RODLESS CYLINDER

CY1L (BALL BUSHING TYPE) SERIES

OPERATION MANUAL

SMC CORPORATION

INDEX

1. How to install

1-1. Surface to be installed

The surface to be installed is required to have high flatness, but in case the flatness is not sufficient, the installation should be performed in order to enable the slide block (movable carriage) travel under the minimum operating pressure by shim adjusting or other means.

1-2. Installation procedure

Mounting of the body should be performed at the both ends of plate. Do not mount at the slide block (refer to the Figure 1-1). It causes excessive lateral loads that leads the defective operation.

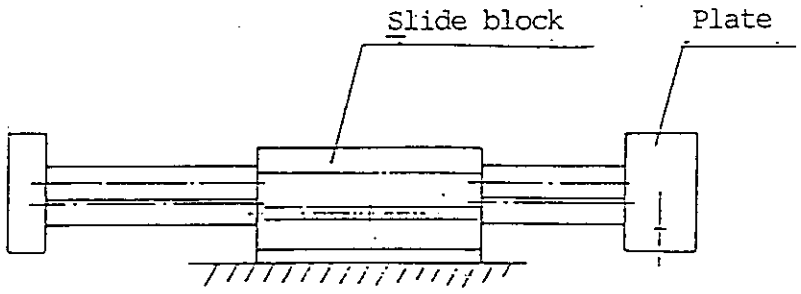


Figure 1-1 Mounting at slide block =Prohibitted=

Machining of installation parts on the plate portions are allowed follwing 2 types. Those selections are for the mounting surface and position.

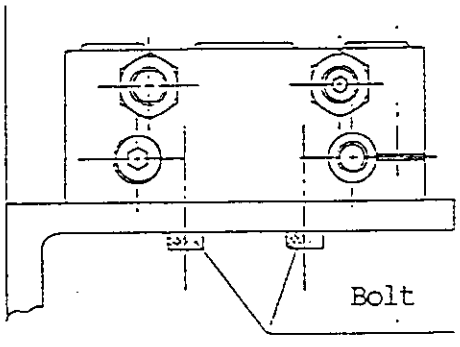


Figure 1-2 Fixing from underneath (Using plate part)

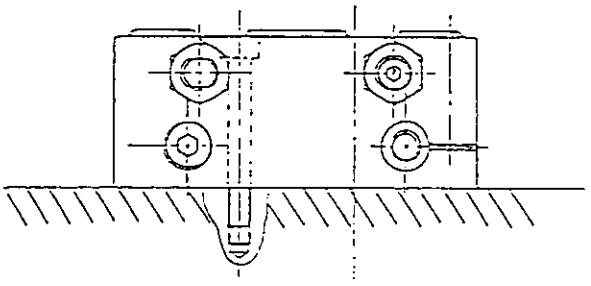


Figure 1-3 Fixing from upper (by hexagon socket head cap screw)

1-3. Piping

The piping port is on the plate A (thinner plate) with capability of concentrated piping. However, it is not available on the plate B (thicker plate).

Note) It is possible to locate the piping ports on the both sides. When it is required, consult us.

Although the piping ports are located at one side, the mounting rail for the auto switch can be mounted on either side.

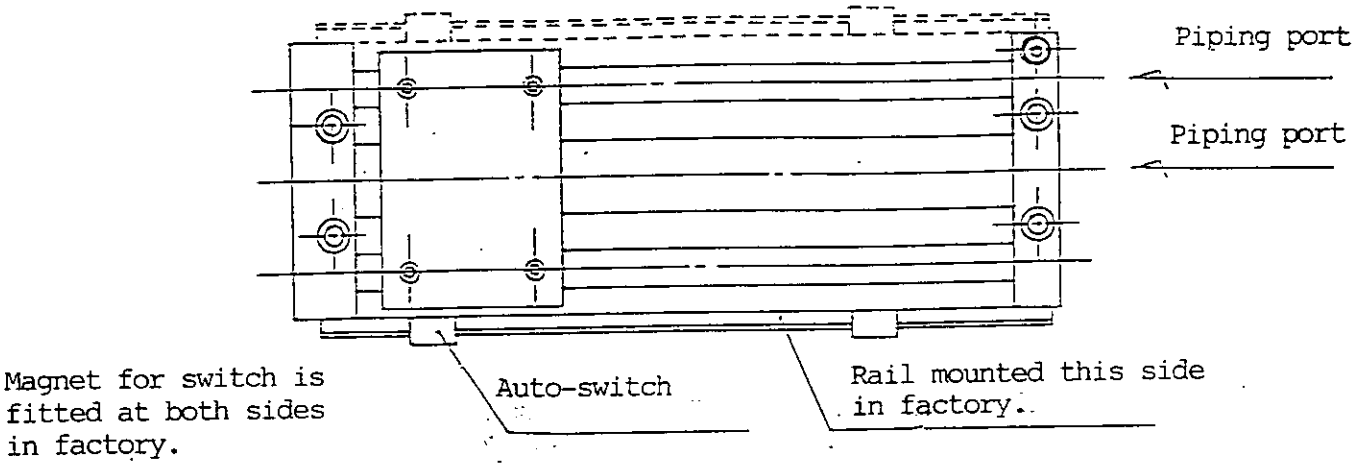


Fig.4. In case of with Auto-switch

1-4. Precautions to use with auto switch

1-4-1) The switch mounting rail (in case of larger than CY1L15 or equal) has a peculiar configuration to allow the lead wire to stay in its groove. (Figure-5)

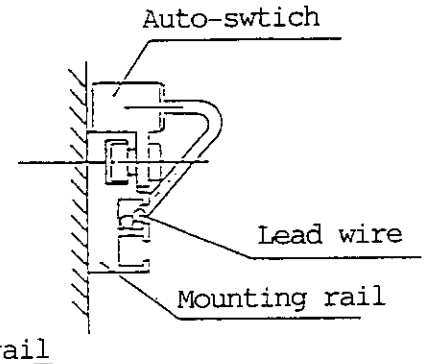


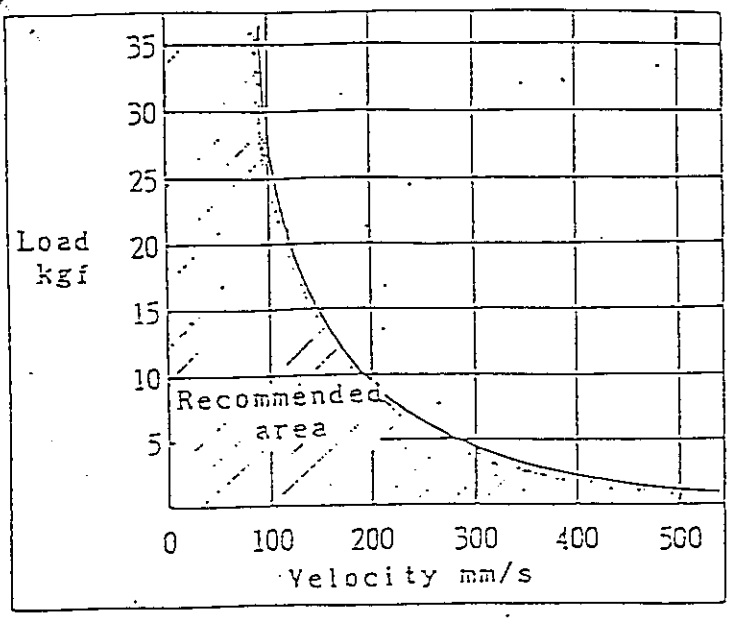
Fig.5. Switch mounting rail

1-4-2) It is possible to install the auto switch at the half way. However, thinking of response time of load relay, the adjustment is required in order to detect the cylinder velocity within 300mm/sec.

1-4-3) As for the precautions for circuit diagram of switch inside and protection box of contact point etc., refer to the catalog of Rodless cylinder (CY1 series).

1-5. How to use the adjust bolt (damper).

The adjustment of stroke can be performed at the stroke end by the standard adjust bolt. Thinking of durability, its operation to stop by adjust bolt is advised within range of loads and velocity shown in the following Fig.



Standard adjust bolt: Relation between loads and velocity

Note) Operation beyond above legal range, use of shock absorber (RB series of SMC) is advised.

Even working pressure is more than holding force, no anxiety for piston jumping is needed at the stroke end. However, when stroke (of minus side) is adjusted more than stated figure ℓ (in table 1) by adjust bolt (like shock absorber), care should be taken to adjust under maximum working pressure.

Table 1. Adjusting span of adjust bolt

Model	Adjust: ℓ mm
CY1L6H	1.5
CY1L10H	2.5
CY1L15*	4.0
CY1L25*	5.0
CY1L32*	6.0
CY1L40*	6.5

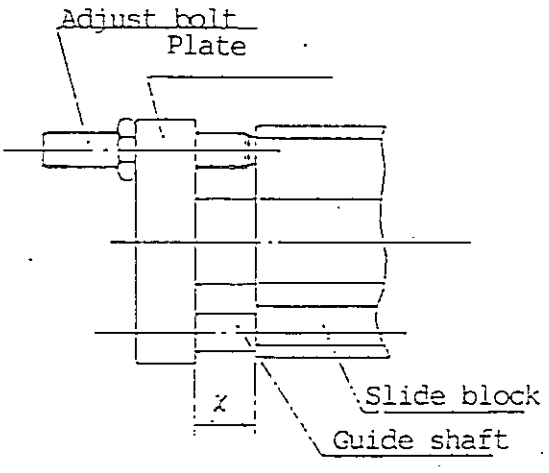


Fig.6. Adjustment by adjust bolt

1-6. Precautions to use with shock absorber

1-6-1)Both shock absorber and adjust bolt can be installed together.

1-6-2)Adjustment is possible at stroke end by shock absorber as by adjust bolt.

Note)About adjusting span, please refer to item 1-5 of Table 1.

1-6-3)Screws at bottom of the body, shock absorber must not be turned (they are not adjustment screw), loosening those may cause leakage.

1-6-4)Nut tightening torque to install shock absorber to the plate part should be subject to following Table 2.

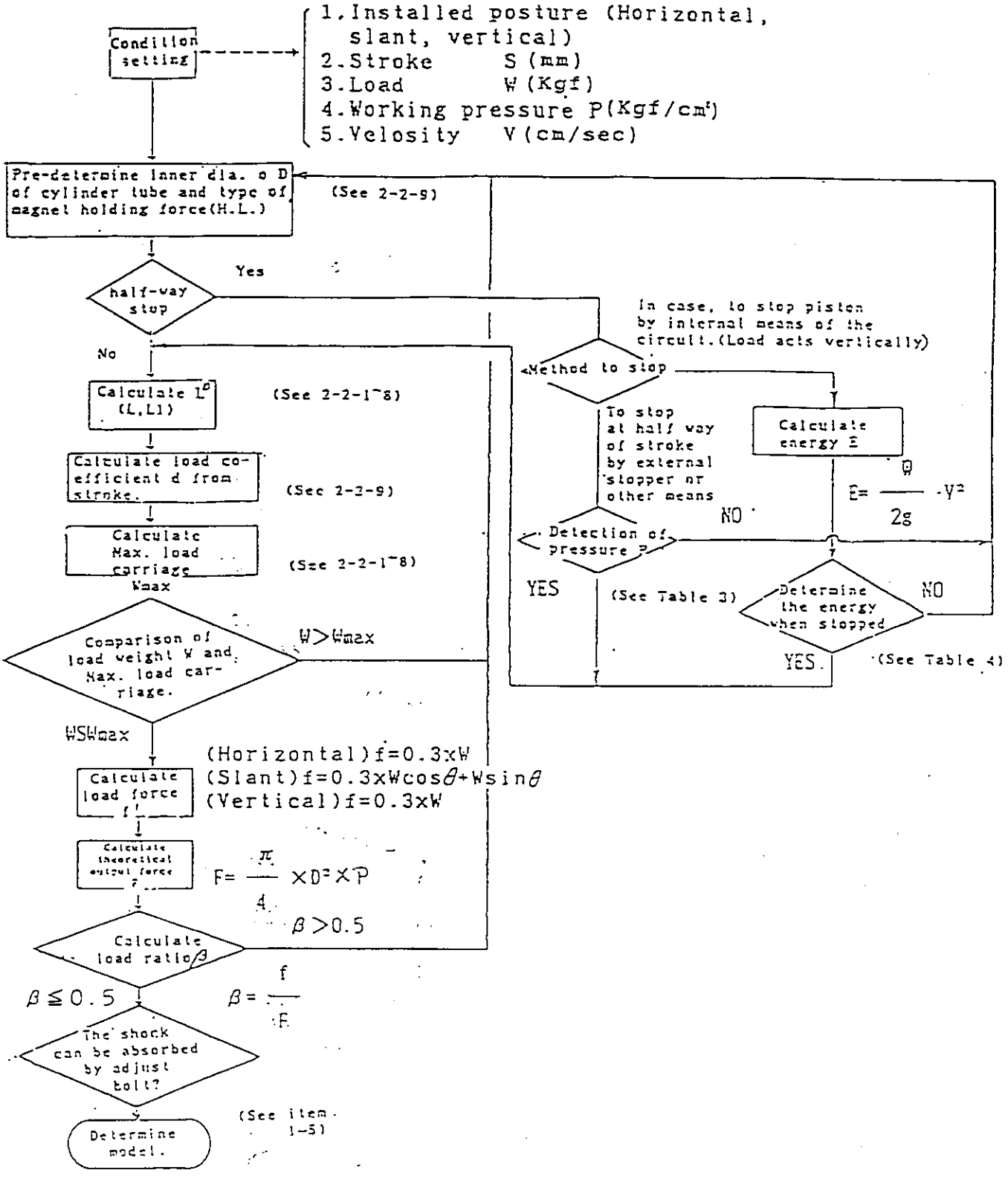
Table 2. Tightening torque of the nut to shock absorber

Model	RB0805	RB1411	RB2015
O.D. of screw mm	M8	M14	M20
Nut tightening torque kgf·m	0.17	1.1	2.4

2.Allowable loads and its selecting method.

2 - 1.About selection procedures.

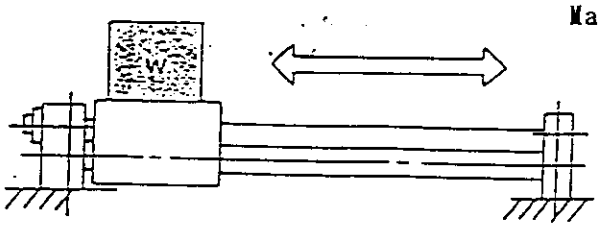
Selection procedures of CYlL* (Bowl bush type)



2-2. Information to select Rod-less CYlinder

(CY1L: Ball bushing type)

2-2-1) Horizontl movement (Installed on the floor)



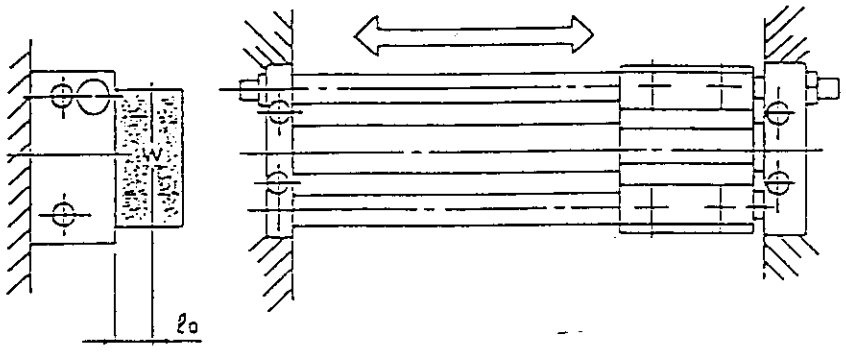
Max. Load capacity. (Slide block at center)[kg]

Tube I.D.	ϕ6	ϕ10	ϕ15	ϕ25	ϕ32	ϕ40
W (kg)	1.8	3.0	7.0	20.0	30.0	50
Stroke(MAX)	~300	~300	~500	~500	~600	~600

Fundamental figure for design:

Max. load weight is defined to obtain 60% of the fighre of Max. thrust (P=0.7MPa). Above figures for weight may be changed depending on length of the stroke of each cylinder subject to deflection limit of guide shaft. (Coefficient α should be noticed.) The allowable load is possible to be changed from the standard depending on th operating direction.

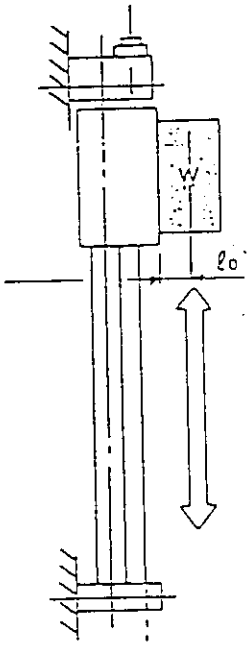
2-2-2) Horizontal movement (Installed on the wall)



ℓo: Distance from installation surface to the center of the load. (cm)

Tube I.D.	Allowable load (kg)
ϕ6	$\frac{\alpha \cdot 6.48}{6.8+2\ell}$
ϕ10	$\frac{\alpha \cdot 15.0}{8.9+2\ell}$
ϕ15	$\frac{\alpha \cdot 45.5}{11.3+2\ell}$
ϕ25	$\frac{\alpha \cdot 180}{15.2+2\ell}$
ϕ32	$\frac{\alpha \cdot 330}{18.9+2\ell}$
ϕ40	$\frac{\alpha \cdot 624}{22.5+2\ell}$

2-2-3) Vertical movement

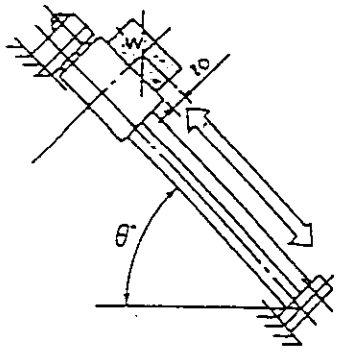


ℓo: Distance from installation surface to the center of the load. (cm)

Note) Safety factor is taken into consideration to prevent from falling.

Tube I.D.	Allowable load (kg)
ℓ6	$\frac{\alpha \cdot 1.53}{1.6+\ell}$
ℓ10	$\frac{\alpha \cdot 5.00}{1.95+\ell}$
ℓ15	$\frac{\alpha \cdot 15.96}{2.4+\ell}$
ℓ25	$\frac{\alpha \cdot 54.48}{3.1+\ell}$
ℓ32	$\frac{\alpha \cdot 112.57}{3.95+\ell}$
ℓ40	$\frac{\alpha \cdot 212.09}{4.75+\ell}$

2-2-4)Slant movement (Moving direction)



Angle	~45°	~60°	~75°	~90°
k	1	0.9	0.8	0.7

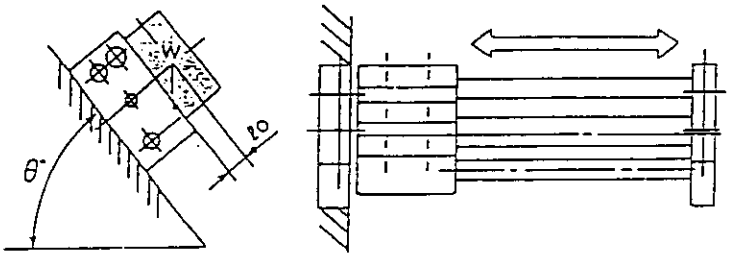
Tube I.D.	Allowable load (kg)
φ6	$\frac{\alpha \cdot 4.05k}{1.7\cos\theta+2(1.6+\ell)\sin\theta}$
φ10	$\frac{\alpha \cdot 10.2k}{2.8\cos\theta+2(1.95+\ell)\sin\theta}$
φ15	$\frac{\alpha \cdot 31.1k}{2.9\cos\theta+2(2.4+\ell)\sin\theta}$
φ25	$\frac{\alpha \cdot 105.4k}{3.55\cos\theta+2(3.1+\ell)\sin\theta}$
φ32	$\frac{\alpha \cdot 178k}{4.0\cos\theta+2(3.95+\ell)\sin\theta}$
φ40	$\frac{\alpha \cdot 361.9k}{5.7\cos\theta+2(4.75+\ell)\sin\theta}$

Angle coefficient K;

K=[~45° (=θ)]=1, [~60°]=0.9, [~75°]=0.8, [~90°]=0.7

ℓo:Distance from center of the slide block to center of gravity of the load (cm).

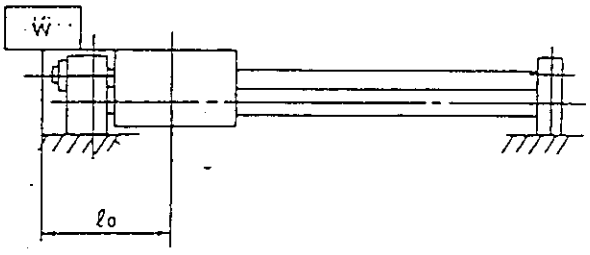
2-2-5)Slant movement (Vertical to the moving direction)



Tube I.D.	Allowable load (kg)
φ6	$\frac{\alpha \cdot 6.48}{3.6+2(1.6+\ell)\sin\theta}$
φ10	$\frac{\alpha \cdot 15}{5+2(1.95+\ell)\sin\theta}$
φ15	$\frac{\alpha \cdot 45.5}{6.5+2(2.4+\ell)\sin\theta}$
φ25	$\frac{\alpha \cdot 180}{9+2(3.1+\ell)\sin\theta}$
φ32	$\frac{\alpha \cdot 330}{11+2(3.95+\ell)\sin\theta}$
φ40	$\frac{\alpha \cdot 624}{13+2(4.75+\ell)\sin\theta}$

ℓo:Distance from center of the slide block to center of gravity of the load (cm).

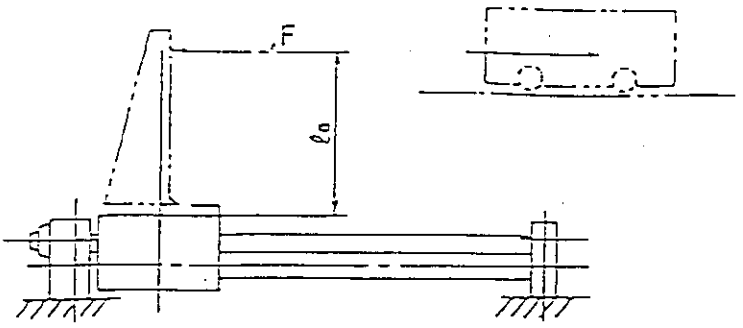
2-2-6)Center of the load travels direction of movement(ℓ)



Tube I.D.	Allowable load (kg)
ℓ6	$\frac{\alpha \cdot 2}{\ell+1.7}$
ℓ10	$\frac{\alpha \cdot 5.6}{\ell+2.8}$
ℓ15	$\frac{\alpha \cdot 13.34}{\ell+2.9}$
ℓ25	$\frac{\alpha \cdot 46.15}{\ell+3.55}$
ℓ32	$\frac{\alpha \cdot 80}{\ell+4}$
ℓ40	$\frac{\alpha \cdot 188.1}{\ell+5.7}$

ℓo:Distance from center of the slide block to center of gravity of the load (cm)

2-2-7) Horizontal movement (Pushing the load, pusher)



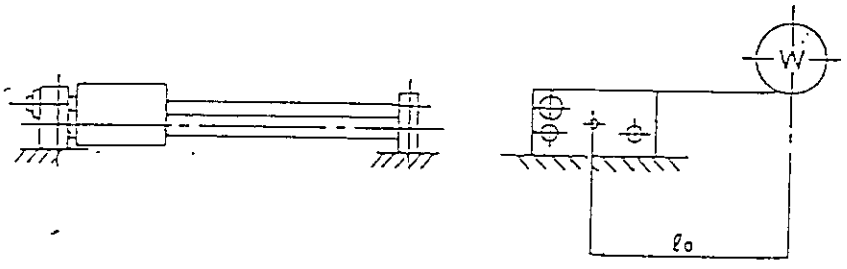
Tube I.D.	Allowable load (kg)
φ6	$\frac{\alpha \cdot 2.72}{1.6+\ell}$
φ10	$\frac{\alpha \cdot 5.55}{1.95+\ell}$
φ15	$\frac{\alpha \cdot 15.96}{2.4+\ell}$
φ25	$\frac{\alpha \cdot 58.9}{3.1+\ell}$
φ32	$\frac{\alpha \cdot 106.65}{3.95+\ell}$
φ40	$\frac{\alpha \cdot 228}{4.75+\ell}$

F: Resistance force against acutuation(kg)
(position ℓo from slide block)

ℓo: Distance from installation surface to
the center of gravity of the load (cm)

2-2-8) Horizontal movenent (The load travels lateral direction)

ℓo: Distance from center of the slide block to
center of gravity of the load (cm)



Tube I.D.	Allowable load (kg)
φ6	$\frac{\alpha \cdot 6.48}{\ell+3.6}$
φ10	$\frac{\alpha \cdot 15}{\ell+5}$
φ15	$\frac{\alpha \cdot 45.5}{\ell+6.5}$
φ25	$\frac{\alpha \cdot 144}{\ell+9}$
φ32	$\frac{\alpha \cdot 275}{\ell+11}$
φ40	$\frac{\alpha \cdot 520}{\ell+13}$

How to obtain α when select allowable load

α is a coefficient which is determined by particular stroke because it changes depending on stroke of each cylinder.

An example) In case of CY1L25□-650

1) Max. load to carry = 20kg

2) Max. load to carry at 650st= 13.6kg

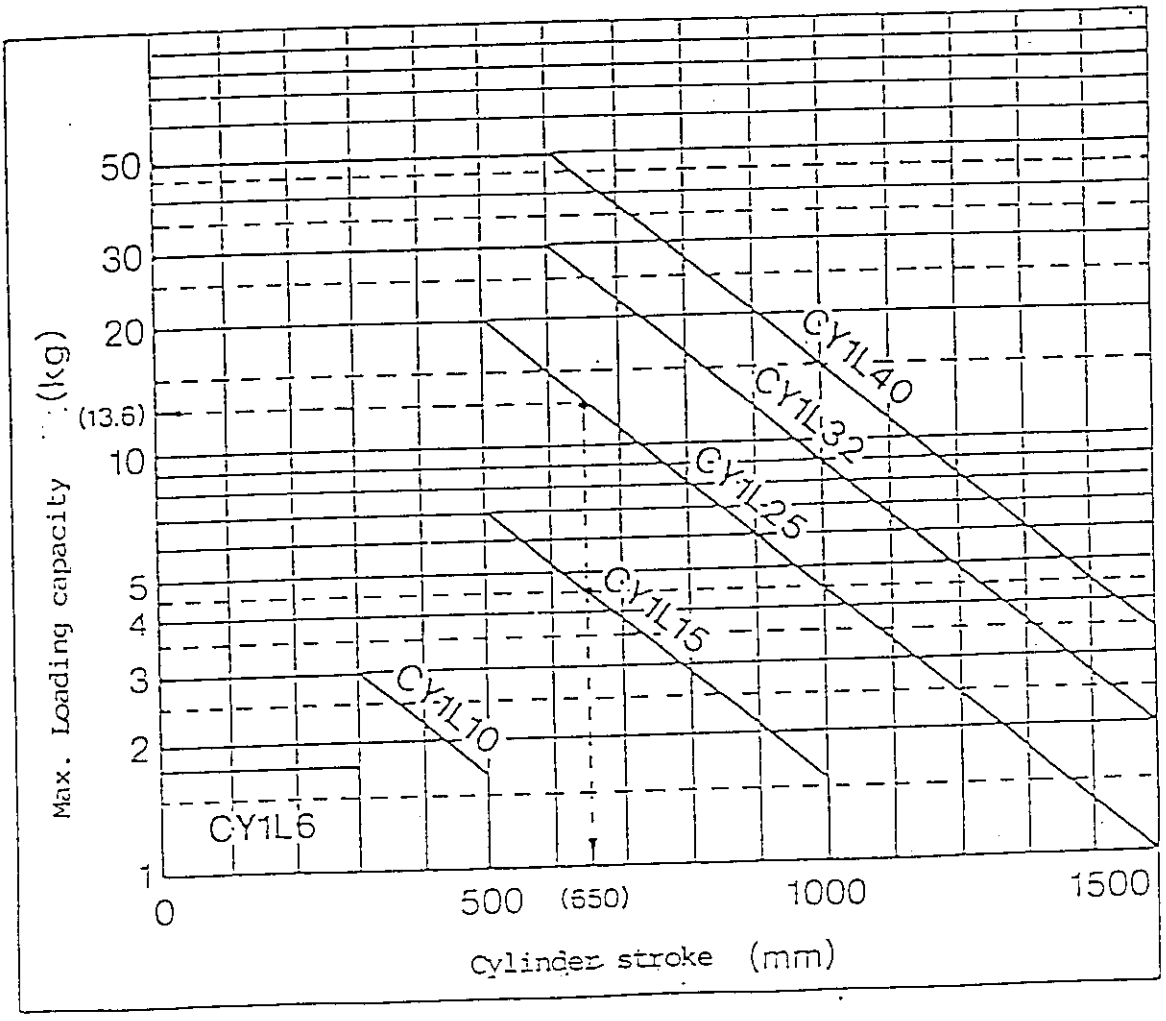
3) Therefore, $\alpha = \frac{13.6}{20} = 0.68$

Mathematical formula to obtain α ($\alpha \leq 1$) ST: Stroke (mm)

MODEL	CY1L6	CY1L10	CY1L15
$\alpha =$	1	$\frac{10^{(0.86-1.3\times10^{-3}\times ST)}}{3}$	$\frac{10^{(1.5-1.3\times10^{-3}\times ST)}}{7}$

MODEL	CY1L25	CY1L32	CY1L40
$\alpha =$	$\frac{10^{(1.86-1.3\times10^{-3}\times ST)}}{20}$	$\frac{10^{(2.26-1.3\times10^{-3}\times ST)}}{30}$	$\frac{10^{(2.46-1.3\times10^{-3}\times ST)}}{50}$

Note) In case of use until ϕ10-300mmST, ϕ15-500mmST, ϕ25-500mmST, ϕ32-600mmST and ϕ40-600mmST, obtain as α=1



3.Regarding intermediate stop

3-1.In case to stop by external stopper(adjust bolt, shock absorber and etc,.)
Care should be taken for the followings,when it's stopped at half-way of the stroke by external stopper (damper shock absorber and etc,.)

3-1-1)Maximum working pressure.
Operation of this device should be performed within stated figure in Table 3. of working pressure. Setting working pressure above those figures may cause getting out of place of sliding block acting force on travel part of piston side and external side exceeding holding force of those.

Table 3.Limit of working pressure when it's stopped intermediately

Cylinder Bore	Model	Holding force (N)	corresponding force to holding force(MPa)	Limit of working pressure when it's stopped (MPa)
φ6	CY1L 6H	19. 6	0. 7	0. 55
φ10	CY1L 10H	53. 9	0. 7	0. 55
φ15	CY1L 15H	137. 3	0. 79	0. 65
	CY1L 15L	81. 4	0. 47	0. 40
φ25	CY1L 25H	362. 8	0. 75	0. 65
	CY1L 25L	220. 6	0. 46	0. 40
φ32	CY1L 32H	588. 4	0. 74	0. 65
	CY1L 32L	357. 9	0. 45	0. 40
φ40	CY1L 40H	921. 8	0. 75	0. 65
	CY1L 40L	568. 8	0. 46	0. 40

Mathematical formula to calculate equivalent holding force.

$$Po = \frac{4 \cdot F}{\pi D^2}$$

Po;Equivalent holding force

F;Holding force

D;Inner diameter of cylinder tube.

Using this device within given range of working pressure, travel part of piston side and external side never gets out of place. If it's still got out of the place, it may be occurred due to wrong allocation of travel parts each other. In such case occurred, relieve half-way stop functions and at stroke end push travle part manually(or apply equivalent pressure to holding force to travel part at piston side) to right position.

3-2. In case to stop intermediately using by pneumatic circuit
To stop intermediately by pneumatic circuit, following cares should be taken.

3-2-1) Intermediate stop requiring with high accuracy is unattainable. Where required high accuracy half-way stop, air-hydraulic type(semi-standard) combining with air-hydro unit (CC series) is recommended. To place order this combination with air-hydro unit, just add -X116 to the end of the parts number. This option is available only sizes larger than ø 25.

3-2-2) Care should be taken for kinetic energy of the load.
When intermediate stop function is performed by closed-center type of directional control valve (same thing is occurred when stop valve of hydro system is used), it may cause to run-away of the load (together with slide block.)
Figures in Table 4. shows kinetic energy which holding force can absorb. Those figures should be referred to use this device under conditions, that enable intermediate stop in relation of load and velocity.

Table 4. Kinetic energy possible to stop intermediately (Reference).

Tube bore (mm)	Model	Holding force (N)	Kinetic energy possible to stop intermediately (J)
φ6	CY1L6	19.6	6.86×10^{-3}
φ10	CY1L10	53.9	2.94×10^{-2}
φ15	CY1L15H	137.3	1.30
	CY1L15L	81.4	7.6×10^{-2}
φ25	CY1L25H	362.8	0.45
	CY1L25L	220.6	0.27
φ32	CY1L32H	588.4	0.88
	CY1L32L	357.9	0.53
φ40	CY1L40H	921.8	1.53
	CY1L40L	568.8	0.95

4. Operating air

Since this cylinder is non-lube type, air to be supplied should be filtered by SMC made AF Series air filter and be regulated by AR Series regulator. When it is needed to lubricate, turbine oil (ISO VG32) is recommended.

5. Maintenance

When this device is disassembled to replace piston packing, wearing and etc., care should be taken for following points.

5-1. To remove sliding block or piston from cylinder tube, holding force must be released by shifting positions of sliding block and piston forcibly. Removing those without doing so, respective magnets call each other directly and may become impossible to separate.

5-2. Upon completing above works to separate respective travel parts, by loosening hexagon head cap screw (at plate A side,) remove cylinder tube and plate A from guide rod A and B. (While replacing works (of packing, so on, other parts should not be disassembled, disassembling other parts may cause air leakage.)

5-3. Magnet assembly (piston travel part and external travel part) must not be disassembled. Disassembling this may cause to decrease of holding force and other defects.

5-4. Piston side travel part and external travel part have a direction (L type and $\phi 6.\phi 10$). Refer to the figure 7. Let external travel part (slide lock) and piston contact and insert into cylinder tube to form positions shown in the figure 7. When posture becomes as (b), turn only piston reverse to insert.

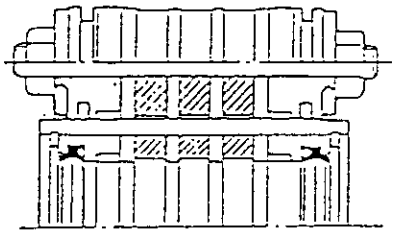


Fig7-(a) Correct direction

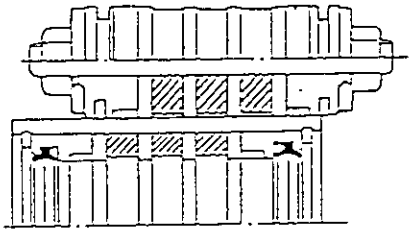


FIg7-(b) Incorrect direction

Fig7. Direction of the travel parts

5-5. When handle magnet assmebly, watch on your arm should be put off (particularly analog one) not to get influence from stron magnetic field.

5-6. Through care should be taken for the magnet not to drop on the floor or knock against metal.

6. Other precautions.

6-1. Parts made of iron are used in travel part so care should be taken no water drops coming on the cylinder tube.

6-2. Grease should be periodically applied to bearing part of slide block. (Please refer to suiable grease in Table 5.)

6-3. When it is installed, through air-flashing to pipings are required not to allow contaminations or chips stay inside.

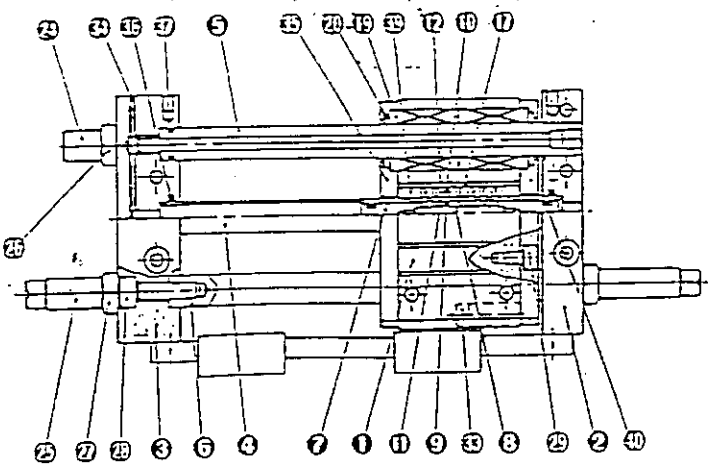
6-4. Care should be taken not to make flaw or gouge on external surface of cylinder tube and guide rod. Leaving those flaw or gouge may promote damage of scraper, wear ring and bush and thus cause to malfunction.

6-5. Change holding force of magnet (for example, CY1L25L→CY1L25H) is carried out in our plant. To ask for this, please contact with our sales office.

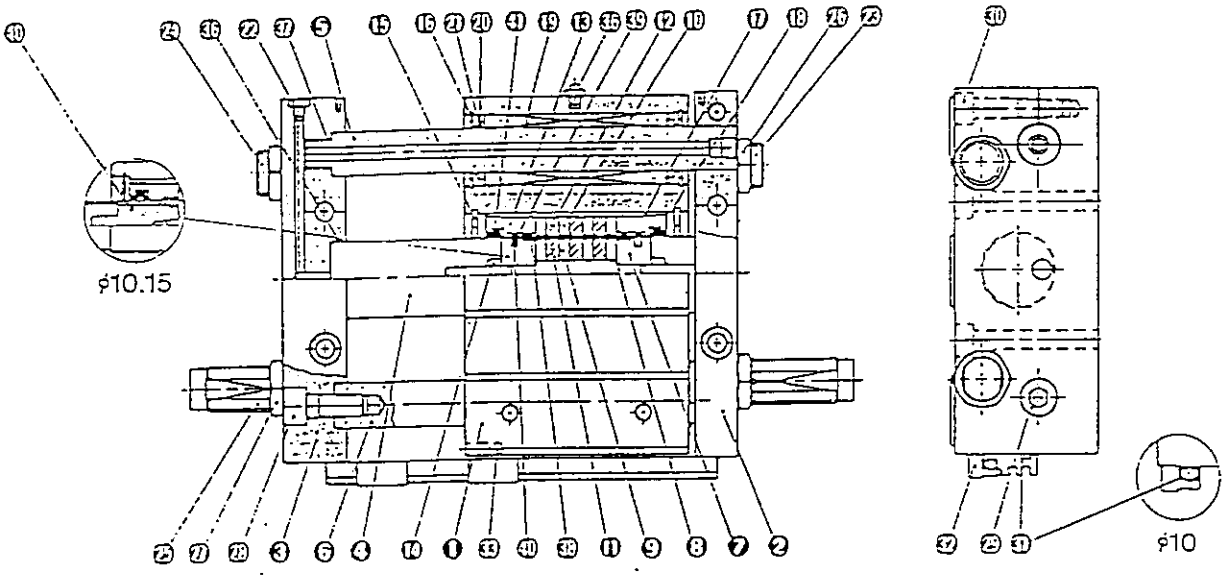
6-6. Expected use under present of water (warmed water), coolant and so on, is advised to consult with us.

CY1L6

旧名用



CY1L10~40



Parts List

No	Name	Material	Ref.
1	Slide block	Aluminum alloy	Hard almite
2	Plate A	Aluminum alloy	Hard black almite
3	Plate B	Aluminum alloy	Hard black almite
4	Cylinder tube	Stainless	
5	Guide shaft A	Carbon steel	Hard chrome plating
6	Guide shaft B	Carbon steel	Hard chrome plating
7	Piston	Aluminum alloy	Chromate
8	Shaft	Stainless	
9	Yoke at piston side	Rolled plate	Zinc chromate
10	Yoke at travel side	Rolled plate	Zinc chromate
11	Magnet A	Rare earth magnet	
12	Magnet B	Rare earth magnet	
13	Wear ring holder	Aluminum alloy	Black almite
14	Piston nut	Carbon steel	Zinc chromate ϕ25-ϕ40 only
15	Snap ring	Carbon tool steel	
16	Snap ring	Carbon tool steel	
17	Tube at external travel side	ϕ6, ϕ10, ϕ15 Stainless ϕ32, ϕ40 Aluminum alloy	
18	Spacer	Rolled plate	Black zinc chromate
19	Ball bush		
20	Felt ring	Felt	
21	Felt holder	Aluminum alloy	
22	Plug	Brass	ϕ25, ϕ32, ϕ40 only
23	Adjust bolt A	Chrome molybdenum steel	Black zinc chromate
24	Adjust bolt B	Chrome molybdenum steel	Black zinc chromate
25	Shock absorber		RB series
26	Hexagon nut	Carbon steel	Black zinc chromate
27	Hexagon nut	Carbon steel	Black zinc chromate
28	Hexagon socket head cap screw	Chrome molybdenum steel	Black zinc chromate
29	Hexagon socket head cap screw	Chrome molybdenum steel	Black zinc chromate
30	Hexagon socket head cap screw	Chrome molybdenum steel	
31	Rail for mounting switch	Aluminum alloy	
32	Auto switch		

Parts List

33	Magnet for auto switch	Rare earth magnet	
34	Steel ball		ϕ6, ϕ10, ϕ15 only.
35	Side cover	Carbon steel	ϕ6 onlu
36	Grease cup	Carbon steel	More than ϕ15

Spare Parts

No	Name	Material	Parts No.
36	Cylinder tube gasket	NBR	
37	Guide shaft gasket	NBR	
38	Wear ring A	Special resin	
39	Wear ring B	Special resin	
40	Piston packing	NBR	
41	Scraper	NBR	

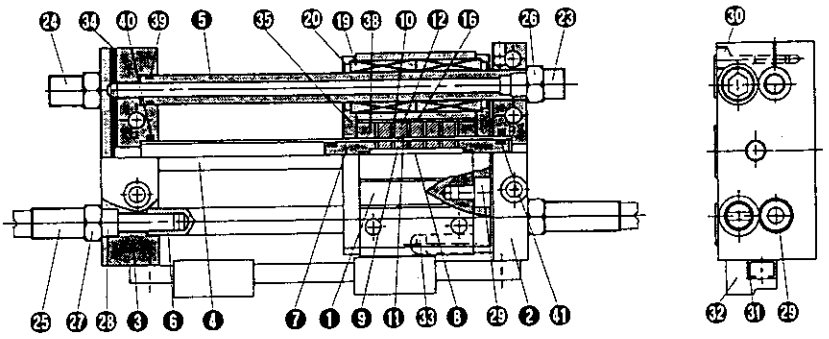
Table 5. Grease(Lithium soap base grease viscosity No.1 or 2.)

Name of grease	Maker	Name of grease	Maker
Kyoseki rizonick grease No.1	Kyodo Sekyu	Dinamax grease super No.1	Cosmo
-ditto- No.2	-ditto-	-ditto- No.2	-ditto-
Listan No.1	Esso	Cosmo concentrated grease No.1	-ditto-
-ditto- No.2	-ditto-	-ditto- No.2	-ditto-
-ditto- EP1	-ditto-	Kacoal multi-purpose grease No.1	Fuji Kosan
-ditto- EP2	-ditto-	-ditto- No.2	-ditto-
Daffny colonex grease No.1	Idemitsu Kosan	Multi-knock greaseNo.1	Nihon Sekyu
-ditto- No.2	-ditto-	-ditto- No.2	-ditto-
Diamond multi-purpose grease No.1	Mitsubishi sekyu	Epi-knock grease No.1	-ditto-
-ditto- No.2	-ditto-	-ditto- No2	-ditto-
Mobilux grease No.1	Mobile Sekyu	Fuji sunlite grease No.2	Showa sekyu
-ditto- No.2	-ditto-	-ditto- EM1	-ditto-
Shell alvania grease No.1	Shell	-ditto- EP1	-ditto-
-ditto- No.2	-ditto-	-ditto- EP2	-ditto-
Shell alvania EP grease No.1	-ditto-	Zemico grease MP-1	General sekyu
-ditto- No.2	-ditto-	-ditto- MP-2	-ditto-
		-ditto- MH-1	-ditto-
		-ditto- MH-2	-ditto-

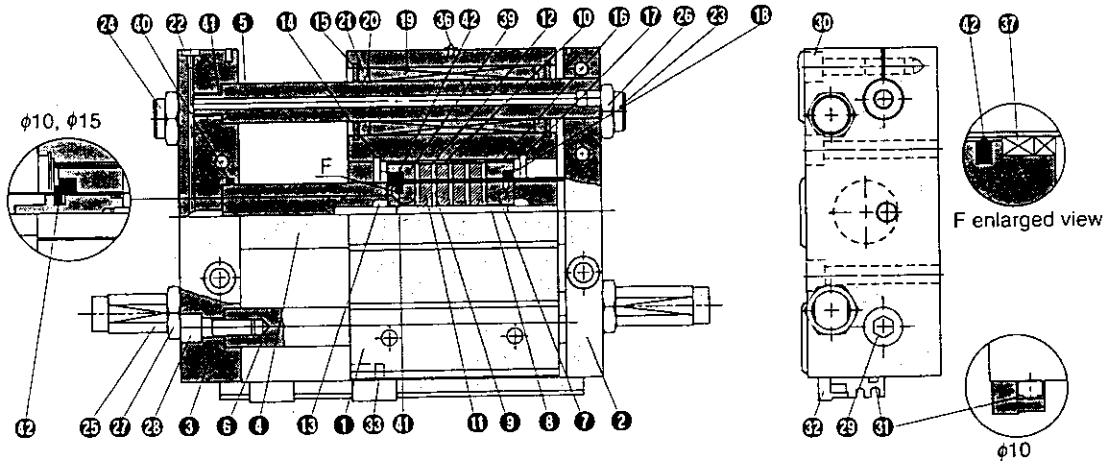
Note)Numbers with grease name directly means viscosity.

Slider Type/Ball Bush Bearing: Construction/Parts List

CY1L6



CY1L10~40



Parts List

No.	Description	Material	Note
❶	Slide block	Aluminum alloy	Hard alumite
❷	Plate A	Aluminum alloy	Colored hard alumite
❸	Plate B	Aluminum alloy	Colored hard alumite
❹	Cylinder tube	Stainless steel	
❺	Guide shaft A	Carbon steel	Hard chromium plating
❻	Guide shaft B	Carbon steel	Hard chromium plating
❼	Piston	※ Aluminum alloy	Chromate
❽	Shaft	Stainless steel	
❾	Piston side yoke	Rolled steel	Zinc chromate
❿	External moving element side yoke	Rolled steel	Zinc chromate
⓫	Magnet A	Rare-earth metal magnet	
⓬	Magnet B	Rare-earth metal magnet	
⓭	Piston nut	Carbon steel	Zinc chromate (φ25~φ40)
⓮	Retaining ring	Carbon tool steel	Nickel plating
⓯	Retaining ring	Carbon tool steel	Nickel plating
⓰	External moving element side tube	Aluminum alloy	
⓱	Moving element spacer	Rolled steel	Nickel plating
⓲	Spacer	Rolled steel	Nickel plating

※ Brass in case of φ6~φ15.

Parts List

No.	Description	Material	Note
⓳	Ball bushing	–	
⓴	Felt ring	Felt	
㉑	Felt holder	Aluminum alloy	
㉒	Plug	Brass	φ25,φ32,φ40 only
㉓	Adjusting bolt A	Chrome-Molybden steel	Nickel plating
㉔	Adjusting bolt B	Chrome-Molybden steel	Nickel plating
㉕	Shock absorber	–	
㉖	Hexagon nut	Carbon steel	Nickel plating
㉗	Hexagon nut	Carbon steel	Nickel plating
㉘	Hexagon socket head cap screw	Chrome-Molybden steel	Nickel plating
㉙	Hexagon socket head cap screw	Chrome-Molybden steel	Nickel plating
㉚	Hexagon socket head cap screw	Chrome-Molybden steel	Nickel plating
㉛	Switch mounting rail	Aluminum alloy	
㉜	Auto switch	–	
㉝	Magnet for auto switch	Rare-earth metal magnet	
㉞	Steel ball	–	φ6,φ10,φ15 only
㉟	Side cover	Carbon steel	φ6 only
㊱	Grease cup	Carbon steel	φ15 or more

Spare Parts/Exchange Parts

No.	Bore size	φ6		φ10		φ15		φ25		φ32		φ40	
	Packing set No.	CY1L6-PS-N		CY1L10-PS-N		CY1L15-PS-N		CY1L25-PS-N		CY1L32-PS-N		CY1L40-PS-N	
	Description	Parts No.	pcs.	Parts No.	pcs.	Parts No.	pcs.	Parts No.	pcs.	Parts No.	pcs.	Parts No.	pcs.
㊲	Wearing A	–	–	CY-010-07A22999	2	CY-015-07A19920	2	CY-025-07A19921	2	CY-032-07A19922	2	CY-040-07A19923	2
㊳	Wearing B	CY-006-07-23536	2	CYB10-36-A8009	2	CYS15-36-A8019	2	CYS25-36-A8021	2	CYS32-36-A8022	2	CYS40-36-A8023	2
㊴	Cylinder tube gasket	C8	2	C12.5	2	C17	2	C27	2	C34	2	C42	2
㊵	Guide shaft gasket	C6	1	C8	1	C7	1	C8	1	C12	1	C18	1
㊶	Piston packing	DYP6	2	PPD-10	1	PPD-15	1	PPD-25-19	1	PPD-32	1	PPD-40	1
㊷	Scraper	–	–	PDU-12Z	2	PDU-23x16	2	PDU-34x26	2	PDU-45x34	2	PDU-51x42	2

Revision

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