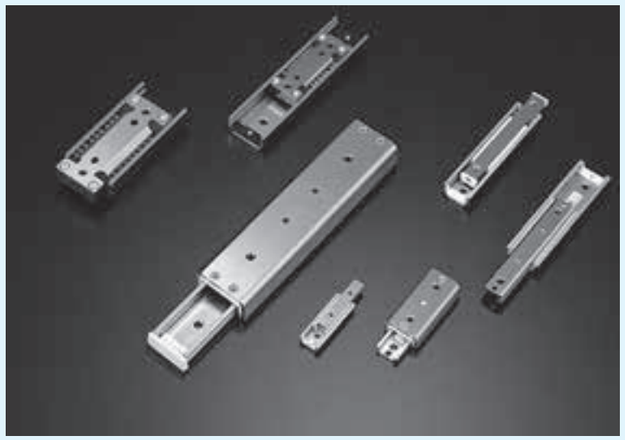
Linear Ball Spline

C-Lube Linear Ball Spline MAG
Linear Ball Spline G
Block Type Linear Ball Spline
Stroke Ball Spline

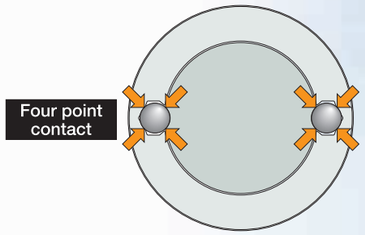


Excellent features of compact linear structure by four-points contact in ball spline realized by a simple two-row raceways

IKO Linear Ball Spline is a linear motion rolling guide in which an external cylinder or slide unit makes linear motion along the spline shaft. Since the structure lets a ball to rotate on the spline track groove, it can receive not only the radial load but also rotating torque. Therefore it best fits the structure in which torque transmission and linear motion take place in parallel.

High rigidity despite of compact size

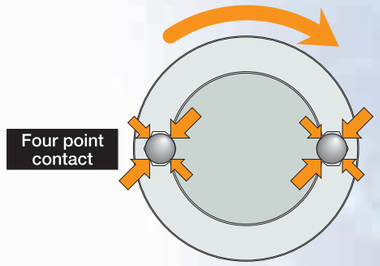
The structure places large diameter balls in two rows and has four-point contact with the track, allowing greater rigidity and compact design.



For the load from all directions it gives a good balance and high rigidity!

Allows high accuracy and accurate positioning

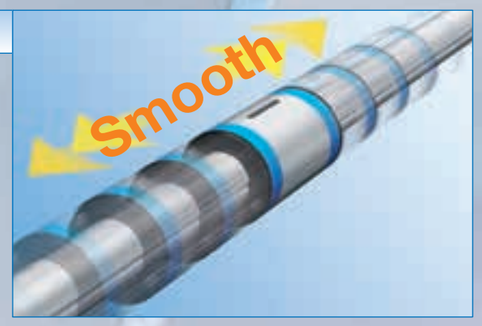
Preload removes the clearance along the rotation direction, allowing accurate positioning along the rotation direction.



No play along the rotation direction!

Low frictional resistance and smooth motion

The optimum design based on the thorough analysis of ball recirculating route realized low frictional resistance and smooth linear motion durable for high speed operations.



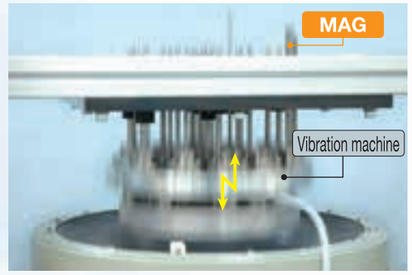
Both high speed durability performance and maintenance free performance are achieved

C-lube Linear Ball Spline MAG realizes a long term maintenance free using the built-in lubrication parts C-Lube for ball recirculation way in external cylinder. Since the lubrication oil inside C-Lube maintains the lubrication performance for a long time, it reduces the annoying lubricating management works and also allows total system cost saving by reducing the oil supply structures.

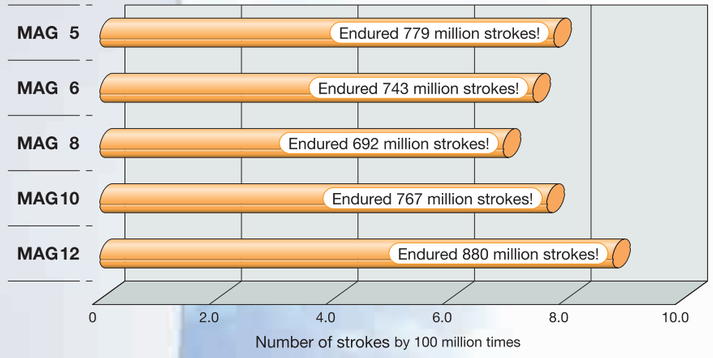
Durability test assuming the chip mounter

《Test conditions》

Lubrication conditions	Only lubrication oil inside C-lube, with no pre-packed grease	
Test method	Vibration test machine	
Operation condition	Posture	Vertical
	Maximum velocity	860 mm/s
	Acceleration	10 G
	Number of cycle	18.2 Hz
	Stroke length	15 mm



《Result》



Endured total strokes of 200 million times without a problem, only by lubrication oil inside C-Lube, for vertical shaft and super high tact operation!
Realized the maintenance free of 10 years of use equivalent to 10 years, in the test condition assuming the use for general chip mounters!!

Achieved maintenance free of more than 600 million total strokes in this severe operation conditions!!

Wide variation

A wide variety of models and sizes, such as super miniature size of 2 mm spline shaft diameter, block types and limited stroke types, is provided for your selection to meet each requirement.

Series		Model	Size	Spline shaft diameter Min	Max
C-Lube Linear Ball Spline MAG	MAG	6 models	6 sizes	4 ～	12 mm
Linear Ball Spline G	LSAG	8 models	12 sizes	2 ～	30 mm
Block Type Linear Ball Spline	LSB	3 models	7 sizes	6 ～	25 mm
Stroke Ball Spline	LS	2 models	3 sizes	4 ～	6 mm

Free combination is enabled for model/accuracy/preload!!

Extreme interchangeable system

Interchangeable specification

Interchangeable specification has realized the unparalleled high interchangeability in the background of unique high processing technology, by severely managing the dimensions of external cylinder, slide unit and spline shaft. This feature allows independent handling of external cylinder or slide unit and spline shaft, thus allowing you to select the free combination and to order any products, for any volume and at any necessary time.

Requirements of ;

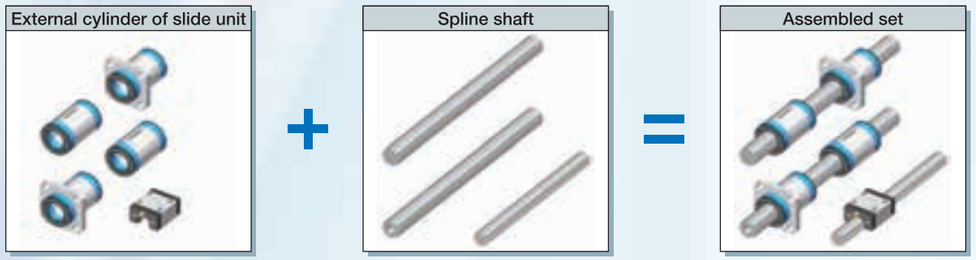
- Wish to improve the rigidity and life of machines
- Wish to improve the accuracy of machines
- Wish to replace the external cylinders or slide units immediately
- The number of external cylinders or slide units is in short
- Wish to replace the spline shaft immediately
- The length of spline shaft is not sufficient
- Wish to store only the external cylinders or slide units in stock for emergency

Interchangeable specification realizes ;

- Wish to prepare for a sudden design change
- Wish to select freely the combination of high accuracy and preload
- Independent handling of external cylinders or slide units and spline shafts
- Free and independent combination of external cylinders or slide units and spline shafts
- Compactness - independent storing of external cylinders or slide units and spline shafts

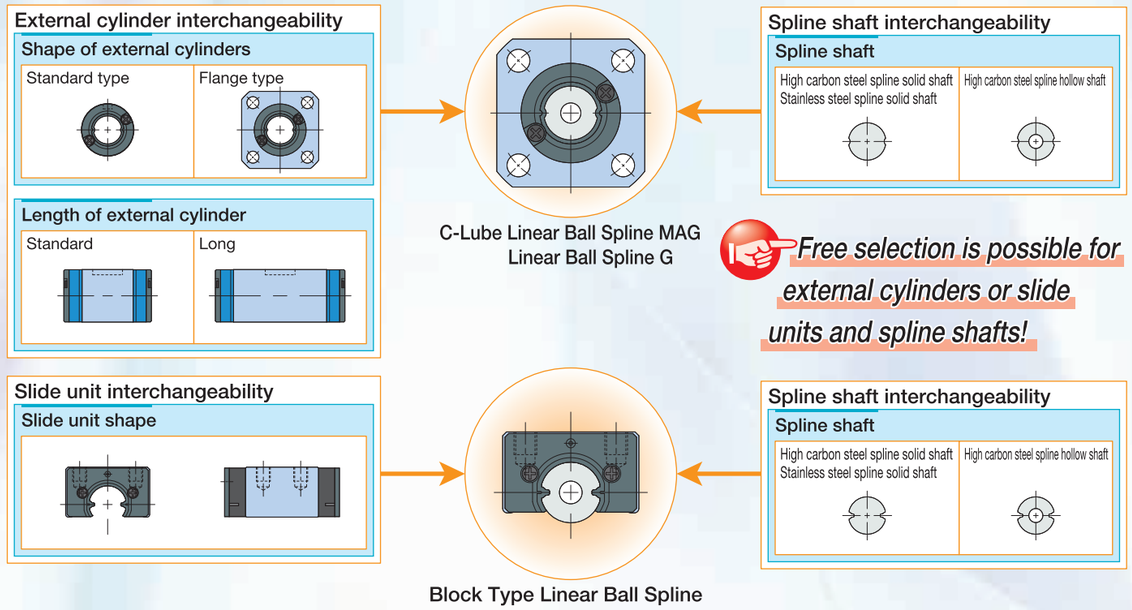
Select the products as many as you wish.

External cylinder of slide unit + Spline shaft = Assembled set



External cylinder interchangeability / unit interchangeability

A wide variety of models with different sectional shape and length are provided, for free replacement on the same spline shaft.



Free selection is possible for external cylinders or slide units and spline shafts!

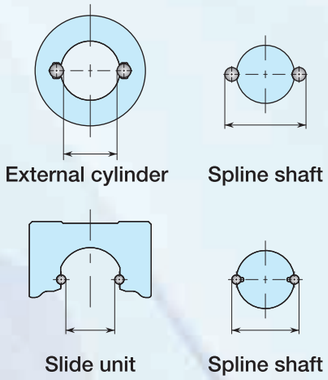
Accuracy interchangeability

The simple structure of four-contact in two-row raceway yields small manufacturing errors or accuracy measurement errors, allowing the maintenance of each raceway in the high dimensions accuracy.
Two accuracy classes of ordinary and high level are provided, to support even high traveling accuracy purposes.

It allows the accuracy improvement of units without design changes!

Preload interchangeability

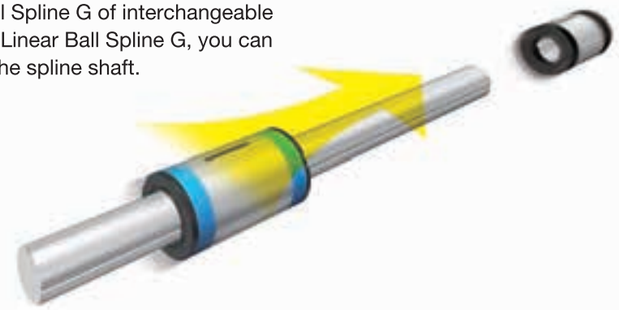
The high accuracy dimensions management utilizing the simple structure achieved the interchangeability of preloaded external cylinders and slide units.
It supports the applications requiring the rigidity of one higher rank.



It allows the rigidity improvement of units without design changes!

Maintenance free is achieved only by replacing the external cylinder!

By exchanging the external cylinder of Linear Ball Spline G of interchangeable specification with an external cylinder of C-Lube Linear Ball Spline G, you can achieve the maintenance free without changing the spline shaft.



C-Lube Linear Ball Spline MAG

MAG

C-Lube Maintenance-free

Long term maintenance free supported!

Linear Ball Spline G

LSAG

Points

Compact size

1

Uses a unique ball retaining mechanism without using a retainer, allowing a small external cylinder outside diameter against shaft diameter.

Extremely small size realized by simple structure

2

The minimum size LSAG2 realizes an unparalleled small size of 2 mm shaft diameter and 6 mm external cylinder's outside diameter.

Wide range of variations for your needs

3

The external cylinder shape can be selected from two types, the standard (cylindrical shape) type and the flange type, and there are two types with different length of external cylinder with same section.
Also for spline shaft, the solid shaft and the hollow shaft that allows piping/wiring/air removal are prepared for your selection to meet the requirements of mechanical/unit specifications.

Stainless steel shaft with high corrosion resistance

2

The spline shafts made of stainless steel are highly corrosion-resistant. They are suitable where rust prevention oil is not preferred, such as in a cleanroom environment.

Identification Number and Specification

Example of an identification number

The specifications of MAG and LSAG series are indicated by the identification number. Indicate the identification number, consisting of a model code, dimensions, a part code, a preload symbol, a classification symbol, an interchangeable code, and any supplemental codes for each specification to apply.

	1	2	3	4	5	6	7	8	9	10
Non-interchangeable specification										
Assembled set	MAG	L	T	5	C1	R150	T_1	H		/N
Interchangeable specification										
Single external cylinder	MAG	L		5	C1		T_1	H	S1	/N
Single spline shaft (1)	LSAG		T	5		R150		H	S1	
Assembled set	MAG	L	T	5	C1	R150	T_1	H	S1	/N

1 **Model**

2 **External cylinder length** — Model code Page Ⅱ－109

3 **Spline shaft shape**

4 **Size** — Dimensions Page Ⅱ－109

5 **Number of external cylinders** — Part code Page Ⅱ－109

6 **Spline shaft length**

7 **Preload amount** — Preload symbol Page Ⅱ－111

8 **Accuracy class** — Classification symbol Page Ⅱ－112

9 **Interchangeable** — Interchangeable code Page Ⅱ－115

10 **Special specification** — Supplemental code Page Ⅱ－115

Note (1) Indicate "LSAG" (solid shaft) or "LSAGT" (hollow shaft) for the model code of the single spline shaft regardless of the series and the combination of external cylinder models.

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

Identification Number and Specification —Model · External Cylinder Length ·

1 Model

C-Lube Linear Ball Spline MAG (MAG series)	Standard type	: MAG
	Flange type	: MAGF
Linear Ball Spline G (1) (LSAG series)	Standard type	: LSAG
	Flange type	: LSAGF

For applicable models and sizes, see Table 1.
Indicate "LSAG" (solid shaft) or "LSAGT" (hollow shaft) for the model code of the single spline shaft regardless of the series and the combination of external cylinder models.

Note (1) This model has no built-in C-Lube.

2 External cylinder length

Standard	: No symbol	For applicable models and sizes, see Table 1.
Long	: L	

3 Spline shaft shape

Solid shaft	: No symbol	For applicable models and sizes, see Table 1.
Hollow shaft	: T	

4 Size

2, 3, 4, 5, 6, 8, 10, 12, 15
20, 25, 30

For applicable models and sizes, see Table 1.

5 Number of external cylinders

: C○

For an assembled set, indicates the number of external cylinders assembled on a spline shaft. For a single external cylinder, only "C1" is specified.

6 Spline shaft length

: R○

The spline shaft length is indicated in mm.
For standard and maximum lengths, see the dimension table.

Spline Shaft Shape · Size · Number of External Cylinders · Spline Shaft Length—

Table 1 Models and sizes of MAG and LSAG series

Shape	External cylinder length	Model	Size 2	3	4	5	6	8	10	12	15	20	25	30
Standard type Solid shaft	Standard	MAG	–	–	○	○	○	○	○	○	–	–	–	–
		LSAG	○	○	○	○	○	○	○	○	○	○	○	○
	Long	MAGL	–	–	○	○	○	○	–	–	–	–	–	–
		LSAGL	–	–	–	○	○	○	○	○	○	○	○	○
Standard type Hollow shaft	Standard	MAGT	–	–	○	○	○	○	○	○	–	–	–	–
		LSAGT	–	–	○	○	○	○	○	○	–	–	–	–
	Long	MAGLT	–	–	○	○	○	○	–	–	–	–	–	–
		LSAGLT	–	–	–	○	○	○	○	○	–	–	–	–
Flange type Solid shaft	Standard	MAGF	–	–	–	○	○	○	○	○	–	–	–	–
		LSAGF	○	○	○	○	○	○	○	○	○	○	○	○
	Long	LSAGFL	–	–	–	○	○	○	○	○	○	○	○	○
Flange type Hollow shaft	Standard	MAGFT	–	–	–	○	○	○	○	○	–	–	–	–
		LSAGFT	–	–	○	○	○	○	○	○	–	–	–	–
	Long	LSAGFLT	–	–	–	○	○	○	○	○	–	–	–	–

Remark: For the models indicated in ▭, the interchangeable specification is available.

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

—Preload Amount—

7 Preload amount

Clearance Standard	: T_0	Specify this item for an assembled set or a single external cylinder.
Light preload	: No symbol	For details of the preload amount, see Table 2.
	: T_1	For applicable preload types, see Table 3.

Table 2 Preload amount

Item / Preload type	Preload symbol	Preload amount N	Operational conditions
Clearance	T_0	0 (1)	· Very light motion
Standard	(No symbol)	0 (2)	· Light and precise motion
Light preload	T_1	0.02 C_0	· Almost no vibrations · Load is evenly balanced · Light and precise motion

Notes (1) There is zero or subtle clearance.
(2) Indicates zero or minimal amount of preload.
Remark: C_0 indicates the basic static load rating.

Table 3 Application of preload

Size	Preload type (preload symbol)		
	Clearance (T_0)	Standard (No symbol)	Light preload (T_1)
2	○	○	–
3	○	○	–
4	○	○	–
5	–	○	○
6	–	○	○
8	–	○	○
10	–	○	○
12	–	○	○
15	–	○	○
20	–	○	○
25	–	○	○
30	–	○	○

Remark: The mark ▭ indicates that interchangeable specifications products are available.

—Accuracy Class—

8 Accuracy class

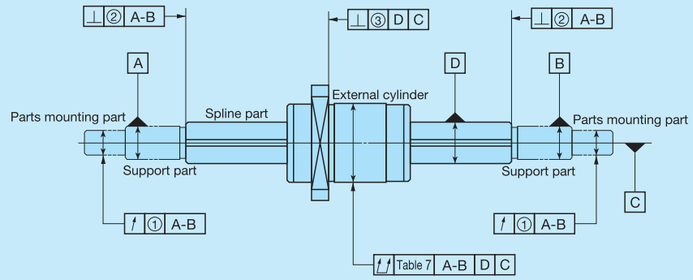
Ordinary	: No symbol	For interchangeable specification products, assemble an external cylinder and a spline shaft of the same accuracy class.
High	: H	For applicable accuracy class, see Table 4.
Precision	: P	For details of accuracy class, see Table 5, Table 6, and Table 7.

Table 4 Application of accuracy class

Size	Class (classification symbol)		
	Ordinary (No symbol)	High (H)	Precision (P)
2	○	○	○
3	○	○	○
4	○	○	○
5	○	○	○
6	○	○	○
8	○	○	○
10	○	○	○
12	○	○	○
15	○	○	○
20	○	○	○
25	○	○	○
30	○	○	○

Remark: The mark ▭ indicates that interchangeable specifications products are available.

Table 5 Tolerance of each part



unit: μm

Size	Relative to axial line of supporting part of spline shaft						③ Perpendicularity of mounting surface of flange with respect to axial line of spline shaft (2)		
	① Radial runout of periphery of parts mounting part (1)			② Perpendicularity of spline part end face (1)					
	Ordinary (No symbol)	High (H)	Precision (P)	Ordinary (No symbol)	High (H)	Precision (P)	Ordinary (No symbol)	High (H)	Precision (P)
2	33	14	8	22	9	6	27	11	8
3	33	14	8	22	9	6	27	11	8
4	33	14	8	22	9	6	27	11	8
5	33	14	8	22	9	6	27	11	8
6	33	14	8	22	9	6	27	11	8
8	33	14	8	22	9	6	27	11	8
10	41	17	10	22	9	6	33	13	9
12	41	17	10	22	9	6	33	13	9
15	46	19	12	27	11	8	33	13	9
20	46	19	12	27	11	8	33	13	9
25	53	22	13	33	13	9	39	16	11
30	53	22	13	33	13	9	39	16	11

Notes (1) The values are for the processed shaft ends.
(2) Applicable to the flange type.

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

***Table 6** Twist of grooves with respect to effective length of the spline part*

unit: μm

Accuracy class	Ordinary (No symbol)	High (H)	Precision (P)
Allowable value	33	13	6

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

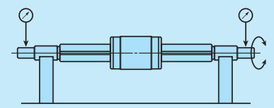
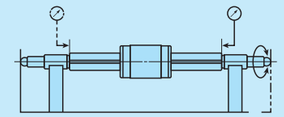
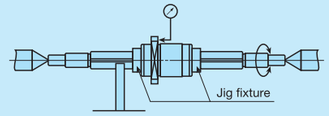
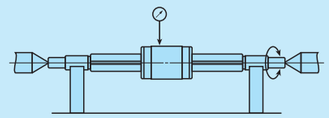
Table 7 Allowable values of total radial runout of spline shaft axial line

unit: μm

Overall length of spline shaft mm		Size and accuracy class								
		Size								
		2, 3, 4, 5, 6, 8			10, 12			15, 20		
		Ordinary (No symbol)	High (H)	Precision (P)	Ordinary (No symbol)	High (H)	Precision (P)	Ordinary (No symbol)	High (H)	Precision (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		Size and accuracy class		
		Size		
		25, 30		
		Ordinary (No symbol)	High (H)	Precision (P)
–	200	53	32	18
200	315	58	39	21
315	400	70	44	25
400	500	78	50	29
500	630	88	57	34
630	800	103	68	42
800	1 000	124	83	52
1 000	1 250	151	102	65

Table 8 Measuring methods of accuracy

Item	Measuring method	Illustration of measuring method
(1) Radial runout of periphery of parts mounting part with respect to axial line of supporting part of spline shaft (see Table 5 ①)	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.	
(1) Perpendicularity of spline part end face with respect to axial line of supporting part of spline shaft (See Table 5 ②)	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.	
Perpendicularity of mounting surface of flange with respect to axial line of spline shaft (see Table 5 ③)	While supporting the spline shaft at both centers and the outer peripheral faces of the spline shaft near the external cylinder and fixing the external cylinder on the spline shaft, place the dial gage probe on the flange mounting surface 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 6)	While supporting the spline shaft fixed, apply a unidirectional torsion moment load to the external cylinder (or 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 7)	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 (or measuring unit) and measure the deflection from one rotation of the spline shaft at several positions in the axial direction to obtain the maximum value.	

Note (1) The accuracy are for the processed shaft ends.

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

9 Interchangeable

S1 specification	: S1	This is specified for the interchangeable specifications. Assemble a spline shaft and an external cylinder with the same interchangeable code. Performance and accuracy of "S1" and "S2" are the same. For applicable models and sizes, see Table 1. "No symbol" is indicated for non-interchangeable specification.
S2 specification	: S2	
Non-interchangeable specification	: No symbol	

10 Special specification

/BS, /N, /OH, /Q, /RE, /S, /Y

For applicable special specifications, see Table 9.1 and Table 9.2.
For combination of multiple special specifications, see Table 10.
For details of special specifications, see pages Ⅱ-116 and Ⅱ-117.

Table 9.1 Application of special specifications (Interchangeable specification, single external cylinder, and assembled set)

Special specification	Supplemental code	Size											
		2	3	4	5	6	8	10	12	15	20	25	30
No seal	/N	–	–	–	○	○	○	○	○	○	○	○	○
Oil hole (1)	/OH	–	–	–	○	○	○	○	○	○	○	○	○
With C-Lube plate (1)	/Q	–	–	–	○	○	○	○	○	–	–	–	–

Note (1) Applicable to LSAG series.

Table 9.2 Application of special specifications (Non-interchangeable specification)

Special specification	Supplemental code	Size											
		2	3	4	5	6	8	10	12	15	20	25	30
Stainless steel end plate (1)	/BS	–	–	–	○	○	○	○	○	○	–	–	–
No seal	/N	–	–	–	○	○	○	○	○	○	○	○	○
Oil hole (1)	/OH	–	○	○	○	○	○	○	○	○	○	○	○
With C-Lube plate (1)	/Q	–	–	–	○	○	○	○	○	–	–	–	–
Special environment seal (1)	/RE	–	–	–	○	○	○	○	○	○	–	–	–
Stainless steel spline shaft (2)	/S	–	–	–	○	○	○	○	○	○	○	○	○
Specified grease (1)	/Y	–	–	–	○	○	○	○	○	○	–	–	–

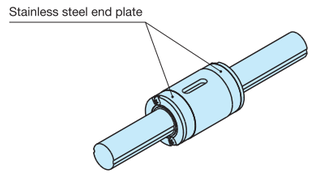
Notes (1) Applicable to LSAG series.
(2) Applicable to solid shaft.

Table 10 Combination of supplemental codes

N	●					
OH	●	○				
Q	●	○	○			
RE	●	–	●	●		
S	●	●	●	●	●	
Y	●	●	●	–	●	●
	BS	N	OH	Q	RE	S

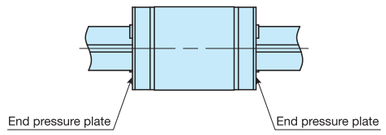
Remarks 1. The combination of "-" shown in the table is not available.
2. Contact IKO for the combination of the interchangeable specification marked with ●.
3. When using multiple types for combination, please indicate by arranging the symbols in alphabetical order.

Stainless steel end plate /BS



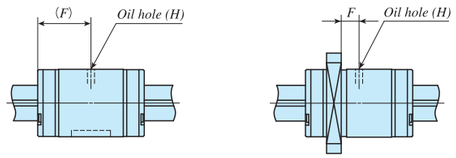
The standard synthetic resin end plates are replaced with stainless steel end plates. The total length of the external cylinder remains unchanged.

No seal /N



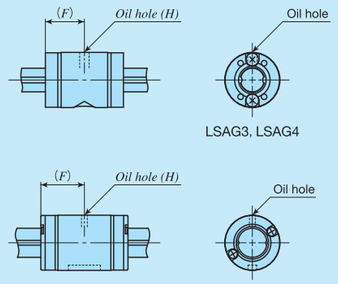
Seals at both ends of the external cylinder can be replaced with end pressure plates, which do not come in contact with the spline shaft, to reduce frictional resistance.
This specification is not effective for dust protection.

Oil hole /OH



An oil hole is created on the external cylinder. For dimensions, see Table 11.1 and Table 11.2.

Table 11.1 Location and diameter of oil hole on a standard type external cylinder (Supplemental code /OH)

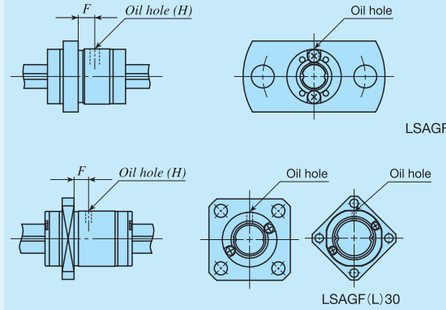


unit: mm

Identification number	F	H	Identification 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		LSAGL 8	18.5	
LSAG10	15	2	LSAGL10	23.5	2
LSAG12	17.5		LSAGL12	27	
LSAG15	20		LSAGL15	32.5	
LSAG20	25	3	LSAGL20	35.5	3
LSAG25	30		LSAGL25	42	
LSAG30	35		LSAGL30	49	

Remark: A typical identification number is indicated, but is applied to all LSAG series standard type models of the same size.

Table 11.2 Location and diameter of oil hole on a flange type external cylinder (Supplemental code /OH)



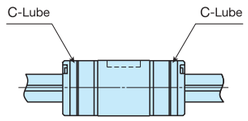
unit: mm

Identification number	F	H	Identification number	F	H
LSAGF 3	2.1	1.2	–	–	–
LSAGF 4	2.8	1.5	–	–	–
LSAGF 5			LSAGFL 5	5.8	1.5
LSAGF 6	3.5		LSAGFL 6	8	
LSAGF 8			LSAGFL 8	9.5	
LSAGF10	5	2	LSAGFL10	13.3	2
LSAGF12	7.5		LSAGFL12	17	
LSAGF15	9		LSAGFL15	21.5	
LSAGF20	11	3	LSAGFL20	21.5	3
LSAGF25	13		LSAGFL25	25	
LSAGF30	14		LSAGFL30	28	

Remark: A typical identification number is indicated, but is applied to all LSAG series flange type models of the same size.

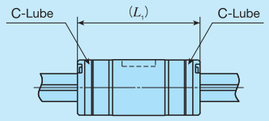
1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

With C-Lube plate /Q



The C-Lube impregnated with lubrication oil is attached inside the seal of the external cylinder, so that the interval for reapplicating lubricant can be extended. For the total length of the external cylinder with C-Lube plate, see Table 12.

Table 12 Dimension of external cylinder with C-Lube plate (Supplemental code /Q)

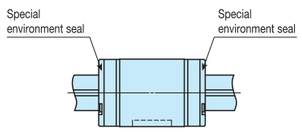


unit: mm

Identification number	L_1	Identification number	L_1
LSAG 5	24	LSAGL 5	32
LSAG 6	27	LSAGL 6	36
LSAG 8	33	LSAGL 8	45
LSAG10	38	LSAGL10	55
LSAG12	43	LSAGL12	62

Remarks 1. The dimensions of the external cylinder with C-Lube at both ends are indicated.
2. A typical identification number is indicated, but is applied to all LSAG series models of the same size.

Special environment seal /RE



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

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.

Specified grease /YCG /YCL /YAF /YBR /YNG

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

① /YCG Low Dust-Generation Grease for Clean Environment CG2 is pre-packed.
② /YCL Low Dust-Generation Grease for Clean Environment CGL is pre-packed.
③ /YAF Anti-Fretting Corrosion Grease AF2 is pre-packed.
④ /YBR MOLYCOTE BR2 Plus Grease [Dow Corning] is pre-packed.
⑤ /YNG No grease is pre-packed.

Spline shaft strength

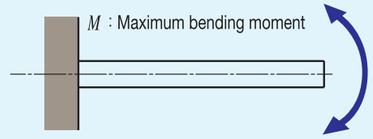
IKO Linear Ball Spline spline shafts can receive loads in all directions. Therefore, attention must be paid to spline shaft strength.

For bending load

For bending load on the spline shaft, select a shaft diameter that fulfills the conditions in formula (1).

$$M=\sigma \times Z \quad \cdots\cdots (1)$$

M : Maximum bending moment acting on spline shaft N·mm
σ : Spline shaft allowable bending stress 98 N/mm^2
Z : Section modulus of spline shaft mm^3 (See Table 13)

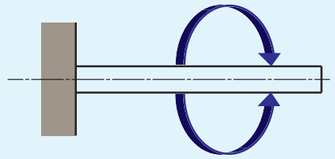


For torsion load

For torsion load on the spline shaft, select a shaft diameter that fulfills the conditions in formula (2).

$$T=\tau a \times Zp \quad \cdots\cdots (2)$$

T : Maximum torsion moment N·mm
τa : Spline shaft allowable torsion stress 49 N/mm^2
Zp : Polar section modulus of spline shaft mm^3 (See Table 13)



For simultaneous torsion and bending load

For simultaneous torsion and bending load on the spline shaft, calculate the shaft diameters from the equivalent bending moment formula (3) and the equivalent torsion moment formula (4) and use the larger value.

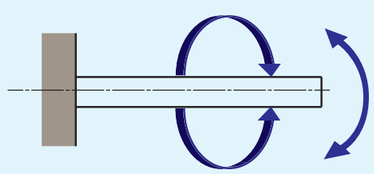
T : Maximum torsion moment

Equivalent bending moment Me

$$Me=\frac{1}{2}(M+\sqrt{M^2+T^2}) \quad \cdots\cdots (3)$$
$$Me=\sigma \times Z$$

Equivalent torsion moment Te

$$Te=\sqrt{M^2+T^2} \quad \cdots\cdots (4)$$
$$Te=\tau a \times Zp$$

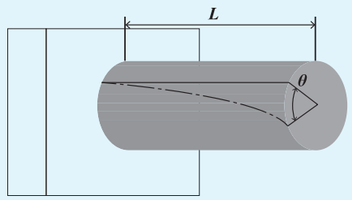


Stiffness of spline shaft

The torsion angle of the spline shaft caused by torsion moment must not exceed 0.25° per 1 meter.

$$\theta=\frac{T \times L}{G \times Ip}\times\frac{360}{2\pi} \quad \cdots\cdots (5)$$
$$0.25^\circ \geqq \frac{1000}{L}\theta$$

θ : Torsion angle °
L : Spline shaft length mm
G : Shear Modulus 7.9×10^4 N/mm^2
Ip : Polar moment of inertia of section area of spline shaft mm^4 (See Table 13)



1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

Spline shaft sectional characteristics

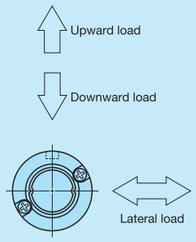
Table 13 Spline shaft sectional characteristics

Size	Moment of inertia of sectional area mm⁴		Section modulus : Z mm³		Polar moment of inertia of section area of spline shaft: I_P mm⁴		Polar section modulus : Z_P mm³	
	Solid shaft	Hollow shaft	Solid shaft	Hollow shaft	Solid shaft	Hollow shaft	Solid shaft	Hollow shaft
2	0.60	–	0.65	–	1.4	–	1.4	–
3	3.6	–	2.5	–	7.5	–	5.0	–
4	12	12	6.0	6.0	24	24	12	12
5	29	28	12	11	59	58	24	23
6	61	60	21	20	120	120	41	41
8	190	190	49	47	390	380	98	96
10	470	460	95	93	960	940	190	190
12	990	920	170	160	2 010	1 880	330	310
15	1 580	–	240	–	3 260	–	480	–
20	5 100	–	570	–	10 500	–	1 150	–
25	12 000	–	1 080	–	24 800	–	2 200	–
30	25 300	–	1 890	–	52 200	–	3 840	–

Load Direction and Load Rating

The MAG and LSAG series must be used with their 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 14.

Table 14 Load ratings corrected for load direction



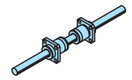
Load rating and load direction / Size	Basic dynamic load rating			Basic static load rating		
	Load direction			Load direction		
	Downward	Upward	Lateral	Downward	Upward	Lateral
2~12	C	C	1.47C	C_0	C_0	1.73C_0
15~30	C	C	1.13C	C_0	C_0	1.19C_0

Identification number and quantity for ordering

To order an assembled set of MAG and LSAG series, please specify the number of sets based on the number of spline shafts. For single external cylinder or single spline shaft of the interchangeable specification, please specify the number of units.

Non-interchangeable specification

Assembled set



(When 1 set is needed)

Example of identification number indication

MAGF 10 C2 R200 T1 H /N

Order quantity: 1 set

Interchangeable specification

Single external cylinder

(When 2 pieces are needed)

Example of identification number indication

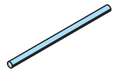
MAGF 10 C1 T1 H S○ /N

Please specify S1 or S2.

Only C1 can be specified.

Order quantity: 2 pieces

Single spline shaft



(When 1 unit is needed)

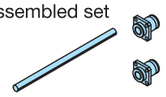
Example of identification number indication

LSAG 10 R200 H S○

Please specify S1 or S2.

Order quantity: 1 unit

Assembled set



(When 1 set is needed)

Example of identification number indication

MAGF 10 C2 R200 T1 H S○ /N

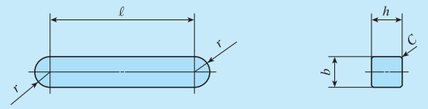
Please specify S1 or S2.

Order quantity: 1 set

Dimensions of Attached Key

The MAG and LSAG series standard types have keys shown in Table 15 attached.

Table 15 Dimensions and tolerance of attached key



unit: mm

Size	b	Dim. b tolerance	h	Dim. h tolerance	ℓ	r	C
5	2	+0.016 +0.006	2	0 −0.025	3.8	1	0.16~0.25
6					5.8		
8	2.5		2.5			1.25	
10	3		3		7.8	1.5	
12					11.8		
15	3.5	+0.024 +0.012	3.5	0 −0.030	16	1.75	
20	4		4		21.5	2	
25	5		5		23.5	2.5	0.25~0.4
30	7	+0.030 +0.015	7	0 −0.036	27.5	3.5	

Remark: No key is attached to the Size 2, 3, and 4 series. For details of how to fix the key, see page Ⅱ-121.

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

Lubrication

Lithium-soap base grease with extreme-pressure additive (Alvania EP Grease 2 [SHOWA SHELL SEKIYU K. K.]) is pre-packed in MAG and LSAG series. Additionally, MAG series has C-Lube placed in the recirculation part of balls, so that the interval for reapplicating lubricant can be extended and maintenance works such as grease job can be reduced significantly.
Perform re-greasing as below.
(1) Size 2, 3, and 4 series
Specify either direct application of grease to the spline shaft raceway surface or oil hole specification (/OH). Note that the oil hole specification (/OH) is not available for the Size 2 series.
(2) Size 5 and higher series
Apply grease directly to the spline shaft raceway surface or the rolling elements. You may also specify the oil hole specification (/OH).

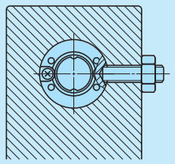
Dust Protection

The external cylinders of MAG and LSAG series are equipped with special rubber seals as standard for dust protection. However, if large amount of contaminant or dust are floating, or if large particles of foreign substances such as chips or sand may adhere to the spline shaft, it is recommended to attach a protective cover to the linear motion mechanism.
The Size 2, 3, and 4 series are not provided with seals. If the Size 3 and 4 series with seals is needed, contact IKO.

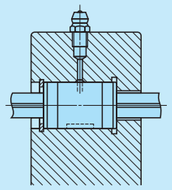
Precaution for Use

❶Fitting 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.

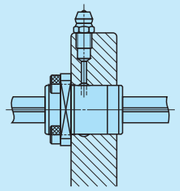
❷ Typical mounting structure
Mounting examples of the external cylinder are shown in Fig. 1.
The rotation detent for external cylinders of the Size 2, 3, and 4 series should be mounted using the countersink provided on the external cylinder. Use screws M1.2 to M1.6 for Size 2, M1.6 to M2 for Size 3, and M2 to M2.5 for Size 4. At this point, be careful not to deform the external cylinder with screws.



Rotation detent for external cylinder for size 2, 3 and 4



Mounting example for standard type
(Oil hole /OH specification)



Mounting example for flange type
(Oil hole /OH specification)

Fig. 1 Mounting examples of external cylinder

❸ Multiple external cylinders used in close proximity
When using multiple external cylinders in close proximity, greater load may be applied than the calculated value depending on the accuracy of the mounting surfaces and reference mounting surfaces of the machine or device. In such cases, allowance for greater applied load than the calculated value should be made.
If two or more external cylinders are assembled on a spline shaft and two or more keys are used to fix the rotational direction of the external cylinder, the keyway position of the external cylinders are aligned before delivery. Please contact IKO.

❹ 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.

❺ Operating temperature
MAG Series contains C-Lube. The operating temperature should not exceed 80˚C. The maximum operating temperature for LSAG series is 120˚C and temperature up to 100˚C is allowed for continuous operation. When the temperature exceeds 100˚C, contact IKO.
When specifying LSAG series special specification with C-Lube plate (supplemental code /Q), utilize it below 80˚C.

❻ Arrangement of flange type (non-interchangeable specification) external cylinder
Table 16 shows arrangements of multiple flange type external cylinders in non-interchangeable specification. Arrangements that are not in Table 16 can be prepared upon request. Contact IKO for further information.

Table 16 Arrangement of flange type (Non-interchangeable specification) external cylinder

Number of external cylinders	Arrangement of external cylinders
1	
2	
3	
4	
5	
6	

❼ When mounting multiple assembled sets at the same time
For interchangeable specification products, assemble an external cylinder and a spline shaft with the same interchangeable code ("S1" or "S2").
For non-interchangeable specification products, use the same combination of external cylinder and spline shaft upon delivery.

❽ 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 damaging of seals or dropping of steel balls.
The non-interchangeable specification products are already adjusted so as to provide the best accuracy when the IKO marks of the external cylinder and the spline shaft face the same direction (see Fig. 2). Be careful not to change the assembly direction.

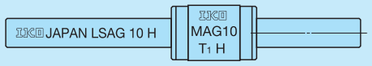


Fig. 2 Assembly direction of external cylinder

❾ 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.)

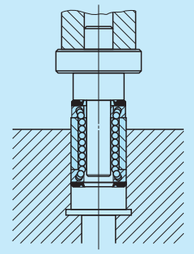


Fig. 3 Press-fitting of external cylinder

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

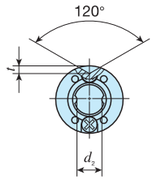
IKO C-Lube Linear Ball Spline MAG

Standard type

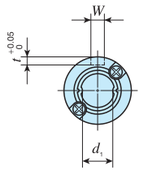
Shape: **MAG · LSAG**

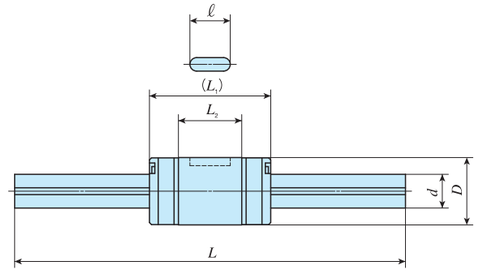
Size	2	3	4	5	6	8
	10	12	15	20	25	30

MAG(L)T
Hollow shaft dimension for LSAG(L)T



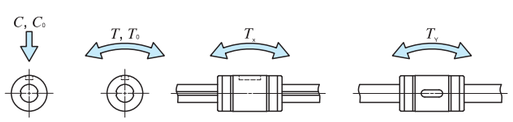
MAG(L)(T) 4
LSAG 2
LSAG 3
LSAG(T) 4





Identification number: MAG series	Identification number: LSAG series (No C-Lube)	Interchangeable	Mass (Ref.) g: External cylinder	Mass (Ref.) g: Spline shaft (per 100 mm)	External cylinder dimensions and tolerances mm: D	Dim. D tolerance	L_1	L_2	W	Dim. W tolerance	t	ℓ	d	Spline shaft dimensions and tolerances mm: Dim. d tolerance	d_1 (2)	d_2	L (3)	Maximum length	Basic dynamic load rating (4) C N	Basic static load rating (4) C_0 N	Dynamic torque rating (4) T N · m	Static torque rating (4) T_0 N · m	Static moment rating (4) T_X N · m	Static moment rating (4) T_Y N · m
–	LSAG 2 (1)	–	1.0	2.3	6	0 -0.008	8.5	4.7	–	–	0.7	–	2	0 -0.010	1.2	–	50 100	100	222	237	0.28	0.30	0.22 1.4	0.39 2.4
–	LSAG 3 (1)	–	2.1	5.4	7	0 -0.009	10	5.9	–	–	0.8	–	3	0 -0.010	2.2	–	100 150	150	251	285	0.45	0.51	0.31 1.9	0.53 3.3
MAG 4 (1)		–	2.5	9.6	8	0 -0.009	15	7.9	–	–	1	–	4	0 -0.012	3.2	–	100 150	200	303	380	0.70	0.87	0.52 3.80	0.90 6.50
	LSAG 4 (1)	–					12																0.52 2.9	0.90 5.0
MAGT 4 (1)		–		8.2			15									1.5		150					0.52 3.80	0.90 6.50
	LSAGT 4 (1)	–					12																0.52 2.9	0.90 5.0
MAGL 4 (1)	–	–	4.1	9.6			21	13.9								–		200	441	665	1.00	1.50	1.50 8.60	2.60 15.0
MAGLT 4 (1)	–	–		8.2												1.5		150						
MAG 5	LSAG 5	○	4.8	14.9	10	0 -0.009	18	9.4	2	+0.014 0	1.2	6	5	0 -0.012	4.2	–	100 150	200	587	641	1.8	1.9	1.0 7.9	1.8 13.6
MAGT 5	LSAGT 5	○		12.4												2								
MAGL 5	LSAGL 5	○	8.1	14.9			26	16.9								–			879	1 180	2.6	3.5	3.2 19.3	5.5 33.4
MAGLT 5	LSAGLT 5	○		12.4												2								
MAG 6	LSAG 6	○	8.9	19	12	0 -0.011	21	12.4	2	+0.014 0	1.2	8	6	0 -0.012	5.2	–	150 200	300	711	855	2.5	3.0	1.7 11.7	3.0 20.3
MAGT 6	LSAGT 6	○		16.5												2								
MAGL 6	LSAGL 6	○	14.5	19			30	21.4								–			1 030	1 500	3.6	5.2	5.0 27.6	8.6 47.8
MAGLT 6	LSAGLT 6	○		16.5												2								
MAG 8	LSAG 8	○	15.9	39	15	0 -0.011	25	14.6	2.5	+0.014 0	1.5	8.5	8	0 -0.015	7	–	150 200 250	500	1 190	1 330	5.5	6.2	3.3 22.0	5.6 38.1
MAGT 8	LSAGT 8	○		33												3		400						
MAGL 8	LSAGL 8	○	26.5	39			37	26.6								–		500	1 800	2 470	8.4	11.5	10.3 56.3	17.8 97.5
MAGLT 8	LSAGLT 8	○		33												3		400						

Notes (1) No seal is included.
(2) d_1 represents the maximum diameter for end machining.
(3) 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.
(4) The direction of basic dynamic load rating (C), basic static load rating (C_0), dynamic torque rating (T), static torque rating and static moment rating (T_0, T_X, T_Y) are shown in the sketches below.
The upper values of T_X and T_Y are for one external cylinder and the lower values are for two external cylinders inclose contact.



Example of identification number of assembled set

Model code			Dimensions	Part code		Preload symbol	Classification symbol	Interchangeable code	Supplemental code
MAG	L	T	5	C2	R150	T1	H		/N
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩

① Model
MAG	Standard type
LSAG	

② Length of external cylinder
No symbol	Standard
L	Long

③ Spline shaft shape
No symbol	Solid shaft
T	Hollow shaft

④ Size
2, 3, 4, 5, 6, 8

⑤ Number of external cylinders (2)

⑥ Length of spline shaft (150 mm)

⑦ Preload amount
T0	Clearance
No symbol	Standard
T1	Light preload

⑧ Accuracy class
No symbol	Ordinary
H	High
P	Precision

⑨ Interchangeable
No symbol	Non-interchangeable specification
S1	S1 specification
S2	S2 specification

⑩ Special specification
BS, N, OH, Q, RE, S, Y

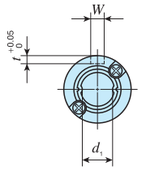
1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

IKO C-Lube Linear Ball Spline MAG

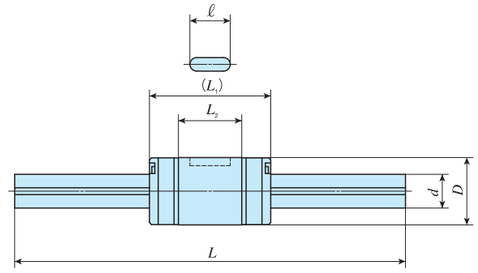
Standard type

Shape: **MAG · LSAG**

Size	2	3	4	5	6	8
	10	12	15	20	25	30

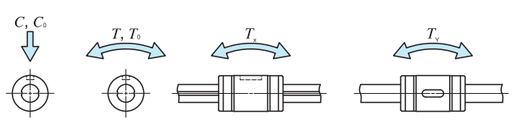


MAGT
Hollow shaft dimension for LSAG(L)T



Identification number		Interchangeable	Mass (Ref.) g		External cylinder dimensions and tolerances mm								Spline shaft dimensions and tolerances mm					Basic dynamic load rating (3)	Basic static load rating (3)	Dynamic torque rating (3)	Static torque rating (3)	Static moment rating (3)	
MAG series	LSAG series (No C-Lube)		External cylinder	Spline shaft (per 100 mm)	D	Dim. D tolerance	L_1	L_2	W	Dim. W tolerance	t	ℓ	d	Dim. d tolerance	d_1(1)	d_2	L(2)	Maximum length	C N	C_0 N	T N · m	T_0 N · m	T_X N · m	T_Y N · m
MAG 10	LSAG 10	○	31.5	60.5	19	0 -0.013	30	18.2	3	+0.014 0	1.8	11	10	0 -0.015	8.9	–	200 300	600	1 880	2 150	10.9	12.5	7.0 / 41.5	12.1 / 71.9
MAGT 10	LSAGT 10	○		51												4								
–	LSAGL 10	○	56.5	60.5			47	34.9								–			2 850	4 040	16.6	23.4	22.7 / 115	39.3 / 200
–	LSAGLT 10	○		51												4								
MAG 12	LSAG 12	○	44	87.5	21	0 -0.013	35	23	3	+0.014 0	1.8	15	12	0 -0.018	10.9	–	200 300 400	800	2 180	2 690	14.8	18.3	10.6 / 59.1	18.3 / 102
MAGT 12	LSAGT 12	○		66												6								
–	LSAGL 12	○	76.8	87.5			54	42								–			3 220	4 850	21.9	33.0	32.2 / 157	55.7 / 272
–	LSAGT 12	○		66												6								
–	LSAG 15	○	59.5	111	23	0 -0.013	40	27	3.5	+0.018 0	2	20	13.6	0 -0.018	11.6	–	200 300 400	1 000	4 180	6 070	31.3	45.6	27.8 / 152	33.2 / 181
–	LSAGL 15	○	110				65	52								–			6 400	11 500	48.0	86.5	94.0 / 449	112 / 535
–	LSAG 20	○	130	202	30	0 -0.016	50	33	4	+0.018 0	2.5	26	18.2	0 -0.021	15.7	–	300 400 500 600	1 000	6 600	9 040	66.0	90.4	48.6 / 288	58.0 / 343
–	LSAGL 20	○	198				71	54								–			9 270	15 100	92.7	151	127 / 650	151 / 774
–	LSAG 25	○	220	310	37	0 -0.016	60	39.2	5	+0.018 0	3	29	22.6	0 -0.021	19.4	–	300 400 500 600 800	1 200	11 200	14 300	139	178	92.8 / 551	111 / 656
–	LSAGL 25	○	336				84	63.2								–			15 400	23 200	193	290	229 / 1 190	273 / 1 420
–	LSAG 30	○	430	450	45	0 -0.016	70	43	7	+0.022 0	4	35	27.2	0 -0.021	23.5	–	400 500 600 700 1 100	1 200	15 400	19 400	231	292	147 / 874	176 / 1 040
–	LSAGL 30	○	634				98	71								–			21 300	31 600	320	474	364 / 1 900	434 / 2 260

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), dynamic torque rating (T), static torque rating and static moment rating (T_0, T_X, T_Y) are shown in the sketches below.
The upper values of T_X and T_Y are for one external cylinder and the lower values are for two external cylinders inclose contact.



Example of identification number of assembled set

Model code			Dimensions	Part code		Preload symbol	Classification symbol	Interchangeable code	Supplemental code
MAG		T	12	C2	R300	T1	H		/N
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩

① Model

MAG	Standard type
LSAG	

② Length of external cylinder

No symbol	Standard
L	Long

③ Spline shaft shape

No symbol	Solid shaft
T	Hollow shaft

④ Size

10, 12, 15, 20, 25, 30

⑤ Number of external cylinders (2)

⑥ Length of spline shaft (300 mm)

⑦ Preload amount

No symbol	Standard
T1	Light preload

⑧ Accuracy class

No symbol	Ordinary
H	High
P	Precision

⑨ Interchangeable

No symbol	Non-interchangeable specification
S1	S1 specification
S2	S2 specification

⑩ Special specification

BS, N, OH, Q, RE, S, Y

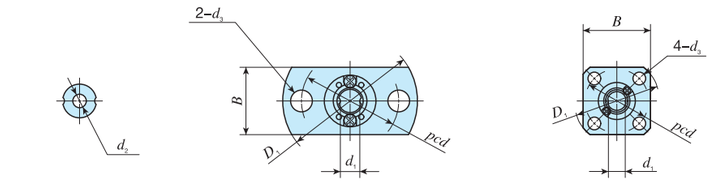
1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

IKO C-Lube Linear Ball Spline MAG

Flange type

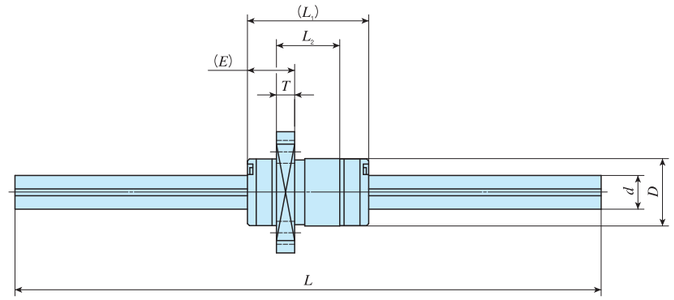
Shape: **MAGF · LSAGF**

Size	2	3	4	5	6	8
	10	12	15	20	25	30



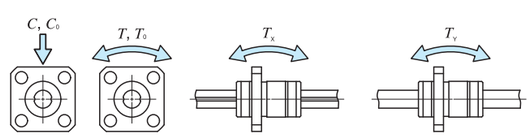
MAGFT
Hollow shaft dimension for LSAGF(L)T

LSAGF 2
LSAGF 3
LSAGF(T) 4



Identification number: MAG series	Identification number: LSAG series (No C-Lube)	Interchangeable	Mass (Ref.) g: External cylinder	Mass (Ref.) g: Spline shaft (per 100 mm)	External cylinder dimensions and tolerances mm: D	Dim. D tolerance	L_1	L_2	D_1	B	E	T	pcd	d_3	Spline shaft dimensions and tolerances mm: d	Dim. d tolerance	d_1(2)	d_2	L(3)	Maximum length	Basic dynamic load rating (4) C N	Basic static load rating (4) C_0 N	Dynamic torque rating (4) T N·m	Static torque rating (4) T_0 N·m	Static moment rating (4): T_X N·m	Static moment rating (4): T_Y N·m
–	LSAGF 2(1)	–	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	1.2	–	50 100	100	222	237	0.28	0.30	0.22 1.4	0.39 2.4
–	LSAGF 3(1)	–	3.7	5.4	7	0 -0.009	10	5.9	18	9	4	1.9	13	2.9	3	0 -0.010	2.2	–	100 150	150	251	285	0.45	0.51	0.31 1.9	0.53 3.3
–	LSAGF 4(1)	–	5.1	9.6	8	0 -0.009	12	7.9	21	10	4.6	2.5	15	3.4	4	0 -0.012	3.2	–	100 150	200	303	380	0.70	0.87	0.52 2.9	0.90 5.0
–	LSAGFT 4(1)	–		8.2														1.5		150						
MAGF 5	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	4.2	–	100 150	200	587	641	1.8	1.9	1.0 7.9	1.8 13.6
MAGFT 5	LSAGFT 5	○		12.4														2								
–	LSAGFL 5	○	12	14.9			26	16.9										–			879	1 180	2.6	3.5	3.2 19.3	5.5 33.4
–	LSAGFLT 5	○		12.4														2								
MAGF 6	LSAGF 6	○	13.9	19	12	0 -0.011	21	12.4	25	20	7	2.7	19	3.4	6	0 -0.012	5.2	–	150 200	300	711	855	2.5	3.0	1.7 11.7	3.0 20.3
MAGFT 6	LSAGFT 6	○		16.5														2								
–	LSAGFL 6	○	19.5	19			30	21.4										–			1 030	1 500	3.6	5.2	5.0 27.6	8.6 47.8
–	LSAGFLT 6	○		16.5														2								
MAGF 8	LSAGF 8	○	23.5	39	15	0 -0.011	25	14.6	28	22	9	3.8	22	3.4	8	0 -0.015	7	–	150 200 250	500	1 190	1 330	5.5	6.2	3.3 22.0	5.6 38.1
MAGFT 8	LSAGFT 8	○		33														3		400						
–	LSAGFL 8	○	34.1	39			37	26.6										–		500	1 800	2 470	8.4	11.5	10.3 56.3	17.8 97.5
–	LSAGFLT 8	○		33														3		400						

Notes (1) No seal is included.
(2) d_1 represents the maximum diameter for end machining.
(3) 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.
(4) The direction of basic dynamic load rating (C), basic static load rating (C_0), dynamic torque rating (T), static torque rating and static moment rating (T_0, T_X, T_Y) are shown in the sketches below.
The upper values of T_X and T_Y are for one external cylinder and the lower values are for two external cylinders inclose contact.



Example of identification number of assembled set

Model code			Dimensions	Part code		Preload symbol	Classification symbol	Interchangeable code	Supplemental code
MAGF	L	T	5	C2	R150	T1	H		/N
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩

① Model
MAGF	Flange type
LSAGF	

② Length of external cylinder
No symbol	Standard
L	Long

③ Spline shaft shape
No symbol	Solid shaft
T	Hollow shaft

④ Size
2, 3, 4, 5, 6, 8

⑤ Number of external cylinders (2)

⑥ Length of spline shaft (150 mm)

⑦ Preload amount
T_0	Clearance
No symbol	Standard
T_1	Light preload

⑧ Accuracy class
No symbol	Ordinary
H	High
P	Precision

⑨ Interchangeable
No symbol	Non-interchangeable specification
S1	S1 specification
S2	S2 specification

⑩ Special specification
BS, N, OH, Q, RE, S, Y

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

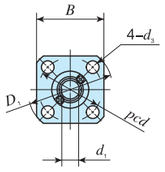
IKO C-Lube Linear Ball Spline MAG

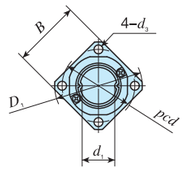
Flange type

Shape: **MAGF · LSAGF**

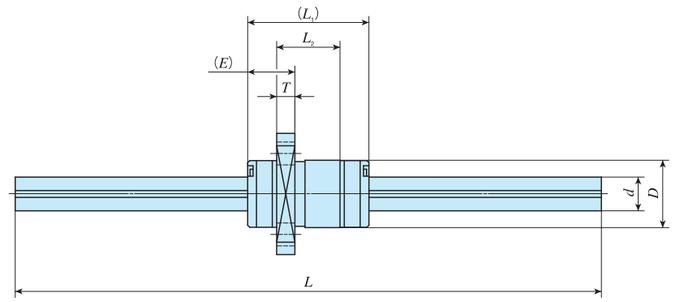
Size	2	3	4	5	6	8
	10	12	15	20	25	30

MAGFT
Hollow shaft dimension for LSAGF(L)T



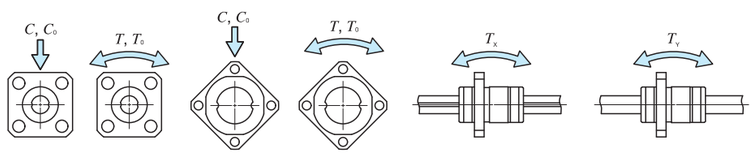


LSAGF(L) 30



Identification number		Interchangeable	Mass (Ref.) g		External cylinder dimensions and tolerances mm										Spline shaft dimensions and tolerances mm						Basic dynamic load rating (3)	Basic static load rating (3)	Dynamic torque rating (3)	Static torque rating (3)	Static moment rating (3)	
MAG series	LSAG series (No C-Lube)		External cylinder	Spline shaft (per 100 mm)	D	Dim. D tolerance	L_1	L_2	D_1	B	E	T	pcd	d_3	d	Dim. d tolerance	d_1(1)	d_2	L(2)	Maximum length	C N	C_0 N	T N · m	T_0 N · m	T_X N · m	T_Y N · m
MAGF 10	LSAGF 10	○	45	60.5	19	0 -0.013	30	18.2	36	28	10	4.1	28	4.5	10	0 -0.015	8.9	–	200 300	600	1 880	2 150	10.9	12.5	7.0 / 41.5	12.1 / 71.9
MAGFT 10	LSAGFT 10	○		51														4								
–	LSAGFL 10	○	70.1	60.5			47	34.9										–			2 850	4 040	16.6	23.4	22.7 / 115	39.3 / 200
–	LSAGFLT 10	○		51														4								
MAGF 12	LSAGF 12	○	59	87.5	21	0 -0.013	35	23	38	30	10	4	30	4.5	12	0 -0.018	10.9	–	200 300 400	800	2 180	2 690	14.8	18.3	10.6 / 59.1	18.3 / 102
MAGFT 12	LSAGFT 12	○		66														6								
–	LSAGFL 12	○	91.8	87.5			54	42										–			3 220	4 850	21.9	33.0	32.2 / 157	55.7 / 272
–	LSAGFLT 12	○		66														6								
–	LSAGF 15	○	77	111	23	0 -0.013	40	27	40	31	11	4.5	32	4.5	13.6	0 -0.018	11.6	–	200 300 400	1 000	4 180	6 070	31.3	45.6	27.8 / 152	33.2 / 181
–	LSAGFL 15	○	128				65	52										–			6 400	11 500	48.0	86.5	94.0 / 449	112 / 535
–	LSAGF 20	○	150	202	30	0 -0.016	50	33	46	35	14	5.5	38	4.5	18.2	0 -0.021	15.7	–	300 400 500 / 600	1 000	6 600	9 040	66.0	90.4	48.6 / 288	58.0 / 343
–	LSAGFL 20	○	218				71	54										–			9 270	15 100	92.7	151	127 / 650	151 / 774
–	LSAGF 25	○	255	310	37	0 -0.016	60	39.2	57	43	17	6.6	47	5.5	22.6	0 -0.021	19.4	–	300 400 500 / 600 800	1 200	11 200	14 300	139	178	92.8 / 551	111 / 656
–	LSAGFL 25	○	371				84	63.2										–			15 400	23 200	193	290	229 / 1 190	273 / 1 420
–	LSAGF 30	○	476	450	45	0 -0.016	70	43	65	50	21	7.5	54	6.6	27.2	0 -0.021	23.5	–	400 500 600 / 700 1 100	1 200	15 400	19 400	231	292	147 / 874	176 / 1 040
–	LSAGFL 30	○	680				98	71										–			21 300	31 600	320	474	364 / 1 900	434 / 2 260

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), dynamic torque rating (T), static torque rating and static moment rating (T_0, T_X, T_Y) are shown in the sketches below.
The upper values of T_X and T_Y are for one external cylinder and the lower values are for two external cylinders inclose contact.



LSAGF(L) 30

Example of identification number of assembled set

Model code			Dimensions	Part code		Preload symbol	Classification symbol	Interchangeable code	Supplemental code
MAGF	__	T	12	C2	R300	T1	H	__	/N
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩

① Model

MAGF	Flange type
LSAGF	

② Length of external cylinder

No symbol	Standard
L	Long

③ Spline shaft shape

No symbol	Solid shaft
T	Hollow shaft

④ Size: 10, 12, 15, 20, 25, 30

⑤ Number of external cylinders (2)

⑥ Length of spline shaft (300 mm)

⑦ Preload amount

No symbol	Standard
T1	Light preload

⑧ Accuracy class

No symbol	Ordinary
H	High
P	Precision

⑨ Interchangeable

No symbol	Non-interchangeable specification
S1	S1 specification
S2	S2 specification

⑩ Special specification: BS, N, OH, Q, RE, S, Y

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

Block Type Linear Ball Spline

LSB

Points

● Block type for easy mounting

1 The screw holes for mounting are provided on the slide unit, so that it can be easily mounted to the machine or device using bolts.

● Stainless steel selections for excellent corrosion resistance

2 Products made of stainless steel are highly resistance to corrosion, so that they are suitable for applications where rust prevention oil is not preferred, such as in a cleanroom environment.

Identification Number and Specification

Example of an identification number

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

Interchangeable specification	1	2	3	4	5	6	7	8	9	10
Single slide unit	LSB		10	C1		SL	T_1		S1	/U
Single spline shaft	LSB		10		R200	SL		H	S1	
Assembled set	LSB		10	C1	R200	SL	T_1	H	S1	/U

1 **Model** — Model code Page Ⅱ－133

2 **Spline shaft shape** — Model code Page Ⅱ－133

3 **Size** — Dimensions Page Ⅱ－133

4 **Number of slide units** — Part code Page Ⅱ－133

5 **Spline shaft length** — Part code Page Ⅱ－133

6 **Material type** — Material code Page Ⅱ－133

7 **Preload amount** — Preload symbol Page Ⅱ－134

8 **Accuracy class** — Classification symbol Page Ⅱ－134

9 **Interchangeable** — Interchangeable code Page Ⅱ－136

10 **Special specification** — Supplemental code Page Ⅱ－136

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

Identification Number and Specification —Model · Spline Shaft Shape · Size · Slide Unit · Number of Slide Unit · Spline Shaft Length · Material Type · Preload Amount · Accuracy Class—

1 Model

Block Type Linear Ball Spline (LSB series) : LSB

For applicable models and sizes, see Table 1.

2 Spline shaft shape

Solid shaft	: No symbol	For applicable models and sizes, see Table 1.
Hollow shaft	: T	

3 Size

6, 8, 10, 13, 16, 20, 25 — For applicable models and sizes, see Table 1.

4 Number of slide units

: C○

For an assembled set, indicates the number of slide units assembled on a spline shaft. For a single slide unit, only "C1" is specified.

5 Spline shaft length

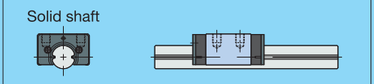
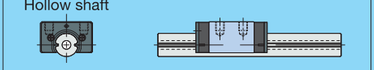
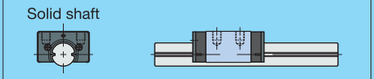
: R○

The spline shaft length is indicated in mm.
For standard and maximum lengths, see the dimension table.

6 Material type

High carbon steel made	: No symbol	For applicable models and sizes, see Table 1.
Stainless steel made	: SL	

Table 1 Models and sizes of LSB series

Material	Shape	Model	Size 6	8	10	13	16	20	25
High carbon steel made	Solid shaft 	LSB	○(1)	○(1)	○(1)	○	○	○	○
	Hollow shaft 	LSBT	○(1)	○(1)	○(1)	○	○	○	○
Stainless steel made	Solid shaft 	LSB···SL	○	○	○	–	–	–	–

Note (1) Slide units of size 6, 8, and 10 series are stainless steel-made only. When high carbon steel-made is specified for an assembled set, only the spline shaft will be high carbon steel-made.
Remark: The LSB series are all interchangeable specification. Non-interchangeable specification is not available.

7 Preload amount

Standard	: No symbol	Specify this item for an assembled set or a single slide unit.
Light preload	: T1	For details of the preload amount, see Table 2.
		For applicable preload types, see Table 3.

Table 2 Preload amount

Item / Preload type	Preload symbol	Preload amount N	Operational conditions
Standard	(No symbol)	0(1)	· Light and precise motion
Light preload	T_1	0.02 C_0	· Almost no vibrations · Load is evenly balanced · Light and precise motion

Note (1) Indicates zero or minimal amount of preload.
Remark: C_0 indicates the basic static load rating.

Table 3 Application of preload

Size	Preload type (preload symbol) Standard (No symbol)	Light preload (T_1)
6	○	–
8	○	○
10	○	○
13	○	○
16	○	○
20	○	○
25	○	○

8 Accuracy class

Ordinary	: No symbol	Specify this item for an assembled set or a single spline shaft.
High	: H	For details of accuracy class, see Fig. 1, Table 4 and Table 5.

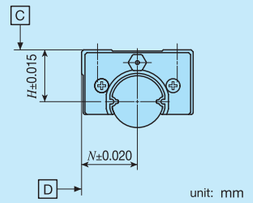


Fig. 1 Accuracy

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

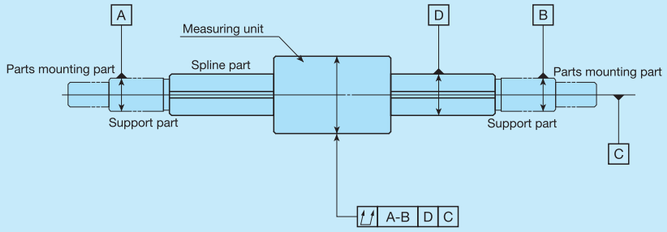
Table 4 Twist of grooves with respect to effective length of the spline part

unit: μm

Accuracy class	Ordinary (No symbol)	High (H)
Allowable value	33	13

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

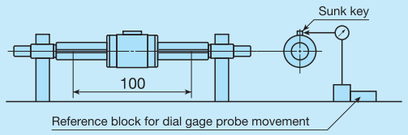
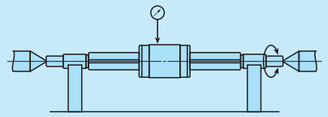


unit: μm

Overall length of spline shaft mm		Size 6, 8 Ordinary (No symbol)	6, 8 High (H)	10, 13 Ordinary (No symbol)	10, 13 High (H)	16, 20 Ordinary (No symbol)	16, 20 High (H)	25 Ordinary (No symbol)	25 High (H)
–	200	72	46	59	36	56	34	53	32
200	315	133	89	83	54	71	45	58	39
315	400	185	126	103	68	83	53	70	44
400	500	236	163	123	82	95	62	78	50
500	630	–	–	151	102	112	75	88	57
630	800	–	–	190	130	137	92	103	68
800	1 000	–	–	–	–	170	115	124	83
1 000	1 250	–	–	–	–	–	–	151	102

Remark: Applied to all models of the same size.

Table 6 Measuring methods of accuracy

Item	Measuring method	Illustration of measuring method
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 measuring unit and measure the deflection from one rotation of the spline shaft at several positions in the axial direction to obtain the maximum value.	

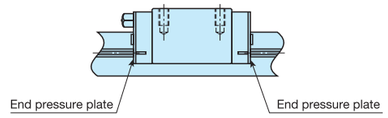
9 Interchangeable	S1 specification S2 specification	: S1 : S2	Assemble a spline shaft and a slide unit with the same interchangeable code. Performance and accuracy of "S1" and "S2" are the same.
10 Special specification	/N, /U		For applicable special specifications, see Table 7.

Table 7 Application of special specifications (Single slide unit and assembled set)

Special specification	Supplemental code	Size 6	8	10	13	16	20	25
No seal	/N	○	○	○	○	○	○	○
Under seal	/U	○	○	○	○	○	○	○

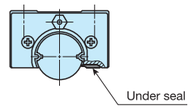
Remark: The combination of no seal (supplemental code/N) and under seal (supplemental code/U) is not available.

No seal /N



End seals at both ends of the slide unit can be replaced with end pressure plates, which do not come in contact with the spline shaft, to reduce frictional resistance.
This specification is not effective for dust protection.

Under seal /U



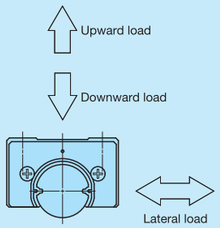
The seal is attached to the bottom of the slide unit to prevent foreign substances from entering from underneath.

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

Load Direction and Load Rating

The LSB 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 8.

Table 8 Load ratings corrected for load direction



Load rating and load direction / Size	Basic dynamic load rating			Basic static load rating		
	Load direction			Load direction		
	Downward	Upward	Lateral	Downward	Upward	Lateral
6~20	C	C	$0.84C$	C_0	C_0	$0.84C_0$
25	C	C	C	C_0	C_0	C_0

Identification Number and Quantity for Ordering

To order an assembled set of LSB series, please specify the number of sets based on the number of spline shafts. For slide unit or single spline shafts, please specify the number of units.

Single slide unit

(When 2 units are needed)

Example of identification number indication

LSB 13 C1 T1 S○ /U

Please specify S1 or S2.

Only C1 can be specified.

Order quantity: 2units

Single spline shaft

(When 1 unit is needed)

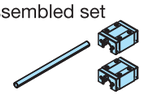
Example of identification number indication

LSB 13 R200 H S○

Please specify S1 or S2.

Order quantity: 1unit

Assembled set



(When 1 set is needed)

Example of identification number indication

LSB 13 C2 R200 T1 H S○ /U

Please specify S1 or S2.

Order quantity: 1set

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

Table 9 Moment of inertia of sectional area and section coefficient of spline shaft

Identification number	Moment of inertia of sectional area mm⁴		Section coefficient mm³	
	Solid shaft	Hollow shaft	Solid shaft	Hollow shaft
6	55	54	19	19
8	170	170	44	43
10	440	420	90	87
13	1 220	1 160	190	180
16	2 830	2 630	360	340
20	7 110	6 620	730	680
25	17 600	15 100	1 440	1 230

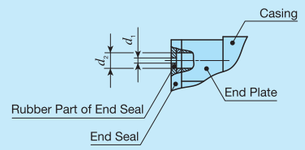
Lubrication

Lithium-soap base grease (MULTEMP PS No.2 [KYODO YUSHI CO., LTD.]) is pre-packed in LSB series.
The LSB series has grease nipple or oil hole as indicated in Table 10 and Table 11. For supply nozzle applicable to each grease nipple and dedicated supplying equipment (miniature greaser) applicable to oil holes, see Table 13 and Table 14.

Table 10 Parts for lubrication

Size	Grease nipple type	Applicable supply nozzle type
6, 8, 10	Oil hole	Miniature greaser
13, 16, 20	A-M3	A-5120V A-5240V B-5120V B-5240V
25	A-M4	

Table 11 Oil hole specifications



Size	d_1	d_2
6, 8	0.5	1.2
10		1.5

Table 12 Dimensions and shape of grease nipple

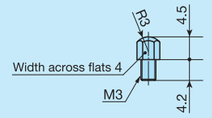
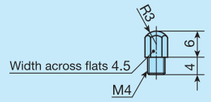
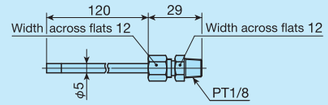
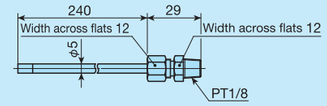
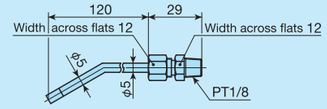
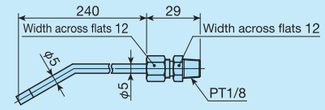
Model	Dimensions and shape
A-M3	
A-M4	

Table 13 Miniature greaser

Identification number	Grease name	Amount	Outside diameter of grease feed needle
MG10/MT2	MULTEMP PS No.2 [KYODO YUSHI CO., LTD.]	10ml	ϕ1mm
MG10/CG2	IKO Low Dust-Generation Grease for Clean Environment CG2		
MG2.5/EP2	Alvania EP Grease 2 [SHOWA SHELL SEKIYU K. K.]	2.5ml	
MG2.5/CG2	IKO Low Dust-Generation Grease for Clean Environment CG2		
MG2.5/CGL	IKO Low Dust-Generation Grease for Clean Environment CGL		
MG2.5/AF2	IKO Anti-Fretting Corrosion Grease AF2		

Table 14 Types and dimensions of supply nozzle

Model	Dimensions and shape
A-5120V	
A-5240V	
B-5120V	
B-5240V	

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

Dust Protection

The slide units of LSB series are equipped with end seals as standard for dust protection. However, if large amount of contaminant or dust are floating, or if large particles of foreign substances such as chips or sand may adhere to the spline shaft, it is recommended to attach a protective cover to the linear motion mechanism.

Precaution for Use

❶ Mounting surface, reference mounting surface and typical mounting structure

When mounting the LSB, properly align the reference mounting surface D of the slide unit with the reference mounting surface of the table and fix it. (See Fig. 2)
Outside diameter surface of the spline shaft, reference mounting surface D and mounting surface C are precisely ground. Machining the mounting surface of the table and bed, such as machine or device, to high accuracy and mounting them properly will ensure stable linear motion with high accuracy.
Reference mounting surface of the slide unit is the opposite side of the IKO mark. (See Fig. 3)

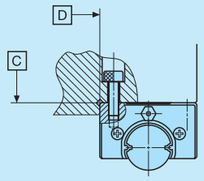


Fig. 2 Reference mounting surface and typical mounting structure

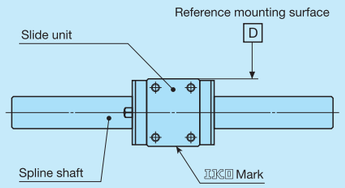


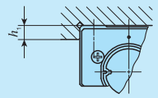
Fig. 3 Reference mounting surface

❷ Shoulder height of reference mounting surface

For the opposite corner of the mating reference mounting, it is recommended to have relieved fillet as indicated in Fig. 4. Recommended value for the shoulder height on the mating side is indicated in Table 15.

Fig. 4 Corner of the mating reference mounting

Table 15 Shoulder height



unit: mm

Size	Shoulder height
6	2
8	2.5
10	3
13	3.5
16	4
20	5
25	6

❸ 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.

❹ Multiple slide units used in close proximity

When using multiple slide units in close proximity, greater load may be applied than the calculated value depending on the accuracy of the mounting surfaces and reference mounting surfaces of the machine or device. In such cases, allowance for greater applied load than the calculated value should be made.
In addition, special products with variation between H and N dimensions aligned can be prepared upon request. Contact IKO for further information.

❺ Operating temperature

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

❻ When mounting multiple assembled sets at the same time

Assemble a slide unit and a spline shaft with the same interchangeable code ("S1" or "S2").

❼ Assembly of slide unit on spline shaft

When inserting a slide unit to the spline shaft, handle with care not to pry open the shaft and drop the balls.

❽ Tightening torque for fixing screw

Typical tightening torque for mounting of the LSB series to the steel mating member material is indicated in Table 16. When vibration and shock of the machine or device are large, fluctuating load is large, or moment load is applied, fix it by using the torque 1.2 to 1.5 times larger than the value indicated in the table as necessary. If the mating member material is cast iron or aluminum alloy, reduce the tightening torque depending on the strength characteristics of the mating member material.

Table 16 Tightening torque for fixing screw

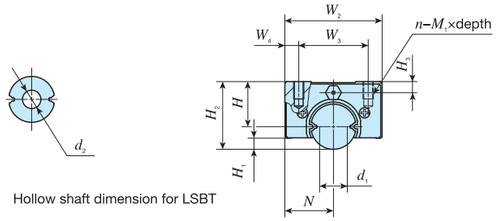
Bolt size	Tightening torque N・m	
	High carbon steel-made screw	Stainless steel-made screw
M2×0.4	0.50	0.31
M3×0.5	1.8	1.1
M4×0.7	4.1	–
M5×0.8	8.0	–
M6×1	13.6	–

Note (1) The tightening torque is calculated based on strength division 12.9 and property division A2-70.

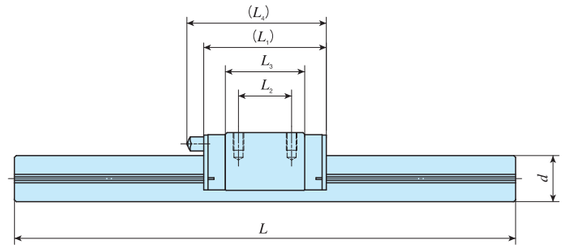
1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

IKO Block Type Linear Ball Spline

Shape	LSB
Size	6 8 10 13 16 20 25



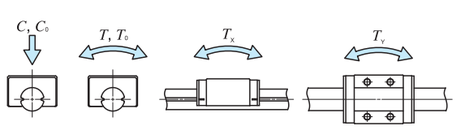
Hollow shaft dimension for LSBT



Identification number	Interchangeable	Mass (Ref.) g: Slide unit	Mass (Ref.) g: Spline shaft (per 100 mm)	Dimensions of assembly mm: H	H_1	H_2	N	Dimensions of slide unit mm: W_2	W_3	W_4	L_1	L_2	L_3	L_4	n–M_1× depth	H_3	Spline shaft dimensions and tolerances mm: d	Dim. d tolerance(1)	d_1(2)	d_2	L(3)	Maximum length	Basic dynamic(4) load rating C N	Basic static(4) load rating C_0 N	Dynamic(4) torque rating T N·m	Static(4) torque rating T_0 N·m	Static moment rating(4): T_X N·m	T_Y N·m
LSB 6	○	7.6	21.2	6	1.1	9	6.5	13	8	2.5	20	—	12.5	—	2—M2× 3	1.5	6	$^{0}_{-0.012}$	3.7	—	150 200	300	675	1 090	2.0	3.3	$^{2.3}_{13.6}$	$^{1.9}_{11.4}$
LSBT 6	○		18.8																	2							
LSB 6 ···SL	○		21.2																	—			540	875	1.6	2.6	$^{1.8}_{10.9}$	$^{1.5}_{9.1}$
LSB 8	○	18	37.6	8	1.3	12	9	18	12	3	25	8	15.6	—	4—M3× 3	1.5	8	$^{0}_{-0.015}$	5	—	150 200 250	500	1 340	1 890	5.4	7.6	$^{4.7}_{30.2}$	$^{3.9}_{25.4}$
LSBT 8	○		32.1																	3		400					
LSB 8 ···SL	○		37.6																	—		500	1 070	1 510	4.3	6.1	$^{3.7}_{24.2}$	$^{3.1}_{20.3}$
LSB 10	○	34	59.7	10	1.9	15	10.5	21	15	3	31	10	21.2	—	4—M3× 4	2.5	10	$^{0}_{-0.015}$	6.9	—	200 300	600	1 810	2 760	9.1	13.8	$^{9.1}_{53.0}$	$^{7.6}_{44.5}$
LSBT 10	○		49.8																	4							
LSB 10 ···SL	○		59.7																	—			1 450	2 200	7.3	11.0	$^{7.3}_{42.4}$	$^{6.1}_{35.6}$
LSB 13	○	62	100	13	3.2	19.5	14	28	20	4	35	15	22.4	40	4—M3× 5	3.2	13	$^{0}_{-0.018}$	9	—	200 300 400	800	3 330	4 290	21.7	27.9	$^{15.4}_{96.3}$	$^{12.9}_{80.8}$
LSBT 13	○		77.9																	6							
LSB 16	○	112	152	16	4.2	24	16.5	33	25	4	43	20	28.8	48	4—M4× 6	4	16	$^{0}_{-0.018}$	11.4	—	200 300 400	1 000	4 980	6 490	39.9	51.9	$^{29.7}_{176}$	$^{24.9}_{148}$
LSBT 16	○		113																	8							
LSB 20	○	215	240	20	5.8	30	20	40	30	5	53	25	37.3	58	4—M5×10	5	20	$^{0}_{-0.021}$	15	—	300 400 500 600	1 000	6 670	9 080	66.7	90.8	$^{52.7}_{299}$	$^{44.2}_{251}$
LSBT 20	○		178																	10							
LSB 25	○	403	376	25	6	37.5	26	52	40	6	67	30	41.8	70	4—M6×12	6	25	$^{0}_{-0.021}$	19.3	—	300 400 500 600 800	1 200	10 500	13 400	136	175	$^{95.6}_{566}$	$^{95.6}_{566}$
LSBT 25	○		237																	15							

Notes (1) This does not apply to hollow shaft (LSBT).
(2) d_1 represents the maximum diameter for end machining.
(3) 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.
(4) The direction of basic dynamic load rating (C), basic static load rating (C_0), dynamic torque rating (T), static torque rating and static moment rating (T_0, T_X, T_Y) are shown in the sketches below.
The upper values of T_X and T_Y are for one slide unit and the lower values are for two slide units in close contact.

Remarks 1. Block type Linear Ball Spline are all interchangeable specification.
2. LSB 6, LSBT 6, LSB 6···SL, LSB 8, LSBT 8, LSB 8···SL, LSB 10, LSBT 10, and LSB 10···SL are provided with oil holes.
The specifications of grease nipple and oil hole are shown in Table 11 and Table 12 on page Ⅱ-138.



Example of identification number of assembled set

Model code		Dimensions	Part code		Material code	Preload symbol	Classification symbol	Interchangeable code	Supplemental code
LSB		10	C2	R300	SL	T1	H	S1	/N
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩

① Model: LSB

② Spline shaft shape

No symbol	Solid shaft
T	Hollow shaft

③ Size: 6, 8, 10, 13, 16, 20, 25

④ Number of slide units (2 pcs.)

⑤ Length of spline shaft (300 mm)

⑥ Material type

No symbol	High carbon steel made
SL	Stainless steel made

⑦ Preload amount

No symbol	Standard
T1	Light preload

⑧ Accuracy class

No symbol	Ordinary
H	High

⑨ Interchangeable

S1	S1 specification
S2	S2 specification

⑩ Special specification: N, U

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

Stroke Ball Spline

LS

Points

● Achieved extremely smooth motion

1 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.

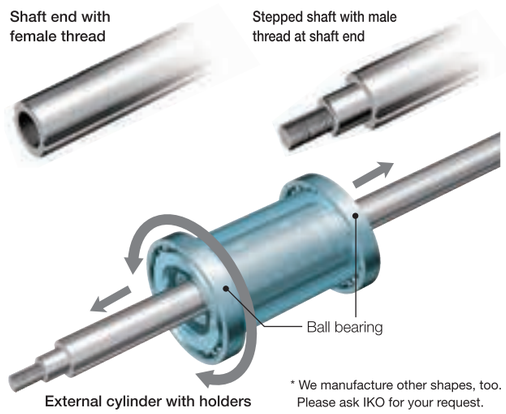
● Best for nozzle part for chip mounter

2 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.

● Supports special shapes

3 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)



External cylinder with holders

* 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.

	1	2	3	4	5	6	7	8
Assembled set	LS		5	C1	R150	T_1	P	/S

1 Model — Model code — Page Ⅱ－145

2 Spline shaft shape — Model code — Page Ⅱ－145

3 Size — Dimensions — Page Ⅱ－145

4 Number of external cylinders — Part code — Page Ⅱ－145

5 Spline shaft length — Part code — Page Ⅱ－145

6 Preload amount — Preload symbol — Page Ⅱ－145

7 Accuracy class — Classification symbol — Page Ⅱ－146

8 Special specification — Supplemental code — Page Ⅱ－147

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

Identification Number and Specification —Model · Spline Shaft Shape · Size · Number of External Cylinders · Spline Shaft Length · Preload Amount · Accuracy Class—

1 Model

Stroke Ball Spline (LS series) : LS

For applicable models and sizes, see Table 1.

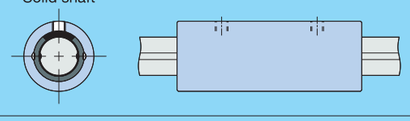
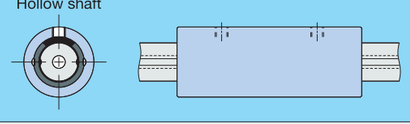
2 Spline shaft shape

Solid shaft	: No symbol	For applicable models and sizes, see Table 1.
Hollow shaft	: T	

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_1 — For preload amount, only light preload (T_1) can be specified.
For details of the preload amount, see Table 2.

Table 2 Preload amount

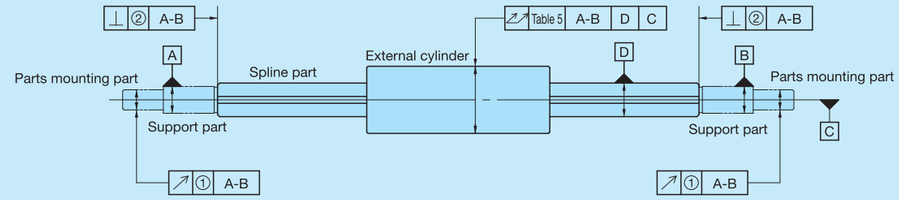
Item / Preload type	Preload symbol	Preload amount N	Operational conditions
Light preload	T_1	$0.02C_0$	· Almost no vibrations · Load is evenly balanced · Light and precise motion

Remark: C_0 indicates the basic static load rating.

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: μm

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

Note (1) The values are for the processed shaft ends.

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

unit: μm

Accuracy class	Precision (P)
Allowable value	6

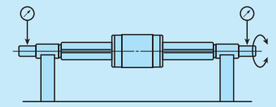
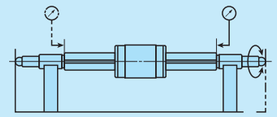
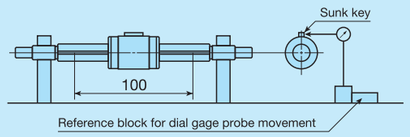
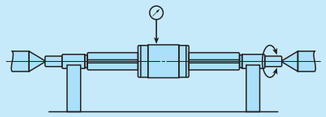
Remark: The values can be applied to 100 mm of the effective length of the spline at any position.

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

unit: μm

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
(1) 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.	
(1) 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 (1) The accuracy are for the processed shaft ends.

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

8 Special specification	Stainless steel spline shaft /S	Applicable to the solid shaft of size 5 and 6.

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.

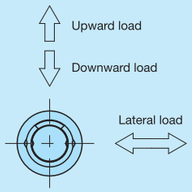
Allowable Load

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 / Size	Basic dynamic load rating			Basic static load rating		
	Load direction			Load direction		
	Downward	Upward	Lateral	Downward	Upward	Lateral
4, 5, 6	C	C	1.47C	C_0	C_0	1.73C_0

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^4		Section coefficient mm^3	
	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.

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.

Precaution for Use

❶ 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.

❷ 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.

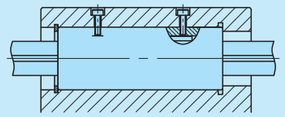


Fig. 1 Mounting example

❸ 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.

❹ 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.

❺ 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.

❻ 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 IKO 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

❼ 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)

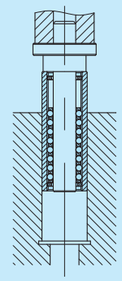
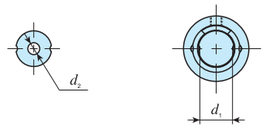


Fig. 3 Press-fitting of external cylinder

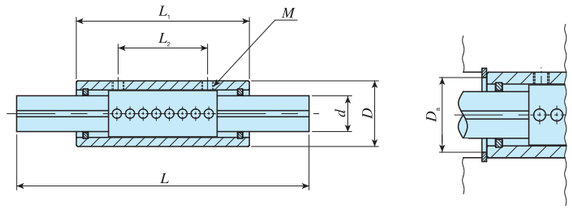
1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

IKO Stroke Ball Spline

Shape	LS		
Size	4	5	6

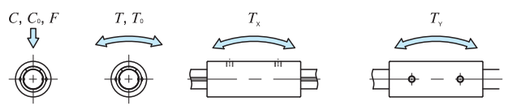


Hollow shaft dimension for LST



Identification number	Interchangeable	Mass (Ref.) g		External cylinder dimensions and tolerances mm						Spline shaft dimensions and tolerances mm					L (2)	Maximum length	Effective stroke length	Maximum stroke length	Mounting Maximum dimensions	Basic dynamic load rating (3)	Basic static load rating (3)	Allowable load (3)	Dynamic torque rating (3)	Static torque rating (3)	Static moment rating (3)	
		External cylinder	Spline shaft (per 100 mm)	D	Dim. D tolerance	L_1	L_2	M	Maximum fixing thread depth	d	Dim. d tolerance	d_1 (1)	d_2				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
LS 4	–	5.7	9.6	8	0 −0.009	24	10	M2	1.3	4	0 −0.012	3.2	–		100 150	200	10	13.2	5	285	380	127	0.66	0.87	0.88	1.5
LST 4	–		8.6										1.5			150										
LS 5	–	8.9	14.9	10	0 −0.009	27	12	M2	1.4	5	0 −0.012	4.2	–		100 150	200	10	14	7	616	748	249	1.8	2.2	2.0	3.5
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	–		150 200	300	10	13.6	8	673	855	285	2.4	3.0	2.6	4.4
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.



Example of identification number of assembled set

Model code		Dimensions	Part code		Preload symbol	Classification symbol	Supplemental code
LS		5	C1	R150	T1	P	/S
①	②	③	④	⑤	⑥	⑦	⑧

① Model: LS

② Spline shaft shape

No symbol	Solid shaft
T	Hollow shaft

③ Size: 4, 5, 6

④ Number of external cylinders (1)

⑤ Length of spline shaft (150 mm)

⑥ Preload amount

T1	Light preload

⑦ Accuracy class

P	Precision

⑧ Special specification: S

1N=0.102kgf=0.2248lbs.
1mm=0.03937inch