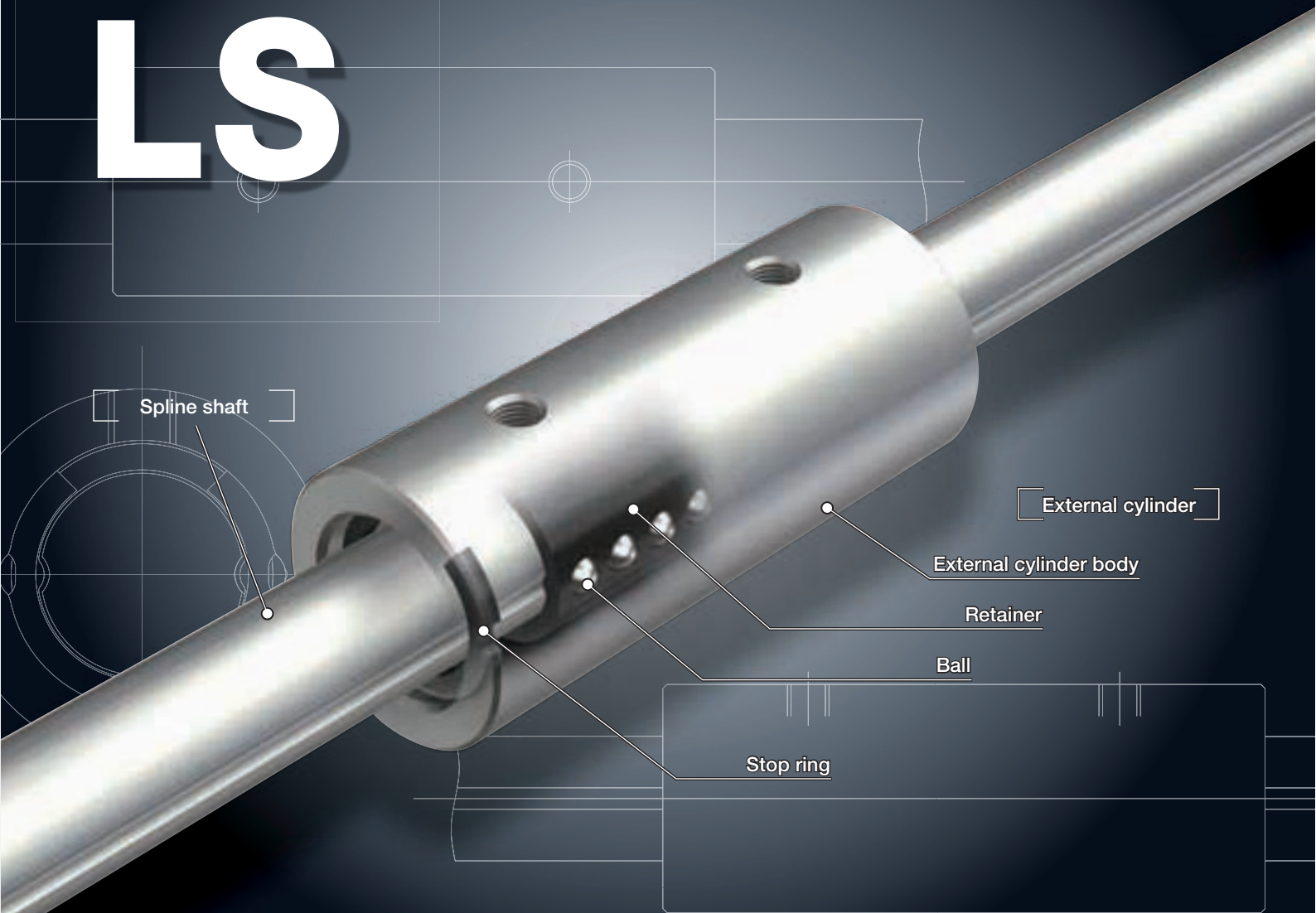


# Stroke Ball Spline

# LS



## Points

### 1 Achieved extremely smooth motion

By building the high accuracy retainer into the limited stroke type with small recirculation resistance of the balls, a light and smooth motion with extremely small fluctuation of frictional resistance even in vertical shaft use has been achieved.

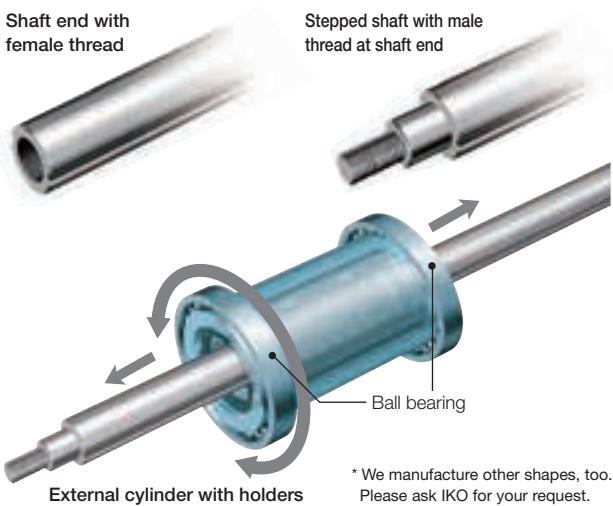
### 2 Best for nozzle part for chip mounter

Since it exhibits a stable and high positioning accuracy for stroke direction, it is best for the uses of vertical shaft and high-tact operations such as chip mounter.

### 3 Supports special shapes

We manufacture special shapes to meet the customer's uses such as end machining and external cylinder with holders. Please ask IKO for your needs.

#### End machining, holder specification (example)

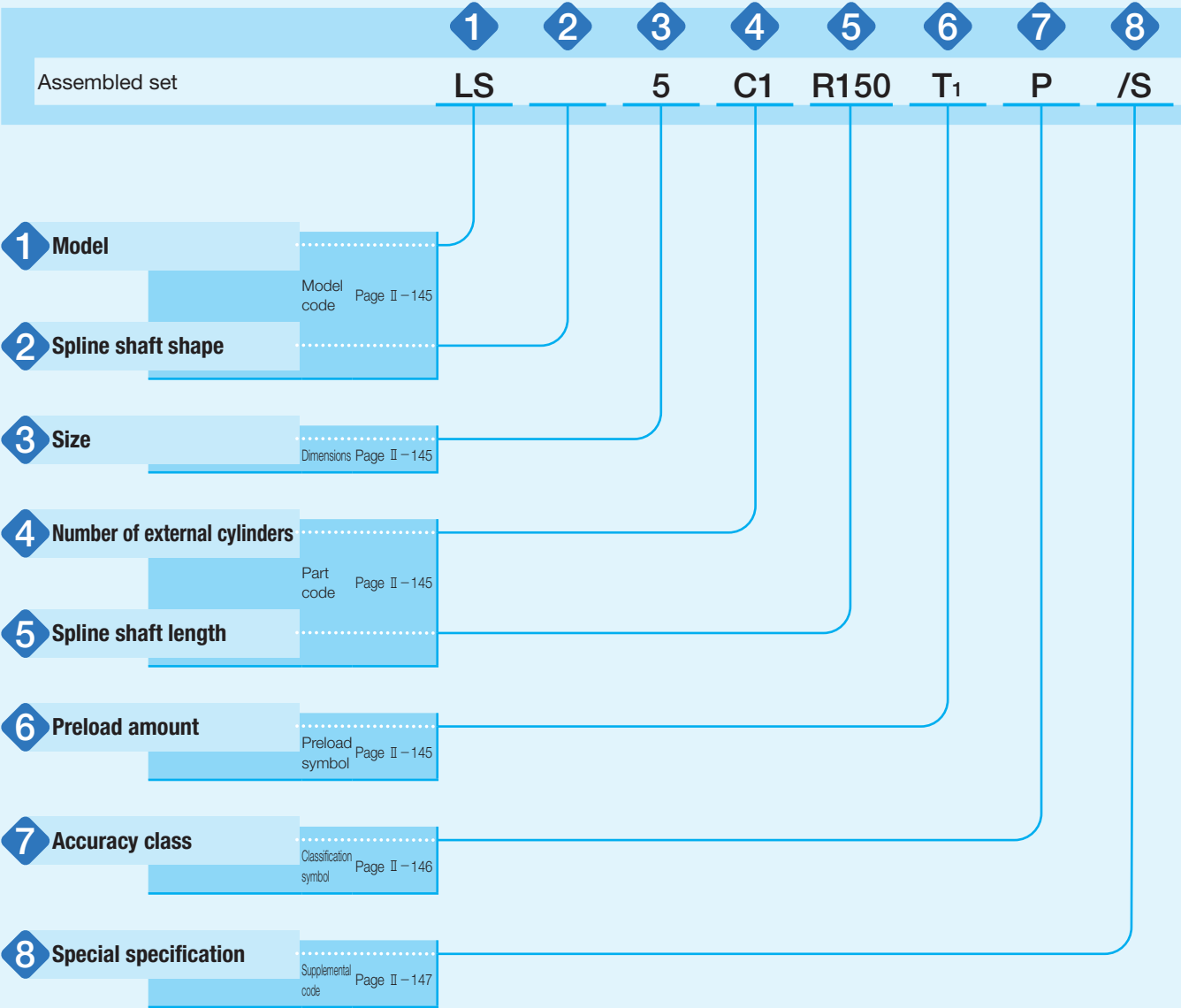


\* We manufacture other shapes, too.  
Please ask IKO for your request.

# Identification Number and Specification

## Example of an identification number

The specification of LS series is indicated by the identification number. Indicate the identification number, consisting of a model code, dimensions, a part code, a preload symbol, a classification symbol, and a supplemental code for each specification to apply.



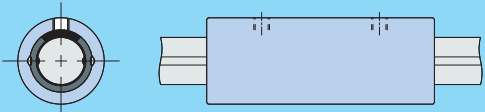



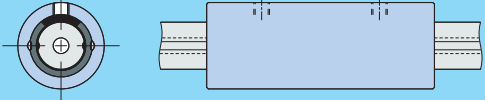



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Identification Number and Specification

— Model · Spline Shaft Shape ·

1	Model	Stroke Ball Spline (LS series)	: LS	
		For applicable models and sizes, see Table 1.		
2	Spline shaft shape	Solid shaft Hollow shaft	: No symbol : T	For applicable models and sizes, see Table 1.
3	Size	4, 5, 6		For applicable models and sizes, see Table 1.

Table 1 Models and sizes of LS series

Shape	Model	Size		
		4	5	6
Solid shaft 	LS			
Hollow shaft 	LST			

4	Number of external cylinders		: C1	For the number of external cylinders assembled on a spline shaft, only one unit (C1) can be specified.
5	Spline shaft length		: R○	The spline shaft length is indicated in mm. For standard and maximum lengths, see the dimension table.
6	Preload amount	Light preload	: T <sub>1</sub>	For preload amount, only light preload (T <sub>1</sub> ) can be specified. For details of the preload amount, see Table 2.

Table 2 Preload amount

Item Preload type	Preload symbol	Preload amount N	Operational conditions
Light preload	T <sub>1</sub>	0.02C <sub>0</sub>	<ul style="list-style-type: none"><li>· Almost no vibrations</li><li>· Load is evenly balanced</li><li>· Light and precise motion</li></ul>

Remark: C<sub>0</sub> indicates the basic static load rating.

Size · Number of External Cylinders · Spline Shaft Length · Preload Amount · Accuracy Class—

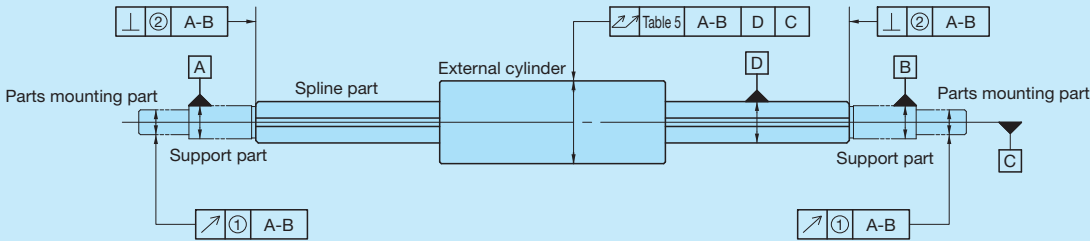
7

Accuracy class

Precision : P

For accuracy class, only precision (P) can be specified.  
For details of accuracy class, see Table 3, Table 4 and Table 5.

Table 3 Allowable value of each part



unit:  $\mu\text{m}$

Size	Relative to axial line of supporting part of spline shaft	
	① Radial runout of periphery of parts mounting part <sup>(1)</sup>	② Perpendicularity of spline part end face <sup>(1)</sup>
	Precision (P)	Precision (P)
4	8	6
5		
6		

Note <sup>(1)</sup> The values are for the processed shaft ends.

Table 4 Twist of grooves with respect to effective length of the spline part

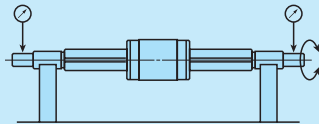
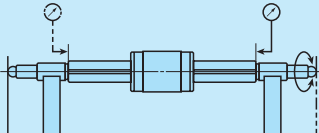
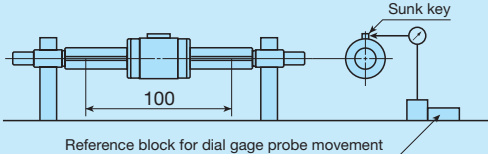
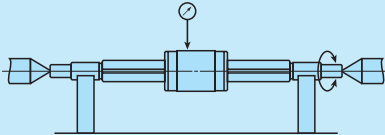
Accuracy class	Precision (P)
Allowable value	6

Remark: The values can be applied to 100 mm of the effective length of the spline at any position.

Table 5 Allowable values of total radial runout of spline shaft axial line

Total spline shaft length mm		Precision (P)
Over	Incl.	
—	200	26
200	300	57

Table 6 Measuring methods of accuracy

Item	Measuring method	Illustration of measuring method
<sup>(1)</sup> Radial runout of periphery of parts mounting part with respect to axial line of supporting part of spline shaft(see Table 3①)	While supporting the spline shaft at its support part, place the dial gage probes on the outer peripheral faces of the parts mounting part and measure the deflection from one rotation of the spline shaft.	
<sup>(1)</sup> Perpendicularity of spline part end face with respect to axial line of supporting part of spline shaft (see Table 3②)	While supporting the spline shaft at its support part and one spline shaft end, place the dial gage probes on the spline end faces and obtain perpendicularity by measuring the deflection from one rotation of the spline shaft.	
Twist of grooves with respect to effective length of the spline part (See Table 4)	While supporting the spline shaft fixed, apply a unidirectional torsion moment load to the measuring unit, place the dial gage probe vertically to the spline shaft on the side face of the sunk key attached on the external cylinder, and measure the deflection when the external cylinder and the dial gage probe are moved 100 mm in the axial direction at any position on the effective length of the spline shaft. However, the dial gage probe should be applied as near as possible to the outer peripheral face of the external cylinder.	
Total radial runout of axial line of spline shaft (See Table 5)	While supporting the spline shaft at its support part or at both centers, place a dial gage probe on the outer peripheral face of the external cylinder and measure the deflection from one rotation of the spline shaft at several positions in the axial direction to obtain the maximum value.	

Note <sup>(1)</sup> The accuracy are for the processed shaft ends.

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— Special Specification —

8	Special specification	Stainless steel spline shaft /S	Applicable to the solid shaft of size 5 and 6.
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Stainless steel spline shaft /S
The material of the solid spline shaft is changed to stainless steel. The load rating will change to a value obtained by multiplying the load rating for the steel spline shaft by a factor of 0.8.

Allowable Load

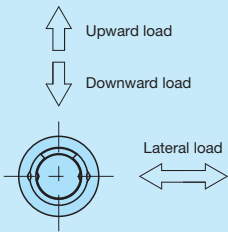
Allowable load refers to load of smooth rolling motion on contact surface to which maximum contact stress is applied and the sum of whose elastic deformation of rolling elements and raceway is small.

Therefore, use applied load within the allowable load range if very smooth rolling motion and high accuracy are required.

Load Direction and Load Rating

The LS series must be used with its load rating corrected in accordance to the load direction. The basic dynamic load rating and basic static load rating shown in the dimension table should be corrected to values in Table 7.

Table 7 Load ratings corrected for load direction



Load rating and load direction	Basic dynamic load rating			Basic static load rating		
	Load direction			Load direction		
	Downward	Upward	Lateral	Downward	Upward	Lateral
Size						
4, 5, 6	C	C	1.47C	C <sub>0</sub>	C <sub>0</sub>	1.73C <sub>0</sub>

Moment of Inertia of Sectional Area and Section Coefficient of Spline Shaft

Table 8 Moment of inertia of sectional area and section coefficient of spline shaft

Size	Moment of inertia of sectional area mm <sup>4</sup>		Section coefficient mm <sup>3</sup>	
	Solid shaft	Hollow shaft	Solid shaft	Hollow shaft
4	12	12	6	6
5	29	29	12	12
6	61	61	21	21

## Lubrication

Grease is not pre-packed in the LS series, so please perform adequate lubrication as needed.  
Upon delivery, anti-rust oil is applied. Therefore, perform cleaning with clean solution before mounting and apply high-quality lubrication oil or grease before use. For grease lubrication, use of high-quality lithium-soap base grease is recommended.  
Since no grease nipple or oil hole is provided, apply grease directly to the raceway part of the spline shaft when supplying the grease.

## Precaution for Use

### ① Fitting of external cylinder

Generally, transition fit (J7) is used for fitting between the external cylinder and the housing bore. When high accuracy and high rigidity are not required, clearance fit (H7) can also be used.

### ② Typical mounting structure

Mounting examples of the external cylinder are shown in Fig. 1. The rotation detent for external cylinder can be made by using the screw hole provided on the external cylinder. The fixing thread depth must not exceed the maximum fixing thread depth indicated in the dimension table. Since the screw hole for the external cylinder is penetrated, the spline shaft or retainer will be pushed by the screw if the fixing thread depth is too deep, and the running accuracy and life will be adversely affected.  
Since there is no built-in mechanical stopper to regulate linear motion, install a stopper mechanism in proximity if risk of overstroke exists.

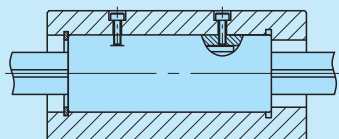


Fig. 1 Mounting example

### ③ Handling upon operation

Stroke should be used within the effective stroke range shown in the dimension table.  
The retainer may be deviated from the right position due to offset load or irregular and high-velocity motion, etc. Fully stroke it once in certain operating time or certain number of reciprocating motion to correct the retainer position.

### ④ Additional machining of spline shaft end

The spline shaft is hardened by induction hardening. When additional machining on the shaft end is needed, make sure that the maximum diameter of the shaft end machining part does not exceed the dimension  $d_1$  in the dimension table.  
Spline shafts with special shaft end shapes can be prepared upon request. Contact IKO for further information.

### ⑤ Operating temperature

The maximum operating temperature for LS series is 120°C and temperature up to 100°C is allowed for continuous operation. When the temperature exceeds 100°C, contact IKO.

## Dust Protection

No dust protection seal is provided for LS series. For applications in other than clean environment, cover the entire unit with a protective case, etc. to prevent harmful foreign substances such as dust and particles from outside from entering.

### ⑥ Assembly of external cylinder on spline shaft


When assembling the external cylinder on the spline shaft, correctly fit the grooves of the external cylinder and the spline shaft and move the external cylinder softly in parallel direction. Rough handling may result in dropping of steel balls. After assembling, correct the position of the retainer to be in the center of the external cylinder. After assembling the external cylinder to the housing, insert the shaft softly. Move the retainer as well as the shaft until they contact one side of the surface and stop. Then push the shaft softly not to damage balls or raceway to the position a half of the maximum stroke length and return it by the same length (a half of the maximum stroke) so that the retainer is positioned regularly at the center of the external cylinder.  
The products are already adjusted so as to provide the best accuracy when the  marks of the external cylinder and the spline shaft face the same direction. Be careful not to change the assembly direction. (See Fig. 2)



Fig. 2 Mounting direction of external cylinder

### ⑦ Mounting of external cylinder

When press-fitting the external cylinder to the housing, assemble them correctly by using a press and a suitable jig fixture. (See Fig. 3)

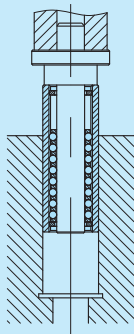
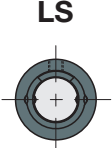
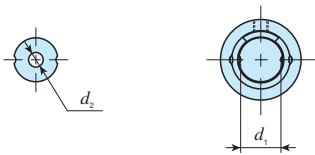


Fig. 3 Press-fitting of external cylinder



# IKO Stroke Ball Spline

Shape			
	LS		
Size	4	5	6

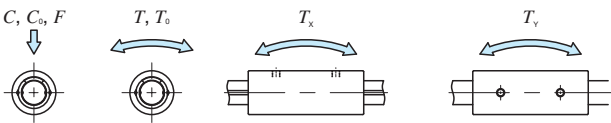


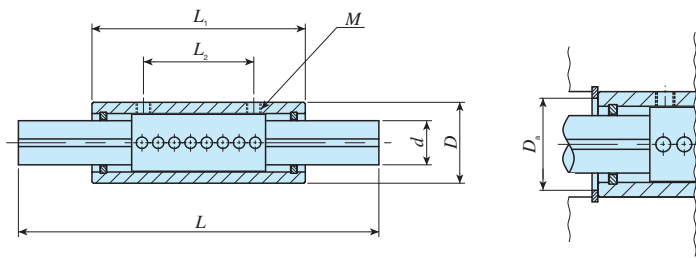
Hollow shaft dimension for LST

Identification number	Interchangeable	Mass (Ref.) g		External cylinder dimensions and tolerances mm						Spline shaft dimensions and tolerances mm				
		External cylinder	Spline shaft (per 100 mm)	D	Dim. D tolerance	L <sub>1</sub>	L <sub>2</sub>	M	Maximum fixing thread depth	d	Dim. d tolerance	d <sub>1</sub> <sup>(1)</sup>	d <sub>2</sub>	
LS 4	—	5.7	9.6	8	0 −0.009	24	10	M2	1.3	4	0 −0.012	3.2	—	
LST 4	—		8.6										1.5	
LS 5	—	8.9	14.9	10	0 −0.009	27	12	M2	1.4	5	0 −0.012	4.2	—	
LST 5	—		12.4										2	
LS 6	—	10.9	19	11	0 −0.011	29	15	M2	1.4	6	0 −0.012	5.2	—	
LST 6	—		16.5										2	

Notes (1)  $d_1$  represents the maximum diameter for end machining.  
(2) Represents standard length. We can produce other than the standard length, please specify the length of spline shaft by indicating the length in mm with the identification number.  
(3) The direction of basic dynamic load rating ( $C$ ), basic static load rating ( $C_0$ ), allowable load ( $F$ ), dynamic torque rating ( $T$ ), static torque rating and static moment rating ( $T_0$ ,  $T_x$ ,  $T_y$ ) are shown in the sketches below.

Remark: Grease is not pre-packed, so please perform adequate lubrication as needed.





			Effective stroke length	Maximum stroke length	Mounting Maximum dimensions	Basic dynamic load rating <sup>(3)</sup>	Basic static load rating <sup>(3)</sup>	Allowable load <sup>(3)</sup>	Dynamic torque rating <sup>(3)</sup>	Static torque rating <sup>(3)</sup>	Static moment rating <sup>(3)</sup>	
	$L^{(2)}$	Maximum length	mm	mm	$D_a$ mm	$C$ N	$C_0$ N	$F$ N	$T$ N · m	$T_0$ N · m	$T_x$ N · m	$T_y$ N · m
	100 150	200	10	13.2	5	285	380	127	0.66	0.87	0.88	1.5
		150										
	100 150	200	10	14	7	616	748	249	1.8	2.2	2.0	3.5
	150 200	300	10	13.6	8	673	855	285	2.4	3.0	2.6	4.4

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Example of identification number of assembled set

Model code	Dimensions	Part code	Preload symbol	Classification symbol	Supplemental code
<u>LS</u>	<u>5</u>	<u>C1</u> <u>R150</u>	<u>T<sub>1</sub></u>	<u>P</u>	<u>/S</u>
①	②	③	④	⑤	⑥
① Model	④ Number of external cylinders (1)		⑦ Accuracy class		
LS			P Precision		
② Spline shaft shape	⑤ Length of spline shaft (150 mm)		⑧ Special specification		
No symbol Solid shaft			S		
T Hollow shaft					
③ Size	⑥ Preload amount				
4, 5, 6	T <sub>1</sub> Light preload				