Document No.: CY*F-OM0002F -A

OPERATION MANUAL

Series CY1F

Magnetically Coupling Rodless Cylinder /Low Center of Gravity Guide

- ○Please read thoroughly and understand this operation manual before the installation and the operation of this product.
- ○Please give special attention to the description concerning safety.
- ○Please keep this operation manual nearby to refer to it at any time.

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SMC CORPORATION

CONTENTS

Series CY1F

Magnetically Coupling Rodless Cylinder/Low Center of Gravity Guide

Series CY1F
Safety Instructions

These safety instructions are intended to prevent hazardous situation and/or equipment damage. These instructions indicate the level of potential hazard by labeling "Caution", "Warning" or "Danger". To ensure safety, be sure to observe ISO4414 Note1), JIS B 8370 Note2) and other safety practices.

⚠ **Caution:** Operator error could result in injury or equipment damage.

⚠ **Warning:** Operator error could result in serious injury or loss of life.

⚠ **Danger:** In extreme conditions, there is a possibility of serious injury or loss of life.

Note1) ISO 4414: Pneumatic fluid power – Recommendations for the application of equipment to transmission and control systems.
Note2) JIS B 8370 : Pneumatic system axiom.

1. The compatibility of pneumatic equipment is the responsibility of the person who designs the pneumatic system or decides its specifications.
Since the products specified here are used in various operating conditions, their compatibility with the specific pneumatic system must be based on specifications or after analysis and/or tests to meet your specific requirements.

2. Only trained personnel should operate pneumatically operated machinery and equipment.
Compressed air can be dangerous if an operator is unfamiliar with it. Assembly, handling or repair of pneumatic systems should be performed by trained and experienced operators.

3. Do not service machinery/equipment or attempt to remove components until safety is confirmed.
1. Inspection and maintenance of machinery/equipment should only be performed after confirmation of safe locked-out control positions.
2. When equipment is to be removed, confirm the safety process as mentioned above. Cut the supply pressure for the equipment and exhaust all residual compressed air in the system.
3. Before machinery/equipment is re-started, take measures to prevent quick extensions of the cylinder piston rod etc.(Bleed air into the system gradually to create back-pressure.)

4. Contact SMC if the product is to be used in any of the following conditions:
1. Conditions and environments beyond the given specifications, or if product is used outdoors.
2. Installation on equipment in conjunction with atomic energy, railway, air navigation, vehicles, medical equipment, food and beverage, recreation equipment, emergency stop circuits, press applications, or safety equipment.
3. An application which has the possibility of having negative effects on people, property, or animals, requiring special safety analysis.

1.Specifications

1-1.Cylinder Specifications

	Bore size[mm]	10	15	25
	Fluid	Air		
	Lubrication	Non-lube		
	Action	Double acting		
	Max. operating pressure[MPa]	0.7		
	Min. operating pressure[MPa]	0.2		
	Proof pressure[MPa]	1.05		
	Ambient and fluid temperature [℃]	-10 to 60		
	Operating piston speed[mm/s]	50 to 500		
	Cushion	Built-in shock absorber		
	Stroke tolerance[mm]	0 to 250st : $^{+1.0}_{0}$	251 to 1000st : $^{+1.4}_{0}$	1001st to : $^{+1.8}_{0}$
Note1)	Allowable stroke adjustment range[mm]	-1.2 to 0.8		-1.4 to 0.6
	Piping	Shock absorber		
Note2)	Piping port size	M5×0.8		Rc 1/8
	Magnetic holding force[N]	53.9	137	363

Note1)Allowable stroke adjustment range indicated above shows the case of standard adjustment bolt.

Note2)Piping connection threads can be selected in case the size is 25.

1-2.Shock Absorber Specifications

	Applicable bore size[mm]		10, 15	25
	Shock absorber		RB0805-X552	RB1006-X552
	Max. absorbing energy[J]		0.98	3.92
	Absorption stroke[mm]		5	6
Note)	Max. impact speed[m/s]		0.05 to 5	
	Max. operating frequency [cycle/min]		80	70
	Spring force[N]	Extended	1.96	4.22
		Retracted	3.83	6.18
	Weight[g]		15	25

Note)Indicate the time of maximum absorbing energy per cycle. Therefore, the operating frequency can be increased according to the energy absorption.

1-3.Standard Stroke

Bore size [mm]	Standard stroke[mm]	Maximum available stroke[mm]
10	50, 100, 150, 200, 250, 300	500
15	50, 100, 150, 200, 250, 300, 350, 400, 450, 500	750
25	100, 150, 200, 250, 300, 350, 400, 450, 500, 550, 600	1200

Note)Strokes are available in 1mm increments, up to the maximum stroke.

However, suffix "-XB10" to the end of the part number for satisfying standard stroke range. Also, when exceeding its range, specify "-XB11" at the end of the part number.

Refer to SMC's catalog for details.

2.Precautions

2-1.Precautions on Handling

⚠ Caution

1.Do not apply strong shocks or excessive moments to the slide table(movable carriage).

The slide table(movable carriage) is supported by precision bearings. Therefore, strong shocks or excessive moments must not be applied when mounting a workpiece.

2.Do not scratch or damage the cylinder tube by striking it or placing objects on it.

The cylinder tube is manufactured to precise tolerances. Therefore, even a slight deformation can cause malfunction.

3.Do not unnecessarily alter the setting of the guide.

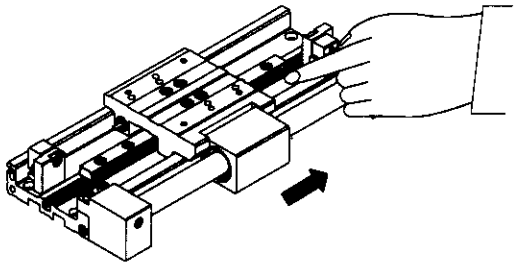
Guide is preset and mounted with appropriate tightening torque. Therefore, do not loosen or remove the mounting bolt of the guide. If unnecessarily loosen the mounting bolt, it can cause malfunction.

4.Do not operate with the magnetic coupling of magnetically coupled rodless cylinder of the actuator out of position.

When the magnetic coupling is out of position due to external force beyond holding force, push the external slider back into the correct position by supplying air pressure of approx.0.7MPa to the cylinder port at the stroke end.

5.Take precautions of preventing your fingers from getting caught.

The clearance between the slide table and the adjustment holder is small at the stroke end, posing the risk of getting your hands caught. Therefore, mount a protective cover at designing process to prevent personnel from coming into direct contact with this area.



6.Do not disassemble the magnetic components(external slider, internal slider) of the actuator(cylinder).

This can cause loss of holding force and malfunction.

7.Do not use till correct operation is verified.

After mounting and repair/refit, conduct adequate functional and leak tests with supplying compressed air and connecting power to see if mounting situation is correct.

2-2.Operating Environment

Warning

1.Do not use in environment where there is a danger of corrosion.

Refer to the construction regarding cylinder materials.

2.Do not use in environment where the cylinder is exposed to coolant, cutting oil, water droplet, adhesive extraneous materials, dust, etc. and avoid using with compressed air containing drainage or extraneous materials.

Extraneous materials and liquid inside/outside of the cylinder can wash away or deteriorate the lubricant grease, and may cause malfunction and breakage.

When the cylinder is used in areas where water or oil droplet splash or in dusty locations, use a cover to protect the cylinder from direct contact and operate under clean compressed air condition.

2-3.Air Supply

Warning

1.Use clean air.

If compressed air contains chemicals, synthetic oils containing organic solvents, salt or corrosive gases, etc., it can cause breakage or malfunction.

Caution

1.Mount air filters.

Mount air filters at the upstream side of valves. The filtration degree should be 5 μm or less.

2.Mount an after cooler, air dryer, water separator, etc.

Compressed air containing excessive drains may cause malfunction of valves and other pneumatic equipment. To prevent this, mount an after cooler, air dryer, water separator, etc.

3.Use the product within the specified range of fluid and ambient temperature.

Take measures to prevent freezing, since moisture in circuits will be frozen under 5°C and it can cause malfunction.

Refer to SMC's "Air Cleaning Equipment" catalog for details on compressed air quality.

2-4.Lubrication

⚠ Caution

1.Lubrication to non-lube type cylinder.

The cylinder can be used without any further lubrication since it has been lubricated for life at the factory.

However, in the event that it will be lubricated, use class 1 turbine oil(with no additives) ISO VG32.

Stopping lubrication later may lead to malfunction due to the loss of the original lubricant. Therefore, lubrication must be continued once it has been started.

2-5.Maintenance

⚠ Warning

1.Machine maintenance, and supply/exhaust of compressed air.

Equipment should be removed after confirmation of safe locked-out control positions and cut the supply pressure for the equipment and exhaust all residual compressed air in the system.

Before restarted, take measures to prevent quick extension.

2.Drain flushing.

Remove drains from air filters regularly.

3.Mounting on the Equipment

3-1.Mounting Surface

Caution

1.While a high level of flatness is desired for the mounting surface, if sufficient flatness cannot be attained, use shims to adjust the height, etc. of body and mounting surface so that the slide table(movable carriage) can operate throughout its stroke under the minimum operating pressure(0.2MPa).

3-2.Precautions on Mounting

Caution

1.Do not apply strong shocks or excessive moments to the slide table(movable carriage).

The slide table(movable carriage) is supported by precision bearings. Therefore, strong shocks or excessive moments must not be applied when mounting a workpiece.

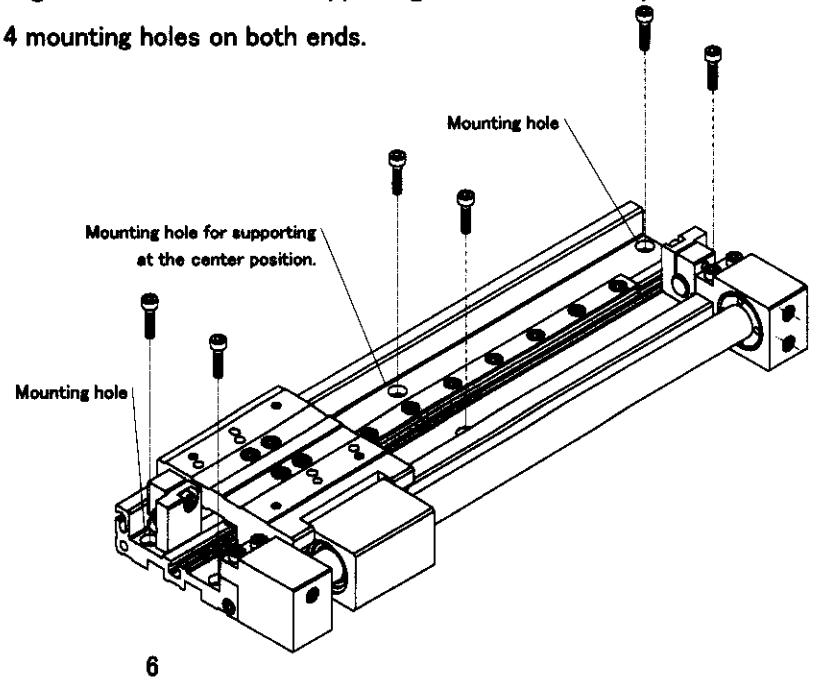
2.Careful alignment is necessary when connecting to a load which has an external guide mechanism.

The magnetically coupled rodless cylinder(series CY1F) can be used with a direct load within the allowable range of guide. However, careful alignment is necessary when connecting to a load which has an external guide mechanism.

Since variation of the shaft center increases as the stroke becomes longer, a connection method(floating mechanism) should be devised which can assimilate this displacement.

3.Be sure to hold with 4 mounting holes on both ends of the guide when mounting.

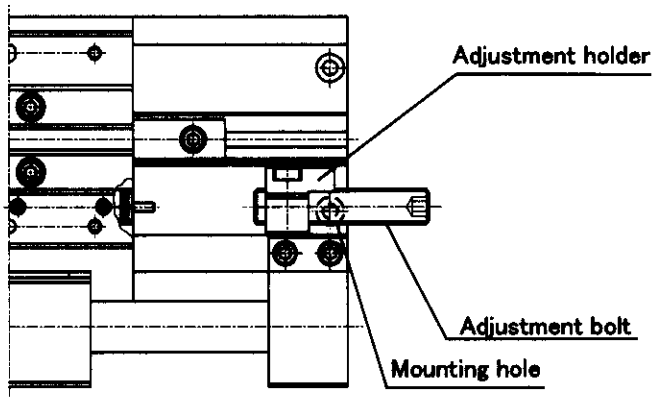
Mounting holes at the center of guide are the one for supporting the intermediate position. Therefore, be sure to hold with 4 mounting holes on both ends.



4.If selecting 25mm adjustment bolt, mounting hole will be interfered by adjustment bolt. Therefore, readjust adjustment bolt after setting the cylinder.

Hold the cylinder using mounting bolt after sliding adjustment bolt to where it does not interfere mounting hole based on the section 5-2 "Adjustment of Adjustment Bolt".

Readjust stroke with adjustment bolt after holding the cylinder.



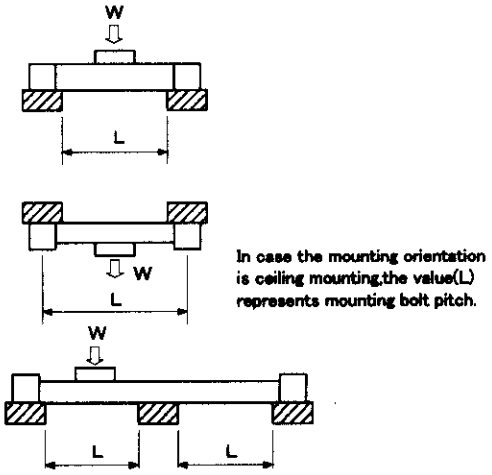
In case of 25mm adjustment bolt

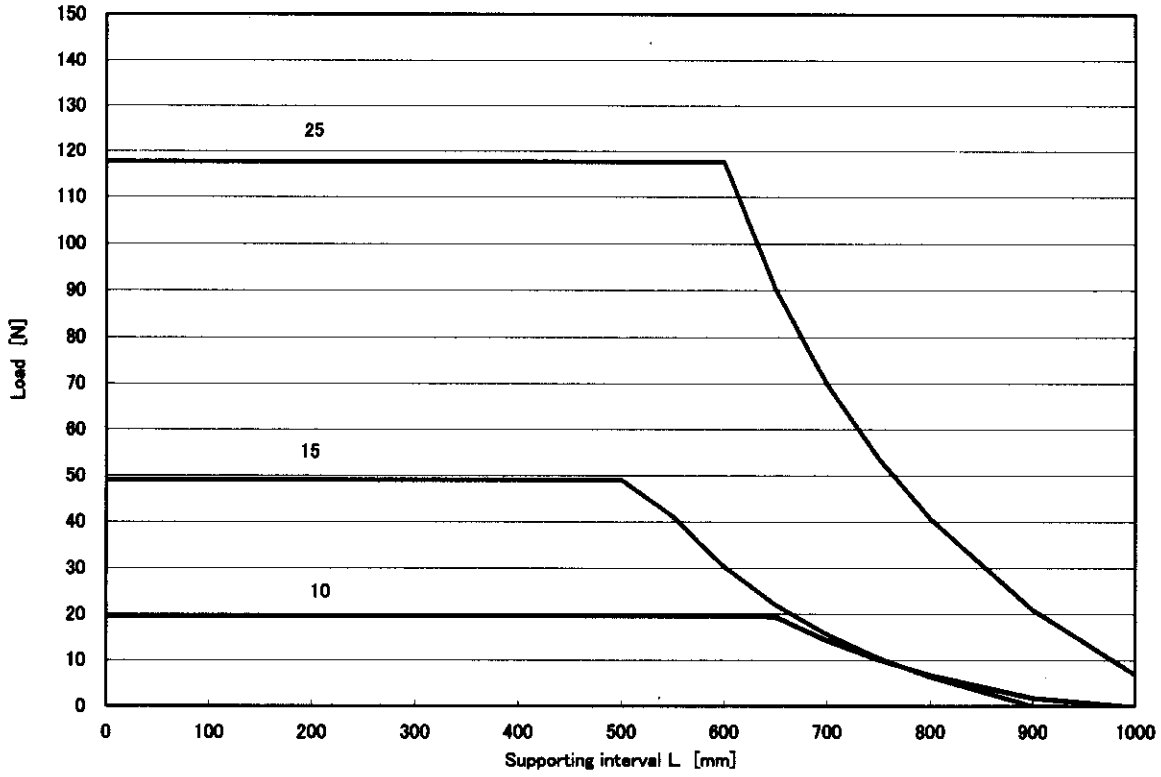
⚠ Caution

5.For long stroke operation, the body and the cylinder tube may be deflected due to its weight and load. In that case, support the center on the cylinder using mounting holes at the center position.

Support the center on the cylinder using mounting hole at the center of body so that supporting interval(L) will be lower than the value shown in the diagram.

- If the accuracy of mounting surface is not sufficient, it may cause malfunction. Therefore, adjust level at the same time.
- Despite the value(L) is lower than the one shown in the diagram, support the center on the cylinder under the condition of pulsation/impact.





Load and Supporting interval

6.Load weight and operating pressure are restricted when operating in the vertical direction.

When operating in the vertical direction, check the allowable value based on the section 7-5 "Restrictions on Vertical Operation".

If operating beyond the allowable value, there is a possibility of drop of the workpiece by breakage of the magnetic coupling.

7.Do not use the actuator as a single part.

The actuator(cylinder) can be installed/removed at/from the guide. However, it is for body driving so that do not use it as a single part or apply a load to the slider.

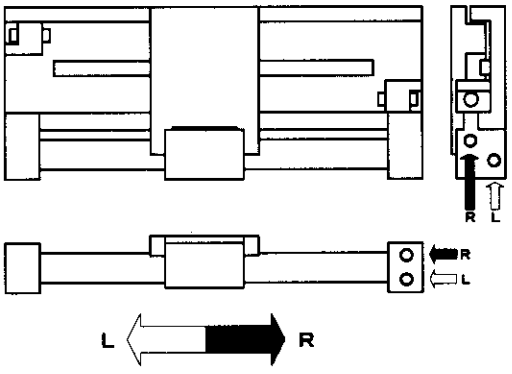
4.Piping

Caution

1.Take precautions of piping port and operating direction of slide table.

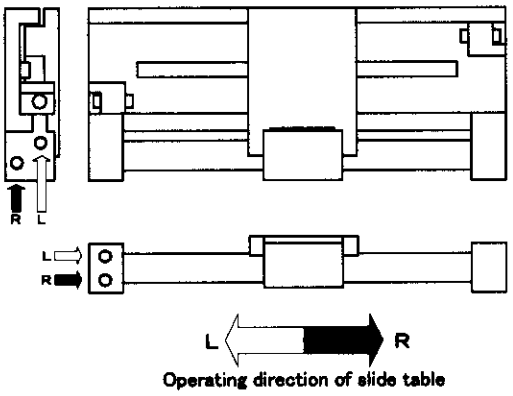
Take precautions that centralized piping on the right side differs from that of left side as to piping port and operating direction.

Centralized piping on right side



Operating direction of slide table

Centralized piping on left side



Operating direction of slide table

2.Piping port can be used by changing plug position according to its operating situation.

Sealant tape should be wrapped to the plug to prevent leakage when re-screwing plug.

(1)In case of M5.

Tighten 1/6 to 1/4 turn from where plug stops by tightening slightly.

(2)In case of Rc1/8.

The tightening torque should be 7 to 9N·m by using screw driver.

3.Take precautions that plugs, which are not indicated above, cannot be used as piping. Therefore, do not remove it.

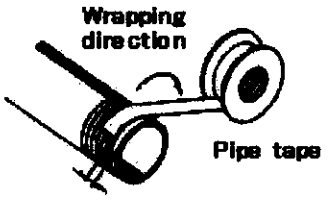
4.Preparation before piping.

Before piping is connected, it should be thoroughly blown out with air(flushing) or washed to remove cutting chips, cutting oil and other debris from inside the pipe.

5.Wrapping of sealant tape.

When connecting pipes and fittings, etc., be sure not to get cutting chips of the pipe threads and sealing material inside the piping.

Also, when sealant tape is used, leave 1.5 to 2 thread ridges exposed at the end of the pipe/fitting.



Expose approx.2 threads

5.Stroke Adjustment

5-1.Stroke Adjustment

For series CY1F, stroke can be adjusted by adjusting adjustment bolt which is included with the cylinder.

Refer to the diagram indicated below for stroke adjustment range.

[mm]

Bore size [mm]	Standard adjustment bolt	25mm adjustment bolt
10	−1.2 to 0.8	−25.2 to 0.8
15		
25	−1.4 to 0.6	−25.4 to 0.6

Adjustment range indicated above represents that of single side.

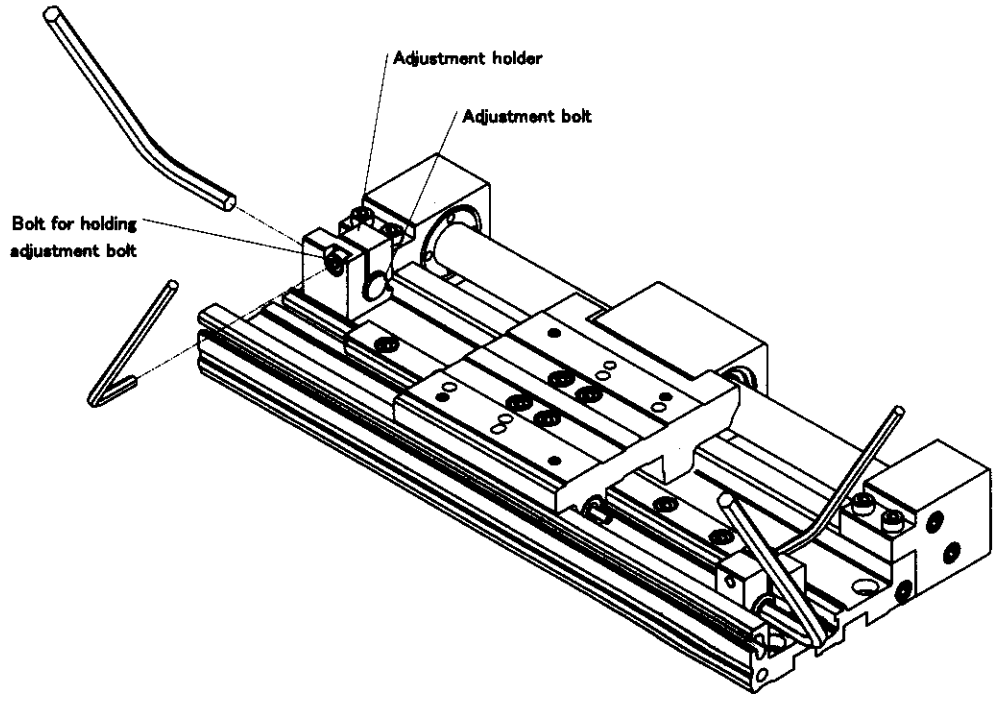
5-2.Adjustment of Adjustment Bolt(Stroke Adjustment)

(1)Loosen the bolt for holding adjustment bolt.

(2)Adjust adjustment bolt by inserting hexagon wrench into hexagon hole on the end face of it.

(3)Tighten bolt for holding adjustment bolt after adjusting.

Bore size [mm]	Bolt for holding adjustment bolt	Tightening torque	Width across flats for adjustment
10	M3	1.0 to 1.3N·m	4
15			
25	M5	4.9 to 6.0N·m	5



5-3.Precautions on Stroke Adjustment

⚠ Warning

1.Do not use till correct operation is verified.

Stroke should be adjusted after confirmation of safe locked-out control positions and cut the supply pressure for the equipment and exhaust all residual compressed air in the system.

Before restarted, take measures to prevent quick extension.

⚠ Caution

2.Take precautions of the restrictions on operating pressure when adjusting stroke.

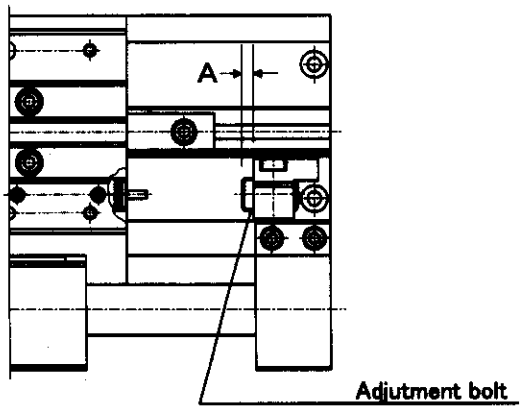
When adjusting stroke shorter than standard stroke using adjustment bolt, operating pressure should be lower than the limit based on the section 7-6, 1 " In case of stopping the load at intermediate position by using external stopper, etc. and adjusting stroke by using adjustment bolt." Magnetic coupling of the actuator(cylinder) will be broken when operating beyond the limit of operating pressure.

3.Adjust stroke based on the distance from the end face of adjustment bolt to that of adjustment holder as a guide.

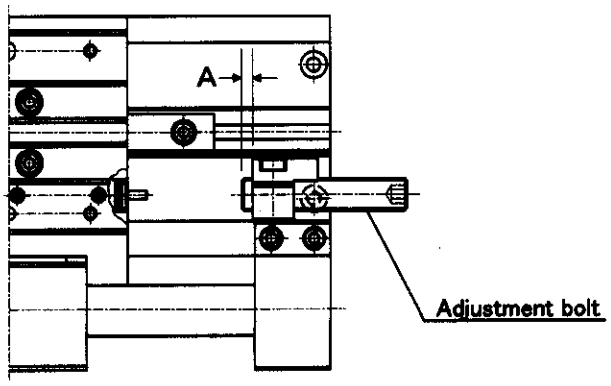
Take precautions that slide table and adjustment holder will be collided when A dimension is smaller than 0. Also, slide table will be scratched and damaged.

[mm]

Bore size [mm]	Standard adjustment bolt at minimum stroke	25mm adjustment bolt at minimum stroke	Standard stroke	At maximum stroke
10	A<2	A<26	A=0.8	A≧0
15				
25	A<2	A<26	A=0.6	



In case of standard adjustment bolt



In case of 25mm adjustment bolt

6.Replacement parts and Maintenance

6-1.Actuator(Cylinder)

1.Actuator(Cylinder) can be replaced in case of series CY1F.

Order the replacement actuator(cylinder) based on the order number indicated below.

Order number of the replacement actuator(cylinder)

CY1F	B	10		R	—	Stroke

Series

Identification symbol of the cylinder

Cylinder tube bore size

10	Φ10
15	Φ15
25	Φ25

Number of piping direction

R	Centralized piping on right side
L	Centralized piping on left side

Piping thread

Symbol	Thread	Tube bore size
NIL	M	10, 15
	Rc	25
TN	NPT	
TF	G	

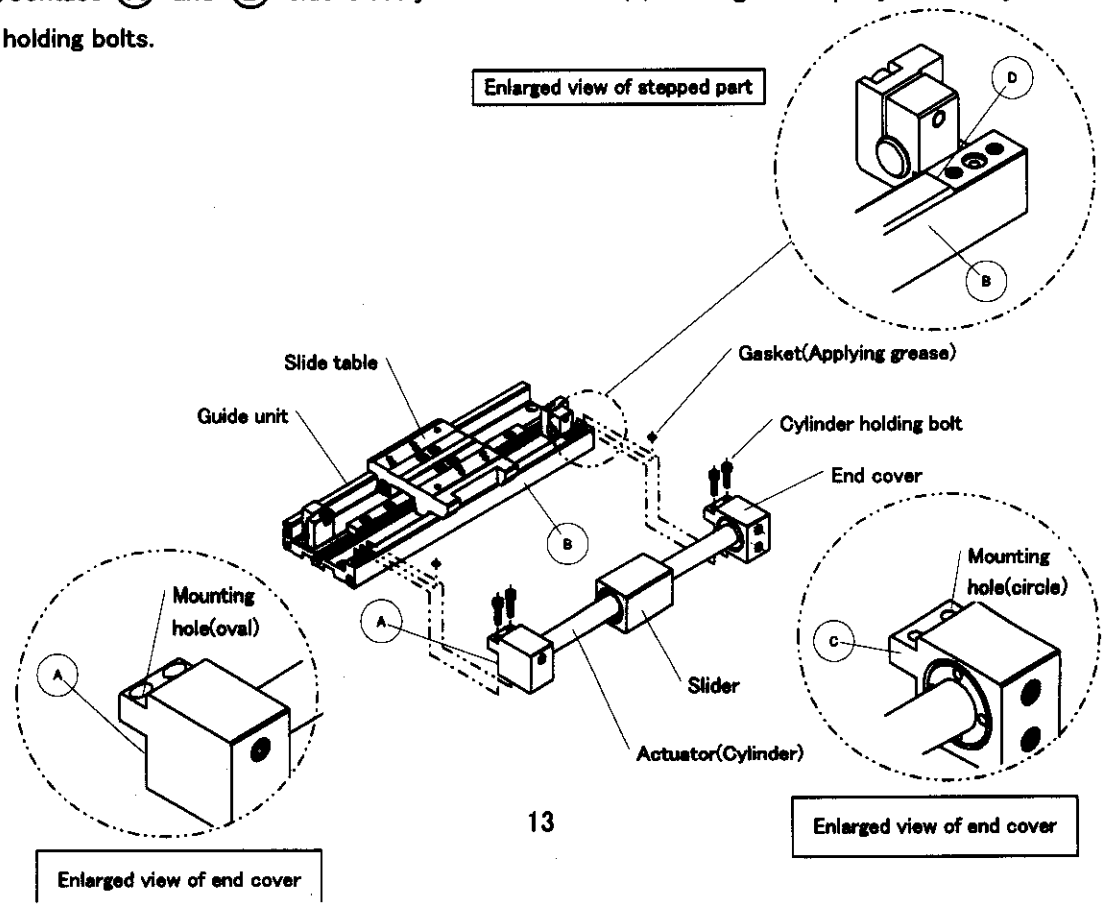
2.Replacement of the actuator(cylinder).

(1)Remove 4 cylinder holding bolts and take the actuator out from guide unit.

(2)Apply grease to gasket which is included with the replacement actuator(cylinder) and replace it from gasket mounted.

(3)Mount slider of the replacement actuator to notch part of slide table and align Ⓒ (circle)side at the end cover of actuator and Ⓓ side at stepped part of guide unit.

(4)Contact Ⓐ and Ⓑ side closely at the time of (3) and tighten equally with 4 cylinder holding bolts.



Bore size [mm]	Cylinder holding bolt	Tightening torque
10	M3	0.55 to 0.72N·m
15		
25	M5	2.5 to 3.5N·m

Caution

Tighten the cylinder holding bolt.

Tighten the cylinder holding bolt in order not to loosen it and to prevent breakage or malfunction.

Also, operate it with conducting functional tests after replacing the actuator.

6-2.Shock Absorber

1.Shock absorber can be replaced in case of series CY1F.

Shock absorber is consumable product so that replace it when deteriorating the energy absorbing capacity.

Order the replacement shock absorber based on the diagram indicated below.

Bore size[mm]	Replacement shock absorber part no.
10	RB0805-X552
15	
25	RB1006-X552

*Order 2 pieces per cylinder.

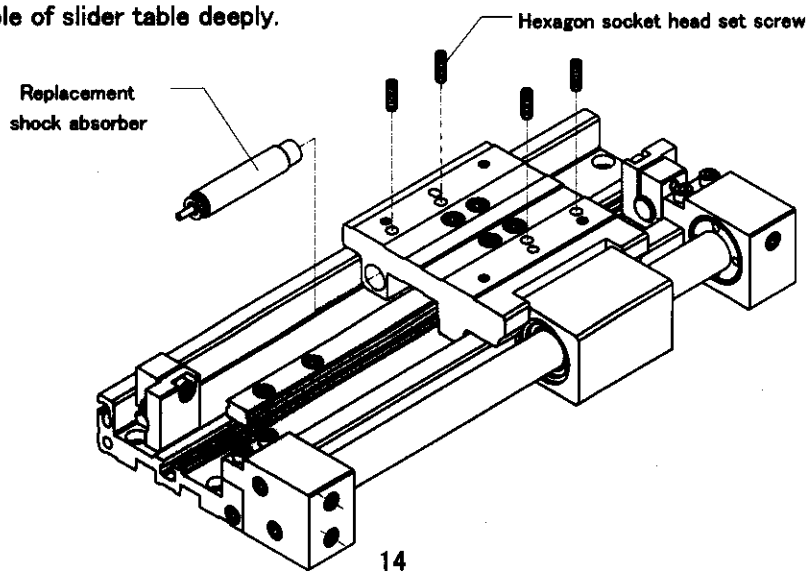
2.Replacement of shock absorber.

Order the replacement shock absorber based on the diagram indicated above.

(1)Remove the workpiece from the slide table.

(2)Loosen 4 hexagon socket head set screws on top of the slide table and take shock absorber out from it.

(3)Tighten 4 hexagon socket head set screws with inserting the replacement shock absorber into the hole of slider table deeply.



Bore size [mm]	Cylinder holding bolt	Tightening torque
10	M3	0.37 to 0.45N·m
15		
25	M5	0.54 to 0.64N·m

⚠ Caution

Take precautions on tightening torque of hexagon socket head set screw.

Too much tightening may cause breakage or malfunction of shock absorber.

6-3.Adjustment Bolt

Adjustment bolt can be replaced in case of series CY1F.

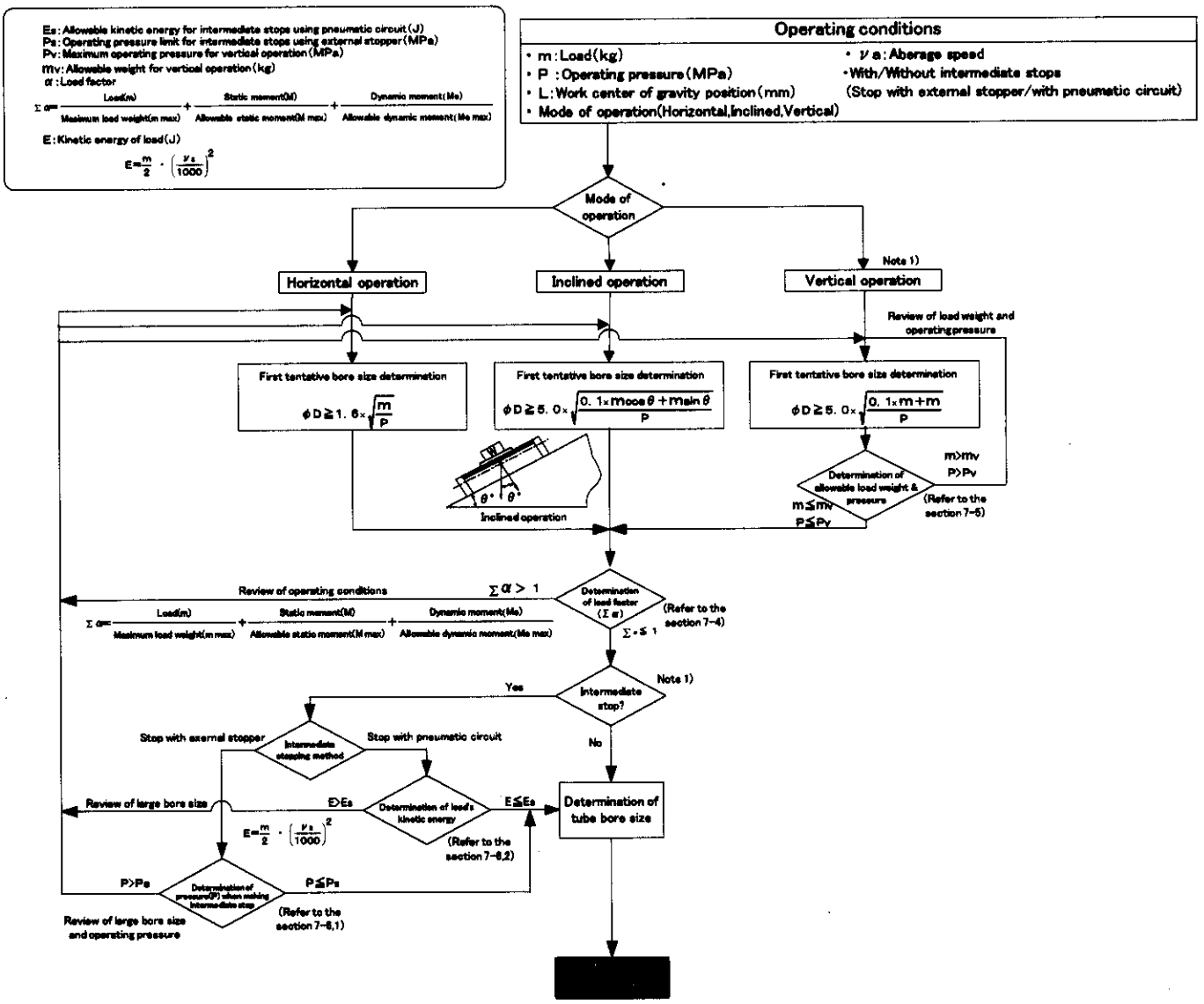
Order adjustment bolt based on the diagram indicated below.

Refer to the section 5-2 "Adjustment of Adjustment Bolt" for replacing adjustment bolt.

Bore size [mm]	Standard adjustment bolt	25mm adjustment bolt
10, 15	CYF-S10	CYF-L10
25	CYF-S25	CYF-L25

17.How to Select

7-1.Selection Flow Chart



Caution

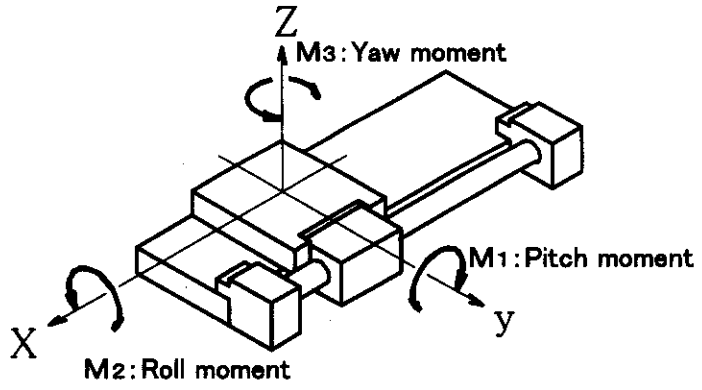
Note1)This cylinder cannot perform an intermediate stop using pneumatic circuit in vertical operation.

In this case, an intermediate stop can be performed only by using an external stopper, etc.

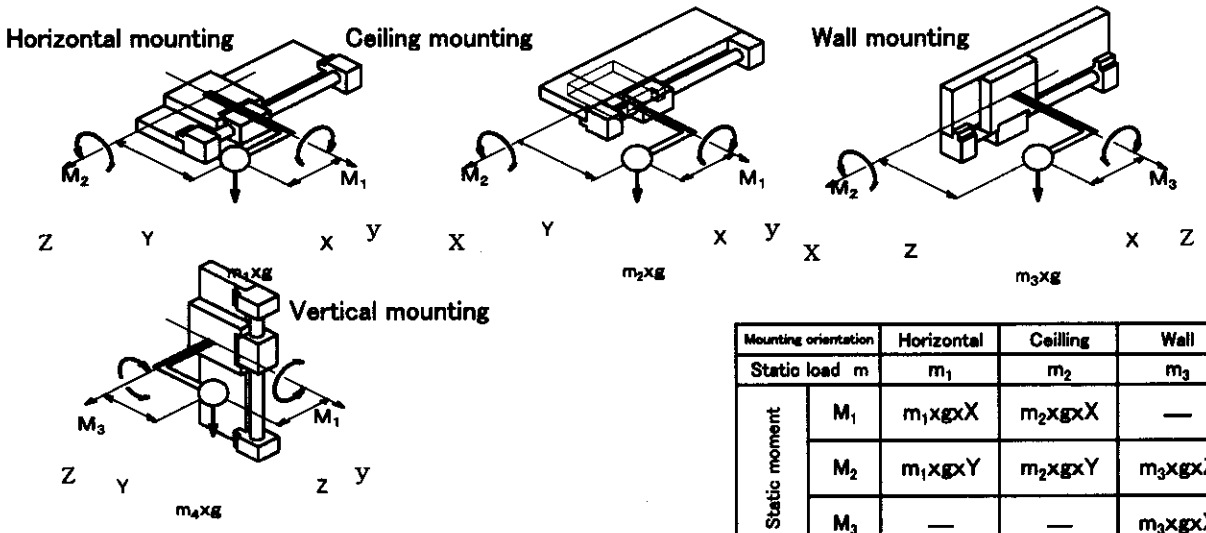
7-2.Moment of Rodless Cylinder

Various moment can be generated depending on the cylinder mounting orientation, load and center of gravity position.

Coordinates and Moments



Static moment

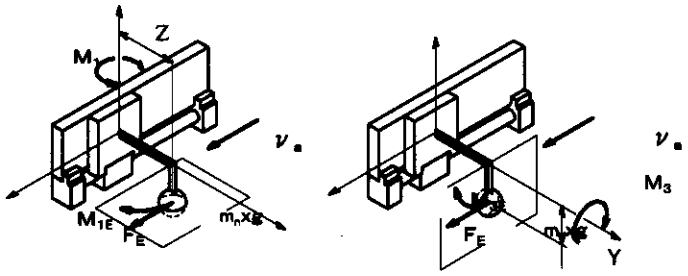


Mounting orientation		Horizontal	Ceilling	Wall	Vertical
Static load m		m_1	m_2	m_3	m_4
Static moment	M_1	$m_1 \times g \times X$	$m_2 \times g \times X$	—	$m_4 \times g \times Z$
	M_2	$m_1 \times g \times Y$	$m_2 \times g \times Y$	$m_3 \times g \times Z$	—
	M_3	—	—	$m_3 \times g \times X$	$m_4 \times g \times Y$

Note) m_4 is a mass movable by thrust.
Use 0.3 to 0.7 times(differs depending on the operating speed) the thrust as a guide for actual use.

g : Gravitational acceleration

Dynamic moment



Mounting orientation		Horizontal	Ceiling	Wall	Vertical
Dynamic load F_E		$\frac{1.4}{100} \times Va \times m_n \times g$			
Dynamic moment	M_{1E}	$\frac{1}{3} \times F_E \times Z$			
	M_{2E}	Dynamic moment M_{2E} does not generate.			
	M_{3E}	$\frac{1}{3} \times F_E \times Y$			

Note) Regardless of the mounting orientation, dynamic moment is calculated with the formulas above.

g : Gravitational acceleration
Va : Average speed

7-3.Maximum Allowable Moment/Maximum Allowable Load

Model	Bore size (mm)	Max. allowable moment (N·m)			Max. allowable load (kg)			
		M1	M2	M3	m1	m2	m3	m4
CY1F	10	1	2	1	2	2	2	1.4
	15	1.5	3	1.5	5	5	5	2
	25	14	20	14	12	12	12	12

The above values are the maximum allowable values for moment and load. Refer to each graph regarding the maximum allowable moment/load for a particular piston speed.

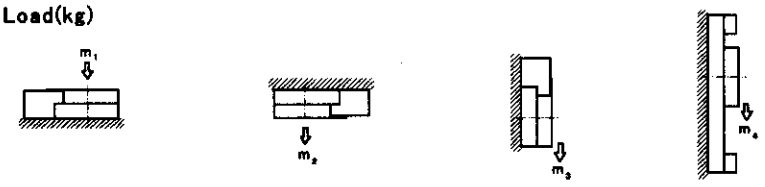
Maximum allowable moment

Select the moment from within the range of operating limits shown in the graphs. Note that the maximum allowable load value may sometimes be exceeded even within the operating limits shown in the graphs. Therefore, also check the allowable load for the selected conditions.

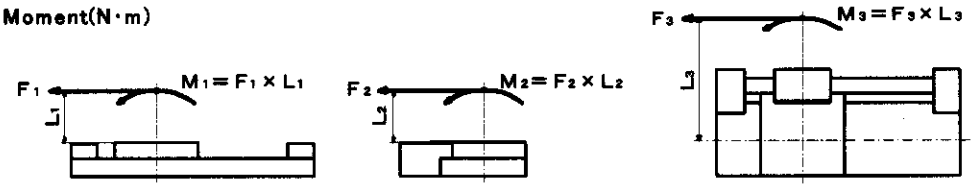
Maximum allowable load

Select the load from within the range of limits shown in the graphs. Note that the maximum allowable moment value may sometimes be exceeded even within the the operating limits shown in the graphs. Therefore, also check the allowable moment for the selected conditions.

Load(kg)

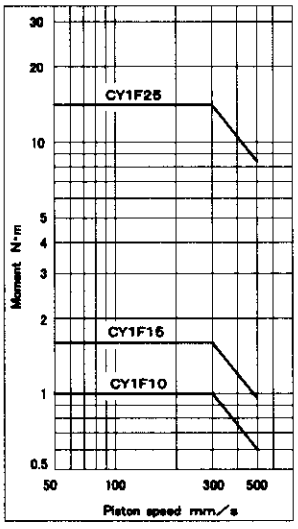


Moment(N·m)

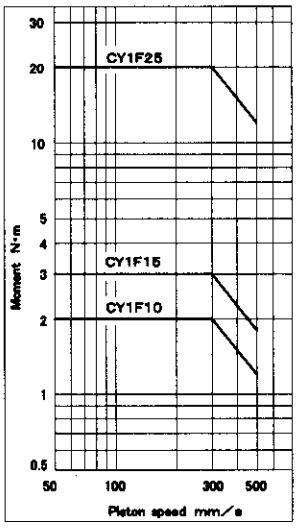


Moment / CY1F

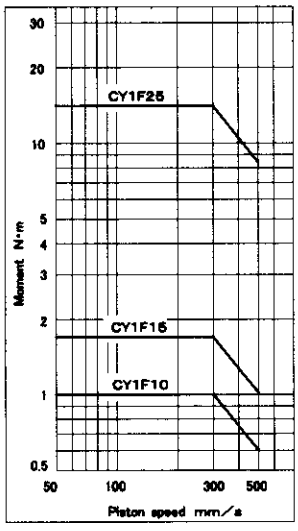
CY1F/ M_1 [1]



CY1F/ M_2 [2]

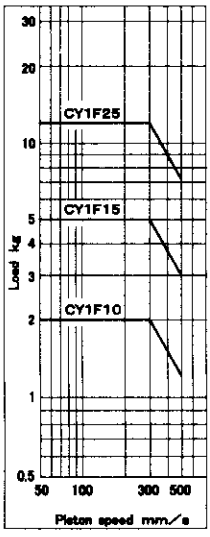


CY1F/ M_3 [3]

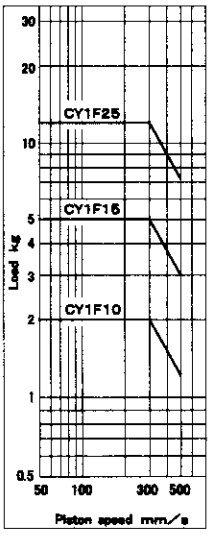


Load / CY1F

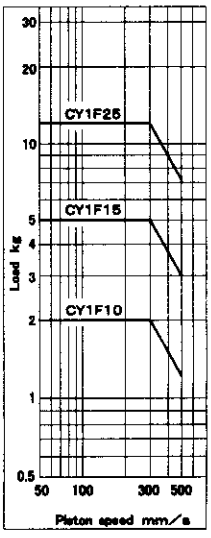
CY1F/ m_1 [4]



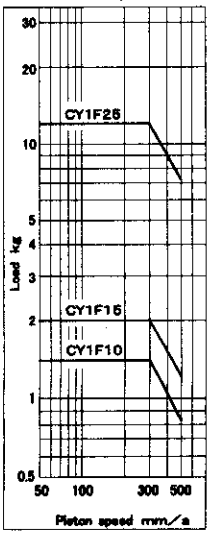
CY1F/ m_2 [5]



CY1F/ m_3 [6]



CY1F/ m_4 [7]



7-4. Calculation of Guide Load Factors

1.Maximum allowable load (1), static moment(2), and dynamic moment(3)(at impact with stopper) must be calculated for selection.

*To evaluate, use υ a(average speed) for (1)and(2), and υ (impact speed υ =1.4υ a) for (3).

Calculate m max for (1) from the maximum allowable load graph(m1,m2,m3,m4)and Mmax for (2)and(3) from the maximum allowable moment graph(M1,M2,M3).

$$\text{Sum of load factor } \Sigma\alpha = \frac{\text{Load weight(m)}}{\text{Max. allowable load(m max)}} + \frac{\overset{\text{(Note1)}}{\text{Static moment[M]}}}{\text{Allowable static moment(Mma)}} + \frac{\overset{\text{(Note 2)}}{\text{Dynamic moment[Mg]}}}{\text{Allowable dynamic moment } (M_{emax})} \leqq 1$$

(Note 1) Moment generated by the load etc., with cylinder in resting condition.
(Note 2) Moment caused by the impact equivalent at stroke end (at impact with stopper).
(Note 3) Depending on the shape of the workpiece, multiple moments may occur.
When this happens, the sum of the load factor($\Sigma\alpha$)is the total of all such moments.

2.Reference formulas[Dynamic moment at impact]

Use the following formulas to calculate dynamic moment when taking stopper impact into consideration.

m : Load weight(kg)
F_E : Load equivalent to impact(at impact with stopper)
υ a : Average speed(mm/s)
υ : Impact speed(mm/s)
L_1 : Distance to the load's center of gravity(m)
M_E : Dynamic moment(N・m)
g : Gravitational acceleration(9.8m/s2)

$$\upsilon = 1.4\upsilon a(mm/s)$$

$$F_E = \frac{1.4}{100}\upsilon a \cdot g \cdot m$$

$$\therefore M_E = \overset{\text{(Note 5)}}{\frac{1}{3}} \cdot F_E \cdot L_1(N \cdot m)$$

(Note4) $\frac{1.4}{100}\cdot\upsilon$ a is a dimensionless coefficient for calculating impact force.

(Note5) Average load coefficien $\frac{1}{3}$: This coefficient is for averaging the maximum load moment at impact with stopper according to service life calculations.

3.Refer to pages 21 to 23 for detailed selection procedures.

7-5.Restrictions on Vertical Operation

1.Vertical Operation

When operating a load vertically, it should be operated within the maximum load weight and maximum operating pressure shown in the table below in order to prevent drop caused by breakage of magnetic coupling.

⚠ Caution

Take precautions, as there is possibility of breaking the magnetic coupling if operated above the maximum load weight and maximum operating pressure.

Bore size[mm]	Maximum load weight m_V [kg]	Maximum operating pressure P_V [MPa]
10	1.4	0.55
15	2.0	0.65
25	12.0	0.65

7-6.Restrictions on Intermediate Stop

1.Intermediate stops of load with an external stopper, etc. and adjusting stroke with adjustment bolt.

When stopping a load in mid-stroke using an external stopper external stopper and adjusting stroke with adjustment bolt which is included with the cylinder, operate within the operating pressure limits shown in the table below.

⚠ Caution

Take precautions, as there is possibility of breaking the magnetic coupling if operated above the maximum operating pressure limits.

Bore size[mm]	Holding force [N]	Operating pressure limit for intermediate stop P_S [MPa]
10	53.9	0.55
15	137	0.65
25	363	0.65

2.Intermediate stops of load with pneumatic circuit.

When stopping a load with pneumatic circuit, operate below the kinetic energy shown in the table below.
Also, when operating a load vertically, intermediate stop cannot be performed with pneumatic circuit.

⚠ Caution

Take precautions, as there is possibility of breaking the magnetic coupling if operated above the allowable kinetic energy.

Bore size[mm]	Allowable kinetic energy for intermediate stop E_S [J]
10	0.03
15	0.13
25	0.45

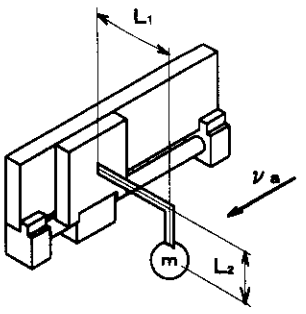
7-7. Selection Examples

The followings are examples of calculating procedures of guide load factor and of investigating intermediate stop to select the most suitable seris CY1F for your application.

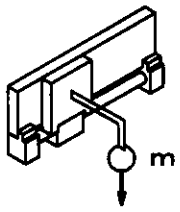
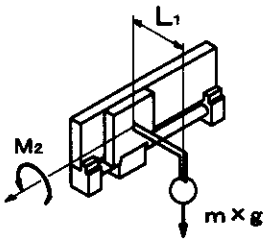
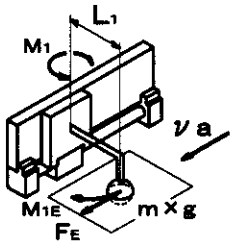
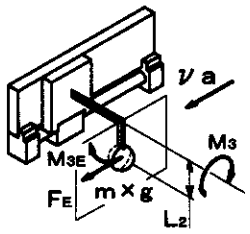
Calculation examples 1)

Operating conditions

Tentative selection of cylinder : CY1F15
Cushion : Standard(Shock absorber)
Mounting : Wall
Speed(Average) : ν a=300[mm/s]
Load : m=0.5[kg](excluding weight of arm section)
L_1=0.05[mm]
L_2=0.04[mm]
With/Without intermediate stop : With(intermediate stop with pneumatic circuit..) A



(1)Investigation of guide load factor

Item	Load factor αn	Note
1. Load weight 	α_1=m/m max =0.5/5 =0.1	Investigate m. Find the vaue of m max at 300mm/s from <Graph 6> due to wall orientation.
2. Static moment 	M_2=m×g×L1 =0.5×9.8×0.05 =0.245[N·m] α2=M_2/M_2 max =0.245/3 =0.082	Investigate M2. M_1 and M_3 are not generated. Therefore, investigation is unnecessary. Find the value of M_2 max at 300mm/s from <Graph 2>.
3. Dynamic moment 	M_{1E}=1/3×F_E×L_1 (F_E=1.4/100×νa×g×m) =0.05×νa×m×L_1 =0.05×300×0.5×0.05 =0.375[N·m] α_{3A}=M_{1E}/M_{1E} max =0.375/1.07 =0.350	Investigate M1E. Find the impact speed ν. ν=1.4×νa =1.4×300 =420[mm/s] Find the value of M_{1E} at 420mm/s from <Graph 1>.
	M_{3E}=1/3×F_E×L_2 =0.05×νa×m×L_2 =0.05×300×0.5×0.04 =0.3[N·m] α_{3B}=M_{3E}/M_{3E} max =0.3/1.07 =0.28	Investigate M3E. From above, Find the value of M_{3E} max at 420mm/s from <Graph 3>.

From mentioned above,
$\Sigma\ \alpha n=\alpha_1+\alpha_2+\alpha_{3A}+\alpha_{3B}=0.1+0.082+0.35+0.28=0.812$
Can be used based on $\Sigma\ \alpha n=0.812\leqq 1$.

(2)Investigation of kinetic energy of load.

Investigate kinetic energy due to intermediate stop with pneumatic circuit.

Kinetic energy $E=\frac{M}{2}\left(\frac{\nu a}{1000}\right)^2=\frac{0.5}{2}\cdot\frac{300}{1000}=0.0225$[J]

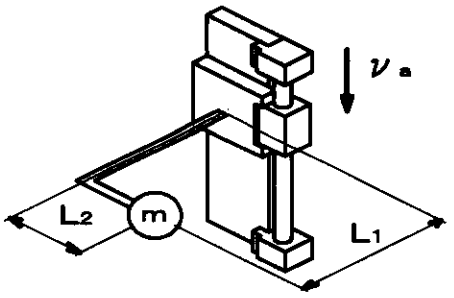
Can be used based on E=0.0225≦Es(Es=0.13[J]) (Refer to page 20)

CY1F15 can be used based on the investigation from (1)and (2).

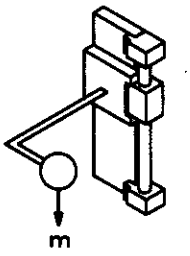
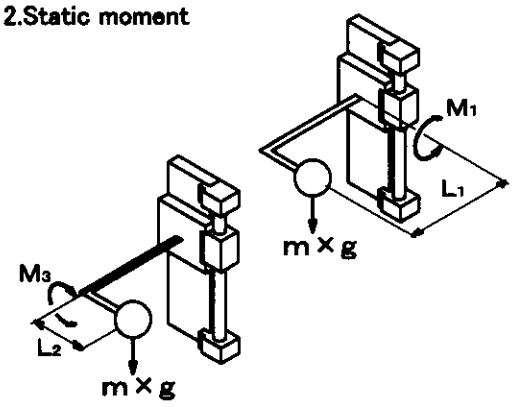
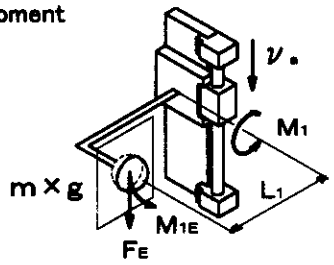
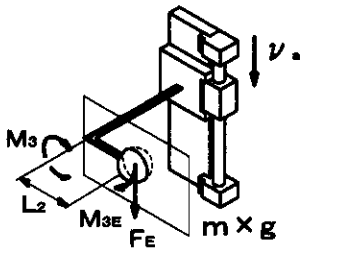
Calculation example 2

Operating conditions

Tentative selection of cylinder : CY1F25
Cushion : Standard(Shock absorber)
Mounting : Vertical　　Operating pressure : 0.4MPa
Speed(Average) : ν a=300[mm/s]
Load weight : m=3[kg](excluding weight of arm section)
L_1=0.05[mm]
L_2=0.04[mm]
With/Without intermediate stop : With(intermediate stop by using external stopper.)



(1)Investigation of guide load factor

Item	Load factor α n	Note
1.Load weight 	α_1=m/m max =3/12 =0.25	Investigate m. Find the value of m max at 300mm/s from <Graph 7> of m_4 due to vertical orientation.
2.Static moment 	M_1=m×g×L_1 =3×9.8×0.05 =1.47[N·m] α_{2A}=M_1/M_1 max =1.47/14 =0.105	Investigate M_1. Find the value of M_1 max at 300mm/s from <Graph 1>.
	M_3=m×g×L_2 =3×9.8×0.04 =1.176[N·m] α_{2B}=M_3/M_3 max =1.176/14 =0.084	Investigate M_3. Find the value of M_3 max at 300mm/s from <Graph 3>.
3.Dynamic moment 	M_{1E}=1/3×F_E×L_1 (F_E=1.4/100×νa×g×m) =0.05×νa×m×L_1 =0.05×300×3×0.05 =2.25[N·m] α_{3A}=M_{1E}/M_{1E} max =2.25/10 =0.225	Investigate M_{1E}. Find the impact speed ν. ν=1.4×νa =1.4×300 =420[mm/s] Find M_{1E} max at 420mm/s from <Graph 1>.
	M_{3E}=0.05×νa×m×L_2 (F_E=1.4/100×νa×g×m) =0.05×300×3×0.04 =1.8[N·m] α_{3B}=M_{3E}/M_{3E} max =1.8/10 =0.18	Investigate M_{3E}. From above, Find the value of M_{3E} max at 420mm/s from <Graph 3>.

From mentioned above,
$\Sigma \alpha_n = \alpha_1 + \alpha_{2A} + \alpha_{2B} + \alpha_{3A} + \alpha_{3B}$=0.25+0.105+0.084+0.225+0.18=0.844
Can be used based on $\Sigma \alpha_n$=0.844≦1.

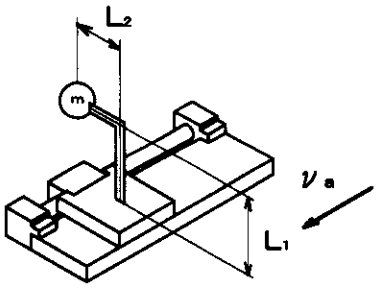
(2)Investigation of pressure at intermediate stop.
Investigate operating pressure due to intermediate stop by using external stopper.
Can be used based on the operating pressure : P=0.4MPa≦Ps(Ps=0.65[MPa]) (Refer to page 20)

CY1F25 can be used based on the investigation from (1) and (2).

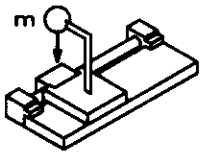
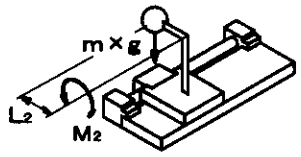
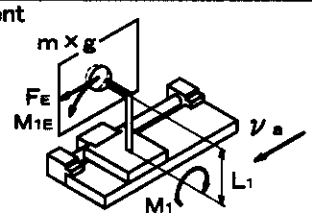
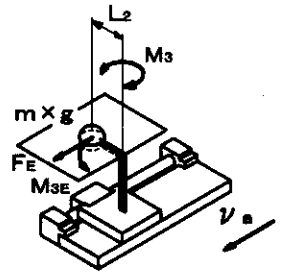
Calculation examples 3

Operating conditions

Tentative selection of cylinder : CY1F10
Mounting : Horizontal
Speed(Averge) : ν a=300[mm/s]
Operating pressure : 0.4[MPa]
Load : m=0.5[kg](excluding weight of arm section)
L_1=0.03[mm]
L_2=0.02[mm]
With/Without intermediate stop : With(intermediate stop with pneumatic circuit.)



(1)Investigation of guide load factor

Item	Load factor αn	Note
1.Load weight 	α_1=m/m max =0.5/2 =0.25	Investigate m. Find the value of m max at 300mm/s from <Graph 4> of m_1 due to horizontal orientation.
2.Static moment 	M_2=m×g×L_2 =0.5×9.8×0.02 =0.098[N·m] α_2=M_2/M_2 max =0.098/2 =0.049	Investigate M_2. $M_1$and M_3 are not generated. Therefore, investigation is unnecessary. Find the value of M_2 max at300mm/s from <Graph 2>.
3.Dynamic moment 	M_{1E}=1/3×F_E×L_1 (F_E=1.4/100×νa×g×m) =0.05×νa×m×L_1 =0.05×300×0.5×0.03 =0.225[N·m] α_{3A}=M_{1E}/M_{1E} mx =0.225/0.71 =0.317	Investigate M_{1E}. Find the impact speed ν. ν=1.4×νa =1.4×300 =420[mm/s] Find the value of M_{1E} max at 420mm/s from <Graph 1>.
	M_{3E}=1/3×F_E×L_2 =0.05×νa×m×L_2 =0.05×300×0.5×0.02 =0.15[N·m] α_{3B}=M_{3E}/M_{3E} max =0.15/0.71 =0.211	Investigate M_{3E}. From above, Find the value of M_{3E} max at 420mm/s from <Graph 3>.

From mentioned above,
$\Sigma \alpha_n = \alpha_1 + \alpha_2 + \alpha_{3A} + \alpha_{3B} = 0.25 + 0.049 + 0.317 + 0.211 = 0.837$
Can be used based on $\Sigma \alpha_n = 0.837 \leqq 1$.

(2)Investigation of kinetic energy of load

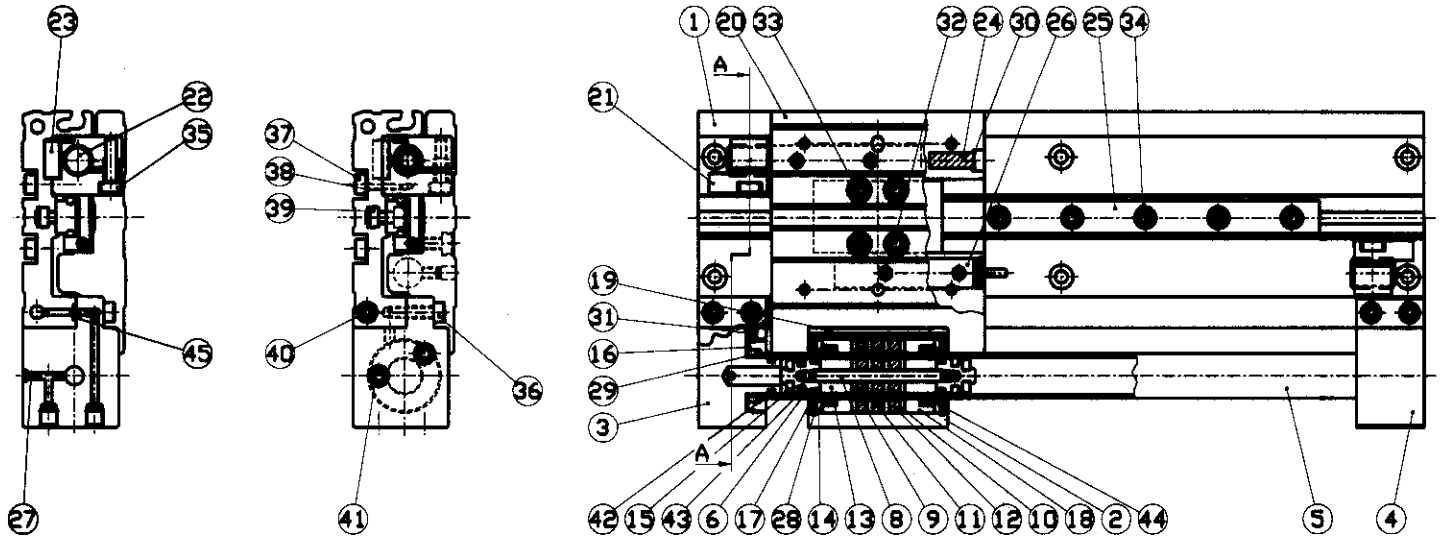
Investigate kinetic energy due to intermediate stop with pneumatic circuit.

Kinetic energy $E = \frac{M}{2} \cdot \left(\frac{\nu_a}{1000}\right)^2 = \frac{0.5}{2} \cdot \left(\frac{300}{1000}\right)^2 = 0.0225$ [J]

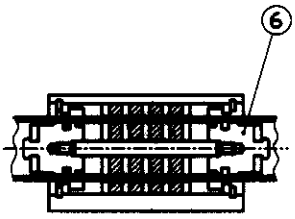
Can be used based on E=0.0225≦ES (ES=0.03[J]) (Refer to page 20)

CY1F10 can be used based on the investigation from (1) and (2).

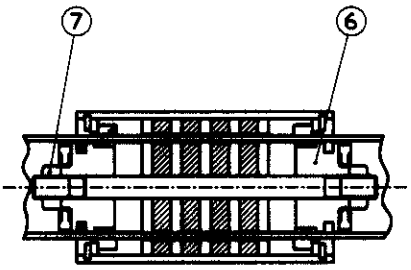
8. Construction



Section A-A



Detail drawing on the cylinder(CY1F15)



Detail drawing on the cylinder(CY1F25)

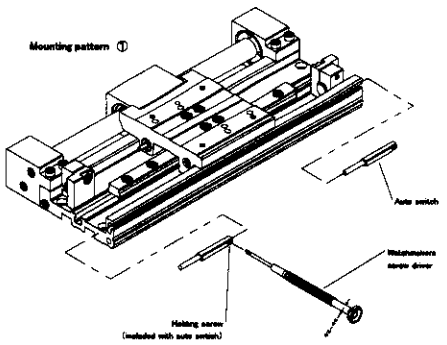
Seal list

NO.	Description	Material	Qty.	CY1F10	CY1F15	CY1F25
4	Body gasket	NBR	2	φ4.6×φ2.6×φ1	φ4.6×φ2.6×φ1	φ5.9×φ3.9×φ1
3	Scraper	NBR	2	PDU−12Z	PDU−23×17	PDU−34×28
2	Piston seal	NBR	1	NLP−10A	NLP−15A	NLP−25−19A
1	Cylinder tube gasket	NBR	2	C8	C12.5	C22

Component parts

NO.	Description	Material	Qty.	Note	NO.	Description	Material	Qty.	Note
19	Wear ring C	Special resin	2		41	Hexagon socket head plug	Molybdenum steel	3	Nickel plated
18	Wear ring B	Special resin	2						Hexagon socket head taper plug for Φ25
17	Wear ring A	Special resin	2		40	Hexagon socket head plug	Molybdenum steel	2	Nickel plated
16	Attachment ring	Aluminum alloy	2	Hard anodized	39	Square nut	Carbon steel	—	Nickel plated
15	Bumper	Urethane rubber	2		38	Flat washer	Rolled steel	4	Nickel plated
14	Spacer	Rolled steel	2	Nickel plated	37	Hexagon socket head cap screw	Molybdenum steel	4	Nickel plated
13	Piston spacer	Rare earth magnet	2	Chromated	36	Hexagon socket head cap screw	Molybdenum steel	4	Nickel plated
12	Magnet B	Rare earth magnet	3	(Φ10)	35	Hexagon socket head cap screw	Molybdenum steel	2	Nickel plated
			4	(Φ15・25)	34	Hexagon socket head cap screw	Molybdenum steel	—	Nickel plated
11	Magnet A	Rare earth magnet	3	(Φ10)	33	Hexagon socket head cap screw	Molybdenum steel	4	Nickel plated
			4	(Φ15・25)	32	Hexagon socket head set screw	Molybdenum steel	4	Nickel plated
10	External slider side yoke	Rolled steel	4	Zinc chromated(Φ10)	31	Hexagon socket head set screw	Molybdenum steel	2	Nickel plated
			5	Zinc chromated(Φ15・25)	30	Snap ring	Stainless		
9	Piston yoke	Rolled steel	4	Zinc chromated(Φ10)	29	C type snap ring for shaft	Stainless	2	(Φ10・15)
			5	Zinc chromated(Φ15・25)			Hard steel wire		(Φ25)
8	Shaft	Stainless	1		28	C type snap ring for hole	Carbon tool steel	2	Nickel plated
7	Piston nut	Carbon steel	2	Use only Φ25	27	Steel ball	Ball-bearing steel	2	
6	Piston	Brass	2	Electroless nickel plated(Φ10)	26	Shock absorber	—	2	
		Aluminum alloy		Chromated(Φ25)	25	Guide	—	1	
5	Cylinder tube	Stainless	1		24	Magnet	Rare earth magnet	1	
4	End cover B	Aluminum alloy	1		23	Positioning key for adjustment holder	Carbon steel	2	Zinc chromated
3	End cover A	Aluminum alloy	1		22	Adjustment bolt	Molybdenum steel	2	Nickel plated
2	Body	Aluminum alloy	1		21	Adjustment holder	Carbon steel	2	Electroless nickel plated
1	Base frame	Aluminum alloy	1	Hard anodized	20	Slide table	Aluminum alloy	1	Hard anodized

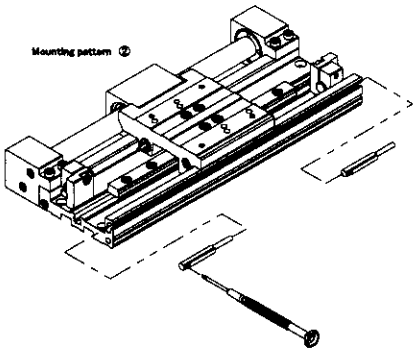
9.Auto Switch



⚠ Caution

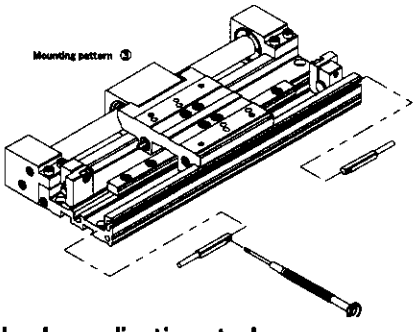
9-1.Mounting Auto Switch

1.There are 3 patterns indicated in the right diagram when mounting auto switch.
Tightening the holding screw which is included using flat head watchmakers screw driver after inserting auto switch into the cylinder's switch groove and placing it in the mounting position.



2.When tightening the holding screw included with the auto switch, use a watchmakers screw driver with a handle 5 to 6mm in diameter.
The tightening torque should be 0.1 to 0.2N・m.

3.Refer to SMC's catalog for precautions on applicable auto switch.



9-2.Minimum Stroke for Mounting Auto Switch

⚠ Caution

1.Take precautions of minimum stroke for mounting auto switch when adjusting stroke.
Refer to the diagram indicated below for minimum stroke for mounting auto switch.

・Minimum stroke for mounting one auto switch [mm]

Bore size [mm]	D－A9□, D－A9□V D－F9□, D－F9□V	D－F9□W D－F9□WV
10	5	10
15		
25		

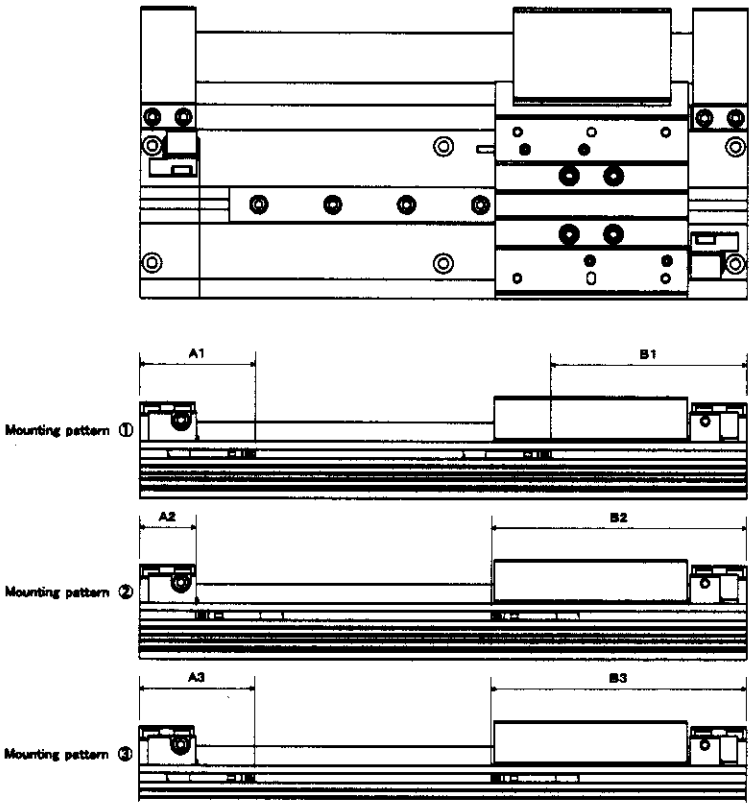
•Minimum stroke for mounting two auto switches

Bore size [mm]	D - A90 D - A96	D - A93	D - A90V D - A96V D - A93V	D - F9□ D - F9□W	D - F9□V D - F9□WV
Mounting pattern(1),(2)	32	35	22	32	20
Mounting pattern(3)	20			12	

9-3.Auto Switches / Proper Mounting Positions for Stroke End Detection

Caution

1.Take precautions that proper mounting position of auto switch for series CY1F will be differ depending on electrical entry direction of auto switch.



D - A9□, D - A9□V

[mm]

Bore size [mm]	Mounting pattern(1)		Mounting pattern(2)		Mounting pattern(3)		* Operating range
	A1	B1	A2	B2	A3	B3	
10	38	60	18	80	38	80	9
15	39	66	19	86	39	86	10
25	44.5	95.5	24.5	115.5	44.5	115.5	11

D - F9□, D - F9□V

[mm]

Bore size [mm]	Mounting pattern(1)		Mounting pattern(2)		Mounting pattern(3)		* Operating range
	A1	B1	A2	B2	A3	B3	
10	34	64	22	76	34	76	5.5
15	35	70	23	82	35	82	5
25	40.5	99.5	28.5	111.5	40.5	111.5	5

D - F9□W, D - F9□WV

[mm]

Bore size [mm]	Mounting pattern(1)		Mounting pattern(2)		Mounting pattern(3)		* Operating range
	A1	B1	A2	B2	A3	B3	
10	34	64	22	76	34	76	5.5
15	35	70	23	82	35	82	5
25	40.5	99.5	28.5	111.5	40.5	111.5	5

*The operating range is a standard including hysteresis, and is not guaranteed.

(Variations ±30%)

There may be large variation depending on the surrounding environment.

Revision

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