U.S. PATENTED

IKO

C-Lube Linear Ball Spline

MAG

Maintenance free for 20,000 km or 5 years

CAT-57180

Oil Minimum
IKO Gentle to The Earth

See you again at
IKO Website
http://www.ikont.co.jp/eg/

June 2011 IKO Overseas Dept.(OKU)

IKO

C-Lube Linear Ball Spline MAG has launched.

IKO strives to be a leader in Technology. Our primary source for development is listening to the customer wants and needs. Our performance and work separate us from others by utilizing our creative thinking and original technologies. IKO is constantly developing and implementing new and advanced technologies in pursuit of excellent motion performance and service for your cost savings.

Maintenance free for 20,000km or 5 years

IKO C-Lube Maintenance-free®

MAG(T)4 NEW
MAGL(T)4, 5, 6, 8

Size 4 and high rigidity long external cylinder are newly available.

The final answer to your lube requirement.

Releasing maintenance free type for IKO C-Lube Linear Ball Spline well-known for its original compact structure

IKO Maintenance Free Series C-Lube Linear Ball Spline

MAG

Maintenance free type has been released for IKO C-Lube Linear Ball Spline MAG having an overwhelmingly high market share in the field of semiconductor and liquid crystal manufacturing systems that are forced to be operated in severe operating conditions of high acceleration/deceleration motion.

U.S. PATENT No. 7,637,662

Maintenance free for 20,000 km or 5 years!!

A large amount of lubricant is incorporated in the compact external cylinder

Incorporating the lubricating component C-Lube in the steel ball circulating path of the external cylinder has achieved maintenance free operation for 5 years or 20,000 km. This lubrication effect lasts for a long time and can reduce the cost of the whole system as a result of the reduction in the lubrication mechanism of the system and in the running cost as the result of reduction in man-hours for lubricational maintenance.

High rigidity and high accuracy have been achieved in spite of the compact size

A simple two-row four-point contact structure using large-diameter steel balls has achieved compactness, high rigidity, high accuracy and low cost.

Ultimate interchangeable system Interchangeable specification

The product conforms to the interchangeable specification in which the external cylinder and the spline shaft can be separately handled. This system allow us to meet customer requirements of short delivery term and selecting what is needed in desired quantity.

The existing type can be changed into the maintenance free type by replacing only the external cylinder.

The following requirements can also be satisfied.

No need of change in your structure

C-Lube Linear Ball Spline MAG can attain maintenance free operation without changing your design.

The external dimensions and stroke lenght of C-Lube Linear Ball Spline MAG that are designed in compact form and are not changed from IKO Linear Ball Spline LSAG. By replacing existing IKO Linear Ball Spline LSAG with C-Lube Linear Ball Spline MAG, you can attain maintenance free operation without changing the structure on your system.

To be operated in an environment in which ordinary lubricant cannot be used

C-Lube Linear Ball Spline MAG can take different lubricants for different requirements.

The lubricant to be impregnated in the C-Lube can be freely selected. This is a good feature for applications such as food machines where the common lubricant cannot be used. Contact IKO if necessary.

Product considering the global environment

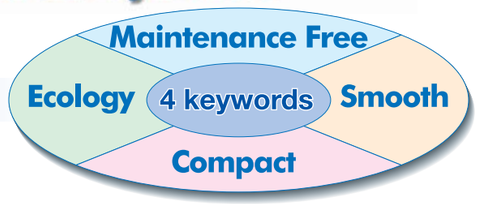
C-Lube Linear Ball Spline MAG contributes to the ecology around the structure.

While the product is in operation, it consumes only a small amount of oil required for lubrication, so that the product meets the ecological requirements controlling the total lubricant consumption.

Features of C-Lube Linear Ball Spline MAG 1

Incorporating a large amount of lubricant in the compact spline external cylinder.

Incorporating the C-Lube has achieved the following.



Maintenance free

The IKO original lubricating component, C-Lube, is incorporated in the external cylinder and the end plate. Its effectiveness had been proven by endurance tests. This can reduce the cost of the whole system as a result of reduction in the lubrication mechanism in the system and also reduce the running cost as a result of reduction in the man-hours for lubricational maintenance.

In addition, grease is prepacked in the external cylinder as standard, so that maintenance free operation for even longer time is achieved.

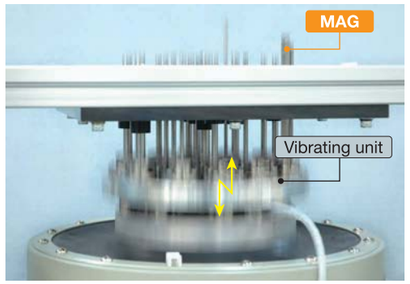
※The above is described on the assumption of the general service life of the system. Lubricant may be required depending on the operating conditions.

For Vertical axis

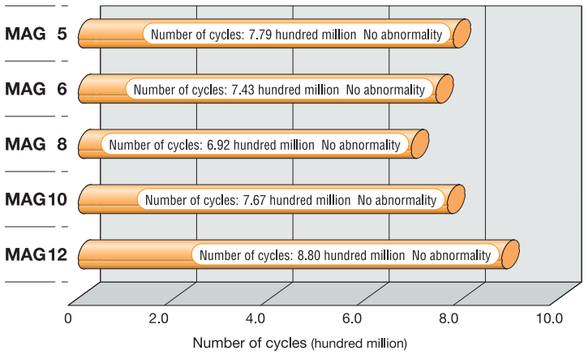
Endurance test supposing a chip mounter

Test conditions

Model No.	MAG8	
Lubricating condition	With C-Lube Without grease prepacked	
Test method	Vibration test machine	
Operating conditions	Mounting attitude	Vertical shaft
	Maximum speed	860 mm/s
	Acceleration	10 G
	Cycle	18.2 Hz
	Stroke length	15 mm



Test result



At vertical shaft and super high tact operation, the product can endure at the total number of reciprocating motions of 2 hundred million without any trouble only with the oil prepacked in the C-Lube.
Maintenance free operation equivalent to the period of 10 years has been achieved in the test conditions supposing the operating conditions for general chip mounters.

In these severe operating conditions, maintenance free operation has been achieved by the total number of reciprocating motions of more than **6 hundred million cycles.**

For Horizontal axis

For general machine use

Supported by our tests in various different conditions, maintenance free operation for the running distance of **20,000 km or more** has been verified in the operating conditions of high speed and long stroke.

Ecology

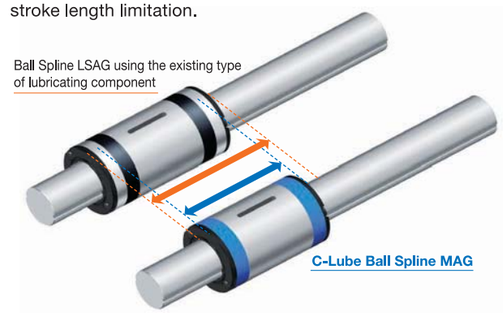
Regarding the prepacked lubricant in the C-Lube, only the amount of lubricant required to maintain the lubrication performance of the rolling guide is supplied, so that a small amount of lubricant is consumed even for a long-time running while keeping the lubrication performance.

Smooth

C-Lube Linear Ball Spline MAG does not generate sliding friction unlike the lubricating component that is mounted on the outer side of the external cylinder in contact with the spline shaft. The product provides good follow-up performance to driving force and contributes to energy saving as a result of the improvement of accuracy and reduction of wear loss.

Compact

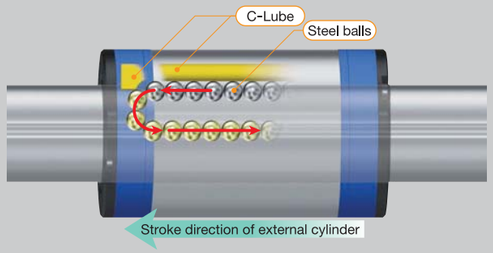
C-Lube Linear Ball Spline MAG incorporates the lubricating component, C-Lube, in the external cylinder, so that the length of external cylinder stays unchanged unlike a type in which the lubricating component is mounted externally. This makes it is possible to replace IKO LSAG by MAG without any space and stroke length limitation.



Lubricant supply mechanism of C-Lube system

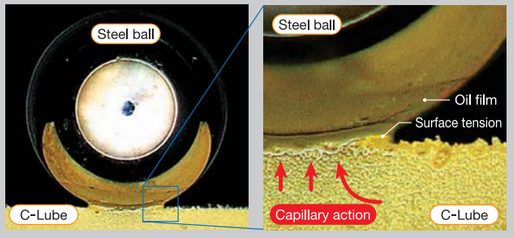
The circulation of the steel balls distributes lubricant.

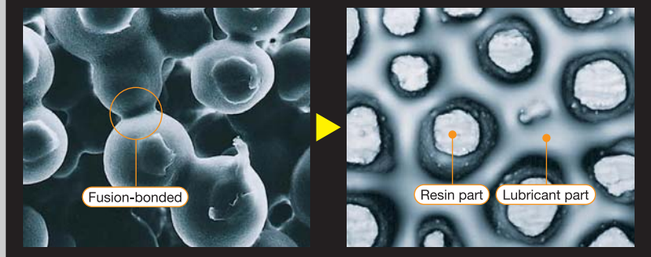
Lubricant is supplied directly to the steel balls. As the steel balls circulate, the lubricant is distributed to the loading area along the spline shaft. This results in adequate lubrication being properly maintained in the loading area for a long time.



Lubricant is deposited directly to the surface of the steel balls.

The surface of C-Lube is always covered with the lubricant. Lubricant is continuously supplied to the surface of steel balls by surface tension in the contact of C-Lube surface and steel balls. New oil permeates automatically from the core of C-Lube to the internal surface that comes in contact with steel balls .





Before impregnating oil
Resin particles are strongly fusion bonded.

After impregnating oil
(Capillary lubrication structure)
Lubricant is retained in cavities amongst resin particles.

Capillary system IKO has developed is a new type lubrication. It is a porous resin Lube-body or plate with steel backing formed by sintering fine resin powder and impregnating a large amount of lubrication oil in its open pores. Capillary system always supplies proper amount of lubrication oil to the cylindrical rollers and lubrication condition of the raceway can be kept well for long period of time.

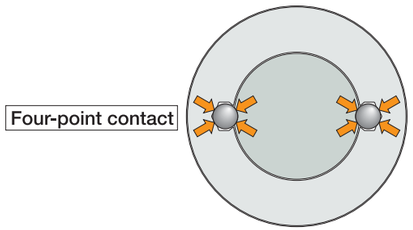
1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

Features of C-Lube Linear Ball Spline MAG 2

In spite of its compact design, high rigidity and high accuracy have been achieved.

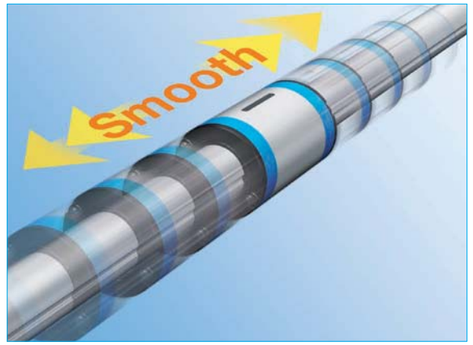
High rigidity and compactness

Large-diameter steel balls are arranged in two rows and are in four-point contact with the raceways. With this structure, this is a high-rigidity and compact-sized Linear Ball Spline. C-Lube Linear Ball Spline MAG adopts a unique steel ball retaining method requiring no ball retainer, and has a small external diameter of external cylinder for the shaft diameter.



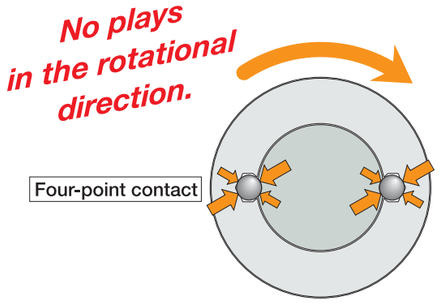
Low-friction smooth motion

The steel ball re-circulating routes are optimally designed through thorough analysis. High-speed operation can thus be achieved with low friction and smooth linear motion.



Accurate positioning is possible

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



Easy handling

This product has a safe structure that prevents steel balls from falling off from the external cylinder even if the external cylinder is removed from the spline shaft. It can also be easily mounted to machines or systems.

High accuracy and a small number of potential errors

The simple two-row four-point contact structure offers a small number of potential errors and enhances the dimensional accuracy between rows to the highest level. In Linear Ball Spline, the external cylinder and the spline shaft are put under strict dimensional control. Thus, the interchangeable specification has been achieved at a high level of interchangeability.

Features of C-Lube Linear Ball Spline MAG 3

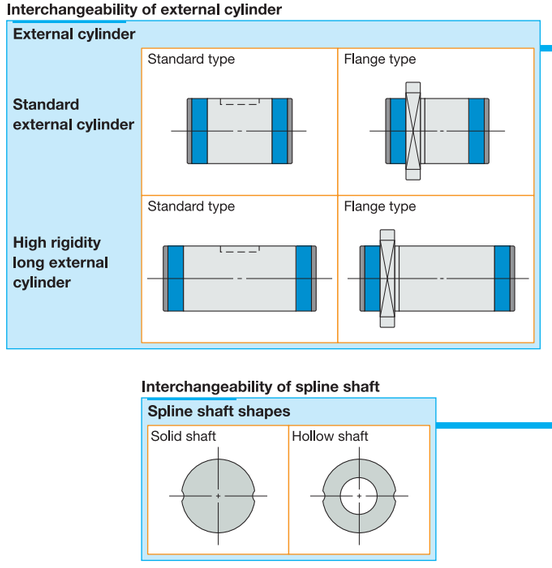
Ultimate interchangeable system, interchangeable specification.

1. The external cylinder and the spline shaft can be ordered separately and a single unit can be delivered.
2. The product type, accuracy, and preload type can be combined freely. This is a high-level interchangeable system product.
3. This is the product customer can order for the least quantity when needed, and its delivery time is short.

Interchangeability of external cylinder

Two types of external cylinder shapes, standard type and flange type, are available.
Both types can be mounted on one spline shaft.

Interchangeability of external cylinder



A combination of external cylinder and spline shaft can be freely selected.

Interchangeability in accuracy classes

Two classes of accuracy, common class and high class are prepared, which can be used for the applications requiring high running accuracy.

Interchangeability in preload classes

Highly accurate dimensional control owing to a simple structure has made it possible to realize the interchangeability in preloaded external cylinders. The product can be used for the applications requiring higher rigidity.

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

Identification Number

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

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

1 Series
2 Lengh of externdl cylinder
3 Shape of spline shaft
4 Size
5 Number of external cylinders
6 Length of spline shaft
7 Preload
8 Accuracy class
9 Interchangeable specification
10 Optional specification

Model code
Size
Part code
Preload symbol
Classification symbol
Interchangeable code
Supplemental code

Note (1) : In case ordering spline shaft only, model code should be changed as LSAG (Solid shaft) or LSAGT (Hollow shaft).

1 Series

C-Lube Linear Ball Spline MAG Standard type	: MAG
C-Lube Linear Ball Spline MAG Flange type	: MAGF

2 Length of external cylinder

Standard	: No symbol
High rigidity long	: L

For applicable models and sizes, see Table 1.
For the model code of a spline shaft of C-Lube Linear Way MAG, indicate LSAG (T) regardless the external cylinder model to be combined.

3 Shape of spline shaft

Solid shaft	: No symbol
Hollow shaft	: T

4 Size

4, 5, 6, 8, 10, 12

For applicable models and sizes, see Table 1.

Table 1 Models and sizes of C-Lube Linear Ball Spline MAG

Size \ Model	Standard model MAG	Standard model MAGL	Flanged model MAGF
4	○	○	—
5	☆	☆	☆
6	☆	☆	☆
8	☆	☆	☆
10	☆	—	☆
12	☆	—	☆

Remark : ☆ marks are also applicable to interchangeable specification.

5 Number of external cylinder

Assembled set	: C○
External cylinder only	: C1

For an assembled set, indicate the number of external cylinder assembled on one spline shaft. For an interchangeable external cylinder only, "C1" is indicated.

6 Length of spline shaft

Assembled set	: R○
Spline shaft only	: R○

Indicate the length of spline shaft in mm. For standard and maximum length, see dimension table from page 17.

7 Preload

Clearance	: T_0
Standard	: No symbol
Light preload	: T_1

Specify this item for an assembled set or an interchangeable external cylinder. Applicable preload size and detail of preload amount, see Table 6 on page 13.

8 Accuracy class

Ordinary	: No symbol
High class	: H
Precision class	: P

The precision class (P) applies to non-interchangeable specification only.
For interchangeable specification products, assemble external cylinder and a spline shaft of the same accuracy class. For details of accuracy classes, see page 11 to 12.

9 Interchangeable specification

Interchangeable code	: S1
	S2
Non-interchangeable	: No symbol

Specify for interchangeable specification. Interchangeable code on external cylinder and shaft must be same to match. The performance and the accuracy on set item are same either with S1 or S2. Applicable model and size are shown in Table 1.
"No symbol" shall be indicated for non-interchangeable specification.

10 Optional specification

/N, /S

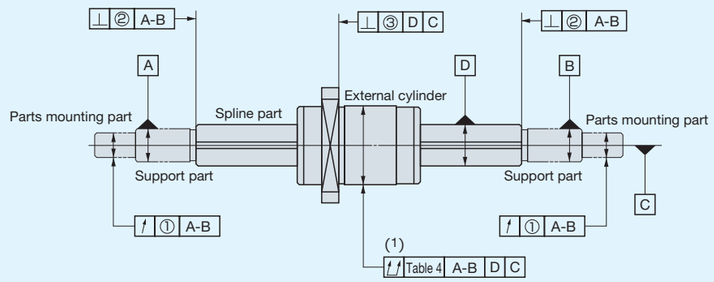
For applicable optional specifications, see Table 7 on page 13.

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

Accuracy

The accuracy of IKO C-Lube Linear Ball Spline MAG is shown in Table 2 and the accuracy of spline shaft is shown in Table 3 and 4.

Table 2 Accuracy of C-Lube Linear Ball Spline MAG



unit : μm

Model number	Relative to axial line of supporting part of spline shaft						③Perpendicularity of mounting surface of flange relative to axial line of spline shaft(3)		
	①Radial runout of outer periphery of parts mounting part(2)			②Perpendicularity of spline part end face(2)					
	Ordinary (No symbol)	High (H)	Precision(4) (P)	Ordinary (No symbol)	High (H)	Precision(4) (P)	Ordinary (No symbol)	High (H)	Precision(4) (P)
MAG 4	33	14	8	22	9	6	27	11	8
MAG 5	33	14	8	22	9	6	27	11	8
MAG 6	33	14	8	22	9	6	27	11	8
MAG 8	33	14	8	22	9	6	27	11	8
MAG 10	41	17	10	22	9	6	33	13	9
MAG 12	41	17	10	22	9	6	33	13	9

Note(1) : Applicable when measured by using external cylinder for measurement.
(2) : Applicable when the shaft ends are finished.
(3) : Applicable to the flange type.
(4) : Applicable to the non-interchangeable specification.
Remark : The table shows representative model numbers only but is applicable to all other models in the same size.

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

unit : μm

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

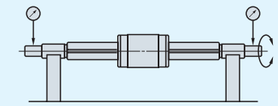
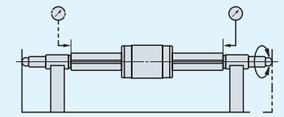
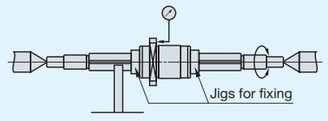
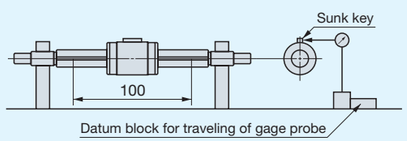
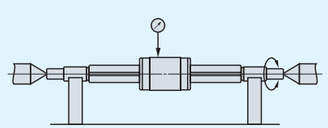
Note(1) : Applicable to non-interchangeable specification
Remark : The values are applicable to any given length of 100 mm over the effective length of the spline part.

Table 4 Total radial runout of axial line of spline shaft unit : μm

Overall length of spline shaft mm		MAG 4 MAG 5 MAG 6 MAG 8			MAG 10 MAG 12		
over	incl.	Ordinary (No symbol)	High (H)	Precision(1) (P)	Ordinary (No symbol)	High (H)	Precision(1) (P)
—	200	72	46	26	59	36	20
200	315	133	89	57	83	54	32
315	400	185	126	82	103	68	41
400	500	236	163	108	123	82	51
500	630	—	—	—	151	102	65
630	800	—	—	—	190	130	85

Note(1) : Applicable to non-interchangeable specification.
Remark : The table shows representative model numbers only but is applicable to all other models in the same size.

Table 5 Measuring method of accuracy

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

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

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

Preload

The average amount of preload for C-Lube Linear Ball Spline MAG is shown in Table 6.

Table 6 Preload

Item / Preload class	Symbol	Preload amount (N)	Application
Clearance	T_0	0(1)	· Very smooth motion
Standard	(No symbol)	0(2)	· Smooth and precise motion
Light preload	T_1	0.02 C_0	· Minimum vibration · Load is evenly balanced · Smooth and precise motion

Note (1) : Zero or minimal amount of clearance.
(2) : Zero or minimal amount of preload.
Remarks : 1. Clearance T_0 is only available for size 4.
2. Light preload T_1 is not applicable for size 4.
3. C_0 means basic static load rating.

Optional specification

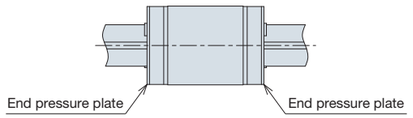
In C-Lube Linear Ball Spline MAG, optional specifications in Table 7 are available.
When a optional specification is required, add the applicable supplemental code to the end of the identification number. If a combination of special specifications (/N and /S) is necessary, arrange supplemental codes in alphabetical order.
(Ex : /NS)

Table 7 Special specifications

Special specifications	Supplemental code	Applicable size
No end seal	/N(1)	5~12
Stainless steel spline shaft	/S(2) (3)	5~12

Note (1) : Applicable to interchangeable external cylinder and assembled set.
(2) : Applicable to non-interchangeable specification.
(3) : Not applicable to the hollow shaft.

No seal /N



Seals at both ends of external cylinder are replaced by steel pressure plate. It does not contact to spline shaft in order to reduce frictional resistance. This is not effective for dust protection.

Stainless steel spline shaft /S

The material of the solid spline shaft is changed to stainless steel. The load rating will be a value obtained by multiplying the load rating for the high carbon steel spline shaft by a factor of 0.8.

Application Example

Direct Drive Electric Cylinder — MAGL

Load Rating and Life

Basic dynamic load rating *C*

The basic dynamic load rating is defined as a constant load both in direction and magnitude under which a group of identical C-Lube Linear Ball Spline MAG is individually operated and 90% of those in the group can travel 50×10^3m free from material damage due to rolling contact fatigue.

Basic static load rating C_0

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

Dynamic rated torque *T*

The dynamic rated torque is defined as a rotational torque (See Fig.2) constant both in magnitude and direction under which 90% of a group of the same C-Lube Linear Ball Spline MAG can travel 50×10^3m without suffering from material damage due to rolling contact fatigue when they are individually operated.

Static rated torque and Static rated moment

T_0, T_X, T_Y

The static rated torque and static rated moment are defined as a static torque or static moment which gives a prescribed constant contact stress at the center of the contact area between the steel ball and raceway receiving the maximum load when a torque or moment (See Fig.2) is loaded. They are the allowable limit torque or moment that permits normal rolling motion. Generally, they are used in combination with the static safety factor.

Load direction and Load rating

Since the load ratings of C-Lube Linear Ball Spline MAG given in the dimension table are for upward/downward load, they must be corrected for the load direction for lateral load. The corrected basic dynamic load ratings and basic static load ratings are shown in Table 8.

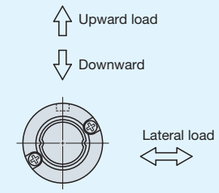


Fig.1 Load direction

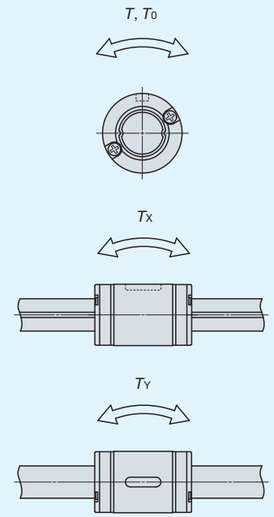


Fig.2 Direction of dynamic rated torque, static rated torque and static rated moment

Table 8 Conversion factor by load direction

Load direction / Size	Upward and downward load		Lateral load	
	Basic dynamic load rating	Basic static load rating	Basic dynamic load rating	Basic static load rating
4~12	*C*	C_0	1.47*C*	1.73C_0

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

Load Rating and Life

Life

The rating life of C-Lube Linear Ball Spline MAG is obtained from the following formula.

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

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

where, L : Rating life, 10^3m
C : Basic dynamic load rating, N
T : Dynamic rated torque, N・m
P : Theoretically calculated radial load, N
M : Theoretically calculated torque, N・m

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

$$L_h=\frac{10^6 L}{2Sn_1\times 60} \quad \cdots\cdots (3)$$

where, L_h : Rating life in hours, hours
S : Stroke length, mm
n_1 : Number of strokes per minute, cpm

Static safety factor

When excessive large or heavy loads are applied on C-Lube Linear Ball Spline MAG, local permanent deformation will be made on balls or raceways, resulting in deterioration in running performance. In general, the allowable loads depend on the operating conditions and the requirements in the application, and the margin of safety is determined considering the above factors.

The static safety factor, fs, can be obtained from the following formula. General values of this factor are shown in Table 9.

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

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

where, f_s : Static safety factor
C_0 : Basic static load rating, N
P_0 : Static radial load, N
T_0 : Static rated torque, N・m
M_0 : Static torque (maximum torque), N・m

Table 9 Static safety factor

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

Load factor

Due to vibration and/or shocks during machine operation, the actual load on each rolling guide becomes greater in many cases than the theoretically calculated load. The applied load is generally calculated by multiplying the theoretically calculated load by the load factor shown in Table 10.

Table 10 Load factor

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

Spline Shaft

Moment of inertia of sectional area and section modulus of the spline shaft are shown in Table 11.

Table 11 Moment of inertia of sectional area and section modulus

Model number	Moment of inertia of sectional area mm⁴		Sectional modulus mm³	
	Solid shaft	Hollow shaft	Solid shaft	Hollow shaft
MAG 4	12	12	6	6
MAG 5	29	29	12	12
MAG 6	61	61	21	21
MAG 8	190	190	49	49
MAG10	470	460	95	94
MAG12	990	960	170	160

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

Lubrication and Dust Protection

Quality lithium-soap base grease containing extreme pressure additive (ALVANIA EP grease 2 -Shell-) is pre-packed in IKO C-Lube Linear Ball Spline MAG. Additionally, C-Lube is placed in the recirculation path, thereby extending the re-lubrication (greasing) interval time and maintenance for a long period.

C-Lube Linear Ball Spline MAG does not have oil hole and grease nipple. If re-lubrication is necessary, please put grease on raceway part of spline shaft.

Product is dust protected by special rubber seals. However, if large amount of fine contaminants are present, or if large particles of foreign matter such as dust or chips may fall, it is recommended to provide protective dust covers such as bellows for the entire linear motion mechanism.

The size 4 model is not provided with seals.

Precautions for use

❶Fit of external cylinder

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

❷Standard mounting example of C-Lube Ball Spline MAG

Fig.3 shows standard mounting methods of external cylinder. To prevent the rotation of the external cylinders of MAG4, an M2 to M2.5 screw are set to the countersink provided on each cylinder. Avoid deforming the external cylinder when tightening the screw.

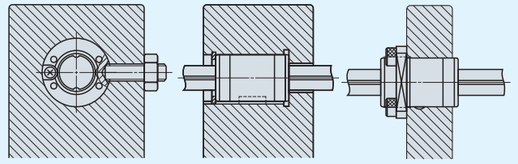


Fig.3 Mounting example of external cylinder

❸Additional machining of spline shaft

The high carbon steel 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 shown in the dimension tables. Spline shafts with special end shapes can be prepared upon request. Consult IKO for further information.

❹Multiple external cylinders in close contact

When using multiple external cylinders in close distance to each other, actual load may be greater than the calculated load depending on the accuracy of the mounting surfaces and the reference mounting surfaces of the machine. It is suggested in such cases to assure a greater load than the calculated load. For C-Lube Linear Ball Spline MAG, the key grooves of the external cylinders are aligned before delivery, when two or more external cylinders are assembled on a single spline shaft and two or more keys are used to fix the external cylinders in the rotational direction.

❺Operating temperature

The maximum operating temperature should not exceed 80℃.

Precautions for mounting

❶When mounting multiple sets at the same time

In interchangeable specification, assemble an external cylinder and a spline shaft with the same interchangeable code.

In non-interchangeable product, use an assembly of external cylinder and spline shaft as delivered without changing the combination.

❷Assembling an external cylinder and spline shaft

When assembling the external cylinder on the spline shaft, correctly fit the raceway grooves of the external cylinder to that of the spline shaft and move the external cylinder gently in parallel direction. Rough handling may cause damaging seals or dropping steel balls. Non-interchangeable specification products are already assembled so as to provide the best accuracy when the IKO marks of external cylinder and spline shaft face the same direction. (see Fig.4)

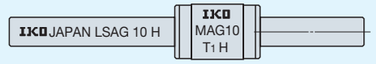


Fig.4 Assembly direction of the external cylinder

❸Mounting the external cylinder

When press-fitting the external cylinder to the housing, assemble them correctly by using a press and a suitable jig fixture, etc. (See Fig.5)

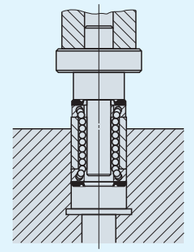
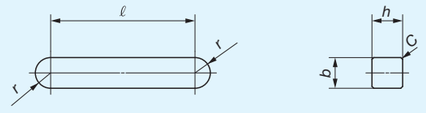


Fig.5 Press-fitting of the external cylinder

❹Attached keys for the external cylinder

The sunk keys shown in Table 12 are provided with the external cylinder.

Table 12 Dimensions and tolerance of attached key



unit : mm

Model number	b	Tolerance	h	Tolerance	ℓ	r	C
MAG 5	2	+0.016 +0.006	2	0 −0.025	3.8	1	0.16～0.25
MAG 6					5.8		
MAG 8	2.5		2.5			1.25	
MAG10	3		3		7.8	1.5	
MAG12					11.8		

Remark : The table shows representative model numbers only but is applicable to all other models in the same size.

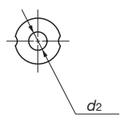
1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

IKO

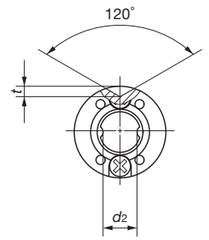
C-Lube Linear Ball Spine MAG

Standard type

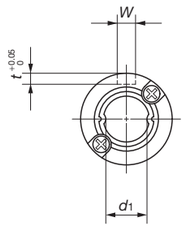
MAG • MAGT

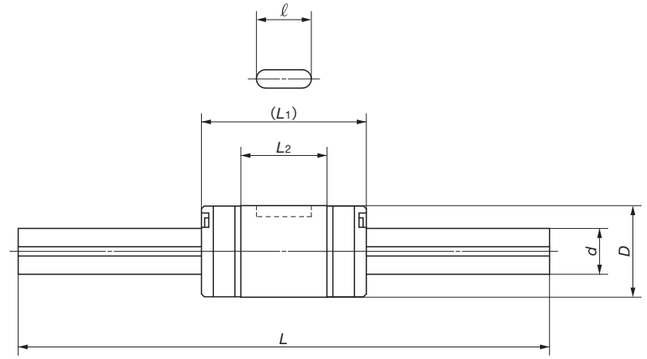


Bore dia. of hollow shaft of MAG (L) T



MAG (L)(T) 4





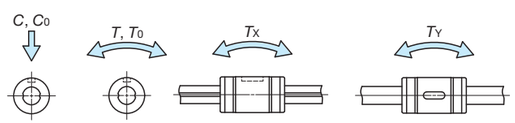
Model number		Interchangeable	Mass (Ref.) g External cylinder	Mass (Ref.) g Spline shaft (per 100mm)	Dimension and tolerance of external cylinder mm D	Tolerance	L1	L2	W	Tolerance	t	ℓ	Dimension of spline shaft mm d	Tolerance	d1(2)	d2	L(3)	Maximum length	Basic dynamic load rating(4) C N	Basic static load rating(4) C0 N	Dynamic torque rating(4) T N・m	Static torque rating(4) T0 N・m	Static moment rating(4) TX N・m	Static moment rating(4) TY N・m	Model number
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	MAG 4(1)
MAGT	4(1)	–		8.2												1.5		150							MAGT 4(1)
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	MAGL 4(1)
MAGLT	4(1)	–		8.2												1.5		150							MAGLT 4(1)
MAG	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	MAG 5
MAGT	5	○		12.4												2									MAGT 5
MAGL	5	○	8.1	14.9			26	16.9								—			879	1 180	2.6	3.5	3.2 19.3	5.5 33.4	MAGL 5
MAGLT	5	○		12.4												2									MAGLT 5
MAG	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	MAG 6
MAGT	6	○		16.5												2									MAGT 6
MAGL	6	○	14.5	19			30	21.4								—			1 030	1 500	3.6	5.2	5.0 27.6	8.6 47.8	MAGL 6
MAGLT	6	○		16.5												2									MAGLT 6
MAG	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	MAG 8
MAGT	8	○		33												3		400							MAGT 8
MAGL	8	○	26.5	39			37	26.6								—		500	1 800	2 470	8.4	11.5	10.3 56.3	17.8 97.5	MAGL 8
MAGLT	8	○		33												3		400							MAGLT 8
MAG	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	MAG 10
MAGT	10	○		51												4									MAGT 10
MAG	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	MAG 12
MAGT	12	○		66												6									MAGT 12

Note (1) : Seals are not prepared.

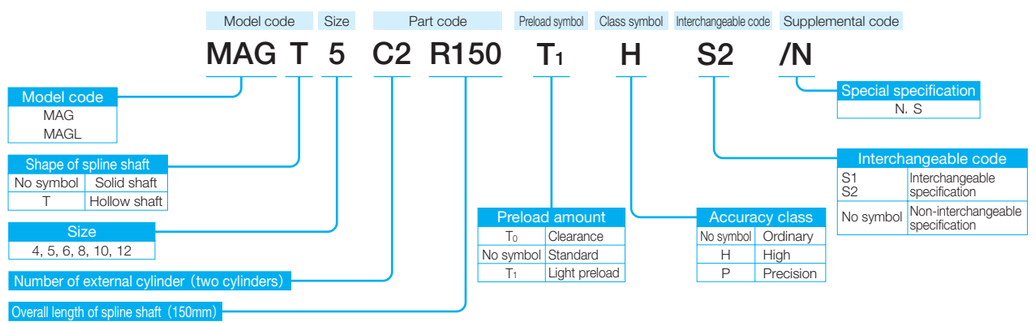
(2) : Dimension d_1 indicates the maximum diameter when machining is done at the shaft ends.

(3) : Lengths indicated are standard length. Spline shafts in different lengths are also available. Simply indicate the necessary length of spline shaft (mm) in the identification number.

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



Example of identification number of assembled set



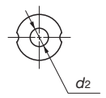
1N=0.102kgf=0.2248lbs.
1mm=0.03937inch

IKO

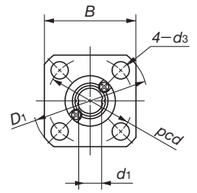
C-Lube Linear Ball Spine MAG

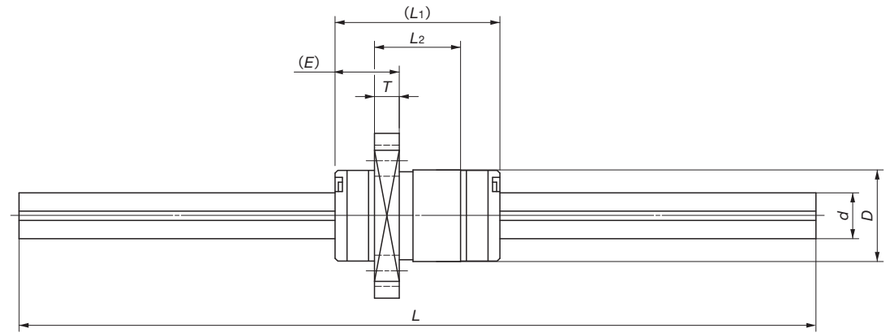
Flange type

MAGF • MAGFT



Bore dia. of hollow shaft of MAGT



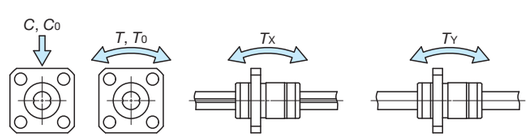


Model number	Interchangeable	Mass (Ref.) g		Dimension and tolerance of external cylinder mm										Dimension of spline shaft mm						Basic dynamic load rating(3)	Basic static load rating(3)	Dynamic torque rating(3)	Static torque rating(3)	Static moment rating(3)		Model number
		External cylinder	Spline shaft (per 100mm)	D	Tolerance	L1	L2	D1	B	E	T	PCD	d3	d	Tolerance		d1(1)	d2	L(2)	Maximum length	C N	C0 N	T N・m	T0 N・m	TX N・m	TY N・m	
MAGF 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	1.8	MAGF 5
MAGFT 5	○		12.4															2							7.9	13.6	MAGFT 5
MAGF 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	3.0	MAGF 6
MAGFT 6	○		16.5															2							11.7	20.3	MAGFT 6
MAGF 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	5.6	MAGF 8
MAGFT 8	○		33															3		400					22.0	38.1	MAGFT 8
MAGF 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	12.1	MAGF 10
MAGFT 10	○		51															4							41.5	71.9	MAGFT 10
MAGF 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	18.3	MAGF 12
MAGFT 12	○		66															6							59.1	102	MAGFT 12

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

(2) : Lengths indicated are standard length. Spline shafts in different lengths are also available. Simply indicate the necessary length of spline shaft (mm) in the identification number.

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



Example of identification number of assembled set

Model code	Size	Part code			Preload symbol	Class symbol	Interchangeable code	Supplemental code
MAGF	T	5	C2	R150	T1	H	S2	/N

- **Model code**: MAGF
- **Shape of spline shaft**: No symbol — Solid shaft; T — Hollow shaft
- **Size**: 5, 6, 8, 10, 12
- **Number of external cylinder (two cylinders)**
- **Overall length of spline shaft (150mm)**
- **Preload amount**: No symbol — Standard; T1 — Light preload
- **Accuracy class**: No symbol — Ordinary; H — High; P — Precision
- **Interchangeable code**: S1, S2 — Interchangeable specification; No symbol — Non-interchangeable specification
- **Special specification**: N. S

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

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Recognizing that conservation of the global environment is the top-priority challenge for the world's population, Nippon Thompson will conduct its activities with consideration of the environment as a corporate social responsibility, reduce its negative impact on the environment, and help foster a rich global environment.

ISO 9001 & 14001 Quality system registration certificate

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