

SPECIAL SELECTION **IKO**

**VOL.3**

*New models are introduced!  
Wide range of variations!*

**LSAG**

Linear Ball Spline G

**CAT-57117** U.S. PATENTED



# Linear Ball Splines featuring Simple Structure and Compact



Design

**IKO** Linear Ball Spline

# LSAG, LSB

Linear Ball Spline G

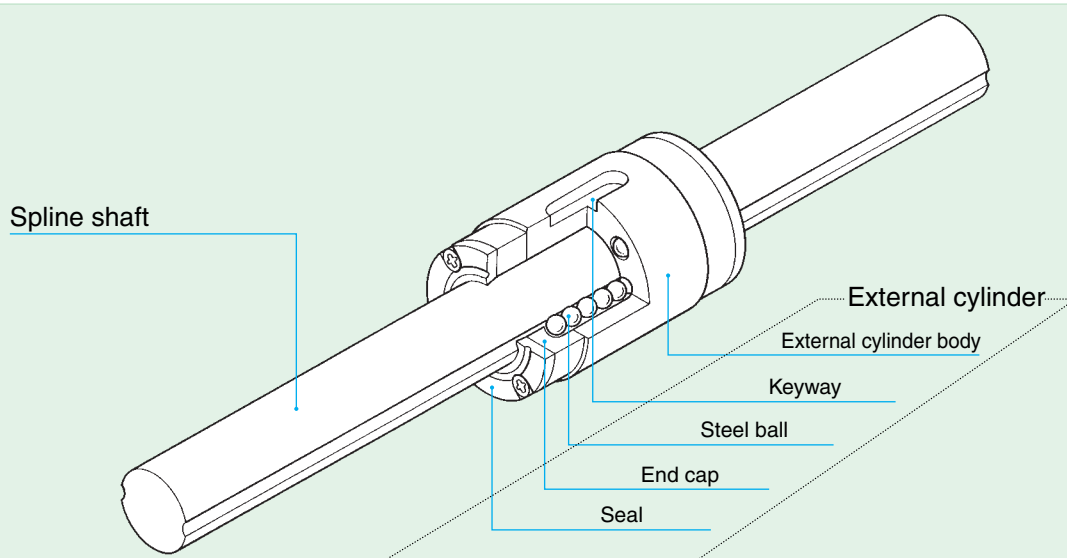
Block type Linear Ball Spline



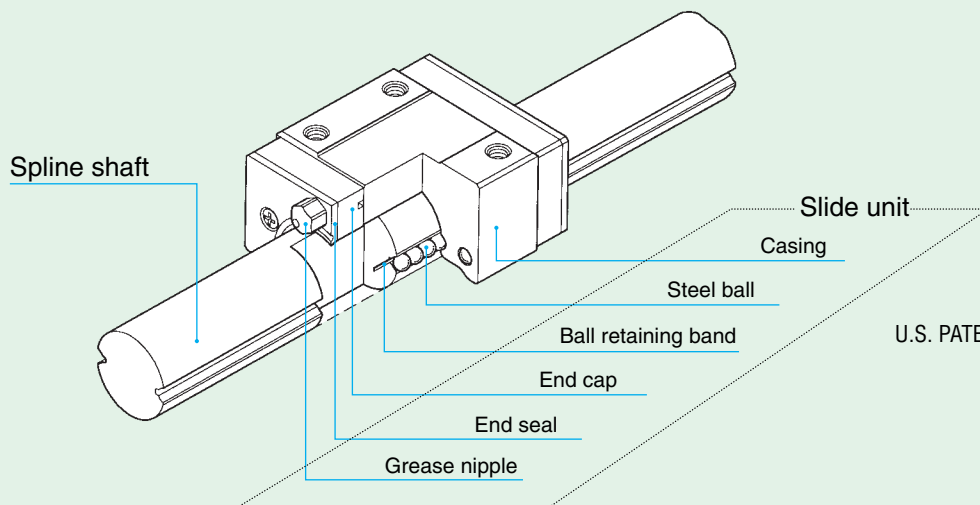
# Super-performance in Size! Rigidity! and

IKO Linear Ball Spline G and IKO Block type Linear Ball Spline are linear motion rolling guides which achieve endless linear motion of an external cylinder or a slide unit along a spline shaft. The two-row four-point contact design is adopted, as in the highly successful Linear Way series, to obtain a simple but compactly efficient structure.

As steel balls are arranged between the raceway grooves of external cylinder (slide unit) and spline shaft, radial loads as well as rotating torque can be received. Therefore, these products are most suitable for applications requiring smooth linear motion and accurate positioning in the rotating direction, for example, IC chip mounters, industrial robots, OA equipment, and measuring instruments.



**Structure of Linear Ball Spline G**



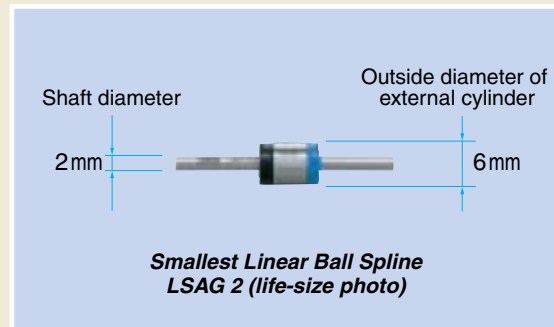
**Structure of Block type Linear Ball Spline**

U.S. PATENT No. 4,799,803  
No. 4,505,522  
No. 5,490,729  
No. 4,505,522  
No. 4,390,215  
No. 6,190,046  
No. 6,176,617  
No. 6,082,899  
No. 5,967,667  
No. 5,464,288  
No. 5,356,223

# Accuracy! Realized by the Two-Row Raceway Design

## High Rigidity and Compact Size

Large steel balls are arranged in two rows and are in four-point contact with the raceways. Thus, Linear Ball Spline has high-rigidity and compact-size. In particular, the outside diameter of external cylinder of Linear Ball Spline G is made small for the shaft diameter, by adopting a unique steel ball retaining method which does not require a ball retainer. The smallest size Linear Ball Splines, LSAG 2 and LSAGF2, having 2 mm shaft diameter and 6 mm outside diameter of external cylinder have newly been introduced.

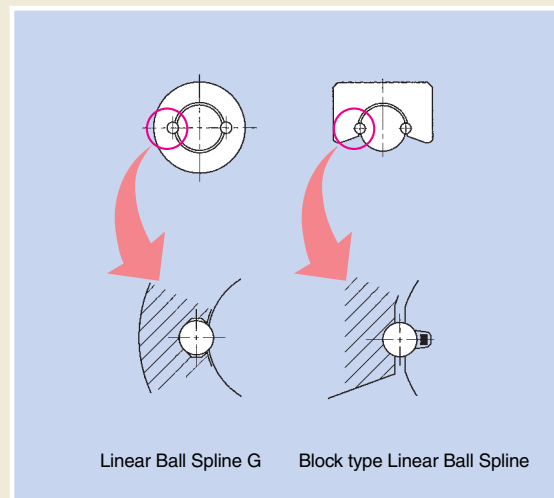


## Low Friction and Smooth Motion

The end cap incorporates recirculating routes of steel balls designed through thorough analysis. High speed operation can thus be achieved providing low friction and smooth motion.

## Easy Mounting

This series has a safety structure that prevents steel balls from falling out even when the external cylinder (slide unit) is separated from the spline shaft. So mounting on machines or equipment is easy.

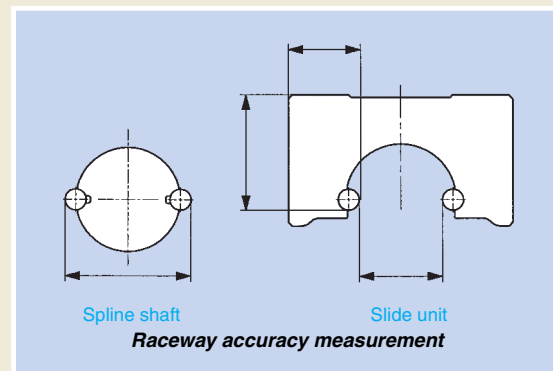


## Accurate Positioning

By applying a suitable preload, the clearance in the rotational direction can be eliminated ensuring accurate angular positioning.

## High Accuracy with Simple Structure

With the simple two-row four-point contact structure, the number of potential errors can be reduced, and the highest level of dimensional accuracy between rows can be achieved. Interchangeable specification products of high-interchangeability level can be manufactured benefiting from this feature by rigorous control of the dimensional accuracy of external cylinder (slide unit) and spline shaft.



## Wide Variations

The external cylinder of Linear Ball Spline G can be selected from two types, the standard(cylindrical) type and the flange type, to meet the requirements for mounting. In each type, standard length and high rigidity long length external cylinders are provided. For spline shafts, the solid shaft and hollow shaft are prepared. The stainless steel made solid shaft is also available. Block type Linear Ball Spline is available in both high carbon steel series and stainless steel series.



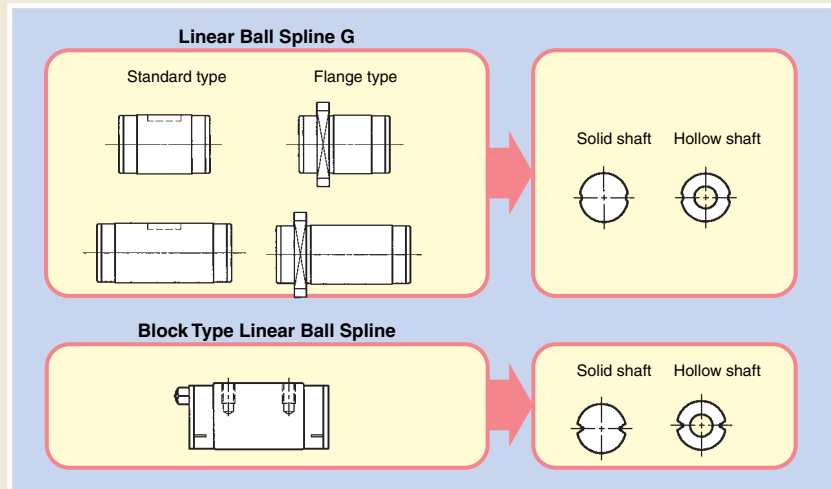
## Interchangeable Specification : Three Features of Interchangeability

Linear Ball Spline series include interchangeable specification products, of which spline shafts and external cylinders (slide units) can be handled separately and can be assembled freely to make a set as required.

The dimensional accuracy of external cylinders (slide units) and the spline shafts is rigorously controlled to achieve interchangeability of incomparable high level, based on the original advanced manufacturing technology.

### Interchangeable external cylinders (slide units)

Many types of external cylinders (slide units) with different shapes and lengths are prepared. All of these external cylinders (slide units) can be freely mounted on the same spline shaft.



The raceway structure of spline shaft of Linear Ball Spline G and that of Block type Linear Ball Spline are different. So, the spline shafts of these two are not interchangeable.

### Interchangeable with High Accuracy

Two accuracy classes, high class and precision class, are set as accuracy classes. They can be selected to meet the requirements in application.

### Interchangeable with Preload


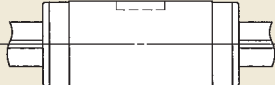
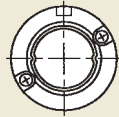
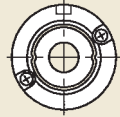
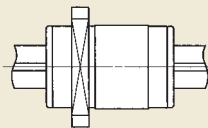
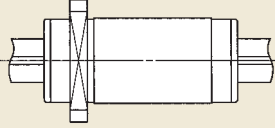
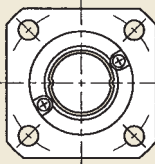
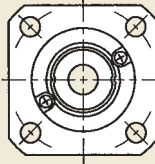
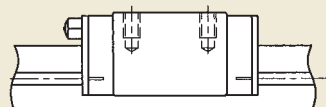
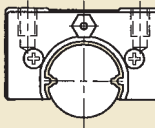
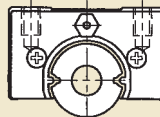
High accuracy dimensional control owing to a simple structure has made it possible to realize the interchangeability among preloaded external cylinders (slide units). These products can be used for applications requiring one step higher rigidity.

## Stainless Steel Series for Special Environments

Block type Linear Ball Spline series includes stainless steel series, of which steel components are made of stainless steel. Stainless steel series Linear Ball Spline is more resistant to corrosion than the high carbon steel made models, and is most suitable for applications in clean rooms and in places where the use of rust preventive oil must be limited or avoided because any oily content is inimical to the environment. Stainless steel made spline shafts are also prepared for Linear Ball Spline G. In addition, special specifications such as "with stainless steel end plates", "no end seal", and "with seals for special environment" are prepared. Product specifications most suitable for the needs in diversified special environment applications can be provided by combining various special specifications.



# Various Types for Diversified Application Needs

Series		Length of external cylinder		Shape of the spline shaft	
		Standard	High-rigidity long	Solid shaft	Hollow shaft
Linear Ball Spline G	Standard type				
	Flange type				
Block Type Linear Ball Spline					

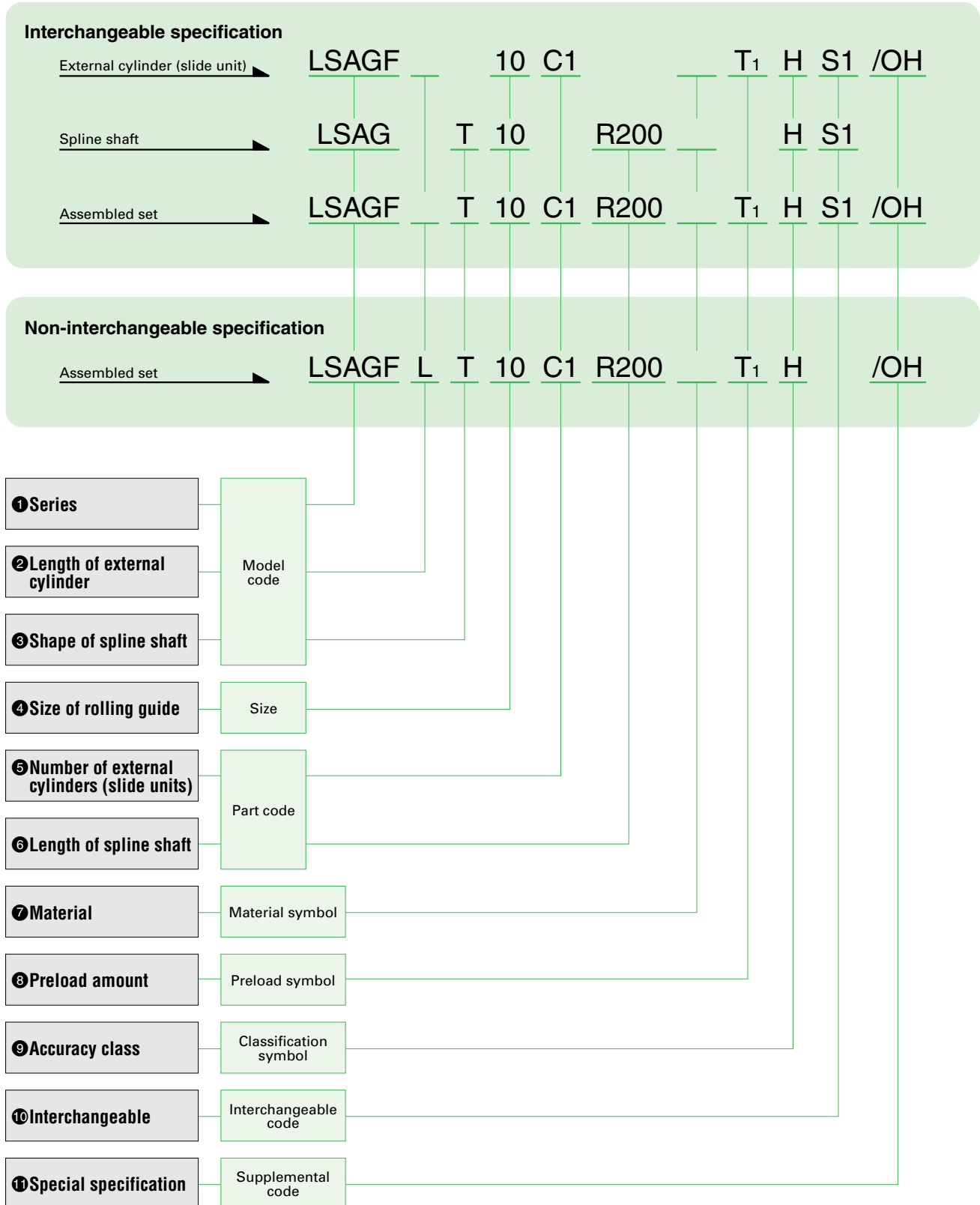
# Wide Variations

	Material	Shape	Length of external cylinder	Shape of the spline shaft	Model code and size
Linear Ball Spline G	High carbon steel made	Standard type	Standard	Solid shaft	LSAG 2 ~ 50
				Hollow shaft	LSAGT 4 ~ 12
			High-rigidity long	Solid shaft	LSAGL 5 ~ 30
				Hollow shaft	LSAGLT 5 ~ 12
		Flange type	Standard	Solid shaft	LSAGF 2 ~ 40
				Hollow shaft	LSAGFT 4 ~ 12
			High-rigidity long	Solid shaft	LSAGFL 5 ~ 30
				Hollow shaft	LSAGFLT 5 ~ 12
Block Type Linear Ball Spline	High carbon steel made		Solid shaft	LSB 6 ~ 25 <sup>(1)</sup>	
			Hollow shaft	LSBT 6 ~ 25 <sup>(1)</sup>	
	Stainless steel made		Solid shaft	LSB 6 ~ 10··SL	

Note<sup>(1)</sup> : In high carbon steel made models of sizes 6 to 10, only the spline shafts are made of high carbon steel, and the slide units are made of stainless steel.

# Identification Number

The specification of Linear Ball Spline is indicated by the identification number, consisting of a model code, a size, a part code, a material symbol, a preload symbol, a classification symbol, an interchangeable code, and any supplemental codes.





<b>① Series</b>	Linear Ball Spline G standard type :LSAG Linear Ball Spline G flange type :LSAGF Block type Linear Ball Spline :LSB	For applicable models and sizes, see Table 1. For the model code of a spline shaft of Linear ball Spline G, indicate LSAG(T) regardless of the external cylinder type to be combined.
<b>② Length of external cylinder</b>	Standard :No symbol High-rigidity long :L	The raceway design of the spline shaft of Linear Ball Spline G and that of Block type Linear Ball Spline are different.
<b>③ Shape of spline shaft</b>	Solid shaft :No symbol Hollow shaft :T	Accordingly, the spline shaft of one type cannot be used for the other type.
<b>④ Size of rolling guide</b>	2, 3, 4, 5, 6, 8, 10, 12, 13, 15, 16, 20, 25, 30, 40, 50	For applicable models and sizes, see Table 1.

**Table 1 Models and sizes of Linear Ball Spline**

Model Size	Linear Ball Spline G				Block type Linear Ball Spline	
	High carbon steel made <sup>(1)</sup>				High carbon steel made	Stainless steel made
	Standard shape type		Flange type			
	Standard length	High-rigidity long	Standard length	High-rigidity long	Standard length	Standard length
LSAG	LSAGL	LSAGF	LSAGFL	LSB	LSB··SL	
2	○ <sup>(2)</sup>	—	○ <sup>(2)</sup>	—	—	—
3	○ <sup>(2)</sup>	—	○ <sup>(2)</sup>	—	—	—
4	○ <sup>(2)</sup>	—	○ <sup>(2)</sup>	—	—	—
5	○	○	○	○	—	—
6	○	○	○	○	○ <sup>(3)(4)</sup>	○ <sup>(3)</sup>
8	○	○	○	○	○ <sup>(3)(4)</sup>	○ <sup>(3)</sup>
10	○	○	○	○	○ <sup>(3)(4)</sup>	○ <sup>(3)</sup>
12	○	○	○	○	—	—
13	—	—	—	—	○ <sup>(3)</sup>	—
15	○	○	○	○	—	—
16	—	—	—	—	○ <sup>(3)</sup>	—
20	○	○	○	○	○ <sup>(3)</sup>	—
25	○	○	○	○	○ <sup>(3)</sup>	—
30	○	○	○	○	—	—
40	○ <sup>(2)</sup>	—	○ <sup>(2)</sup>	—	—	—
50	○	—	—	—	—	—

Note <sup>(1)</sup>: For the solid shafts with a size of 5 to 30 of non-interchangeable specification, the stainless steel spline shaft (supplemental code "/S") is prepared.

<sup>(2)</sup>: The interchangeable specification is not available.

<sup>(3)</sup>: The non-interchangeable specification is not available.

<sup>(4)</sup>: Only the spline shaft is made of high carbon steel, and the slide unit is made of stainless steel.

Remark: For the models indicated in  , hollow shafts are available.

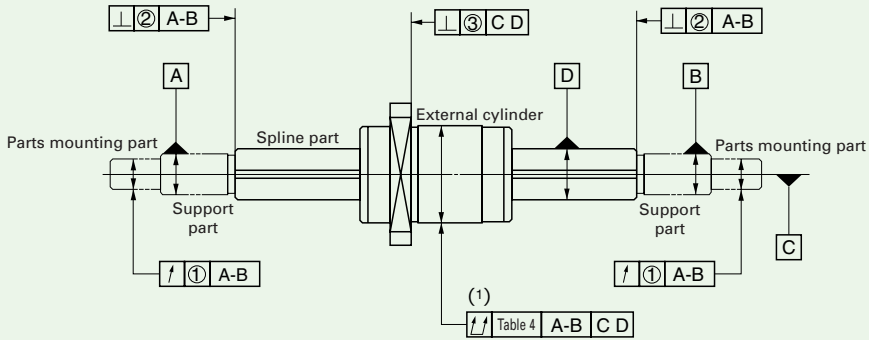
<b>⑤ Number of external cylinders (slide units)</b>	Assembled set :C○ External cylinder (slide unit) :C1	For an assembled set, indicate the number of external cylinders (slide units) assembled on one spline shaft. For a single external cylinder (slide unit), only "C1" can be indicated.
<b>⑥ Length of spline shaft</b>	Assembled set :R○ Spline shaft :R○	Indicate the length of spline shaft in mm. For standard and maximum lengths, see the table of dimensions.
<b>⑦ Material</b>	High carbon steel made :No symbol Stainless steel made :SL	The stainless steel made (SL) applies to Block Type Linear Ball Spline. See Table 1.
<b>⑧ Preload amount</b>	Clearance :To Standard preload :No symbol Light preload :T1	Specify this item for an assembled set or a single external cylinder (slide unit). For applicable preload amount, see Table 6 on page 12.
<b>⑨ Accuracy class</b>	Ordinary class :No symbol High class :H Precision class :P	The precision class (P) applies to Linear Ball Spline G of non-interchangeable specification. For interchangeable specification products, assemble an external cylinder (slide unit) and a spline shaft of the same accuracy class. For details of accuracy classes, see pages 9 to 10.
<b>⑩ Interchangeable code</b>	S1 specification :S1 S2 specification :S2	Specify this item for the interchangeable specification products. Assemble a spline shaft and an external cylinder (slide unit) with the same interchangeable code. Performance and accuracy of "S1" group and "S2" group are the same.
<b>⑪ Special specification</b>	/BS,/N,/OH,/Q,/RE,/S,/U,/Y○	For applicable special specifications, see Table 7 on page 12.

# Accuracy

The accuracy of Linear Ball Spline G is shown in Table 2. The accuracy of Block type Linear Ball Spline is shown

in Figure 1. The accuracy of spline shaft is shown in Table 3 and Table 4.

**Table 2 Accuracy of Linear Ball Spline G**



unit:  $\mu\text{m}$

Model number	Relative to axial line of supporting part of spline shaft						③Perpendicularity of mounting surface of flange relative to axial line of spline shaft (③)		
	①Radial runout of outer periphery of parts mounting part (②)			②Perpendicularity of spline part end faces (②)			Ordinary (No symbol)	High (H)	Precision (P) (④)
	Ordinary (No symbol)	High (H)	Precision (P) (④)	Ordinary (No symbol)	High (H)	Precision (P) (④)			
LSAG 2	33	14	8	22	9	6	27	11	8
LSAG 3	33	14	8	22	9	6	27	11	8
LSAG 4	33	14	8	22	9	6	27	11	8
LSAG 5	33	14	8	22	9	6	27	11	8
LSAG 6	33	14	8	22	9	6	27	11	8
LSAG 8	33	14	8	22	9	6	27	11	8
LSAG 10	41	17	10	22	9	6	33	13	9
LSAG 12	41	17	10	22	9	6	33	13	9
LSAG 15	46	19	12	27	11	8	33	13	9
LSAG 20	46	19	12	27	11	8	33	13	9
LSAG 25	53	22	13	33	13	9	39	16	11
LSAG 30	53	22	13	33	13	9	39	16	11
LSAG 40	62	25	15	39	16	11	46	19	13
LSAG 50	62	25	15	39	16	11	—	—	—

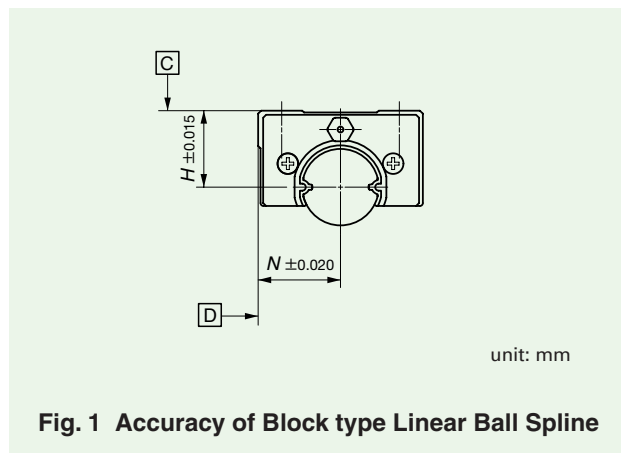
Note (1): Also applicable to Block type Linear Ball Spline, when measurement is made by using a slide unit for measurement.

(2): Applicable when the shaft ends are finished.

(3): Applicable to the flange type.

(4): Applicable to the non-interchangeable specification.

Remark: Only the representative model numbers are shown, but this table is applicable to all Linear Ball Spline G models of the same size.



**Table 3 Twist of grooves with respect to effective length of the spline part**

unit:  $\mu\text{m}$

Accuracy class	Ordinary (No symbol)	High (H)	Precision <sup>(1)</sup> (P)
Allowable value	33	13	6

Note (1): Applicable to Linear Ball Spline G of non-interchangeable specification.

Remark: The values are applicable to any length of 100 mm over the effective length of spline part.

**Table 4 Total radial runout of axial line of spline shaft**

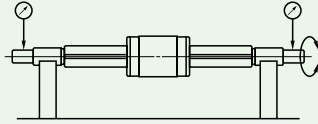
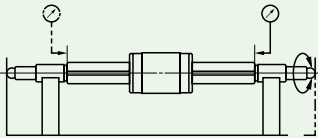
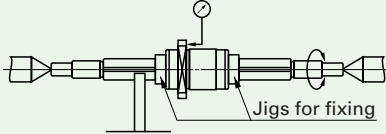
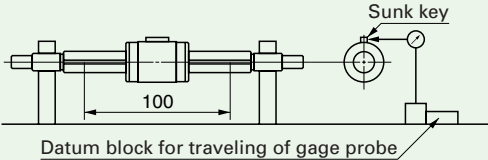
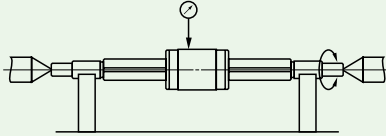
unit:  $\mu\text{m}$

Overall length of spline shaft mm		LSAG 2 LSAG 3 LSAG 4 LSB 6 LSAG 5 LSB 8 LSAG 6 LSAG 8			LSAG 10 LSB 10 LSAG 12 LSB 13			LSAG 15 LSB 16 LSAG 20 LSB 20		
over	incl.	Ordinary (No symbol)	High (H)	Precision <sup>(1)</sup> (P)	Ordinary (No symbol)	High (H)	Precision <sup>(1)</sup> (P)	Ordinary (No symbol)	High (H)	Precision <sup>(1)</sup> (P)
—	200	72	46	26	59	36	20	56	34	18
200	315	133	89	57	83	54	32	71	45	25
315	400	185	126	82	103	68	41	83	53	31
400	500	236	163	108	123	82	51	95	62	38
500	630	—	—	—	151	102	65	112	75	46
630	800	—	—	—	190	130	85	137	92	58
800	1 000	—	—	—	—	—	—	170	115	75
1 000	1 250	—	—	—	—	—	—	—	—	—
Overall length of spline shaft mm		LSAG 25 LSB 25 LSAG 30			LSAG 40 LSAG 50					
over	incl.	Ordinary (No symbol)	High (H)	Precision <sup>(1)</sup> (P)	Ordinary (No symbol)	High (H)	Precision <sup>(1)</sup> (P)			
—	200	53	32	18	53	32	16			
200	315	58	39	21	58	36	19			
315	400	70	44	25	63	39	21			
400	500	78	50	29	68	43	24			
500	630	88	57	34	74	47	27			
630	800	103	68	42	84	54	32			
800	1 000	124	83	52	97	63	38			
1 000	1 250	151	102	65	114	76	47			

Note (1): Applicable to Linear Ball Spline G of non-interchangeable specification.

Remark: Only the representative model numbers are shown, but this table is applicable to all models of the same size.

**Table 5 Measuring methods of accuracy**

Measuring item	Measuring method	Illustration of measuring method
<p>(1) Radial runout of periphery of parts mounting part relative to axial line of supporting part of spline shaft (See Table 2, ①.)</p>	<p>While supporting the spline shaft at its supporting parts, place dial gage probes to the outer peripheral faces of the parts mounting part, and measure the runout from one rotation of the spline shaft.</p>	
<p>(1) Perpendicularity of spline end face relative to axial line of supporting part of spline shaft (See Table 2, ②.)</p>	<p>While supporting the spline shaft at its supporting parts and at one spline shaft end, place a dial gage probe to the spline end face and measure runout from one rotation of the spline shaft.</p>	
<p>Perpendicularity of mounting surface of flange relative to axial line of spline shaft (See Table 2, ③.)</p>	<p>While supporting the spline shaft at both center holes and at the outer peripheral face of the spline shaft adjacent to the external cylinder, and while fixing the external cylinder to the spline shaft, place a dial gage probe to the mounting surface of the flange of the external cylinder and measure the perpendicularity from runout caused by one rotation of the spline shaft.</p>	
<p>Twist of grooves with respect to effective length of the spline part (See Table 3.)</p>	<p>Fix and support the spline shaft. Then apply a uni-directional torsional moment on the external cylinder (slide unit for measurement), before placing a dial gage probe to the side face of the sunk key attached on the external cylinder. Measure runout when the external cylinder and the gage probe have traveled together 100 mm on any effective part of the spline shaft. However, the gage probe should be applied as near as possible to the outer periphery of the external cylinder.</p>	
<p>Total radial runout of axial line of spline shaft (See Table 4.)</p>	<p>While supporting the spline shaft at its supporting parts or at both center holes, place a dial gage probe to the external peripheral face of the external cylinder (slide unit for measurement), and measure runout at several positions in the axial direction while turning the spline shaft one rotation. Use the maximum value.</p>	

Note (1): This accuracy is applicable when special machining is done to the shaft ends.

# Preload

The average amount of preload for Linear Ball Spline is shown in Table 6.

**Table 6 Preload**

Preload type \ Item	Symbol	Preload amount (N)	Application
Clearance <sup>(1)</sup>	T <sub>0</sub>	0 <sup>(3)</sup>	·Very smooth motion
Standard	(No symbol)	0 <sup>(4)</sup>	·Smooth and precise motion
Light preload <sup>(2)</sup>	T <sub>1</sub>	0.02C <sub>0</sub>	·Minimum vibration ·Load is evenly balanced. ·Smooth and precise motion

Note (1): Applicable to the size 2, 3, and 4 models.

(2): Not applicable to the size 2, 3, and 4 models and to the Block type Linear Ball Spline size 6 model. Not applicable to the size 15, 20, and 30 models of Linear Ball Spline G interchangeable specification.

(3): Not applicable to the high-rigidity long external cylinder of interchangeable specification.

(4): Zero or minimal amount of clearance

Remark: Zero or minimal amount of preload  
C<sub>0</sub> means the basic static load rating.

# Special Specifications

Linear Ball Spline series of the special specifications shown in Table 7 are available.

When a special specification is required, add the applicable supplemental code to the end of the identification number. When a combination of several special specifications is required (See Table 8.), arrange their supplemental codes in alphabetical order.

**Table 7 Special specifications**

Special specification	Supplemental code	Applicable series and sizes	
		Linear Ball Spline G	Block type Linear Ball Spline
Stainless steel end caps	/BS <sup>(1)</sup>	5~15	—
No end seal	/N <sup>(2)</sup>	5~40	6~25
Oil hole	/OH <sup>(2)</sup>	3~40	—
Capillary plate	/Q	5~12	—
Seal for special environment	/RE <sup>(1)</sup>	5~15	—
Stainless steel spline shaft	/S <sup>(1)(3)</sup>	5~30	—
Under seal	/U <sup>(2)</sup>	—	6~25
Specified grease	/YO <sup>(1)</sup>	5~15	—

Note (1): Applicable to the non-interchangeable specification.

(2): Applicable to a single external cylinder (slide unit) and an assembled set.

(3): Not applicable to the hollow shaft.

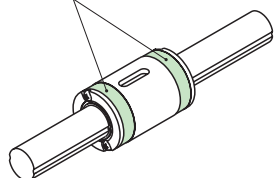
**Table 8 Combination of special specifications**

N	○						
OH	○	○					
Q	○	○	○				
RE	○	—	○	○			
S	○	○	○	○	○		
U	—	—	—	—	—	—	
Y	○	○	○	—	○	○	—
	BS	N	OH	Q	RE	S	U

Remark: The specifications marked ○ in this table can be combined.

### With stainless steel end caps /BS

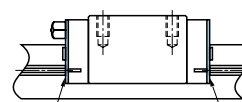
Stainless steel end cap



The standard synthetic resin end caps are replaced with stainless steel end caps, keeping the total length of the external cylinder unchanged.

When superior heat resistance is required, it is recommended to apply this specification in combination with the "with seals for special environment (supplemental code /RE)" or "with no end seal (supplemental code /N)" specification.

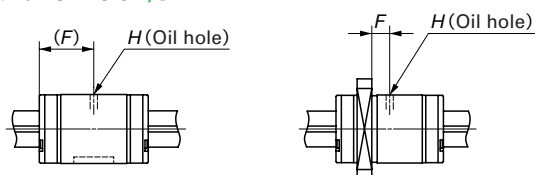
### No end seal /N



End seals at both ends of external cylinder (slide unit) are replaced by end pressure plates (not in contact with the spline shaft) to reduce frictional resistance.

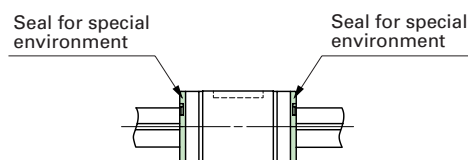
This specification is not effective for dust protection.

### With an oil hole /OH



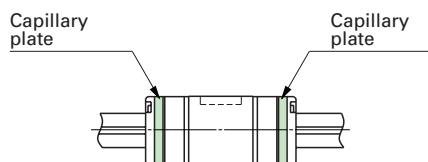
An oil hole is provided on the external cylinder of Linear Ball Spline G. For details of dimensions, see Table 9 and Table 10.

### With seals for special environment /RE



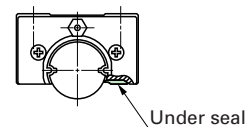
The standard end seals are replaced by seals for special environment that can be used at high temperature. The total length of the external cylinder remains unchanged.

### With capillary plates /Q



The capillary plate is assembled inside the end seal of the external cylinder. It is impregnated with lubricant so that the re-lubrication interval can be made longer. For the total length of the external cylinder with capillary plates, see Table 11.

### With under seals /U



To prevent foreign substances from intruding from the lower side of Block type Linear Ball Spline, seals are provided on the bottom faces of slide unit.

### Spline shaft in stainless steel /S

The material of the solid spline shaft of Linear Ball Spline G is changed to stainless steel.

The load rating will be a value obtained by multiplying the load rating for the high carbon steel spline shaft by a factor of 0.8.

### Specified grease /YCG /YBR /YNG

The type of pre-packed grease can be changed by a supplemental code.

#### ① /YCG

 Low Dust Generation Grease for Clean Environment CG2 is pre-packed.

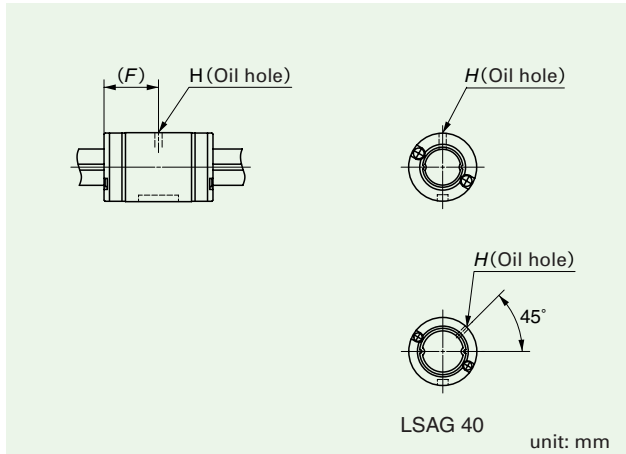
#### ② /YBR

MOLYCOTE BR2 Plus Grease (Dow Corning) is pre-packed.

#### ③ /YNG

No grease is pre-packed.

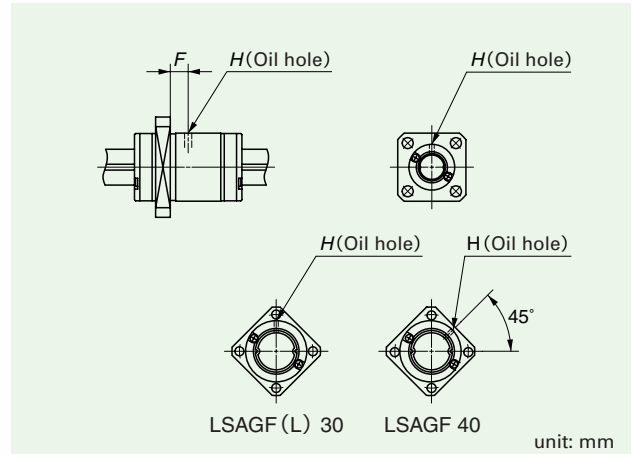
**Table 9 Location and diameter of oil hole of Linear Ball Spline G standard type external cylinder (Supplemental code /OH)**



Model number	F	H	Model number	F	H
LSAG 3	5	1.2	—	—	—
LSAG 4	6	1.5	—	—	—
LSAG 5	9		LSAGL 5	13	1.5
LSAG 6	10.5		LSAGL 6	15	
LSAG 8	12.5	2	LSAGL 8	18.5	2
LSAG 10	15		LSAGL 10	23.5	
LSAG 12	17.5		LSAGL 12	27	
LSAG 15	20	3	LSAGL 15	32.5	3
LSAG 20	25		LSAGL 20	35.5	
LSAG 25	30		LSAGL 25	42	
LSAG 30	35	50	LSAGL 30	49	—
LSAG 40	50		—	—	
LSAG 50	—		—	—	

Remark: The above table shows representative model numbers but is applicable to all Linear Ball Spline G standard type models of the same size.

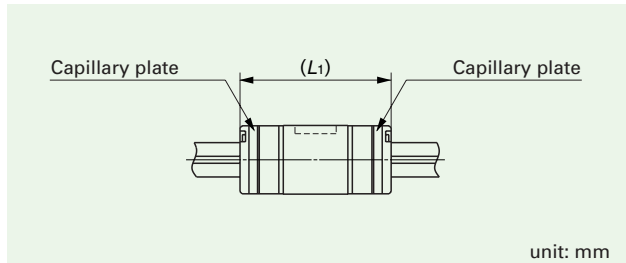
**Table 10 Location and diameter of oil hole of flange type external cylinder of Linear Ball Spline G (Supplemental code /OH)**



Model number	F	H	Model number	F	H
LSAGF 3	2.1	1.2	—	—	—
LSAGF 4	2.8	1.5	—	—	—
LSAGF 5	2.8		LSAGFL 5	5.8	1.5
LSAGF 6	3.5		LSAGFL 6	8	
LSAGF 8	3.5	2	LSAGFL 8	9.5	2
LSAGF 10	5		LSAGFL 10	13.3	
LSAGF 12	7.5		LSAGFL 12	17	
LSAGF 15	9	3	LSAGFL 15	21.4	3
LSAGF 20	11		LSAGFL 20	21.5	
LSAGF 25	13		LSAGFL 25	25	
LSAGF 30	14	23.4	LSAGFL 30	28	—
LSAGF 40	—		—	—	

Remark: The above table shows representative model numbers but is applicable to all Linear Ball Spline G flange type models of the same size.

**Table 11 Dimension of the external cylinder with capillary plates of Linear Ball Spline G (Supplemental code /Q)**



Model number	L <sub>1</sub>	Model number	L <sub>1</sub>
LSAG 5	24	LSAGL 5	32
LSAG 6	27	LSAGL 6	36
LSAG 8	33	LSAGL 8	45
LSAG 10	38	LSAGL 10	55
LSAG 12	43	LSAGL 12	62

Remark: The above table shows representative model numbers but is applicable to all Linear Ball Spline G models of the same size.

# Load Rating and Life

## Basic dynamic load rating $C$

The basic dynamic load rating is defined as a radial load constant both in magnitude and direction under which a group of identical Linear Ball Splines are individually operated and 90% of those in the group can travel  $50 \times 10^3$  meters free from material damage due to rolling contact fatigue.

## Basic static load rating $C_0$

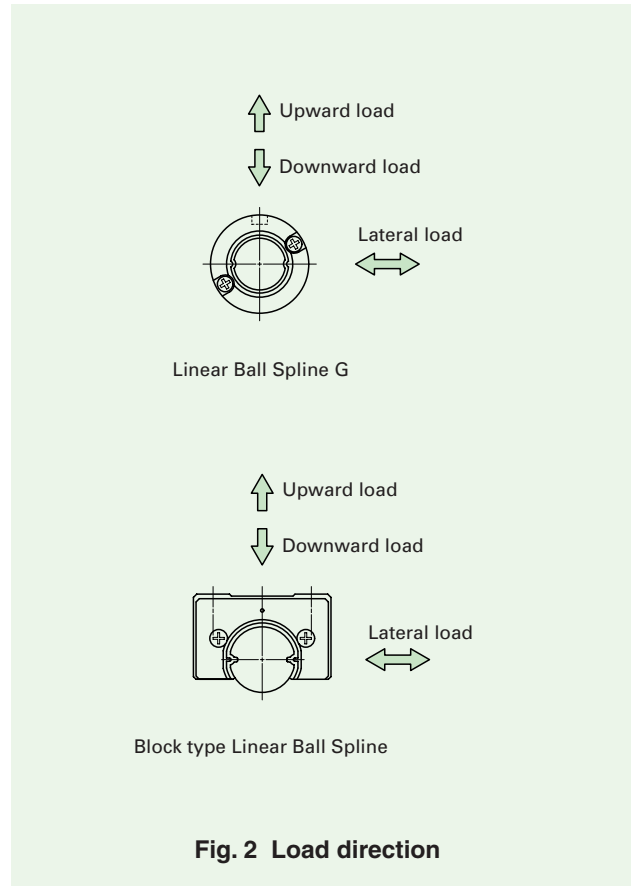
The basic static load rating is defined as the static load that gives a prescribed constant contact stress at the center of the contact area between the rolling elements and raceways receiving the maximum load. It is the allowable limit load that permits normal rolling motion. Generally, the basic static load rating is used in combination with the static safety factor.

## Dynamic rated torque $T$

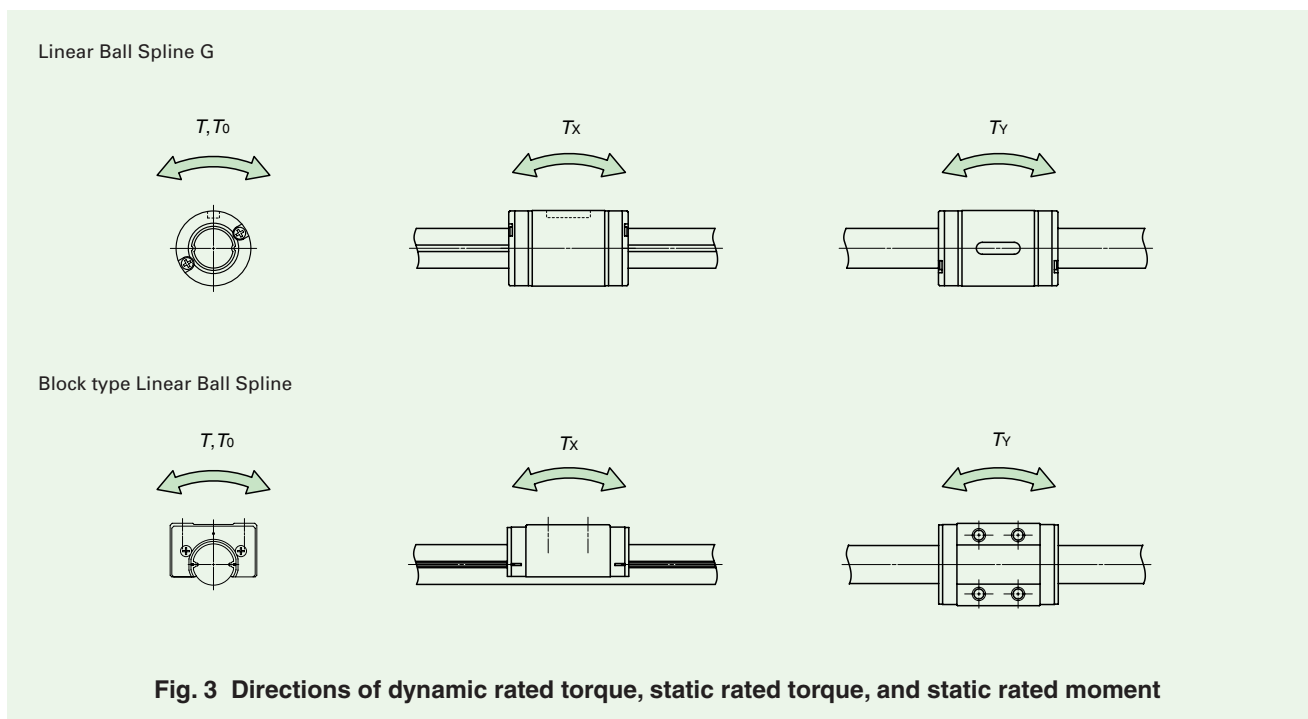
The dynamic rated torque is defined as a rotational torque constant both in magnitude and direction under which a group of identical Linear Ball Splines are individually operated and 90% of those in the group can travel  $50 \times 10^3$  m without suffering from material damage due to rolling contact fatigue.

## Static rated torque $T_0$ Static rated moment $T_x, T_y$

The static rated torque and static rated moment are defined as the static torque or static moment which gives a prescribed constant contact stress at the center of the contact area between the rolling elements and raceways



receiving the maximum load when a torque or moment (See Fig. 3.) is loaded. They are the allowable limit torque or moment that permits normal rolling motion. Generally, they are used in combination with the static safety factor.





## Load direction and load rating

Since the load ratings of Linear Ball Spline given in the table of dimensions are for upward/downward load, they must be corrected for the load direction for lateral load. The corrected basic dynamic load ratings and basic static load ratings are shown in Table 12.

**Table 12 Load ratings corrected for the load direction**

Series and size		Load direction		Lateral direction	
		Upward/downward direction	Basic dynamic load rating	Basic static load rating	Basic dynamic load rating
Linear Ball Spline G	2~12	C	C <sub>0</sub>	1.47C	1.73C <sub>0</sub>
	15~50	C	C <sub>0</sub>	1.13C	1.19C <sub>0</sub>
Block type Linear Ball Spline	6~20	C	C <sub>0</sub>	0.88C	0.84C <sub>0</sub>
	25	C	C <sub>0</sub>	C	C <sub>0</sub>

## Life

The rating life of Linear Ball Spline is obtained from the following formula.

$$L = 50 \left( \frac{C}{P} \right)^3 \dots\dots\dots(1)$$

$$L = 50 \left( \frac{T}{M} \right)^3 \dots\dots\dots(2)$$

where,  $L$  : Rating life,  $10^3$ m  
 $C$  : Basic dynamic load rating, N  
 $T$  : Dynamic rated torque, N-m  
 $P$  : Applied load, N  
 $M$  : Applied torque, N-m

If the stroke length and the number of strokes per minute are given, the life in hours can be obtained from the following formula.

$$L_h = \frac{10^6 L}{2Sm \times 60} \dots\dots\dots(3)$$

where,  $L_h$  : Rating life in hours, h  
 $S$  : Stroke length, mm  
 $m$  : Number of strokes per minute, cpm

## Static safety factor

The static safety factor of Linear Ball Spline can be obtained from the following formula.

$$f_s = \frac{C_0}{P_0} \dots\dots\dots(4)$$

$$f_s = \frac{T_0}{M_0} \dots\dots\dots(5)$$

where  $f_s$  : Static safety factor  
 $C_0$  : Basic static load rating, N  
 $P_0$  : Applied load (maximum load), N  
 $T_0$  : Static rated torque, N-m  
 $M_0$  : Torque (maximum torque), N-m

**Table 13 Static safety factor**

Operating conditions	$f_s$
Operation with vibration and/or shocks	5~7
High operating performance	4~6
Normal operation	3~5

## Load factor

Due to vibration and/or shocks during machine operation, the actual load on each rolling guide becomes greater in many cases than the theoretically calculated load. The applied load is generally calculated by multiplying the theoretically calculated load by the load factor indicated in Table 14.

**Table 14 Load factor**

Operating conditions	$f_w$
Smooth operation free from vibration and/or shocks	1 ~1.2
Normal operation	1.2~1.5
Operation with vibration and/or shocks	1.5~3

# Spline Shaft

Moment of inertia of sectional area and section modulus of the spline shaft are shown in Table 15.


**Table 15 Moment of inertia of sectional area and section modulus of spline shaft**

Model number	Moment of inertia of sectional area mm <sup>4</sup>		Section modulus mm <sup>3</sup>	
	Solid shaft	Hollow shaft	Solid shaft	Hollow shaft
LSAG 2	0.6	—	0.65	—
LSAG 3	3.6	—	2.5	—
LSAG 4	12	12	6	6
LSAG 5	29	29	12	12
LSAG 6	61	61	21	21
LSAG 8	190	190	49	49
LSAG 10	470	460	95	94
LSAG 12	990	960	170	160
LSAG 15	1 590	—	240	—
LSAG 20	5 110	—	570	—
LSAG 25	12 100	—	1 080	—
LSAG 30	25 400	—	1 890	—
LSAG 40	91 000	—	4 930	—
LSAG 50	223 000	—	9 660	—
LSB 6	55	54	19	19
LSB 8	170	170	44	43
LSB 10	440	420	90	87
LSB 13	1 220	1 160	190	180
LSB 16	2 830	2 630	360	340
LSB 20	7 110	6 620	730	680
LSB 25	17 600	15 100	1 440	1 230

Remark: The above table shows representative model numbers but is applicable to all models of the same size.


# Lubrication and Dust Protection

High-quality lithium-soap base grease is pre-packed in Linear Ball Spline (See Table 16.).

A grease nipple or an oil hole for grease replenishment is provided on the slide unit of Block type Linear Ball Spline. Supply nozzles matching the sizes of grease nipples and special grease injectors (miniature greaser) matching the sizes of oil holes are also available. For these parts for lubrication, consult  for further information.

Linear Ball Spline G is not provided with any grease nipple or oil hole. For grease replenishment, apply grease directly to the raceways of the spline shaft. The capillary plate of special specification (supplemental code "/Q") can extend the interval of lubricant replenishment and greatly reduce the maintenance work including grease replenishment.

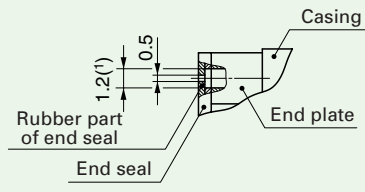
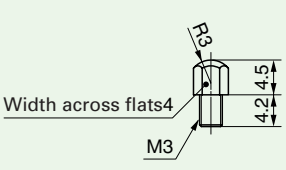
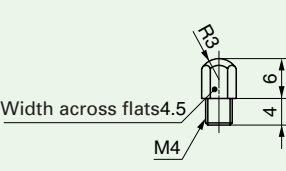
Linear Ball Spline (except size 2, 3, and 4 models) is provided with special rubber seals for dust protection. But, if a large amount of fine contaminants are present, or if

large particles of foreign matter may fall on the spline shaft, it is recommended to provide bellows and other protective covers. When requiring the size 3 and 4 models with seals, consult  for further information.

**Table 16 Pre-packed grease**

Series	Pre-packed grease
Linear Ball Spline G	ALVANIA GREASE EP2 (SHELL)
Block type Linear Ball Spline	MULTEMP PS2 (KYODO OIL)

**Table 17 Grease nipple and oil hole of Block type Linear Ball Spline** unit: mm

Model number	Type	Dimensions and shape
LSB 6 LSB 8 LSB 10	Oil hole	
LSB 13 LSB 16 LSB 20	A-M3	
LSB 25	A-M4	

Note (1): 1.5 mm for LSB 10

Remark: The above table shows representative model numbers but is applicable to all models of Block type Linear Ball Spline of the same size.

# Precautions for Use

## ① Fit of external cylinder

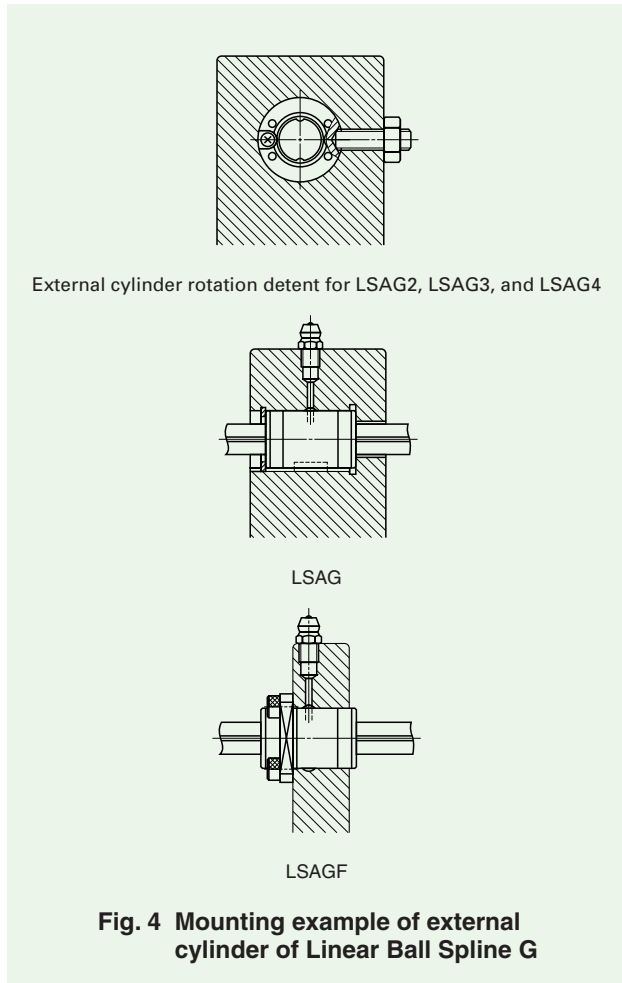
Generally, the transition fit (J7) is applied between the external cylinder of Linear Ball Spline G and the housing bore. When high accuracy and rigidity are not required, the clearance fit (H7) may also be applicable.

## ② Standard mounting example of Linear Ball Spline G


A mounting example of the external cylinder of Linear Ball Spline G is shown in Fig. 4.

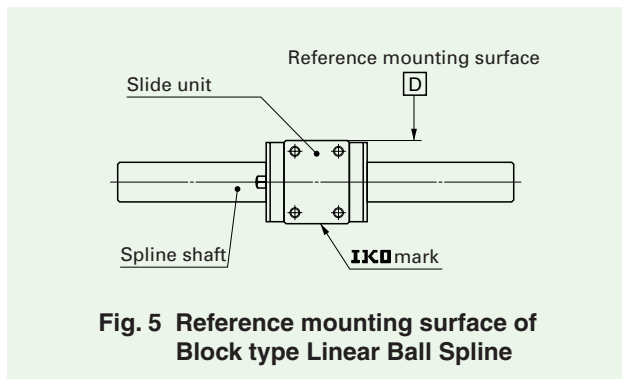
To prevent the rotation of the external cylinders of LSAG2, LSAG3, and LSAG4, an M1.2 to M1.6 screw for LSAG2, an M1.6 to M2 screw for LSAG3, and an M2 to M2.5 screw for

LSAG4 are set to the countersink provided on each cylinder. Avoid deforming the external cylinder when tightening the screw.



### ③ Reference mounting surface of Block type Linear Ball Spline

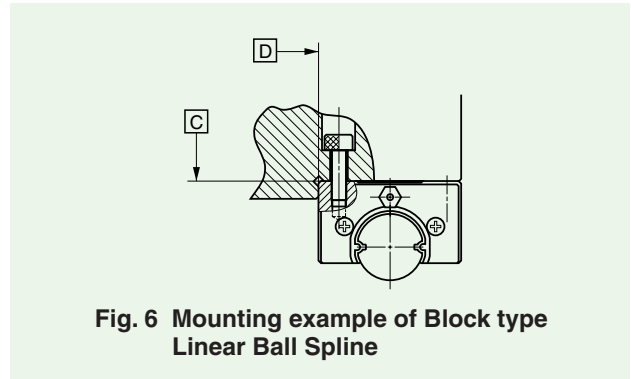
To mount Block type Linear Ball Spline, correctly fit the reference mounting surface of Block type Linear Ball Spline to the mating reference mounting surface of the table, and then fix them tightly. The reference mounting surface of the slide unit of Block type Linear Ball Spline is always the side surface opposite to the  mark. (See Fig. 5.)



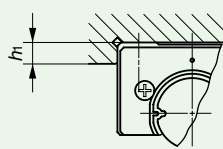
### ④ Standard mounting example of Block type Linear Ball Spline

As shown in Fig. 6, the outer surface of spline shaft, and the reference mounting surface D and the mounting surface C of slide unit are accurately finished by grinding. Stable linear motion of high accuracy will be obtained by accurately finishing the reference mounting surface and mounting surface of the machine or equipment and correctly mounting the Linear Ball Spline on those surfaces.

It is recommended to make a relieved fillet at the corner of the mating reference mounting surface as shown in Table 18. The recommended shoulder height of the mating reference mounting surface is also given in Table 18.



**Table 18 Shoulder height of the mating reference mounting surface for Block type Linear Ball Spline**



unit: mm

Model number	Shoulder height $h_1$
LSB 6	2
LSB 8	2.5
LSB 10	3
LSB 13	3.5
LSB 16	4
LSB 20	5
LSB 25	6

Remark: The above table shows representative model numbers but is applicable to all models of the same size.

# Mounting

## ⑤ Additional machining of spline shaft end

High carbon steel spline shafts are 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 d1 shown in the table of dimensions.

Please use caution when boring, drilling or tapping the ends of solid or hollow shafts because of case hardening depth.

IKO recommends that you furnish us with a drawing showing shaft modifications. By doing so, we can inform you of any problems that you might encounter doing the shaft modifications. We can also quote you on the shafts with the modifications if you so desire. Consult IKO for further information.

## ⑥ Multiple external cylinders or slide units mounted at a close distance

When using multiple external cylinders or slide units at a close distance to each other, the actual load may be greater than the calculated load depending on the accuracy of the mounting surfaces and the reference mounting surfaces of the machine or equipment. It is suggested in such cases to assume a greater load than the calculated load.

When two or more external cylinders of Linear Ball Spline G are assembled on a single spline shaft and two or more keys are used for fixing the external cylinders in the rotational direction, the keyways of the external cylinders can be aligned before delivery. Special products of Block type Linear Ball Spline with specified values of dimensional variations of H and/or N can be prepared. If these products are required, consult IKO.

## ⑦ Operating temperature

The maximum operating temperature is 120°C and a continuous operation is possible at temperatures up to 100°C. When the temperature exceeds 100°C, consult IKO.

In case of the special specification "with capillary plates" (supplemental code "/Q"), operate Linear Ball Spline below 80°C.

## ① When mounting multiple sets at the same time

In the case of interchangeable specification Linear Ball Spline, assemble an external cylinder (slide unit) and a spline shaft with the same interchangeable code ("S1" or "S2").

In the case of non-interchangeable specification Linear Ball Spline, use an assembly of external cylinder and spline shaft as delivered without changing the combination.

## ② Assembling an external cylinder (slide unit) and a spline shaft

When mounting an external cylinder of Linear Ball Spline G on a spline shaft, correctly fit the grooves of the external cylinder to the grooves of the spline shaft, and then move the external cylinder gently in parallel direction. Rough handling will result in seal damage or dropping of steel balls. Linear Ball Spline G of non-interchangeable specification is already adjusted so as to provide the best accuracy when the external cylinder IKO mark (in case of LSAGF2, character "F" on the external cylinder) and the spline shaft IKO mark face the same direction. (See Fig.7) So make sure not to change the assembly direction.

When assembling the slide unit of Block type Linear Ball Spline on the spline shaft, handle them with care to prevent steel balls from falling out. Do not forcibly insert the slide unit onto the spline shaft.

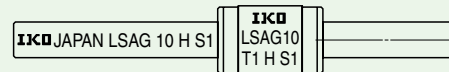


Fig. 7 Assembly direction of the external cylinder of Linear Ball Spline G

## ③ Mounting the external cylinder of Linear Ball Spline G

When press-fitting the external cylinder of Linear Ball Spline G into the housing, assemble them correctly using a press and a suitable jig fixture, etc. (See Fig. 8.)

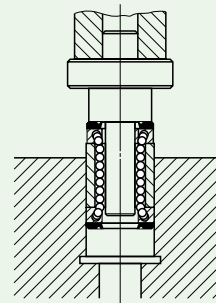


Fig. 8 Press-fitting of the external cylinder of Linear Ball Spline G

#### ④ Tightening torque of fixing bolts of Block type Linear Ball Spline

The standard torque values for Block type Linear Ball Spline fixing bolts are shown in Table 19. When machines or equipment are subjected to severe vibration, shock, large fluctuating load, or moment load, the bolts should be tightened with a torque 1.2 to 1.5 times larger than the standard torque values shown. When the mating member material is cast iron or aluminum, tightening torque should be reduced in accordance with the strength characteristics of the material.

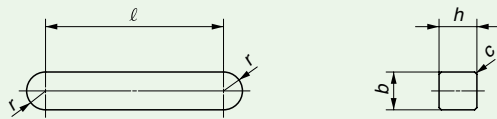
#### ⑤ Attached keys of Linear Ball Spline G

The keys shown in Table 20 are attached to the external cylinders of Linear Ball Spline G standard type (except size 2, 3, and 4 models).

**Table 19 Tightening torque of fixing bolts of Block Type Linear Ball Spline**

Bolt size	Tightening torque N·m	
	Carbon steel bolt (Strength division 12.9)	Stainless steel bolt (Property division A2-70)
M2×0.4	0.49	0.31
M3×0.5	1.7	1.1
M4×0.7	4.0	—
M5×0.8	7.9	—
M6×1	13.3	—

**Table 20 Dimensions and tolerance of attached key**



unit: mm

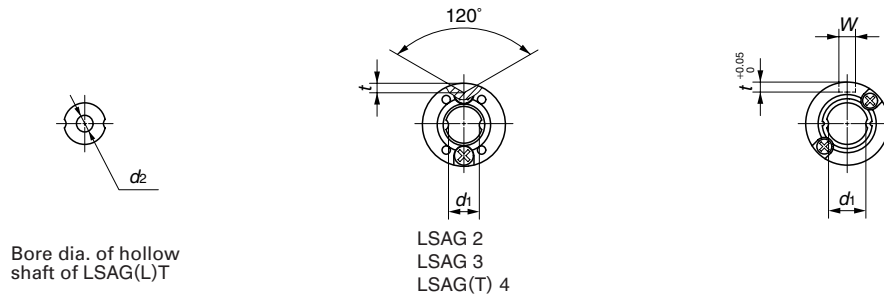
Model number	b	Tolerance	h	Tolerance	l	r	c
LSAG 5	2	+0.016 +0.006	2	0 -0.025	3.8	1	0.16~0.25
LSAG 6					5.8		
LSAG 8	2.5	3	2.5	0 -0.030	7.8	1.25	
LSAG 10	3		3		11.8	1.5	
LSAG 12		3.5	3.5	16	1.75		
LSAG 15	4	+0.024 +0.012	4	0 -0.030	21.5	2	
LSAG 20	5		5		23.5	2.5	
LSAG 25	7	+0.030 +0.015	7	0 -0.036	27.5	3.5	0.25~0.4
LSAG 30	10		8		44.3	5	
LSAG 40	15	+0.036 +0.018	10	0 -0.036	34.3	7.5	0.4 ~0.6
LSAG 50	15		10		34.3	7.5	

Remark: The above table shows representative model numbers but is applicable to all Linear Ball Spline G standard type models of the same size.

# IKO Linear Ball Spline G: Standard type

## LSAG, LSAGT

## LSAGL, LSAGLT



Model number	Interchangeable	Mass (Ref.) g		Dimensions and tolerances of external cylinder mm									
		External cylinder	Spline shaft (per 100 mm)	D	Tolerance	L <sub>1</sub>	L <sub>2</sub>	W	Tolerance	t	ℓ		
LSAG 2 <sup>(1)</sup>		1.0	2.3	6	$\begin{matrix} 0 \\ -0.008 \end{matrix}$	8.5	4.7	—	—	0.7	—	2	$\begin{matrix} 0 \\ -0.010 \end{matrix}$
LSAG 3 <sup>(1)</sup>		2.1	5.4	7	$\begin{matrix} 0 \\ -0.009 \end{matrix}$	10	5.9	—	—	0.8	—	3	$\begin{matrix} 0 \\ -0.010 \end{matrix}$
LSAG 4 <sup>(1)</sup>		2.5	9.6	8	$\begin{matrix} 0 \\ -0.009 \end{matrix}$	12	7.9	—	—	1	—	4	$\begin{matrix} 0 \\ -0.012 \end{matrix}$
LSAGT 4 <sup>(1)</sup>			8.2										
LSAG 5	☆	4.8	14.9	10	$\begin{matrix} 0 \\ -0.009 \end{matrix}$	18	9.4	2	$\begin{matrix} +0.014 \\ 0 \end{matrix}$	1.2	6	5	$\begin{matrix} 0 \\ -0.012 \end{matrix}$
LSAGT 5	☆		12.4										
LSAGL 5	☆	7.9	14.9										
LSAGLT 5	☆		12.4										
LSAG 6	☆	8.9	19	12	$\begin{matrix} 0 \\ -0.011 \end{matrix}$	21	12.4	2	$\begin{matrix} +0.014 \\ 0 \end{matrix}$	1.2	8	6	$\begin{matrix} 0 \\ -0.012 \end{matrix}$
LSAGT 6	☆		16.5										
LSAGL 6	☆	14.5	19										
LSAGLT 6	☆		16.5										
LSAG 8	☆	15.9	39	15	$\begin{matrix} 0 \\ -0.011 \end{matrix}$	25	14.6	2.5	$\begin{matrix} +0.014 \\ 0 \end{matrix}$	1.5	8.5	8	$\begin{matrix} 0 \\ -0.015 \end{matrix}$
LSAGT 8	☆		33										
LSAGL 8	☆	26.5	39										
LSAGLT 8	☆		33										

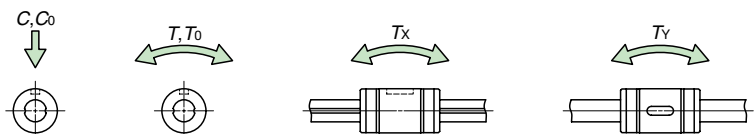
Note (1): No seals are attached.

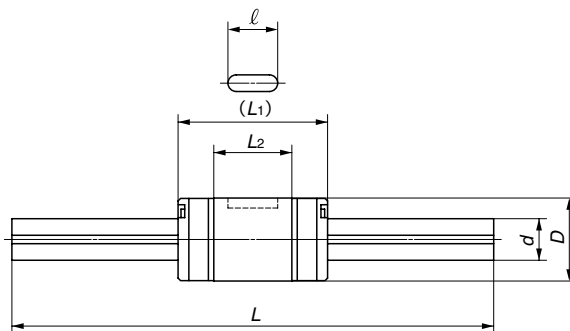
(2): Dimension  $d_1$  indicates the maximum diameter when machining is done at the shaft ends.

(3): This length is the standard length. Spline shafts in other length are also available. Simply indicate the necessary length of spline shaft in mm in the identification number.

(4): The directions of basic dynamic load rating ( $C$ ), basic static load rating ( $C_0$ ), dynamic torque rating ( $T$ ), and static torque/moment rating ( $T_0$ ,  $T_x$ ,  $T_y$ ) are shown in the sketches below. The upper values in the  $T_x$  and  $T_y$  columns apply to one external cylinder, and the lower values apply to two external cylinders in close contact.

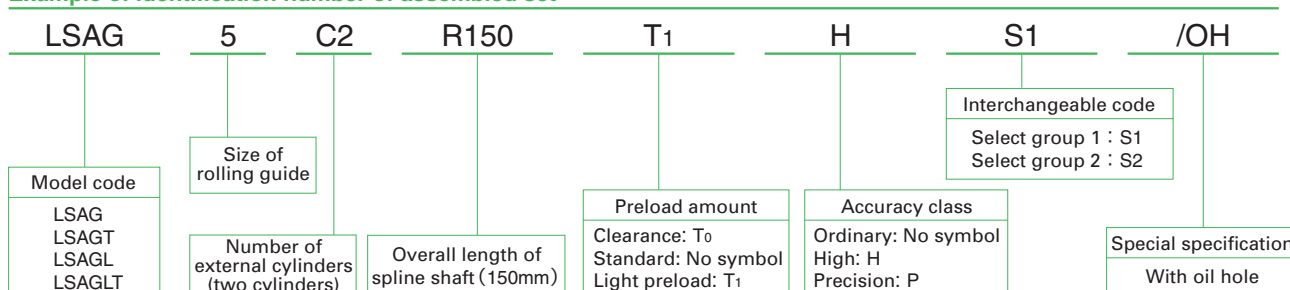
Remark: The mark ☆ indicates that interchangeable specification products are available.





Dimensions and tolerances of spline shaft mm				Basic dynamic load rating <sup>(4)</sup> C N	Basic static load rating <sup>(4)</sup> C <sub>0</sub> N	Dynamic torque rating <sup>(4)</sup> T N-m	Static torque rating <sup>(4)</sup> T <sub>0</sub> N-m	Static moment rating <sup>(4)</sup>		Model number
d <sub>1</sub> <sup>(2)</sup>	d <sub>2</sub>	L <sup>(3)</sup>	Maximum length					T <sub>x</sub> N-m	T <sub>y</sub> N-m	
1.2	—	50 100	100	222	237	0.28	0.30	0.22 1.6	0.39 2.9	<b>LSAG 2<sup>(1)</sup></b>
2.2	—	100 150	150	251	285	0.45	0.51	0.31 1.9	0.53 3.3	<b>LSAG 3<sup>(1)</sup></b>
3.2	—	100 150	200	303	380	0.70	0.87	0.52 2.9	0.90 5.0	<b>LSAG 4<sup>(1)</sup></b>
	1.5		150							<b>LSAGT 4<sup>(1)</sup></b>
4.2	—	100 150	200	587	641	1.8	1.9	1.0 7.9	1.8 13.6	<b>LSAG 5</b>
	2									<b>LSAGT 5</b>
	—									<b>LSAGL 5</b>
	2									<b>LSAGLT 5</b>
5.2	—	150 200	300	711	855	2.5	3.0	1.7 11.7	3.0 20.3	<b>LSAG 6</b>
	2									<b>LSAGT 6</b>
	—									<b>LSAGL 6</b>
	2									<b>LSAGLT 6</b>
7	—	150 200 250	500	1 190	1 330	5.5	6.2	3.3 22.0	5.6 38.1	<b>LSAG 8</b>
	3		400							<b>LSAGT 8</b>
	—		500							<b>LSAGL 8</b>
	3		400							<b>LSAGLT 8</b>

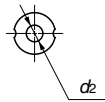
### Example of identification number of assembled set



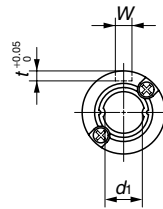
# IKO Linear Ball Spline G: Standard type

## LSAG, LSAGT

## LSAGL, LSAGLT



Bore dia. of hollow shaft of LSAG(L)T



Model number	Interchangeable	Mass (Ref.) g		Dimensions and tolerances of external cylinder mm								d	
		External cylinder	Spline shaft (per 100 mm)	D	Tolerance	L <sub>1</sub>	L <sub>2</sub>	W	Tolerance	t	ℓ		
LSAG 10	☆	31.5	60.5	19	0 -0.013	30	18.2	3	+0.014 0	1.8	11	10	0 -0.015
LSAGT 10	☆		51			47	34.9						
LSAGL 10	☆	56.5	60.5	21	0 -0.013			35	23	3	+0.014 0	1.8	15
LSAGLT 10	☆		51			54	42						
LSAG 12	☆	44	87.5	23	0 -0.013	40	27	3.5	+0.018 0	2	20	13.6	0 -0.018
LSAGT 12	☆		66			65	52						
LSAGL 12	☆	76.8	87.5	30	0 -0.016	50	33	4	+0.018 0	2.5	26	18.2	0 -0.021
LSAGLT 12	☆		66			71	54						
LSAG 15	☆	59.5	111	37	0 -0.016	60	39.2	5	+0.018 0	3	29	22.6	0 -0.021
LSAGL 15	☆	110				84	63.2						
LSAG 20	☆	130	202	45	0 -0.016	70	43	7	+0.022 0	4	35	27.2	0 -0.021
LSAGL 20	☆	198				98	71						
LSAG 25	☆	220	310	60	0 -0.019	100	70.8	10	+0.022 0	4.5	55	37.2	0 -0.025
LSAGL 25	☆	336											
LSAG 30	☆	430	450	75	0 -0.019	100	66.4	15	+0.027 0	5	50	46.6	0 -0.025
LSAGL 30	☆	634											
LSAG 40	☆	760	808	60	0 -0.019	100	70.8	10	+0.022 0	4.5	55	37.2	0 -0.025
LSAG 50	☆	1140	1 320	75	0 -0.019	100	66.4	15	+0.027 0	5	50	46.6	0 -0.025

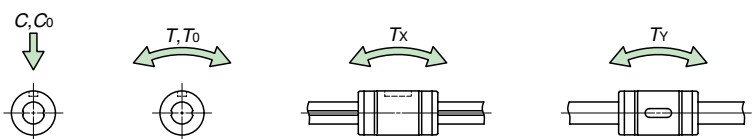
Note (1): Dimension  $d_1$  indicates the maximum diameter when machining is done at the shaft ends.

(2): This length is the standard length. Spline shafts in other length are also available. Simply indicate the necessary length of spline shaft in mm in the identification number.

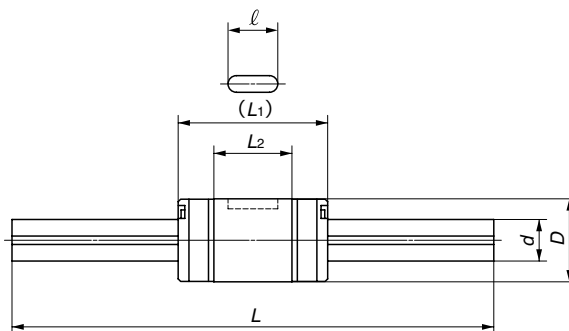
(3): The directions of basic dynamic load rating ( $C$ ), basic static load rating ( $C_0$ ), dynamic torque rating ( $T$ ), and static torque/moment rating ( $T_0$ ,  $T_x$ ,  $T_y$ ) are shown in the sketches below. The upper values in the  $T_x$  and  $T_y$  columns apply to one external cylinder, and the lower values apply to two external cylinders in close contact.

Remark1: The mark ☆ indicates that interchangeable specification products are available.

2: The LSAG 50 is our semi-standard products.







Dimensions and tolerances of spline shaft mm				Basic dynamic load rating <sup>(3)</sup> C N	Basic static load rating <sup>(3)</sup> C <sub>0</sub> N	Dynamic torque rating <sup>(3)</sup> T N-m	Static torque rating <sup>(3)</sup> T <sub>0</sub> N-m	Static moment rating <sup>(3)</sup>		Model number	
d <sub>1</sub> <sup>(1)</sup>	d <sub>2</sub>	L <sup>(2)</sup>						Maximum length	T <sub>x</sub> N-m		T <sub>y</sub> N-m
8.9	—	200	300	600	1 880	2 150	10.9	12.5	7.0 41.5	12.1 71.9	LSAG 10
	4										LSAGT 10
	—										LSAGL 10
	4										LSAGLT 10
10.9	—	200	300	800	2 180	2 690	14.8	18.3	10.6 59.1	18.3 102	LSAG 12
	6										LSAGT 12
	—										LSAGL 12
	6										LSAGLT 12
11.6	—	200	300	1 000	4 180	6 070	31.3	45.6	27.8 152	33.2 181	LSAG 15
	—				6 400	11 500	48.0	86.5	94.0 449	112 535	LSAGL 15
15.7	—	300	400	1 000	6 600	9 040	66.0	90.4	48.6 288	58.0 343	LSAG 20
	—				600	9 270	15 100	92.7	151	127 620	151 738
19.4	—	300	400	1 200	11 200	14 300	139	178	92.8 551	111 656	LSAG 25
	—				600	800	15 400	23 200	193	290	229 1 190
23.5	—	400	500	1 200	15 400	19 400	231	292	147 874	176 1 040	LSAG 30
	—				700	1 100	21 300	31 600	320	474	364 1 900
33.5	—	400	500	1 200	21 300	31 600	426	632	364 1 940	434 2 310	LSAG 40
	—				700	1 100	28 300	36 100	707	904	389 2 300

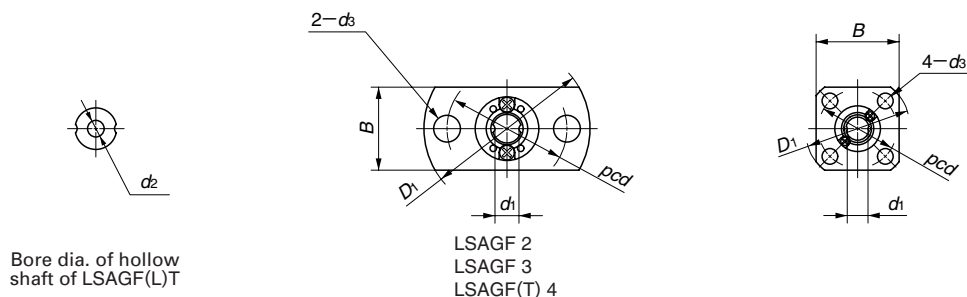
### Example of identification number of assembled set

LSAG	10	C2	R200	T <sub>1</sub>	H	S1	/OH
Model code LSAG LSAGT LSAGL LSAGLT	Size of rolling guide Number of external cylinders (two cylinders)	Overall length of spline shaft (200mm)	Preload amount Clearance: T <sub>0</sub> Standard: No symbol Light preload: T <sub>1</sub>	Accuracy class Ordinary: No symbol High: H Precision: P	Interchangeable code Select group 1 : S1 Select group 2 : S2	Special specification With oil hole	

# IKO Linear Ball Spline G: Flange type

## LSAGF, LSAGFT

## LSAGFL, LSAGFLT



Model number	Interchangeable	Mass (Ref.) g		Dimensions and tolerances of external cylinder mm											
		External cylinder	Spline shaft (per 100 mm)	D	Tolerance	L <sub>1</sub>	L <sub>2</sub>	D <sub>1</sub>	B	E	T	pcd	d <sub>s</sub>	d	Tolerance
LSAGF 2 <sup>(1)</sup>		1.9	2.3	6	$0$ -0.008	8.5	4.7	15.5	8	3.4	1.5	11	2.4	2	$0$ -0.010
LSAGF 3 <sup>(1)</sup>		3.7	5.4	7	$0$ -0.009	10	5.9	18	9	4	1.9	13	2.9	3	$0$ -0.010
LSAGF 4 <sup>(1)</sup>		5.1	9.6	8	$0$ -0.009	12	7.9	21	10	4.6	2.5	15	3.4	4	$0$ -0.012
LSAGFT 4 <sup>(1)</sup>			8.2												
LSAGF 5	☆	8.9	14.9	10	$0$ -0.009	18	9.4	23	18	7	2.7	17	3.4	5	$0$ -0.012
LSAGFT 5	☆		12.4												
LSAGFL 5	☆	12	14.9	10	$0$ -0.009	26	16.9	23	18	7	2.7	17	3.4	5	$0$ -0.012
LSAGFLT 5	☆		12.4												
LSAGF 6	☆	13.9	19	12	$0$ -0.011	21	12.4	25	20	7	2.7	19	3.4	6	$0$ -0.012
LSAGFT 6	☆		16.5												
LSAGFL 6	☆	19.5	19	12	$0$ -0.011	30	21.4	25	20	7	2.7	19	3.4	6	$0$ -0.012
LSAGFLT 6	☆		16.5												
LSAGF 8	☆	23.5	39	15	$0$ -0.011	25	14.6	28	22	9	3.8	22	3.4	8	$0$ -0.015
LSAGFT 8	☆		33												
LSAGFL 8	☆	34.1	39	15	$0$ -0.011	37	26.6	28	22	9	3.8	22	3.4	8	$0$ -0.015
LSAGFLT 8	☆		33												

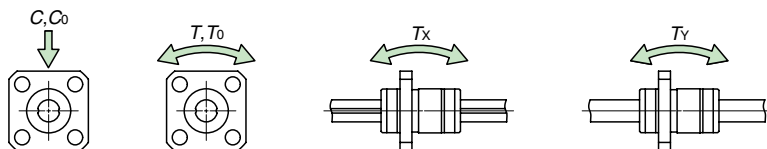
Note (1): These models are not provided with end seals.

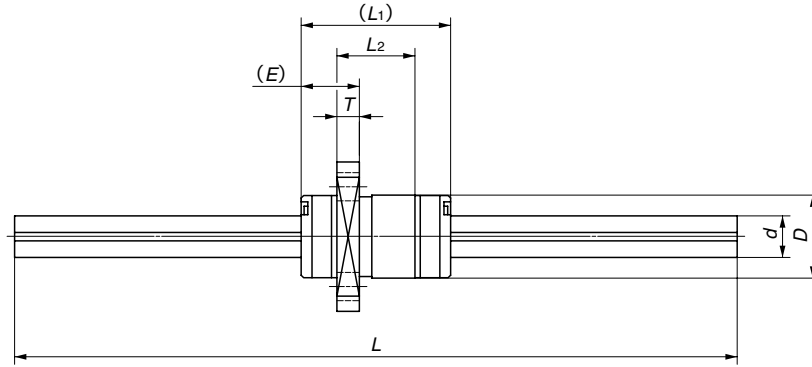
(2): Dimension  $d_1$  indicates the maximum diameter when machining is done at the shaft ends.

(3): This length is the standard length. Spline shafts in other length are also available. Simply indicate the necessary length of spline shaft in mm in the identification number.

(4): The directions of basic dynamic load rating ( $C$ ), basic static load rating ( $C_0$ ), dynamic torque rating ( $T$ ), and static torque/moment rating ( $T_0$ ,  $T_x$ ,  $T_y$ ) are shown in the sketches below. The upper values in the  $T_x$  and  $T_y$  columns apply to one external cylinder, and the lower values apply to two external cylinders in close contact.

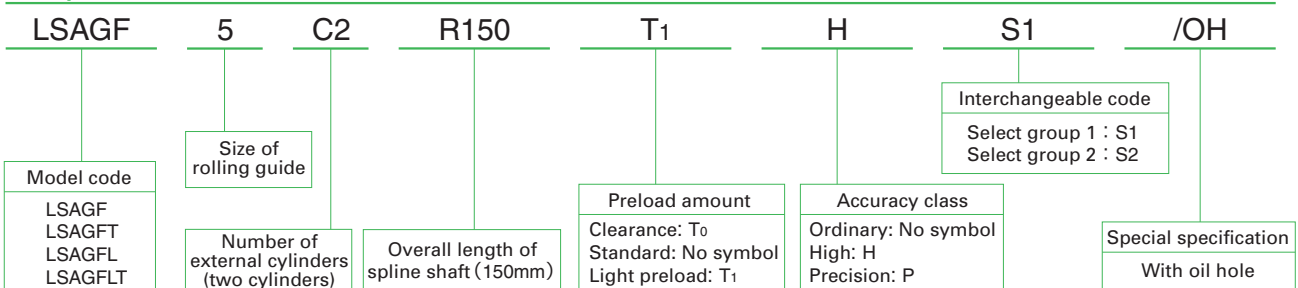
Remark: The mark ☆ indicates that interchangeable specification products are available.





Dimensions and tolerances of spline shaft mm				Basic dynamic load rating <sup>(4)</sup> C N	Basic static load rating <sup>(4)</sup> C <sub>0</sub> N	Dynamic torque rating <sup>(4)</sup> T N-m	Static torque rating <sup>(4)</sup> T <sub>0</sub> N-m	Static moment rating <sup>(4)</sup>		Model number						
d <sub>1</sub> <sup>(2)</sup>	d <sub>2</sub>	L <sup>(3)</sup>	Maximum length					T <sub>x</sub> N-m	T <sub>y</sub> N-m							
1.2	—	50 100	100	222	237	0.28	0.30	0.22 1.6	0.39 2.9	<b>LSAGF 2<sup>(1)</sup></b>						
2.2	—	100 150	150	251	285	0.45	0.51	0.31 1.9	0.53 3.3	<b>LSAGF 3<sup>(1)</sup></b>						
3.2	—	100 150	200	303	380	0.70	0.87	0.52 2.9	0.90 5.0	<b>LSAGF 4<sup>(1)</sup></b>						
	1.5		150							<b>LSAGFT 4<sup>(1)</sup></b>						
4.2	—	100 150	200	587	641	1.8	1.9	1.0 7.9	1.8 13.6	<b>LSAGF 5</b>						
	2									<b>LSAGFT 5</b>						
	—									<b>LSAGFL 5</b>						
	2									<b>LSAGFLT 5</b>						
5.2	—	150 200	300	711	855	2.5	3.0	1.7 11.7	3.0 20.3	<b>LSAGF 6</b>						
	2									<b>LSAGFT 6</b>						
	—									<b>LSAGFL 6</b>						
	2									<b>LSAGFLT 6</b>						
7	—	150 200 250	500	1 190	1 330	5.5	6.2	3.3 22.0	5.6 38.1	<b>LSAGF 8</b>						
	3		<b>LSAGFT 8</b>													
	—		500							1 800	2 470	8.4	11.5	10.3 56.3	17.8 97.5	<b>LSAGFL 8</b>
	3		400													<b>LSAGFLT 8</b>

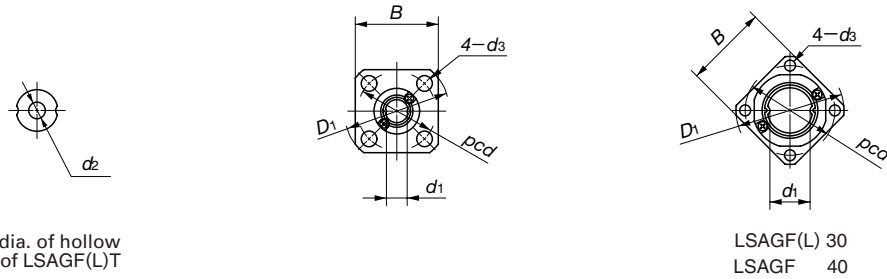
### Example of identification number of assembled set



# IKO Linear Ball Spline G: Flange type

## LSAGF, LSAGFT

## LSAGFL, LSAGFLT



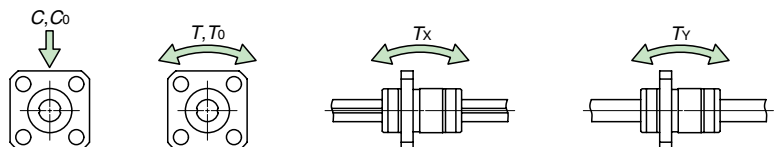
Model number	Interchangeable	Mass (Ref.) g		Dimensions and tolerances of external cylinder mm										Tolerance	
		External cylinder	Spline shaft (per 100 mm)	D		L <sub>1</sub>	L <sub>2</sub>	D <sub>1</sub>	B	E	T	pcd	d <sub>3</sub>		
LSAGF 10	☆	45	60.5	19	0 -0.013	30	18.2	36	28	10	4.1	28	4.5	10	0 -0.015
LSAGFT 10	☆		51			47	34.9								
LSAGFL 10	☆	70.1	60.5	21	0 -0.013	35	23	38	30	10	4	30	4.5	12	0 -0.018
LSAGFLT 10	☆		51			54	42								
LSAGF 12	☆	59	87.5	23	0 -0.013	40	27	40	31	11	4.5	32	4.5	13.6	0 -0.018
LSAGFT 12	☆		66			65	52								
LSAGFL 12	☆	91.8	87.5	30	0 -0.016	50	33	46	35	14	5.5	38	4.5	18.2	0 -0.021
LSAGFLT 12	☆		66			71	54								
LSAGF 15	☆	77	111	37	0 -0.016	60	39.2	57	43	17	6.6	47	5.5	22.6	0 -0.021
LSAGFL 15	☆	128				84	63.2								
LSAGF 20	☆	150	202	45	0 -0.016	70	43	65	50	21	7.5	54	6.6	27.2	0 -0.021
LSAGFL 20	☆	218				98	71								
LSAGF 25	☆	255	310	60	0 -0.019	100	70.8	93	73	26.6	12	73	9	37.2	0 -0.025
LSAGFL 25	☆	371													
LSAGF 30	☆	476	450	60	0 -0.019			93	73	26.6	12	73	9	37.2	0 -0.025
LSAGFL 30	☆	680													
LSAGF 40	☆	962	808	60	0 -0.019	100	70.8	93	73	26.6	12	73	9	37.2	0 -0.025

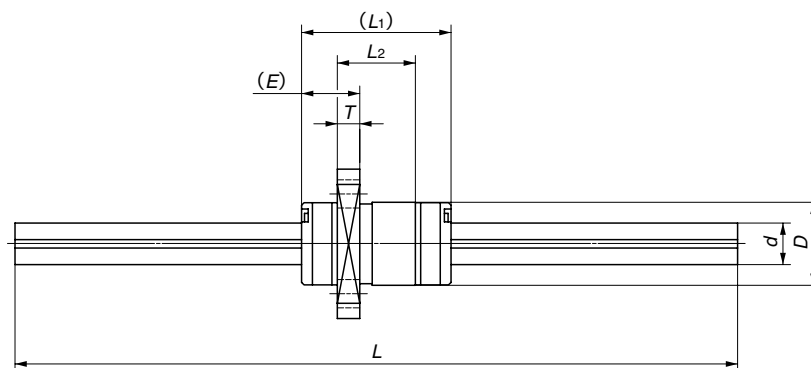
Note (1): Dimension  $d_1$  indicates the maximum diameter when machining is done at the shaft ends.

(2): This length is the standard length. Spline shafts in other length are also available. Simply indicate the necessary length of spline shaft in mm in the identification number.

(3): The directions of basic dynamic load rating ( $C$ ), basic static load rating ( $C_0$ ), dynamic torque rating ( $T$ ), and static torque/moment rating ( $T_0$ ,  $T_x$ ,  $T_y$ ) are shown in the sketches below. The upper values in the  $T_x$  and  $T_y$  columns apply to one external cylinder, and the lower values apply to two external cylinders in close contact.

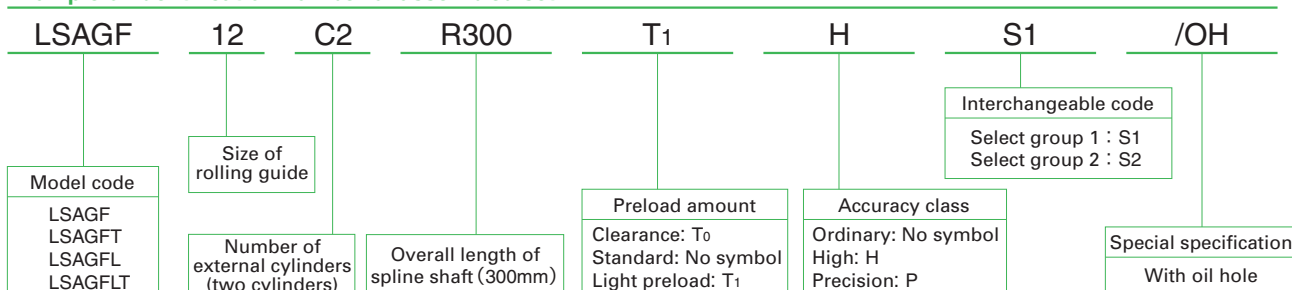
Remark: The mark ☆ indicates that interchangeable specification products are available.





Dimensions and tolerances of spline shaft mm				Basic dynamic load rating <sup>(3)</sup> C N	Basic static load rating <sup>(3)</sup> C <sub>0</sub> N	Dynamic torque rating <sup>(3)</sup> T N-m	Static torque rating <sup>(3)</sup> T <sub>0</sub> N-m	Static moment rating <sup>(3)</sup>		Model number
d <sub>1</sub> <sup>(1)</sup>	d <sub>2</sub>	L <sup>(2)</sup>	Maximum length					T <sub>x</sub> N-m	T <sub>y</sub> N-m	
8.9	—	200 300	600	1 880	2 150	10.9	12.5	7.0	12.1	<b>LSAGF 10</b>
	4							41.5	71.9	
	—			2 850	4 040	16.6	23.4	22.7	39.3	<b>LSAGFL 10</b>
	4							115	200	
10.9	—	200 300 400	800	2 180	2 690	14.8	18.3	10.6	18.3	<b>LSAGF 12</b>
	6							59.1	102	
	—			3 220	4 850	21.9	33.0	32.2	55.7	<b>LSAGFL 12</b>
	6							157	272	
11.6	—	200 300 400	1 000	4 180	6 070	31.3	45.6	27.8 152	33.2 181	<b>LSAGF 15</b>
	—			6 400	11 500	48.0	86.5	94.0 449	112 535	<b>LSAGFL 15</b>
15.7	—	300 400 500 600	1 000	6 600	9 040	66.0	90.4	48.6 288	58.0 343	<b>LSAGF 20</b>
	—			9 270	15 100	92.7	151	127 620	151 738	<b>LSAGFL 20</b>
19.4	—	300 400 500 600 800	1 200	11 200	14 300	139	178	92.8 551	111 656	<b>LSAGF 25</b>
	—			15 400	23 200	193	290	229 1 190	273 1 420	<b>LSAGFL 25</b>
23.5	—	400 500 600 700 1 100	1 200	15 400	19 400	231	292	147 874	176 1 040	<b>LSAGF 30</b>
	—			21 300	31 600	320	474	364 1 900	434 2 260	<b>LSAGFL 30</b>
33.5	—	400 500 600 700 1 100	1 200	21 300	31 600	426	632	364 1 940	434 2 310	<b>LSAGF 40</b>

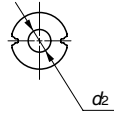
### Example of identification number of assembled set



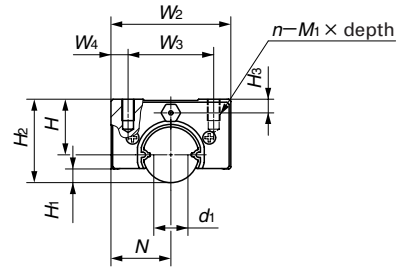
# IKO Block Type Linear Ball Spline

## LSB, LSBT

### LSB···SL (Stainless steel made)



Bore dia. of hollow shaft of LSBT



Model number	Interchangeable	Mass (Ref.) g		Dimensions of assembly mm				Dimensions of slide unit mm								
		Slide unit	Spline shaft (per 100 mm)	H	H <sub>1</sub>	H <sub>2</sub>	N	W <sub>2</sub>	W <sub>3</sub>	W <sub>4</sub>	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	L <sub>4</sub>	n-M <sub>1</sub> ×depth	H <sub>3</sub>
LSB 6	☆	7.6	21.2	6	1.1	9	6.5	13	8	2.5	19	—	12.5	—	2-M2×3	1.5
LSBT 6	☆		18.8													
LSB 6···SL	☆		21.2													
LSB 8	☆	18	37.6	8	1.3	12	9	18	12	3	25	8	15.6	—	4-M3×3	1.5
LSBT 8	☆		32.1													
LSB 8···SL	☆		37.6													
LSB 10	☆	34	59.7	10	1.9	15	10.5	21	15	3	31	10	21.2	—	4-M3×4	2.5
LSBT 10	☆		49.8													
LSB 10···SL	☆		59.7													
LSB 13	☆	62	100	13	3.2	19.5	14	28	20	4	35	15	22.4	40	4-M3×5	3.2
LSBT 13	☆		77.9													
LSB 16	☆	112	152	16	4.2	24	16.5	33	25	4	43	20	28.8	48	4-M4×6	4
LSBT 16	☆		113													
LSB 20	☆	215	240	20	5.8	30	20	40	30	5	53	25	37.3	58	4-M5×10	5
LSBT 20	☆		178													
LSB 25	☆	403	376	25	6	37.5	26	52	40	6	67	30	41.8	70	4-M6×12	6
LSBT 25	☆		237													

Note (1): Not applicable to the hollow shaft (LSBT).

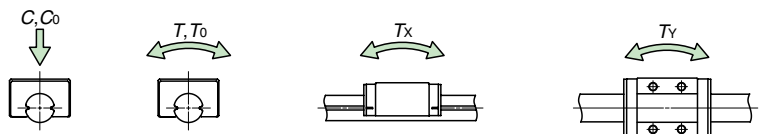
(2): Dimension  $d_1$  indicates the maximum diameter when machining is done at the shaft ends.

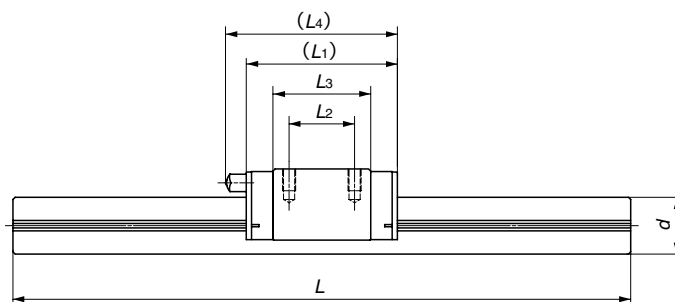
(3): This length is the standard length. Spline shafts in other length are also available. Simply indicate the necessary length of spline shaft in mm in the identification number.

(4): The directions of basic dynamic load rating ( $C$ ), basic static load rating ( $C_0$ ), dynamic torque rating ( $T$ ), and static torque/moment rating ( $T_0$ ,  $T_x$ ,  $T_y$ ) are shown in the sketches below. The upper values in the  $T_x$  and  $T_y$  columns apply to one slide unit, and the lower values apply to two slide units in close contact.

Remark 1: All of Block Type Linear Ball Splines are interchangeable specification products.

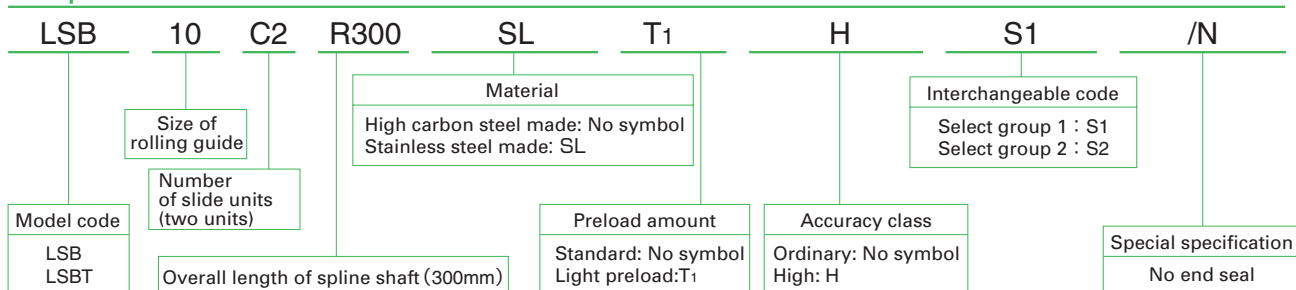
2: The size 6, 8, and 10 models are provided with an oil hole. For grease nipple and oil hole specifications, see Table 17.





Dimensions and tolerances of spline shaft mm						Basic dynamic load rating <sup>(4)</sup> C N	Basic static load rating <sup>(4)</sup> C <sub>0</sub> N	Dynamic torque rating <sup>(4)</sup> T N-m	Static torque rating <sup>(4)</sup> T <sub>0</sub> N-m	Static moment rating <sup>(4)</sup>		Model number		
d	Tolerance <sup>(1)</sup>	d <sub>1</sub> <sup>(2)</sup>	d <sub>2</sub>	L <sup>(3)</sup>	Maximum length					T <sub>x</sub> N-m	T <sub>y</sub> N-m			
6	0 -0.012	3.7	-	150 200	300	612	1 130	1.8	3.4	2.4	2.0	LSB 6		
			2							13.3	11.2		LSBT 6	
			-							489	907		1.5	2.7
8	0 -0.015	5	-	150 200 250	500	1 200	1 960	4.8	7.8	4.9	4.1	LSB 8		
			3		400					31.4	26.3		LSBT 8	
			-		500					963	1 570		3.9	6.3
10	0 -0.015	6.9	-	200 300	600	1 610	2 860	8.1	14.3	9.4	7.9	LSB 10		
			4							200 300	55.0		46.2	LSBT 10
			-							1 290	2 290		6.5	11.4
13	0 -0.018	9	-	200 300 400	800	2 960	4 450	19.2	28.9	16.0	13.4	LSB 13		
			6							99.9	83.8		LSBT 13	
16	0 -0.018	11.4	-	200 300 400	1 000	4 390	6 730	35.1	53.9	30.8	25.9	LSB 16		
			8							183	153		LSBT 16	
20	0 -0.021	15	-	300 400 500 600	1 000	5 830	9 420	58.3	94.2	54.6	45.8	LSB 20		
			10							310	260		LSBT 20	
25	0 -0.021	19.3	-	300 400 500 600 800	1 200	9 360	13 900	122	181	99.2	99.2	LSB 25		
			15							587	587		LSBT 25	

Example of identification number of assembled set



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