text{Rigidity of the shaft} = \frac{\text{Torsion angle}}{\text{Unit length}} = \frac{\theta \cdot \ell}{L} < \frac{1°}{4}$$

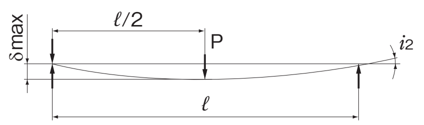
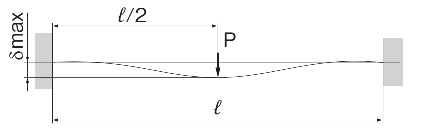
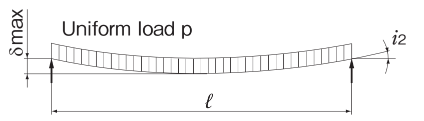
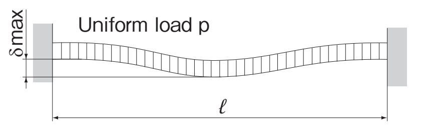
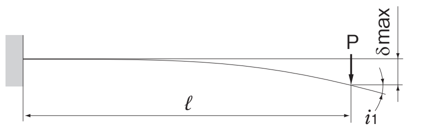
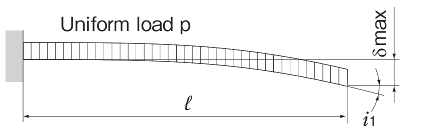
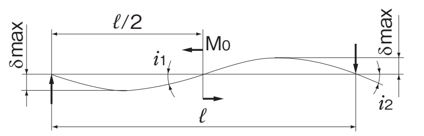
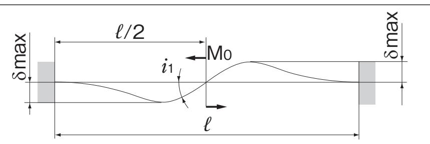
θ: Torsion angle (°)
L: Spline shaft length (mm)
G: Transverse elastic modulus (7.9×10^4 N/mm²)
ℓ: Unit length (1000 mm)
I_P: Polar moment of inertia (see Table 6 on p. 19) (mm⁴)



Deflection and Deflection Angle of the Spline Shaft

The deflection and deflection angle of the spline shaft must be calculated using the formula that matches the conditions. The table below shows the formula that matches each condition.

Deflection and Deflection Angle Formulas

Support method	Condition	Deflection formula	Deflection angle formula
Both ends free		$\delta_{max} = \frac{P\ell^3}{48EI}$	$i_1 = 0$ $i_2 = \frac{P\ell^2}{16EI}$
Both ends fixed		$\delta_{max} = \frac{P\ell^3}{192EI}$	$i_1 = 0$ $i_2 = 0$
Both ends free		$\delta_{max} = \frac{5p\ell^4}{384EI}$	$i_2 = \frac{p\ell^3}{24EI}$
Both ends fixed		$\delta_{max} = \frac{p\ell^4}{384EI}$	$i_2 = 0$
One end fixed		$\delta_{max} = \frac{P\ell^3}{3EI}$	$i_1 = \frac{P\ell^2}{2EI}$ $i_2 = 0$
One end fixed		$\delta_{max} = \frac{p\ell^4}{8EI}$	$i_1 = \frac{p\ell^3}{6EI}$ $i_2 = 0$
Both ends free		$\delta_{max} = \frac{\sqrt{3}M_0\ell^2}{216EI}$	$i_1 = \frac{M_0\ell}{12EI}$ $i_2 = \frac{M_0\ell}{24EI}$
Both ends fixed		$\delta_{max} = \frac{M_0\ell^2}{216EI}$	$i_1 = \frac{M_0\ell}{16EI}$ $i_2 = 0$

δ_{max}: Maximum deflection (mm)
M_0: Moment (N·mm)
ℓ: Span (mm)
I: Moment of inertia (see Table 6 on p. 19) (mm⁴)
i_1: Deflection angle at load point
i_2: Deflection angle at support point
P: Concentrated load (N)
p: Uniform load (N/mm)
E: Modulus of longitudinal elasticity 2.06×10^5 (N/mm²)

Table 6 shows the section modulus (Z), polar section modulus (Z_P), polar moment of inertia (I_P), and moment of inertia (I).

Table 6 Cross-Sectional Characteristics of the Spline Shaft

Nominal shaft diameter		Section modulus Z mm³	Polar section modulus Z_P mm³	Polar moment of inertia I_P mm⁴	Moment of inertia I mm⁴
3	Solid	2.4	5	7.3	3.6
4	Solid	5.7	11.8	23.2	11.2
5	Solid	11.3	23.3	57.2	27.7
6	Solid	19.6	40.4	119.1	57.7
	K Type	18.9	39.1	115.3	55.8
8	Solid	45.0	93.9	366.2	175.6
	K Type	44.0	91.8	358.2	171.6
10	Solid	86.5	183.8	896.9	422.3
	K Type	84.0	178.6	871.7	409.7
13	Solid	191.3	405.3	2574.6	1215.3
	K Type	186.5	395.6	2513.2	1184.6
16	Solid	350.8	749.7	5844.5	2734.3
	K Type	335.6	719.5	5608.8	2616.4
	N Type	258.6	565.4	4407.2	2015.6
20	Solid	716.5	1498.5	14731.7	7043.9
	K Type	666.6	1398.7	13749.9	6553.0
	N Type	524.7	1114.9	10960.2	5158.1
25	Solid	1404.2	2932.9	36067.4	17268.2
	K Type	1321.4	2767.4	34031.6	16250.3
	N Type	985.2	2094.8	25761.4	12115.2
30	Solid	2444.1	5086.3	75160.0	36115.8
	K Type	2226.4	4650.9	68726.1	32898.8
	N Type	1798.0	3794.2	56067.4	26569.7

Critical Speed of the Spline Shaft

When a ball spline shaft is used to transmit power while rotating, the rotation cycle nears the natural frequency of the spline shaft as the rotational speed of the shaft increases. It may cause resonance and eventually result in the inability to operate. Therefore, the maximum rotational speed of the shaft must be limited below the critical speed so as not to cause resonance.
The critical speed of the spline shaft is obtained using formula (6). (It is multiplied by a safety factor of 0.8.)
If the shaft's rotation cycle exceeds or nears the resonance point during operation, reconsider the spline shaft diameter.

■ Critical Speed

$$N_c = \frac{60\lambda^2}{2\pi \cdot \ell_b^2} \cdot \sqrt{\frac{E \times 10^3 \cdot I}{\gamma \cdot A}} \times 0.8 \quad \cdots\cdots(6)$$

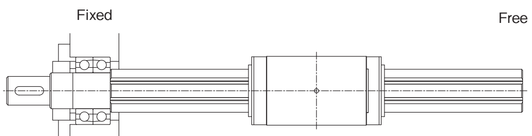
N_c: Critical speed (min^{-1})
ℓ_b: Distance between two mounting surfaces (mm)
E: Young's modulus (2.06×10^5 N/mm²)
I: Minimum moment of inertia of the shaft (mm⁴)

$$I = \frac{\pi}{64} d^4 \qquad \text{d: Minor diameter (mm)}$$

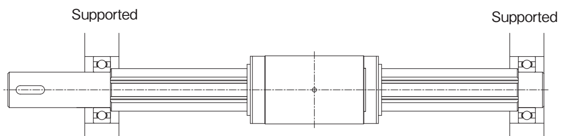
γ: Density (specific gravity) (7.85×10^{-6} kg/mm³)

$$A = \frac{\pi}{4} d^2 \qquad \text{d: Minor diameter (mm)}$$

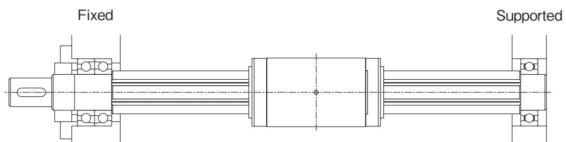
A: Spline shaft cross-sectional area (mm²)
λ: Factor based on the mounting method
(1) Fixed–free: λ=1.875
(2) Supported–supported: λ=3.142
(3) Fixed–supported: λ=3.927
(4) Fixed–fixed: λ=4.73



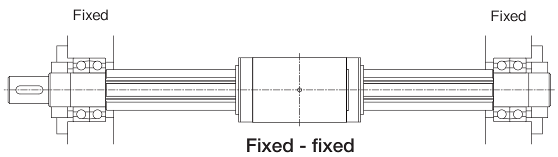
Fixed - free



Supported - supported



Fixed - supported



Fixed - fixed

Predicting the Service Life

Static Safety Factor

When using a ball spline, a static safety factor derived from the basic static load rating and the calculated load in each direction must be considered. In particular, if the system starts and stops frequently, or if impact loads are applied, large moment loads or torque caused by overhanging loads may be applied to the system. When selecting a model, make sure that a sufficient static safety factor has been ensured for its maximum load (whether stationary or in motion). In addition, the static safety factor must be confirmed for each load direction using Formulas 7 and 8. For radial loads, you can obtain the static safety factor for the basic static load rating, and for moment loads, you can obtain the static safety factor for the basic static torque rating. Estimates for the static safety factor are shown in Table 7.

Static Safety Factor per Basic Static Torque Rating

$$f_s = \frac{f_T \cdot f_C \cdot C_{OT}}{T_{max}} \quad \cdots\cdots(7)$$

Static Safety Factor per Basic Static Load Rating

$$f_s = \frac{f_T \cdot f_C \cdot C_0}{P_{max}} \quad \cdots\cdots(8)$$

f_S: Static safety factor
C_{OT}: Basic static torque rating[1] (N·m)
C_0: Basic static load rating[2] (N)
T_{max}: Maximum load torque[3] (N·m)
P_{max}: Maximum applied load[3] (N)
f_T: Temperature factor
f_C: Contact factor

[1] The basic static torque rating is a static torque of a defined direction and size where the sum of the permanent deformation of the ball and that of the raceway at the contact area under maximum stress is 0.0001 times the ball diameter.
[2] The basic static load rating is a static load of a defi ned direction and size where the sum of the permanent deformation of the ball and that of the rolling groove at the contact area under maximum stress is 0.0001 times the ball diameter.
[3] The maximum values for T_C and P_C during a travel cycle, as shown below, are applied to the maximum torque load T_{max} and the maximum load P_{max}.

Table 7 Static Safety Factor (f_S) (Guideline)

Load conditions[4]	Lower limit of f_S
Without vibrations or impacts	3
With vibrations or impacts	5

[4] In general, factors that cause vibration and impacts include acceleration and deceleration, sudden starts and stops, transmission of vibration and impacts from external devices and machines, and changes in processing force over time.

Nominal Life

The service life of the ball spline varies from unit to unit even if they are manufactured the same way and used in the same operating conditions. Therefore, the nominal life defined here is typically used as a guideline for obtaining the service life of the ball spline.
The nominal life is the total travel distance that 90% of a group of units can achieve without flaking (scale-like pieces on the metal surface peeling off) after individually running under the same conditions.

Calculating the Nominal Life

The nominal life of a ball spline varies with the type of load applied during operation: torque load, radial load, and moment load. The corresponding nominal life values are obtained using formulas (9) to (13). (The basic load ratings in these loading directions are indicated in the specification table for the corresponding model number.)

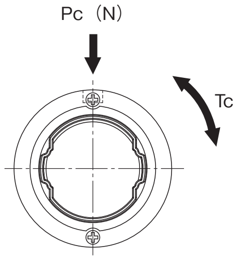
When a Torque Load Is Applied

$$L = \left(\frac{f_T \cdot f_C}{f_W} \cdot \frac{C_T}{T_C}\right)^3 \times 50 \quad \cdots\cdots(9)$$

When a Radial Load Is Applied

$$L = \left(\frac{f_T \cdot f_C}{f_W} \cdot \frac{C}{P_C}\right)^3 \times 50 \quad \cdots\cdots(10)$$

L: Nominal life (km)
C_T: Basic dynamic torque rating (N·m)
T_C: Calculated torque applied (N·m)
C: Basic dynamic load rating (N)
P_C: Calculated radial load (N)
f_T: Temperature factor
f_C: Contact factor
f_W: Load factor
*See the general catalog for the values of each factor.



Calculating the Service Life

Once the nominal life (L) has been obtained with the formula above, the service life can be obtained using formula (11) if the stroke length and the number of reciprocations per minute are constant.

$$L_h = \frac{L \times 10^3}{2 \times \ell_S \times n_1 \times 60} \quad \cdots\cdots(11)$$

L_h: Service life (h)
ℓ_S: Stroke length (m)
n_1: Number of reciprocations per minute (min^{-1})

When a Torque Load and a Radial Load Are Applied Simultaneously

When a torque load and a radial load are applied simultaneously, calculate the nominal life by obtaining the equivalent radial load using formula (12).

$$P_E = P_C + \frac{4 \cdot T_C \times 10^3}{i \cdot dp \cdot \cos\alpha} \quad \cdots\cdots\cdots(12)$$

P_E: Equivalent radial load (N)
$\cos\alpha$: Contact angle $\alpha = 65°$
i = load factor, $i = 2$
dp: Ball center-to-center diameter (mm)

When a Moment Load Is Applied to a Single Nut or Two Nuts in Close Contact with Each Other

Calculate the nominal life by obtaining the equivalent radial load using formula (13).

$$P_u = K \cdot M \quad \cdots\cdots\cdots(13)$$

P_u: Equivalent radial load (N)
(with a moment applied)
K: Equivalent factor
M: Applied moment (N·mm)
However, M should be within the range of the static permissible moment.

When a Moment Load and a Radial Load Are Applied Simultaneously

Calculate the nominal life from the sum of the radial load and the equivalent radial load.

Equivalent Moment Factor

Table 8 Equivalent Moment Factor

Model No.	Equivalent factor: K		
	1 nut	2 nuts in close contact, with no seals	2 nuts in close contact, with seals
LT/LF3X,3XD	1.108	0.187	—
LT/LF4X	0.995	0.169	0.135
LT/LF5X	0.980	0.156	0.125
LT/LF5XL	0.430	0.093	0.074
LT/LF6X	0.660	0.124	0.099
LT/LF6XL	0.360	0.079	0.063
LT/LF8X	0.420	0.078	0.063
LT/LF8XL	0.210	0.051	0.041
LT/LF10X	0.251	0.052	0.047
LT/LF13X	0.241	0.046	0.042
LT/LF16X	0.173	0.035	0.032
LT/LF20X	0.129	0.028	0.025
LT/LF25X	0.114	0.024	0.022
LT/LF30X	0.101	0.022	0.020

Model No.	Equivalent factor: K		
	1 nut	2 nuts in close contact, with no seals	2 nuts in close contact, with seals
LTR16V	0.173	0.035	0.032
LTR20V	0.129	0.028	0.025
LTR25V	0.114	0.024	0.022

Handling

1. Please use at least two people to move any product weighing 20 kg or more, or use a cart or another method of conveyance. Otherwise, it may cause injury or damage the unit.
2. Do not disassemble the parts. This will result in loss of functionality.
3. Tilting a spline nut or spline shaft may cause them to fall by their own weight.
4. Take care not to drop or strike the ball screw. Otherwise, it may cause injury or damage the unit. Even if there is no outward indication of damage, a sudden impact could prevent the unit from functioning properly.
5. When assembling, be sure not to remove the spline nut from the spline shaft.
6. When handling the product, wear safety gloves and safety boots, etc., as appropriate to ensure safety.

Precautions on Use

1. Prevent foreign materials, such as cutting chips or coolant, from getting inside the product. Failure to do so could damage the product.
2. Prevent foreign materials, such as cutting chips, coolant, corrosive solvents, or water from getting in the product by using a bellows or cover when the product is used in an environment where such a thing is likely.
3. Do not use this product if the external temperature exceeds 80°C. If used above this temperature, there is a risk that the resin and rubber parts may deform or become damaged (except for the heat-resistant type).
4. If foreign materials such as cutting chips adhere to the product, replenish the lubricant after cleaning the product.
5. Very small strokes can inhibit the formation of an oil film between the raceways and the area of contact for the balls, resulting in fretting. Therefore, be sure to use a type of grease with high fretting resistance properties if the stroke will be small. We recommend periodically allowing the spline nut to stroke a distance roughly equal to its length to help ensure that a film forms between the raceways and balls.
6. Do not forcibly drive a pin, key, or other positioning device into the product. This could create indentations in the raceways and impair the product's function.
7. Skewing or misalignment of the spline nut and the element that supports the spline shaft can drastically reduce service life. Inspect the components carefully and make sure they are mounted correctly.
8. Inserting and using the spline nut on the spline shaft while balls are missing could lead to premature failure of the product.
9. If any balls fall out of the nut, contact THK. Do not use the product in that condition.
10. When inserting the spline shaft into the spline nut, identify the matching marks on the spline shaft and the spline nut, and then put the shaft straight in while checking their relative positions. Note that forcibly inserting the shaft may cause balls to fall out. If the spline nut has seals or a preload, apply lubricant to the outer surface of the spline shaft.
11. When installing the spline nut into the housing, gently insert it using a jig so that you do not hit the side plates, end caps, or seals.
12. Insufficient rigidity or accuracy of the mounting surface could cause an unexpected load to act on the ball spline, which could lead to premature failure of the product. Therefore, give sufficient consideration to the rigidity and accuracy of the housing and base.
13. If you want to have a flanged-type ball spline undergo additional machining, such as adding a dowel pin hole, contact THK.

Lubrication

1. Thoroughly remove anti-rust oil and apply lubricant before using the product.
2. Do not mix different lubricants. Even grease containing the same type of thickening agent may, if mixed, interact negatively due to disparate additives or other ingredients.
3. When using the product in locations exposed to constant vibrations or in special environments such as in clean rooms, vacuums, and low/high temperatures, use a lubricant suitable for its use/environment.
4. When lubricating products that do not feature a grease nipple or oil hole, directly coat the raceways with lubricant and perform several warm-up strokes to ensure that the grease permeates the interior.
5. Grease viscosity can vary depending on the temperature. Please keep in mind that the ball spline’s sliding resistance and torque may be affected by changes in viscosity.
6. Following greasing, the stirring resistance of the grease can cause the ball spline to exhibit increased sliding resistance and torque. Before commencing operations, make sure to run the unit through several warm-up cycles to ensure that the grease is adequately integrated and dispersed.
7. Excess grease may spatter after lubrication. Wipe off spattered grease as necessary.
8. Grease deteriorates over time, which decreases the lubricity. It is necessary to inspect and replenish the grease in accordance with the usage frequency.
9. The greasing interval varies depending on the usage conditions and environment. Grease the system approximately every 100 km of travel distance (3 to 6 months). The final greasing interval/amount should be set at the actual machine.
10. When lubricating with oil, the lubricant may not get distributed throughout the ball spline depending on the mounting orientation. Contact THK for details.

Storage

When storing the ball spline, enclose it in the package designated by THK, and store it indoors and in a horizontal orientation while avoiding any high temperatures, low temperatures, or high levels of humidity.
Please note that if the product has been kept in storage for an extended period, the lubricant inside may have deteriorated. Please ensure that you replenish the lubricant before using.

Disposal

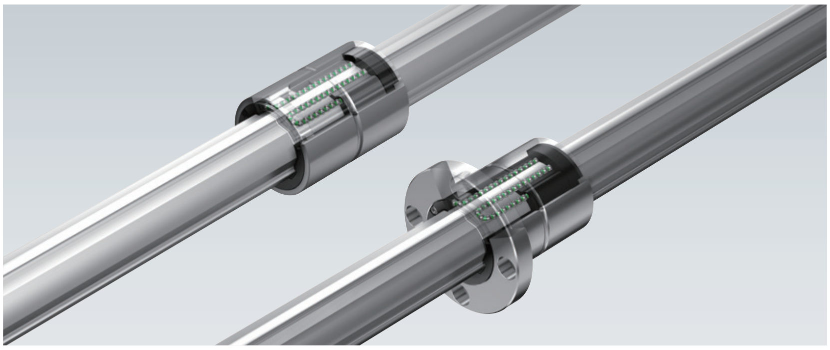
The product should be treated as industrial waste and disposed of appropriately.

Recommended Products

High Torque Caged Ball Spline

SLS/SLF

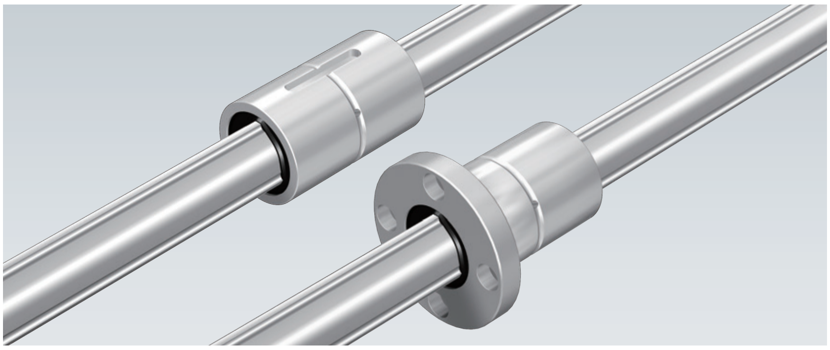
- ○ Caged technology for high-speed operations
- ○ Low, pleasant operating noise and low particle generation
- ○ Lineup: ϕ25–100 mm



High Torque Ball Spline

LBS/LBF

- ○ High-speed travel, high-speed rotation
- ○ High rigidity, accurate positioning
- ○ Lineup: ϕ6–150 mm



Compact Ball Spline **LT-X/LF-X/LTR-V**

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International Sales Department Phone: +81-3-5730-3860

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