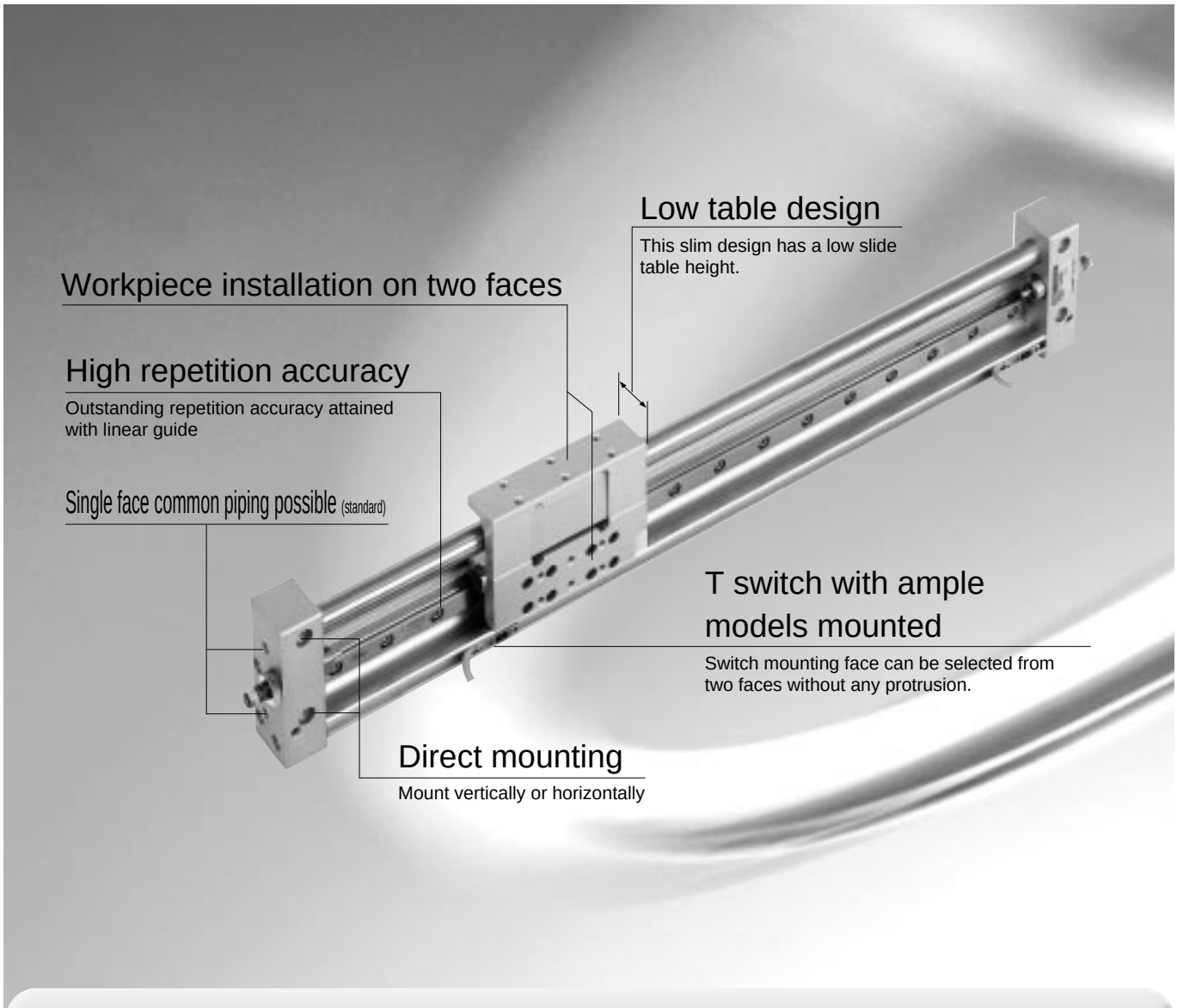
Guide with rated load approx. 1.5-fold higher incorporated!

(Compared to similar ϕ16 product available commercially)

Innovative lubrication mechanism greatly improves life and operation stability.
High precision guided magnetic super rod-less cylinder high accuracy (ϕ10, ϕ16, ϕ25) boasts a high accuracy and high rigidity.

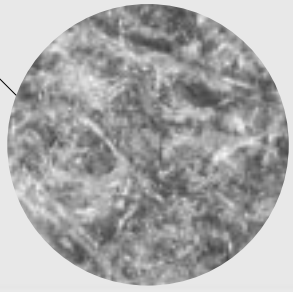


Double durability.

(CKD comparison)

Lube-keeping structure

Textile (lube-keeping structure) impregnated with grease is mounted on the sliding section of the piston and slider, enabling stable long-term lubricant supply and preventing wear.
Long life (more than double by CKD comparison) and stable operation are realized.



Lubrication supply/absorption function

A capillary tube applies impregnated grease evenly and regularly to the sliding surface, absorbing excess grease.

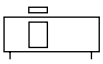
Dust wiper function

Dust and wear power from the packing, etc., are collected by the textile to reduce contamination on the sliding section.

Series variation

Magnet type rodless cylinder high precision guide type MRG2 Series

●: Standard, ◎: Option, :Not available

Variation	Model no.	Bore size (mm)	Standard stroke length (mm)									Min. stroke length (mm)	Max. stroke length (mm)	Option			Switch	Page
			50	100	150	200	300	400	500	600	700			Brackets for full stroke adjustment on both ends A	R side adjustable full-stroke with bracket A1	L side adjustable full-stroke with bracket A2		
Double acting	MRG2	ϕ10	●	●	●	●	●					50	300	◎	◎	◎	◎	2202
		ϕ16	●	●	●	●	●	●	●				500					
		ϕ25	●	●	●	●	●	●	●	●	●		700					

Safety precautions

Always read this section before starting use.
Refer to Intro 71 for general precautions of the cylinder, and to Intro 78 for general precautions of the cylinder switch.

Rodless cylinder MRG2 Series

Design & Selection

⚠ WARNING

■ If the force of the cylinder changes because of torsion at the machine's sliding section, the table could pop out.
In this case, there is a risk of personal injury such as catching of arms or legs, and of machine damage. Always adjust for smooth machine movement, and provide a design that protects the workers from injury.

■ When requiring deceleration circuit and shock absorber.
If the driven object's speed is fast or the weight is large, it may be difficult to absorb the impact just with the standard shock absorber. Provide a circuit which decelerates before the shock absorber, or use an external shock absorber to ease the impact. The machine's rigidity must also be carefully considered in this case.

■ The piston could separate if a load exceeding the allowable value is applied or if used at a pressure exceeding the maximum working pressure.

Installation & Adjustment

⚠ CAUTION

■ Check clearance between the end plate and slider.
Avoid catching fingers or hands while the cylinder is moving.

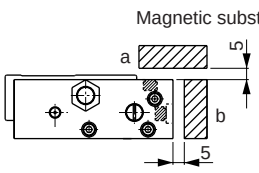
■ Do not apply a load exceeding that allowed given in selection material to the cylinder.

■ Do not use with the table fixing.
Use the cylinder with the end plate fixed. Avoid using at table fixing.

■ Install so the table moves at the minimum working pressure for the entire process.
If the cylinder installation surface is not flat, minimum working pressure rises due to twisting in the guide section, and may cause bearings to wear early. Install the table so it operates at minimum working pressure. The installation surface should be very flat, but if it cannot be confirmed, adjust with a shim, etc.

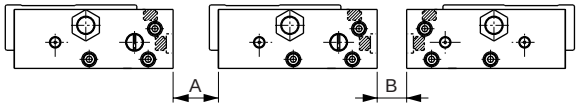
■ Do not scratch or dent the periphery of the cylinder tube.
Lube-keeping structure, scraper, or slider wear ring may be damaged and result in operation faults.

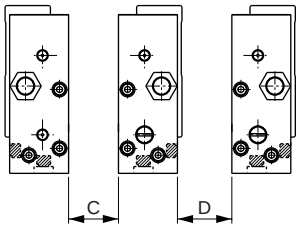
■ The cylinder may malfunction if a magnetic substance, such as a steel plate, is nearby. Separate the cylinder or the magnetic sensor by the distance below.

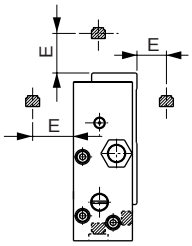


Avoid a, b simultaneous.

■ When using cylinders next to each other, or when using another magnetic sensor in the area, separate the cylinder or magnetic sensor from the slider surface by the distance shown below to prevent faults caused by the leakage field of the magnet in the cylinder.





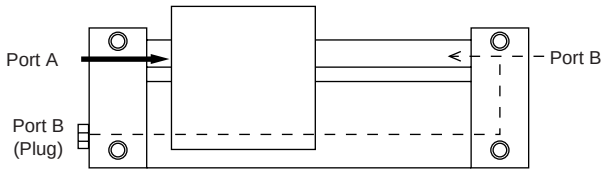


Unit: mm

Port size	A	B	C	D	E
ϕ10	20	10	10	10	20
ϕ16	20	10	10	10	20
ϕ25	50	20	20	20	50

When less than dimension E, faults may be prevented by placing a magnetic object (2 mm or thicker steel plate) between the sensor and slider.

■ Piping port position and operational direction



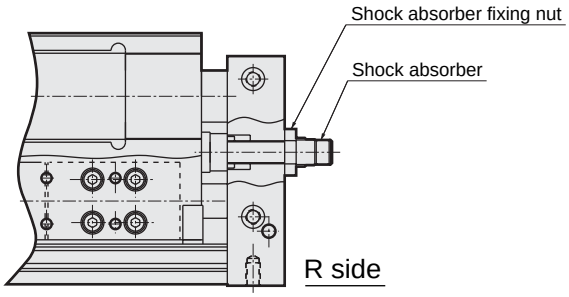
When the port A is pressurized, the slide table will move to the right as shown in the figure.
When the port B is pressurized, the slide table will move to the left as shown in the figure.
The port B (plug) is sealed with a plug when shipped. Common piping can be used by removing the plug and sealing the right port B .

■ The CKD shock absorber is treated as a consumable.

Replace the shock absorber if energy absorption performance drops or if movement is no longer smooth.

■ Adjustable stroke method

Stroke (-) direction ⟷ Stroke (+) direction



Adjustable stroke length (single)

Bore size (mm)	Stroke length (-) direction	Stroke length (+) direction
ϕ10	5	5
ϕ16	5	5
ϕ25	6	4

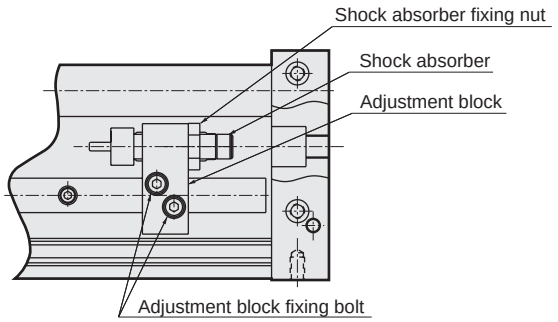
1. Loosen the shock absorber fixing nut, turn the shock absorber so that the slide table comes to the target position. After adjusting, tighten the shock absorber fixing nut with the tightening torque shown right.

CAUTION

The stroke can be adjusted to the values shown above by adjusting the shock absorber, but when adjusting in the stroke (+) direction, special care is required as the switch detection will be disabled at the stroke end only on the R side.

■ Adjustable full-stroke bracket adjustment method

Stroke (-) direction ⟷ Stroke (+) direction



Adjustable full-stroke volume (adjust amount per adjustable full-stroke bracket 1 pc.)

Bore size (mm)	A		A1		A2	
	Stroke length (-) direction	Stroke length (+) direction	Stroke length (-) direction	Stroke length (+) direction	Stroke length (-) direction	Stroke length (+) direction
ϕ10	Stroke length	0	Stroke length	24	Stroke length	24
ϕ16	Stroke length	0	Stroke length	24	Stroke length	24
ϕ25	Stroke length	15	Stroke length	65	Stroke length	65

1. Movement of adjustment block

Loosen the adjustment block fixing bolt, move to a random position, and tighten the adjustment block fixing bolts with the tightening torque shown below.

2. Fine adjustment of shock absorber

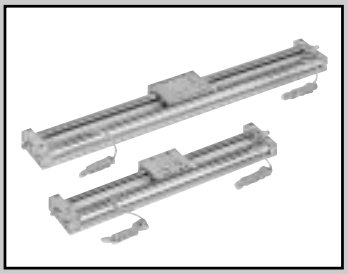
Loosen the shock absorber fixing nut, turn the shock absorber so that the slide table comes to the target position. After adjusting, tighten the shock absorber fixing nut with the tightening torque shown below.

Tightening torque / Bore size (mm)	Shock absorber fixing nut (N·m)	Adjustment block fixing bolt (N·m)
ϕ10	12 to 20	22 to 30
ϕ16	30 to 40	22 to 30
ϕ25	45 to 60	46 to 63

During Use & Maintenance

⚠ CAUTION

■ A magnetic force of integrated magnet is powerful. Do not disassemble the product.

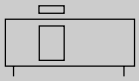


Magnet rodless cylinder high precision guide types

MRG2 Series

Bore size: ϕ 10, ϕ 16, ϕ 25

JIS symbol



RoHS CAD

Specifications

Descriptions		MRG2		
Bore size	mm	ϕ10	ϕ16	ϕ25
Actuation		Double acting		
Working fluid		Compressed air		
Max. working pressure	MPa	0.7		
Min. working pressure	MPa	0.3 (note)	0.2	
Withstanding pressure	MPa	1.05		
Ambient temperature	℃	5 to 60		
Port size		M5		Rc1/8
Stroke tolerance	mm	+1.5 0		
Working piston speed	mm/s	50 to 1000		
Cushion		Shock absorber		
Lubrication		Not required (when lubricating, use turbine oil ISO VG32.)		
Magnet holding force	N	63	166	350
Allowable energy absorption	J	2.1	5.3	8.7

Note: The shock absorber resistance may increase the time to reach the stroke end. Take this into consideration when using this cylinder.
Note: Other than standard stroke length is custom order.

Stroke length

Bore size (mm)	Standard stroke length (mm)	Max. stroke length (mm)	Min. stroke length (mm)	Min. stroke length with switch (mm)
ϕ10	50, 100, 150, 200, 300	300	50	50 (If 2 installed)
ϕ16	50, 100, 150, 200, 300, 400, 500	500		
ϕ25	50, 100, 150, 200, 300, 400, 500, 600, 700	700		

Note: Other than standard stroke length is custom order.

Switch specifications

*The T0/T5 switch can be used with 220 VAC. Consult with CKD for working conditions.

● 1 color/2 color indicator

Descriptions	Proximity 2 wire			Proximity 3 wire			Reed 2 wire			
	T1H/T1V	T2H/T2V	T2YH/T2YV	T3H/T3V	T3PH/T3PV (Custom order)	T3YH/T3YV	T0H/T0V		T5H/T5V	
Applications	Programmable controller, relay, small solenoid valve	Programmable controller		Programmable controller			Programmable controller		Programmable controller, relay, IC circuit (w/o light), serial connection	
Output method	-			NPN output	PNP output	NPN output	-			
Power voltage	-			10 to 28 VDC			-			
Load voltage	85 to 265 VAC	10 to 30 VDC		30 VDC or less			12/24 VDC	110 VAC	5/12/24 VDC	110 VAC
Load current	5 to 100mA	5 to 20mA (Note 1)		100mA or less		50mA or less	5 to 50mA	7 to 20mA	50mA or less	20mA or less
Light	LED (ON lighting)	LED (ON lighting)	Red/green LED (ON lighting)	LED (ON lighting)	Green LED (ON lighting)	Red/green LED (ON lighting)	LED (ON lighting)		Without indicator light	
Leakage current	1mA or less with 100 VAC 2mA or less with 200 VAC	1mA or less		10 μA or less			0mA			

● With preventive maintenance output

Descriptions		Proximity 3 wire	Proximity 4 wire	Proximity 3 wire	Proximity 4 wire
		T2YFH/V	T3YFH/V	T2YMH/V	T3YMH/V
Applications		Programmable controller	Programmable controller	Programmable controller	Programmable controller
Output method		NPN output			
Light	Installation position adjustment section	Red/green LED (ON lighting)			
	Preventive maintenance output	-		Yellow LED (ON lighting)	
Regular	Power voltage	-	10 to 28 VDC	-	10 to 28 VDC
	Load voltage	10 to 30 VDC	30 VDC or less	10 to 30 VDC	30 VDC or less
	Load current	5 to 20mA	50mA or less	5 to 20mA	50mA or less
	Leakage current	1mA or less	10 μA or less	1.2mA or less	10 μA or less
Preventive maintenance output	Load voltage	30 VDC or less			
	Load current	20mA or less	50mA or less	5 to 20mA or less	50mA or less
	Leakage current	10 μA or less			

Note 1: Refer to Ending 1 for other switch specifications.
Note 2: Maximum load current above: 20mA at 25℃. The current will be lower than 20mA if ambient temperature around switch is higher than 25℃. (5 to 10mA when 60℃)

Cylinder weight

Unit (g)

Type	Without switch		Weight of adjustable full-stroke bracket (per 1)
	Weight when stroke length 0mm	Additional weight per S = 100mm	
MRG2-10	610	180	75
MRG2-16	1170	280	110
MRG2-25	3270	490	200

How to order

MRG2 – 10 – 100 – T2H – D – A

Ⓐ Bore size

Ⓑ Stroke length

Ⓒ Switch model no.
* indicates lead wire length.
Note 3

Ⓓ Switch quantity

Ⓔ Option
Note 4

Symbol	Descriptions
Ⓐ Bore size (mm)	
10	ϕ10
16	ϕ16
25	ϕ25
Ⓑ Stroke length (mm)	

	Bore size ϕ (mm)	10	16	25
50	50	●	●	●
100	100	●	●	●
150	150	●	●	●
200	200	●	●	●
300	300	●	●	●
400	400		●	●
500	500		●	●
600	600			●
700	700			●

Ⓒ Switch model no.

Radial lead wire	Axial lead wire	Contact	Indication	Lead wire
T0H*	**T0V***	Reed	1 color indicator type	2-wire
T5H*	**T5V***		Without indicator light	
T1H*	**T1V***	Proximity	1 color indicator type	2-wire
T2H*	**T2V***			
T3H*	**T3V***			3-wire
T3PH*	**T3PV***		1 color indicator type (custom order)	3-wire
T2YH*	**T2YV***		2 color indicator type	2-wire
T3YH*	**T3YV***			3-wire
T2YFH*	**T2YFV***		2 color indicator type (w/o indicator light for preventive maintenance output)	3-wire
T3YFH*	**T3YFV***			4-wire
T2YMH*	**T2YMV***		2 color indicator type (w/ indicator light for preventive maintenance output (1 color))	3-wire
T3YMH*	**T3YMV***			4-wire

***Lead wire length**	
Blank	1m (standard)
3	3m (option)
5	5m (option)
Ⓓ Switch quantity	
R	One on R side (Note 1)
L	One on L side (Note 1)
D	Two
T	Three
4	Four (when more than 4 switches, indicate switch quantity.)
Ⓔ Option	
A	Brackets for full stroke adjustment on both ends
A1	R side adjustable full-stroke with bracket (Note 2)
A2	L side adjustable full-stroke with bracket (Note 2)

⚠ Note on model no. selection

Note1: Refer to the switch installation position dimensions (page 2207) for the R side and L side.
Note2: Refer to page 2208 for the positions of R side and L side stroke adjustment fittings.
Note3: T type switches other than switch model no. are available. (Custom order) Refer to Ending 1 for the details.
Note4: The adjustable full-stroke bracket cannot be retrofitted

<Example of model number>

MRG2-10-100-T2H-D-A

Model: Rodless cylinder high precision guide type
Ⓐ Bore size : ϕ10mm
Ⓑ Stroke length : 100mm
Ⓒ Switch model no. : Proximity switch T2H
Ⓓ Switch quantity : Two
Ⓔ Option : Brackets for full stroke adjustment on both ends

How to order switch

SW – T0H*

Switch model no.
(Item Ⓒ above)

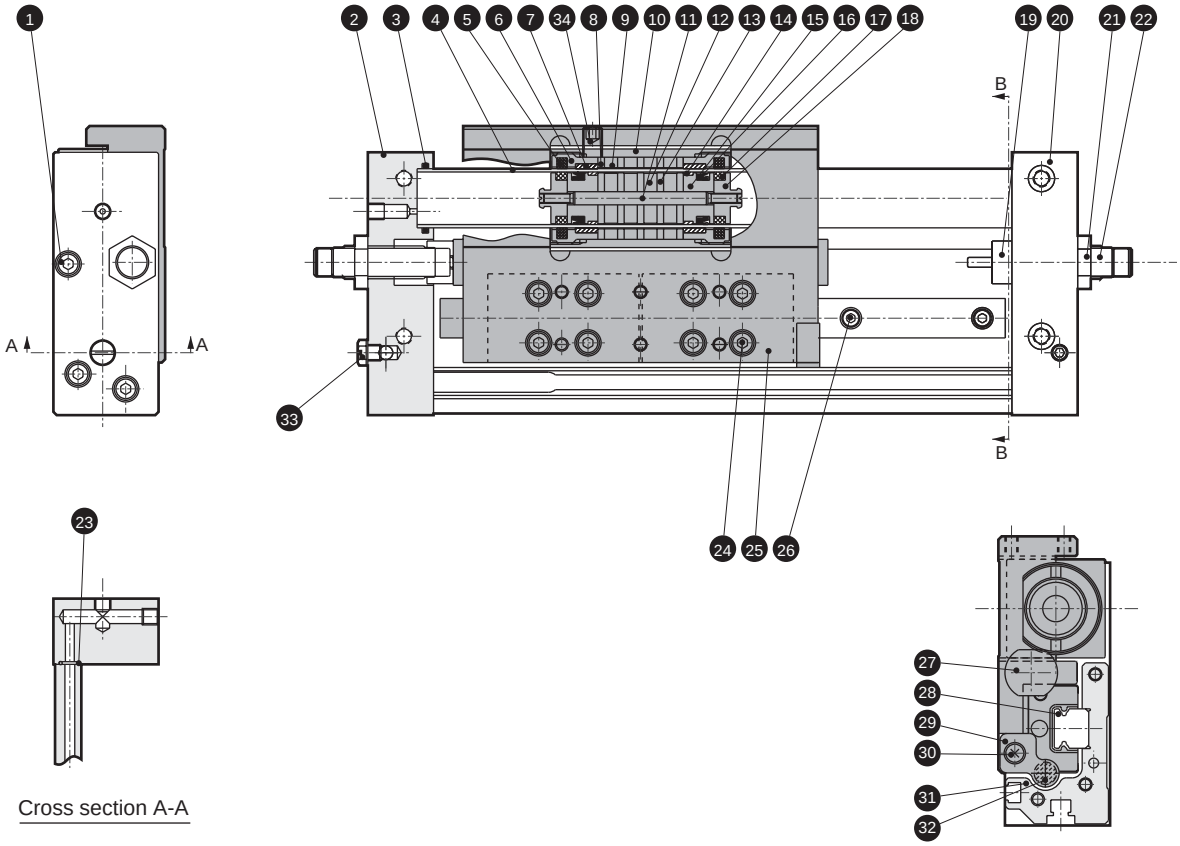
How to order discrete shock absorber

MRG2 – 10 – C

Bore size
(Item Ⓐ above)

Internal structure and parts list

● MRG2 (high precision guide type)



Cross section A-A

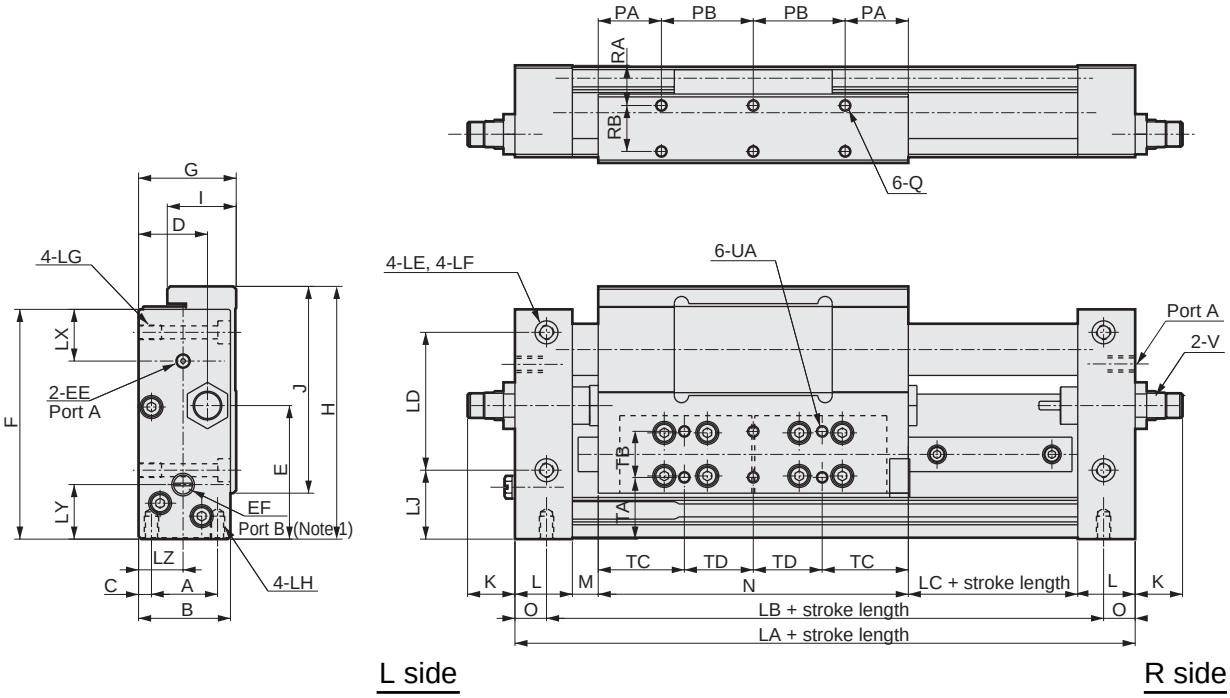
Cross section B-B

MRG2 (high precision guide type)

No.	Parts name	Material	Remarks	No.	Parts name	Material	Remarks
1	Hexagon socket head cap bolt	Stainless steel		18	Piston (2)	Aluminum alloy	Chromate
2	End plate (L)	Aluminum alloy	Alumite	19	Stopper cap	Stainless steel	
3	O ring	Nitrile rubber		20	End plate (R)	Aluminum alloy	Alumite
4	Cylinder tube	Stainless steel		21	Hexagon nut	Steel	Galvanizing
5	Lube keeping structure (slider)	Special rubber		22	Shock absorber		
6	Slider guard	Aluminum alloy	Chromate	23	O ring	Nitrile rubber	
7	Slider wear ring	Polyacetal resin		24	Hexagon socket head cap bolt	Stainless steel	
8	Slider yoke	Steel	Galvanizing	25	Table	Aluminum alloy	Alumite
9	Magnet	Special alloy		26	Hexagon socket head cap bolt	Stainless steel	
10	Slider	Aluminum alloy	Chromate	27	Rod receiving	Stainless steel	
11	Piston shaft	Stainless steel		28	Linear guide		
12	Magnet	Special alloy		29	Magnet holder	Polyacetal resin	
13	Piston yoke	Steel	Galvanizing	30	Cross headed pan	Stainless steel	
14	Piston wear ring	Polyacetal resin		31	Base	Aluminum alloy	Alumite
15	Piston (1)	Aluminum alloy	Chromate	32	Magnet	Special alloy	
16	Piston packing seal	Nitrile rubber		33	Plug	Copper alloy or steel	
17	Lube keeping structure (piston)	Special rubber		34	Hexagon socket head set screw	Stainless steel	Only ϕ25

Dimensions

● MRG2 (high precision guide type)



Symbol	Dimensions					Installation dimensions							
Bore size (mm)	LA	B	G	F	H	O	LB	LD	LJ	LE	LF	LG	LH
ϕ10	138	26	28	70	74	11	116	40	22	ϕ4.5	8 spot face depth 4.4	M5 depth 8	M4 depth 8
ϕ16	166	32	34	80	88	11	144	48	24	ϕ4.5	8 spot face depth 4.4	M5 depth 8	M5 depth 8
ϕ25	214	44	46	100	114	15	184	62	32	ϕ5.5	9.5 spot face depth 5.4	M6 depth 12	M6 depth 10

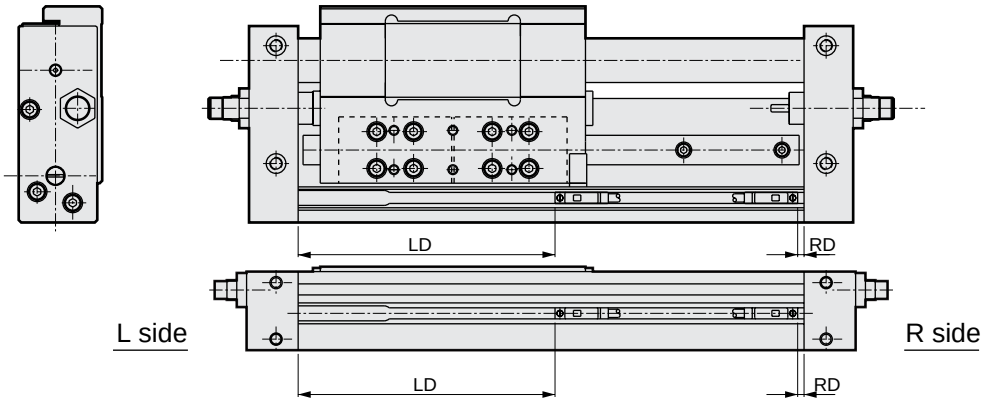
Symbol	Installation dimensions											
Bore size (mm)	A	C	PA	PB	RA	RB	Q	TA	TB	TC	TD	UA
ϕ10	18	4	16	24	12	12	M4 depth 6	19.5	13	24	16	M4 depth 6
ϕ16	23	4.5	22	32	14	16	M4 depth 6	21.5	16	30	24	M4 depth 6
ϕ25	23	5.5	34	40	20	20	M6 depth 8	23	22	38	36	M6 depth 8

Symbol	General dimensions													
Bore size (mm)	D	LX	EE	LY	EF	LZ	E	I	J	K	L	M	N	LC	V
ϕ10	19	18	M5 depth 4	17	M5 depth 4	11.5	38.5	20	58	14	20	9	80	9	MRG2-10-C
ϕ16	24	18	M5 depth 4	19	M5 depth 4	15	46.5	24	72	16.5	20	9	108	9	MRG2-16-C
ϕ25	32.5	23	Rc1/8	21.5	Rc1/8	23	55	32	98	19	25	8	148	8	MRG2-25-C

Note 1: When using the single face common piping, remove the plug from the port B and attach that plug to the R side port A.

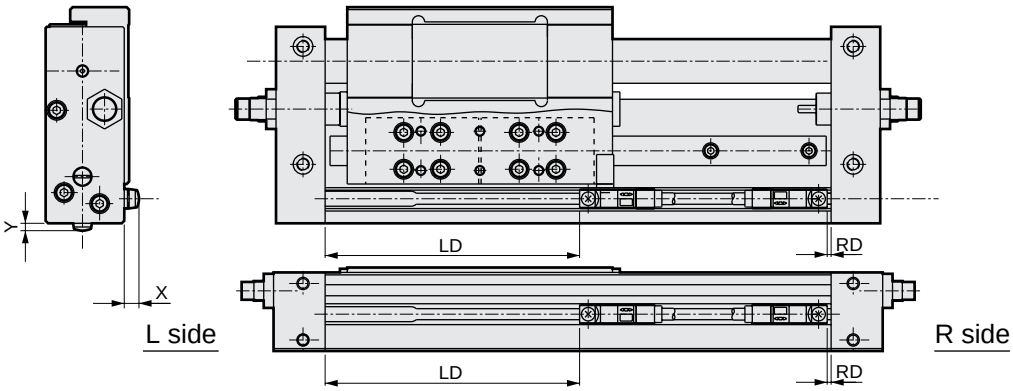
Switch installation position dimensional drawing

● MRG2- (switch: T0H/V, T5H/V, T2H/V, T3H/V)



	Symbol	T0 H/V, T5 H/V		T2 H/V, T3 H/V	
	Bore size (mm)	RD	LD	RD	LD
MRG2	ϕ10	1.5	75.5	2.5	76.5
	ϕ16	1.5	103.5	2.5	104.5
	ϕ25	0.5	142.5	1.5	143.5
MRG2-*-A	ϕ10	26.5	100.5	27.5	101.5
	ϕ16	26.5	128.5	27.5	129.5
	ϕ25	50.5	192.5	51.5	193.5
MRG2-*-A1	ϕ10	51.5	75.5	52.5	76.5
	ϕ16	51.5	103.5	52.5	104.5
	ϕ25	100.5	142.5	101.5	143.5
MRG2-*-A2	ϕ10	1.5	125.5	2.5	126.5
	ϕ16	1.5	153.5	2.5	154.5
	ϕ25	0.5	242.5	1.5	243.5

● MRG2- (switch: T1H/V, T2Y*H/V, T3Y*H/V)

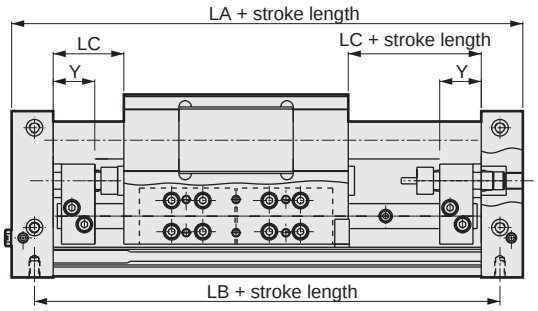


	Symbol	T2Y*H/V, T3Y*H/V			
	Bore size (mm)	RD	LD	X	Y
MRG2	ϕ10	1.5	75.5	6 (11.5)	3 (8.5)
	ϕ16	1.5	103.5	6 (11.5)	3 (8.5)
	ϕ25	0.5	142.5	6 (11.5)	3 (8.5)
MRG2-*-A	ϕ10	26.5	100.5	6 (11.5)	3 (8.5)
	ϕ16	26.5	128.5	6 (11.5)	3 (8.5)
	ϕ25	50.5	192.5	6 (11.5)	3 (8.5)
MRG2-*-A1	ϕ10	51.5	75.5	6 (11.5)	3 (8.5)
	ϕ16	51.5	103.5	6 (11.5)	3 (8.5)
	ϕ25	100.5	142.5	6 (11.5)	3 (8.5)
MRG2-*-A2	ϕ10	1.5	125.5	6 (11.5)	3 (8.5)
	ϕ16	1.5	153.5	6 (11.5)	3 (8.5)
	ϕ25	0.5	242.5	6 (11.5)	3 (8.5)

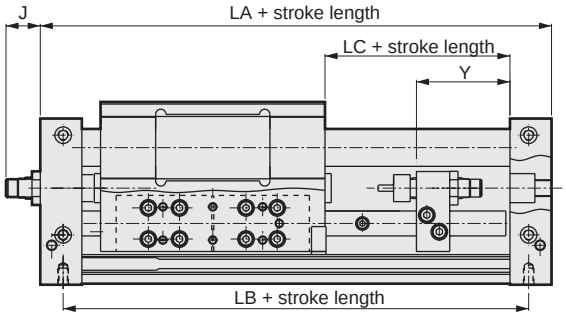
Note 1: Values in parentheses apply for the T1H/V and preventive maintenance output type.

Dimensions

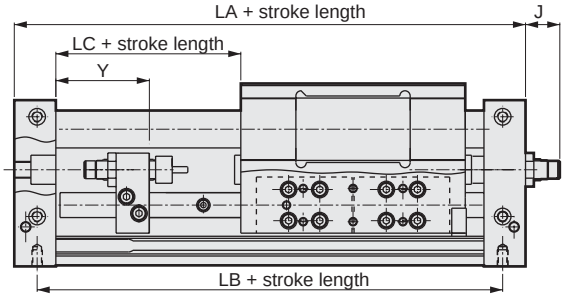
● MRG2-*-A (high precision guide type, brackets for full stroke adjustment on both ends)



● MRG2-*-A1 (high precision guide type, R side adjustable full-stroke with bracket)



● MRG2-*-A2 (high precision guide type, L side adjustable full-stroke with bracket)



Symbol	LA			LB			LC			Y			J		
Bore size (mm)	A	A1	A2	A	A1	A2	A	A1	A2	A	A1	A2	A	A1	A2
ϕ10	188			166			34	59		20	45		-	14	
ϕ16	216			194			34	59		20	45		-	16.5	
ϕ25	314			284			58	108		41	91		-	19	

MRG2 Series selection guide

● Selecting conditions are different from general cylinders. Please check if the proper product is selected according to selection guide.

STEP-1

When selecting new model → STEP-2

When confirming if proper one is selected after working condition and size (bore size) are already determined. → STEP-5

STEP-2

● Working conditions confirmation

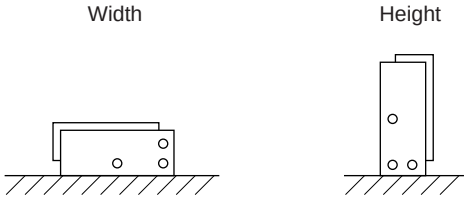
1. Working pressure (P) ☐ (MPa)
2. Load (W) ☐ (N) (Load = workpiece load + jig load)
3. Installation attitude Width/Height (Refer to the following diagram " fig.1")
4. Stroke length (L) ☐ (m)
5. Moving time (t) ☐ (S)
6. Average speed (Va) ☐ (m/s)

Formula of cylinder average speed Va

$$Va = \frac{L}{t} \text{ (m/s)}$$

<Installation attitude>
Operation direction : horizontal, vertical-up, vertical-down
Installation attitude : width, height (refer to the Fig.1)

Fig.1



STEP-3

● Calculating required thrust

Calculate the cylinder required thrust (F_N)

1. At horizontal operation
   $F_N = W \times 0.2^*$ = ☐ (N)
2. At vertical operation
   $F_N = W$ = ☐ (N)

* This is a frictional resistance value such as guide section, etc., when the load was put on the slider. Special consideration is required when a separate resistor is provided externally.

STEP-4

● Roughly selecting cylinder size

$$\text{Cylinder required thrust } F_N \leqq \text{theoretical thrust} \times \frac{\mu}{100} \times \frac{\alpha}{100}$$

μ : Thrust efficiency (%) (Refer to the Fig.2.)
α : Load factor (%) (Refer to the Table 2.)

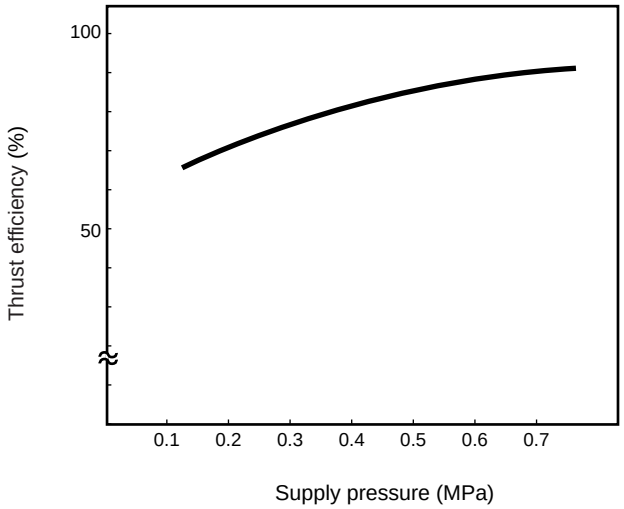
Select a cylinder size which satisfies these conditions.

Table 1. Theoretical thrust

(N)

Bore size (mm)	Working pressure MPa					
	0.2	0.3	0.4	0.5	0.6	0.7
ϕ10	-	24	31	39	47	55
ϕ16	40	60	80	101	121	139
ϕ25	98	147	196	245	295	339

Fig.2. Thrust efficiency μ



Load factor α : should be within the range of the following Table 2 for general use.

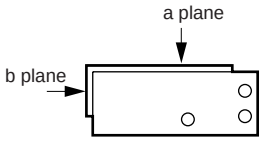
Table 2. Reference of load factor

Working pressure MPa	α (%)
0.2 to 0.3	$\alpha \leqq 40$
0.3 to 0.6	$\alpha \leqq 50$
0.6 to 0.7	$\alpha \leqq 60$

STEP-5

● Calculation of vertical load and each moment value

Calculate vertical load (W1, 2), and moment (M1, M2, M3) according to cylinder installation conditions of load.



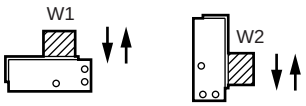
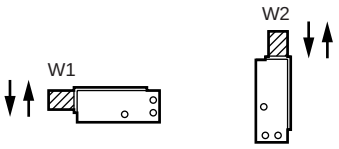
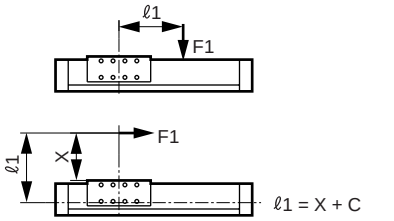
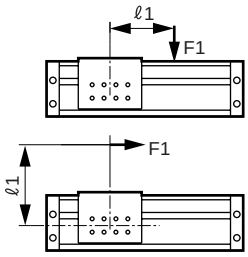
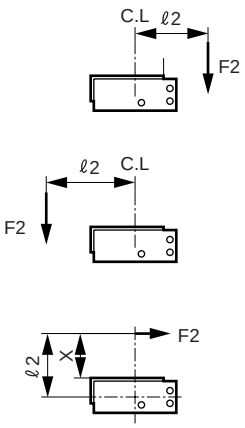
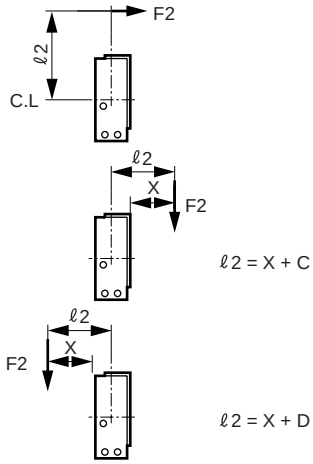
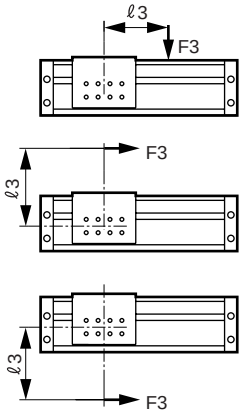
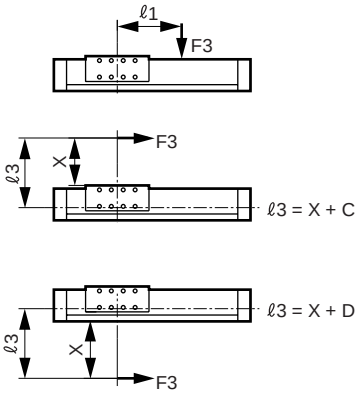
	a plane installation	b plane installation	Calculation result
Vertical load W1 W2			W_1= W_2=
Bending moment M1 = F1x ℓ1	 X is the distance from the slider surface to the force actuation point		M_1=
Radial moment M2 = F2 x ℓ2	 C.L indicates the center between the a surface mounting screws		M_2=
Twist moment M3 = F3 x ℓ3			M_3=

Table 3. Each parameter value

(m)

Bore size (mm)	C	D
ϕ10	0.016	0.012
ϕ16	0.020	0.014
ϕ25	0.026	0.020

STEP-6

● Confirming vertical load and each composite moment

Divide each load by the value on Table 4 to find moment ration, and confirm if the total is 1.0 or less.

$$\frac{W1\ (\text{or } W2)}{W1\ (\text{or } W2)\ \text{max.}} + \frac{M1}{M1max} + \frac{M2}{M2max} + \frac{M3}{M3max} \leqq 1.0$$

If the total is larger than 1.0

1. Reexamine load → STEP-2
2. Review cylinder bore size etc. as selecting large bore size. → Increase cylinder bore size → STEP-5

Table 4. Vertical load, maximum allowable value of each moment

Bore size (mm)	W1max. (N)	W2max. (N)	M1max. (N·m)	M2max. (N·m)	M3max. (N·m)
ϕ10	44	35	2.2	1.2	2.2
ϕ16	103	91	7.4	3.2	7.4
ϕ25	176	176	18.3	7.3	18.3

STEP-7

● Kinetic energy confirmation

Calculate the kinetic energy from the load weight m (kg) and speed V (m/s), and make sure that it is within the specified range for the shock absorber.

If the specifications are exceeded, increase the cylinder size or consider installing an external damper.

(1) Formula of kinetic energy

$$E_1 = \frac{1}{2} \times m \times V^2 = \square\ (J)$$

$$m = \frac{W}{9.8} = \square\ (kg)$$

$$V = \frac{L}{t} \times \left(1 + 1.5 \times \frac{\alpha}{100} \right) = \square\ (m/s)$$

$$\alpha = \frac{FN}{\text{Cylinder theoretical thrust} \times \frac{\mu}{100}} \times 100 = \square\ (\%)$$

E_1	: Kinetic energy	(J)
m	: Load weight	(kg)
V	: Speed	(m/s)
W	: Load	(N)
L	: Cylinder stroke	(m)
t	: Operation time	(s)
α	: Cylinder load factor	(%)
F_N	: Required thrust	(N)
μ	: Thrust efficiency	(%)

(2) Shock absorber

Table 5 shows shock absorbers used for MRG2.

Table 5. Specifications of shock absorber

Model	MRG2-10	MRG2-16	MRG2-25
Shock absorber model no.	MRG2-10-C (NCK-00-0.3 used)	MRG2-16-C (NCK-00-0.7 used)	MRG2-25-C (NCK-00-1.2 used)
Maximum energy absorption (J) Note 1	2.1	5.3	8.7
Stroke length (mm) Note 1	5	7	8.5
Energy absorption per hour (J/Hr)	6.3	12.6	21.6
Max. repeating cycle (time/min)	35	30	30

Note 1) The movement is stopped just before the stroke end with a stopper cap, so the energy and stroke are smaller than the standard product.

● Confirming allowable colliding energy of shock absorber

Calculate colliding object equivalent weight Me, and colliding energy E according to the formula on the table below, and confirm if Me and E should not be greater than the allowable values of Fig.4, Table 5. Also, refer to Table 5 to check if specifications of repeat frequency should be allowable values or less.

● Symbol

E	: Colliding energy		(J)
Me	: Colliding object equivalent weight		(kg)
m	: Load weight		(kg)
F	: Cylinder thrust		(N)
V	: Colliding speed		(m/s)
St	: Stroke of shock absorber		(m)
g	: Gravity acceleration	9.8	(m/s^2)

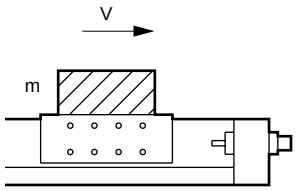
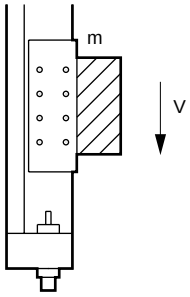
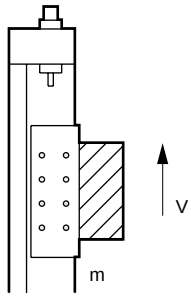
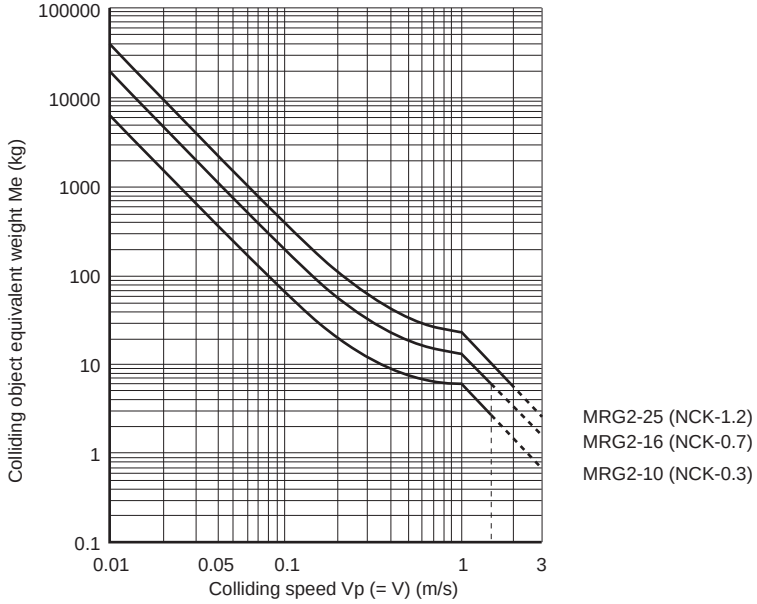
	Horizontal movement	Moving downward	Moving upward
Applications			
Colliding object equivalent weight Me (kg)	$Me = m + \frac{2F \cdot St}{V^2}$	$Me = m + \frac{2 \cdot St\ (F + mg)}{V^2}$	$Me = m + \frac{2 \cdot St\ (F - mg)}{V^2}$
Energy E (J)	$E = \frac{mV^2}{2} + F \cdot St$	$E = \frac{mV^2}{2} + (F + mg) \cdot St$	$E = \frac{mV^2}{2} + (F - mg) \cdot St$

Fig. 4

Vp-Me characteristics (colliding speed-colliding object equivalent weight)



STEP-8

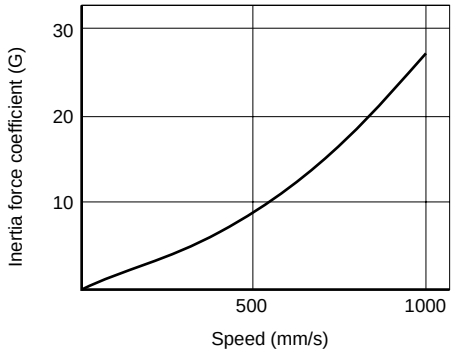
● Inertia load confirmation

The inertial force generated from the load is applied at the stroke end.
Confirm that the force is within the allowable range.

(1) Calculate inertia force (F1) according to velocity (V) and inertia force coefficient on Fig.5.

Fi = 9.8 x m x G (N)
m: Load weight (kg)
G: Inertia force coefficient

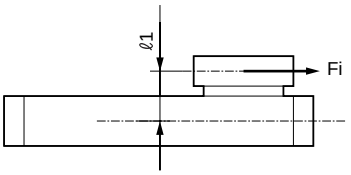
Fig.5. Inertia force coefficient



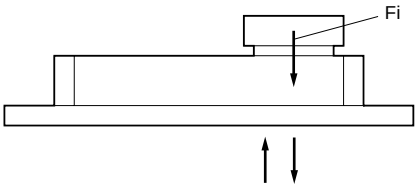
(2) Calculate the load or moment generated from the inertial force.

(Example)

M1i = Fi x ℓ1



W1i = Fi



When elevating the entire cylinder

(3) Add the load or moment generated by the static load and inertial force, and divide it by the allowable value given in Table 4. Confirm that the total is 1.0 or less.

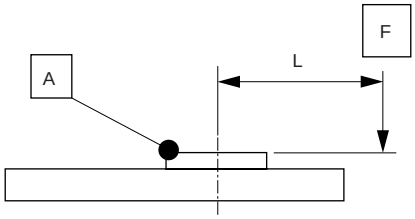
W1g = W1 + W1i
W2g = W2 + W2i

M1g = M1 + M1i
M2g = M2 + M2i
M3g = M3 + M3i

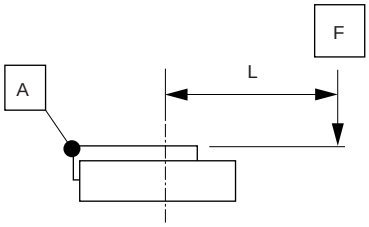
$$\frac{W1g\ (\text{or } W2g)}{W1\ (\text{or } W2)\ \text{max.}} + \frac{M1g}{M1\ \text{max}} + \frac{M2g}{M2\ \text{max}} + \frac{M3g}{M3\ \text{max}} \leqq 1.0$$

Displacement of MRG2 table (reference value)

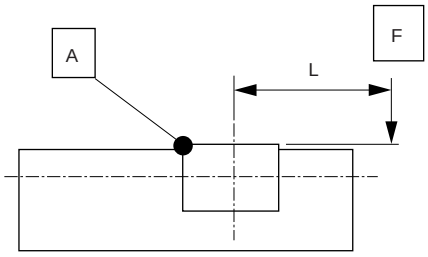
● Bending moment direction
M1 = F x L



● Radial moment direction
M2 = F x L

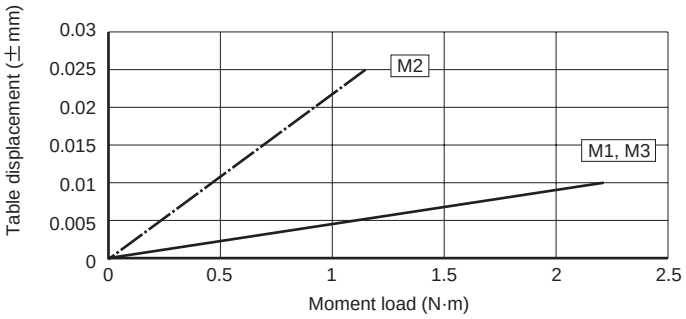


● Twist moment direction
M3 = F x L

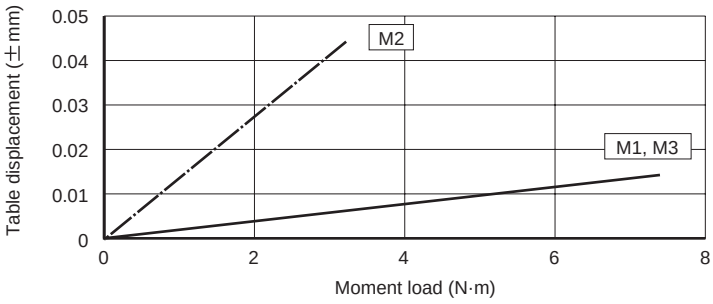


A displacement amount = table displacement amount

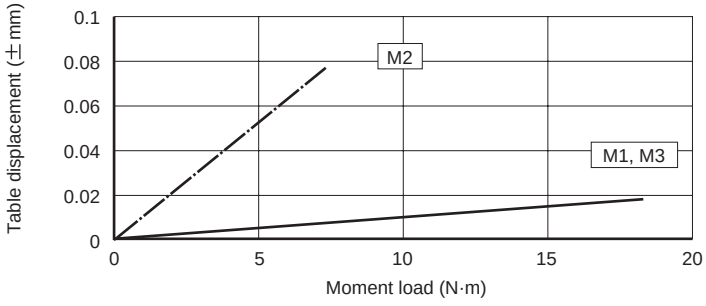
● MRG2-10



● MRG2-16



● MRG2-25



Note: The table displacement amount indicates the reference value at the stroke end.