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# OPERATION MANUAL

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TITLE : Sine Rodless Cylinder  
RE A Series

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- Read this manual thoroughly before mounting and operation.
- Especially, carefully read the description concerning safety.
- Keep this manual where accessible when necessary.

SMC CORPORATION

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I N D E X

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1 . Installation to Application ————— 3

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# Safety Instructions

These safety instructions are intended to prevent hazardous situations and/or equipment damage. These instructions indicate the level of potential hazard with the labels of "Caution," "Warning" or "Danger." They are all important notes for safety and must be followed in addition to International Standards (ISO/IEC)\*1), and other safety regulations.

\*1) ISO 4414: Pneumatic fluid power -- General rules relating to systems.

ISO 4413: Hydraulic fluid power -- General rules relating to systems.

IEC 60204-1: Safety of machinery -- Electrical equipment of machines .(Part 1: General requirements)

ISO 10218: Manipulating industrial robots -Safety.

etc.



## Caution

**Caution** indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.



## Warning

**Warning** indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.



## Danger

**Danger** indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.

## Warning

### 1. The compatibility of the product is the responsibility of the person who designs the equipment or decides its specifications.

Since the product specified here is used under various operating conditions, its compatibility with specific equipment must be decided by the person who designs the equipment or decides its specifications based on necessary analysis and test results.

The expected performance and safety assurance of the equipment will be the responsibility of the person who has determined its compatibility with the product.

This person should also continuously review all specifications of the product referring to its latest catalog information, with a view to giving due consideration to any possibility of equipment failure when configuring the equipment.

### 2. Only personnel with appropriate training should operate machinery and equipment.

The product specified here may become unsafe if handled incorrectly.

The assembly, operation and maintenance of machines or equipment including our products must be performed by an operator who is appropriately trained and experienced.

### 3. Do not service or attempt to remove product and machinery/equipment until safety is confirmed.

1. The inspection and maintenance of machinery/equipment should only be performed after measures to prevent falling or runaway of the driven objects have been confirmed.

2. When the product is to be removed, confirm that the safety measures as mentioned above are implemented and the power from any appropriate source is cut, and read and understand the specific product precautions of all relevant products carefully.

3. Before machinery/equipment is restarted, take measures to prevent unexpected operation and malfunction.

### 4. Contact SMC beforehand and take special consideration of safety measures if the product is to be used in any of the following conditions.

1. Conditions and environments outside of the given specifications, or use outdoors or in a place exposed to direct sunlight.

2. Installation on equipment in conjunction with atomic energy, railways, air navigation, space, shipping, vehicles, military, medical treatment, combustion and recreation, or equipment in contact with food and beverages, emergency stop circuits, clutch and brake circuits in press applications, safety equipment or other applications unsuitable for the standard specifications described in the product catalog.

3. An application which could have negative effects on people, property, or animals requiring special safety analysis.

4. Use in an interlock circuit, which requires the provision of double interlock for possible failure by using a mechanical protective function, and periodical checks to confirm proper operation.



# Safety Instructions

## Caution

### 1. The product is provided for use in manufacturing industries.

The product herein described is basically provided for peaceful use in manufacturing industries.

If considering using the product in other industries, consult SMC beforehand and exchange specifications or a contract if necessary.

If anything is unclear, contact your nearest sales branch.

## Limited warranty and Disclaimer/Compliance Requirements

The product used is subject to the following "Limited warranty and Disclaimer" and "Compliance Requirements".

Read and accept them before using the product.

### Limited warranty and Disclaimer

#### 1. The warranty period of the product is 1 year in service or 1.5 years after the product is delivered, whichever is first.\*2)

Also, the product may have specified durability, running distance or replacement parts. Please consult your nearest sales branch.

#### 2. For any failure or damage reported within the warranty period which is clearly our responsibility, a replacement product or necessary parts will be provided.

This limited warranty applies only to our product independently, and not to any other damage incurred due to the failure of the product.

#### 3. Prior to using SMC products, please read and understand the warranty terms and disclaimers noted in the specified catalog for the particular products.

##### \*2) Vacuum pads are excluded from this 1 year warranty.

A vacuum pad is a consumable part, so it is warranted for a year after it is delivered.

Also, even within the warranty period, the wear of a product due to the use of the vacuum pad or failure due to the deterioration of rubber material are not covered by the limited warranty.

### Compliance Requirements

#### 1. The use of SMC products with production equipment for the manufacture of weapons of mass destruction(WMD) or any other weapon is strictly prohibited.

#### 2. The exports of SMC products or technology from one country to another are governed by the relevant security laws and regulation of the countries involved in the transaction. Prior to the shipment of a SMC product to another country, assure that all local rules governing that export are known and followed.

## Caution

### SMC products are not intended for use as instruments for legal metrology.

Measurement instruments that SMC manufactures or sells have not been qualified by type approval tests relevant to the metrology (measurement) laws of each country.

Therefore, SMC products cannot be used for business or certification ordained by the metrology (measurement) laws of each country.

## 1. Installation to Application

The Sine rodless cylinder (REA series) presented in this manual is not equipped with non-rotation device and allows external slider to rotate. Also, the rod less cylinder can't resist direct large load and needs another axis (LM guide etc.) as a guide to support the load.

### 1-1) Installation of cylinder body

Before installation of cylinder body, be sure to fix head covers at its both ends. (In other words, use the cylinder with support at the both ends.)

Also, do not use the cylinder with fixed at external slider to avoid excessive moment applied to bearing of the cylinder.

And, if the cylinder is mounted with axial compressing force applied, the cylinder tube is deflected and operating failure may be caused. (Fig. 1)

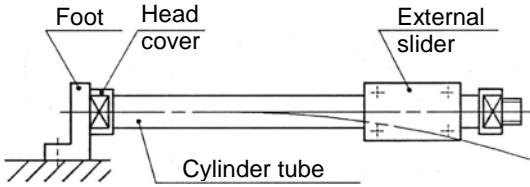
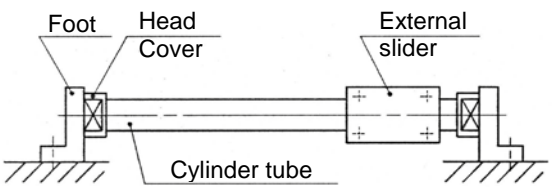
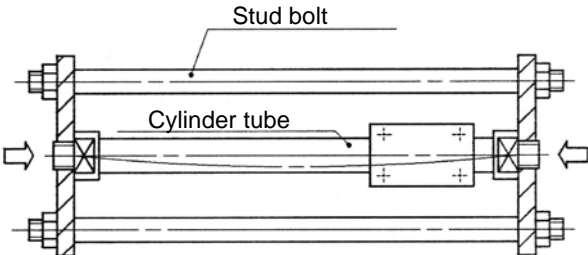
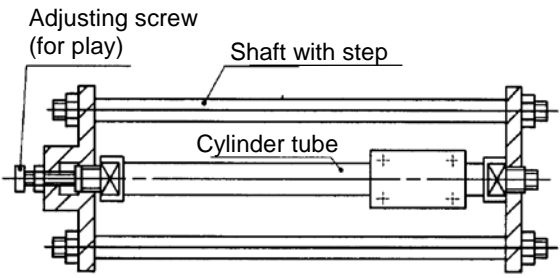
Wrong example	Correct example
 <p style="text-align: center;"><u>Support at one end</u></p>	 <p style="text-align: center;"><u>Support at both ends</u></p>
 <p>If the cylinder body is mounted by stud bolt etc. with axial compressing force applied, the cylinder tube is deflected and breaks alignment, operating failure may be caused.</p>	 <p>Eliminate the axial compressing force from the cylinder body by adequate tool, such as shaft with step. The play created between mounting bracket and cylinder body can be adjusted by adjusting screw etc.</p>

Fig. 1 Installation of cylinder body

1-2) Installation of external slider and load

Consider the following two points for mounting of external slider and load.

- I -a) The cylinder is deflected by self-weight as shown on Fig. 2. This means longer stroke produces larger displacement of alignment.

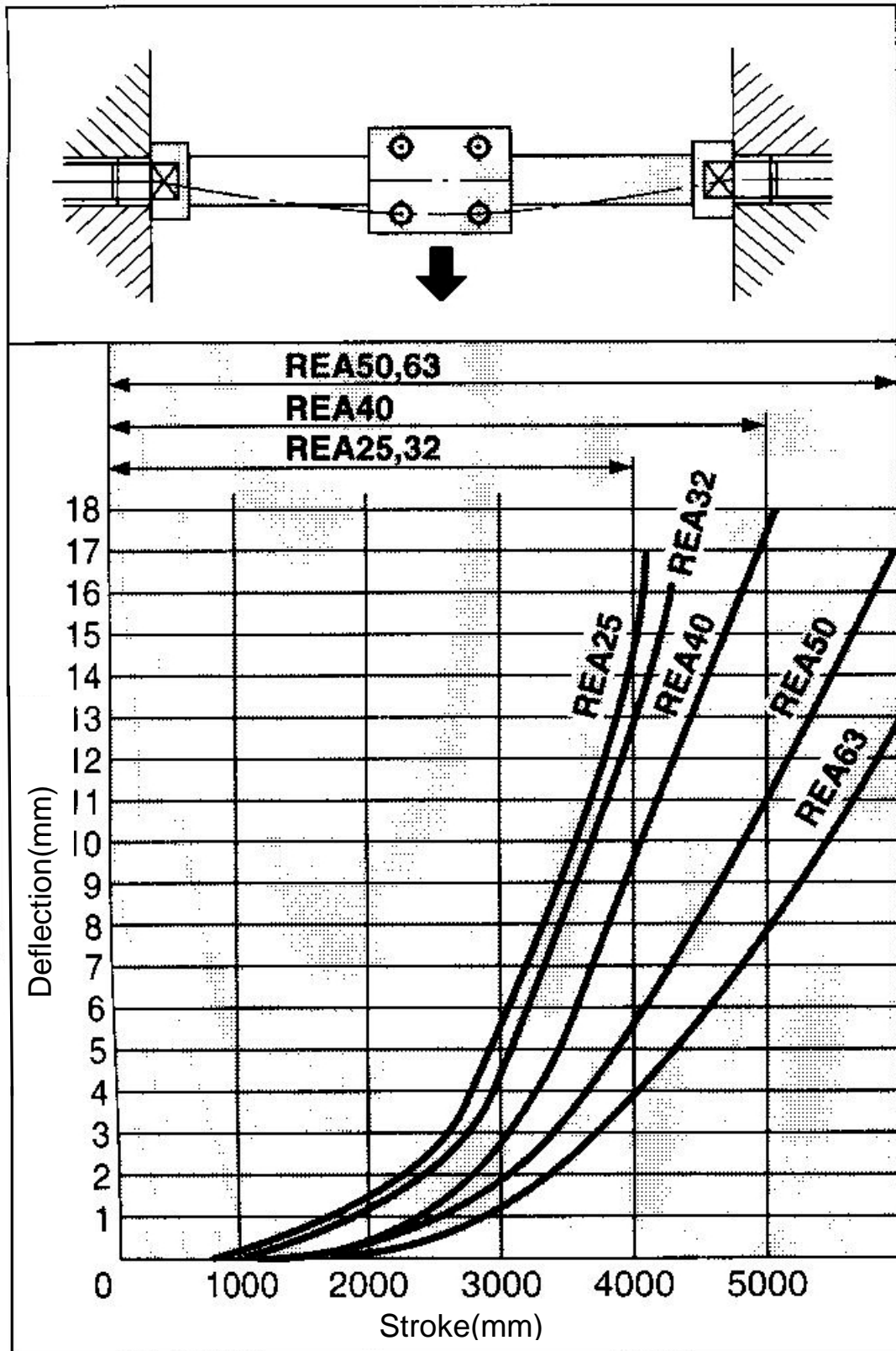


Fig. 2 Deflection of rodless cylinder by self-weight

I -b) The misalignment between cylinder body and guide (orbit) may be caused depending on machining accuracy of the space for mounting. Therefore, **the installation must be performed to compensate the misalignment.** The following two show the example with or without concern about misalignment respectively.

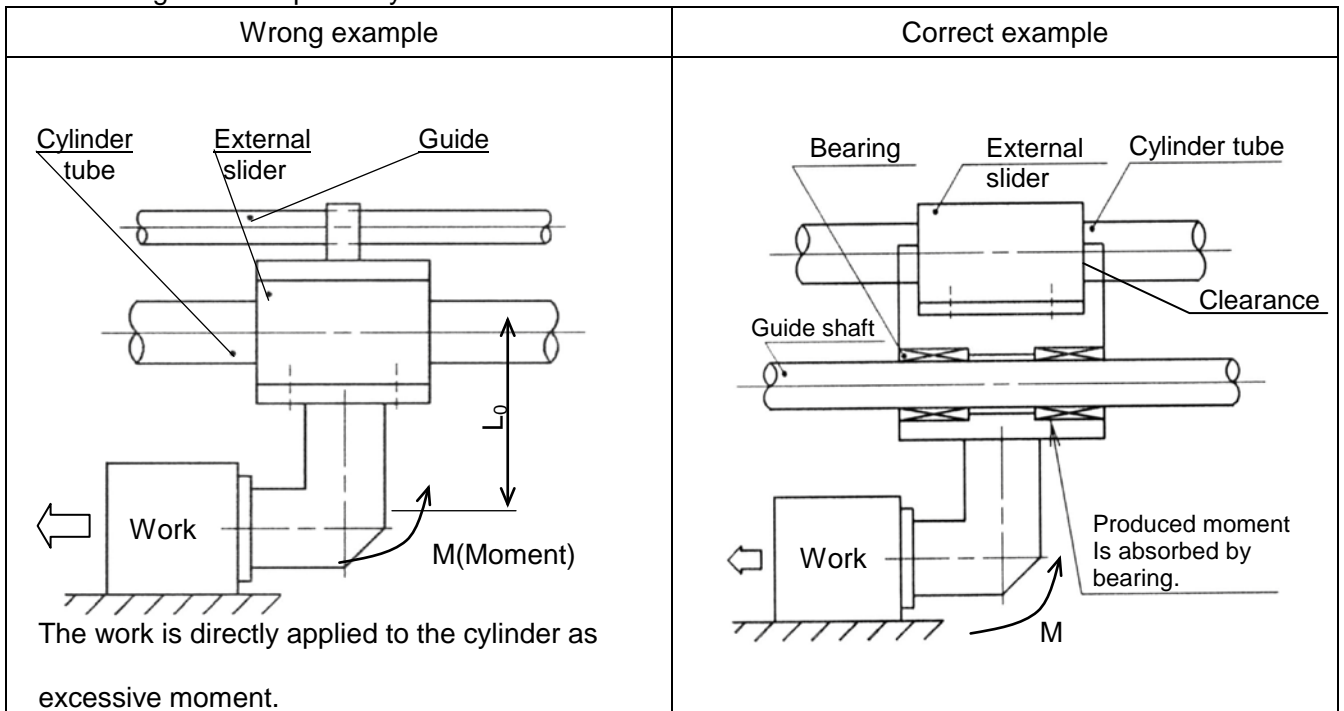


Fig. 3-1 [Ex.-1]

If the load base is directly mounted on external slider, the misalignment produced between the load base and cylinder is not compensated and may cause operating failure. The following shows the solution to compensate the misalignment and deflection created by self-weight of cylinder.

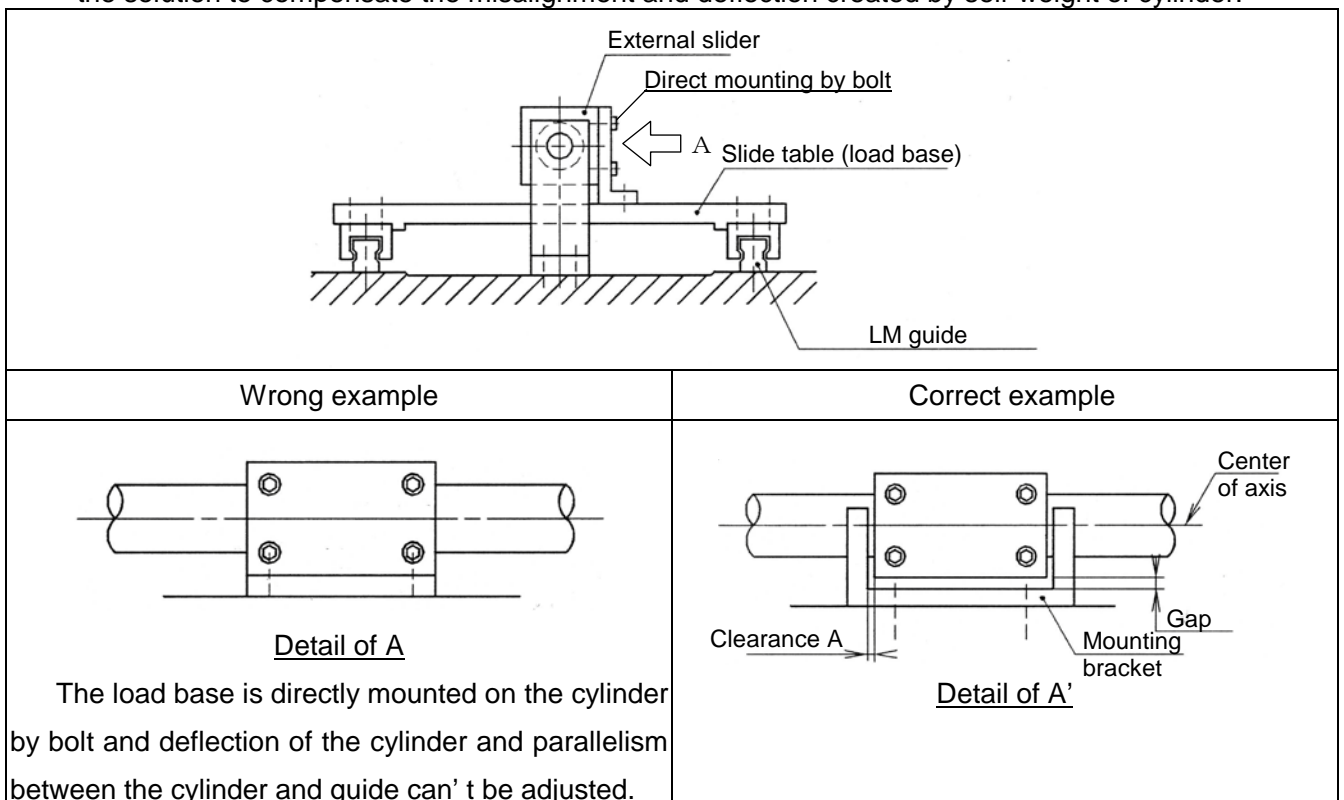
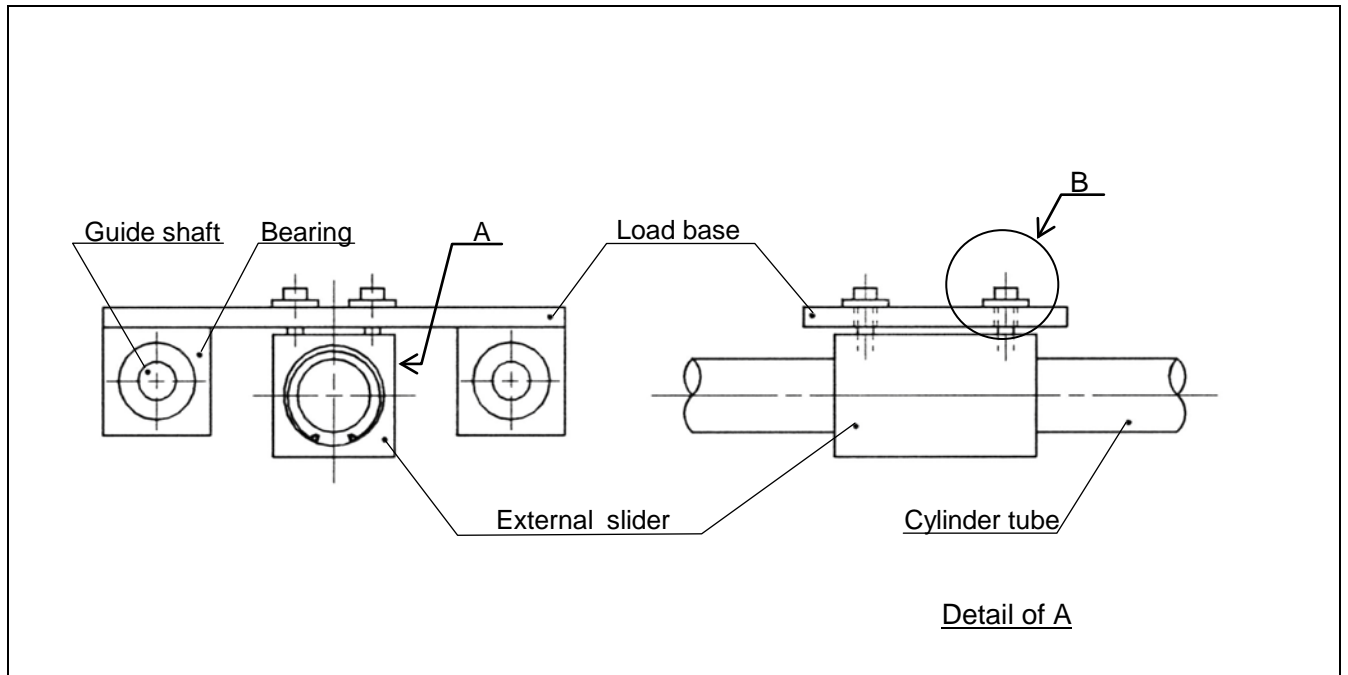
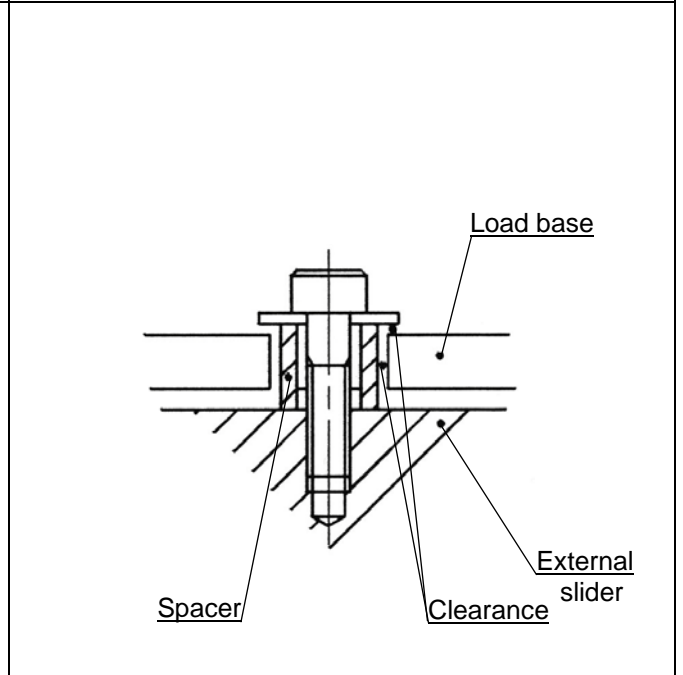
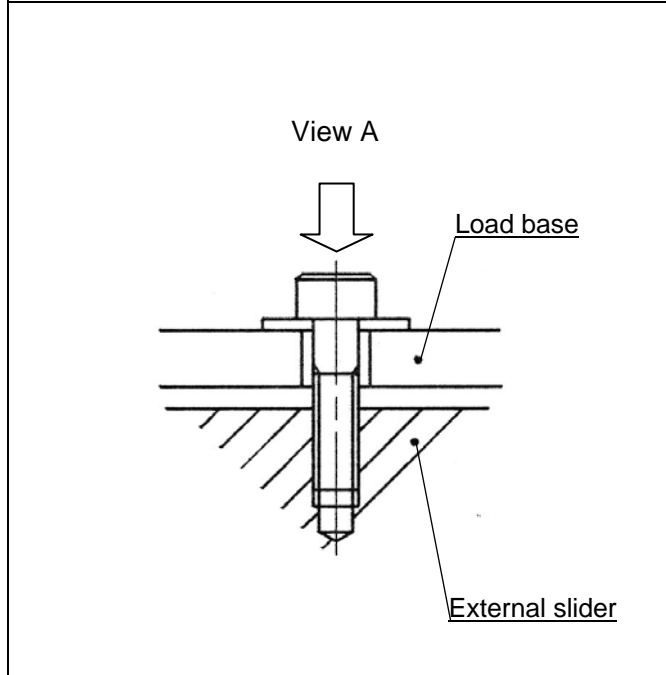


Fig. 3-2 [Ex.-2]



Wrong example

Correct example



Detail of B

By tightening of the bolt, the load base and cylinder body are in the state similar to direct connection.

Detail of B

**Insert the spacer** to keep flexibility in cylinder body and load base even after the bolt is tightened.

\* The installation as shown on Fig. 3-1 and 3-2 are recommended, but if they are not available due to mounted load, the installation like above can be substituted. For this installation, check relationship between actuating force and moment on page 9 in prior.

Fig. 3-3 [Ex.-3]



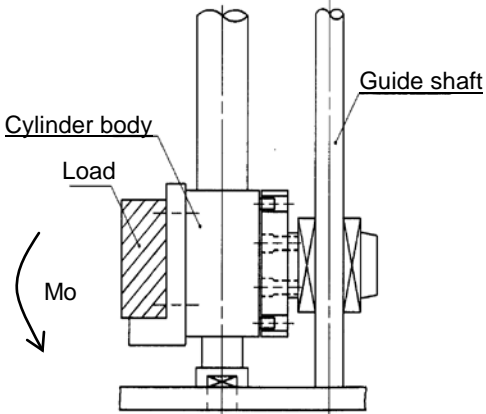
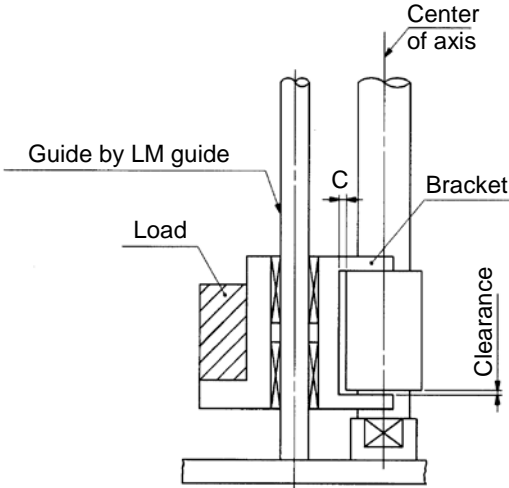
Wrong example	Correct example
 <p data-bbox="199 801 805 936">Since the cylinder is subject to direct moment of load, guide shaft can work as only non-rotation and operating failure may be caused.</p>	 <p data-bbox="842 801 1516 981">The load is supported by guide shaft and the clearance is provided to compensate misalignment. The bracket is longer than center of axis of cylinder to prevent moment applied to external slider.</p>

Fig.3-4 [Ex.-4]

In wrong example shown of Fig. 3-2 [Ex.-2] (with external slider mounted directly on load base), the misalignment between guide (orbit) and cylinder is not compensated and may induce operating failure. To eliminate the misalignment and deflection of cylinder by self-weight, clearance is provided between mounting bracket and cylinder as shown on correct example. Additionally, **the mounting bracket should be longer than center of axis of cylinder** to minimize the moment applied to the external slider.

If the cylinder is mounted as shown on wrong example from Ex.1 to 4, external slider clamped is cylinder tube strongly during operation and the wearing is worn so much as to cause operating failure.

As alternative solution for misalignment between cylinder and load, the cylinder with specific bracket is also by addition of -XC57 to suffix of part no. (Fig. 3-5) However, the floating joint block obtained by -XC57 can't be mounted to standard cylinder because -XC57 is adopting specific external slider. Therefore, if -XC57 spec. is required for standard cylinder purchased independently, the cylinder needs to be sent to SMC factory for repair with description of request "-XC57 spec."

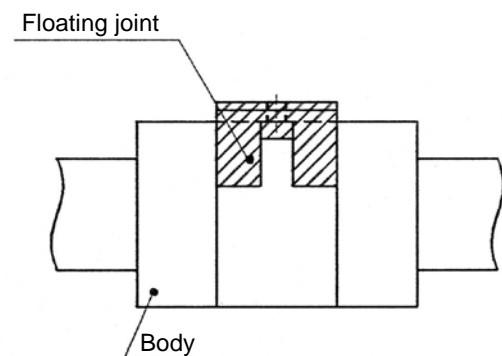


Fig. 3-5 [Ex.-5] (-XC57)

The misalignment can be checked by the following procedure.

- 1) After installation of cylinder to application, increase pressure of regulator gradually before checking operation of cylinder at operating pressure, and then calculate min. pressure which enables smooth operation of cylinder over full stroke.
- 2) The min. operating pressure obtained after mounting of load (actual min. operating pressure) is different from one of independent cylinder, but the difference should be focused.
- 3) The actual min. operating pressure is sum of "sliding resistance of cylinder", "force to operate load" and "sliding resistance of guide".  
(Fig. 4)

This means when misalignment is not compensated enough, sliding resistance of guide increases excessively. Additionally, sliding resistance of external slider increases and causes wearing to wear so much as to induce operating failure.

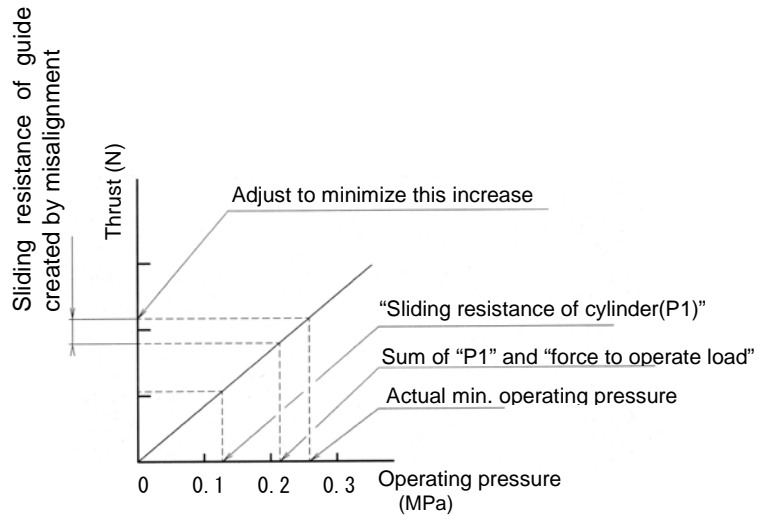


Fig. 4 (Reference)

### 1-3) Speed adjustment

- ① SMC's "throttle" type speed controllers (series AS) are recommended for speed adjustment. (Refer to Table.1)
- ② Speed adjustment is possible with meter-in/meter-out type speed controllers, but it may not be possible to obtain the cushion effect (Smooth start-up, soft-stop).
- ③ In the case of other than horizontal mounting, it is recommended that the system have a reduced pressure supply circuit (Refer to Fig.5) installed at its lower side. (This is also effective as a countermeasure against start-up delay on an upward stroke, and for air saving.)

Type	Type		
	Elbow type	straight type	In-line type
REA25	AS2201F-01-06-X214	AS2301F-01-06-X214	AS2001F-06-X214
REA32	AS2201F-01-06-X214	AS2301F-01-06-X214	AS2001F-06-X214
REA40	AS2201F-02-06-X214	AS2301F-02-06-X214	AS2001F-06-X214
REA50	AS3201F-02-08-X214	AS3301F-02-08-X214	AS3001F-08-X214
REA63	AS3201F-02-08-X214	AS3301F-02-08-X214	AS3001F-08-X214

Table.1 Recommended speed controller

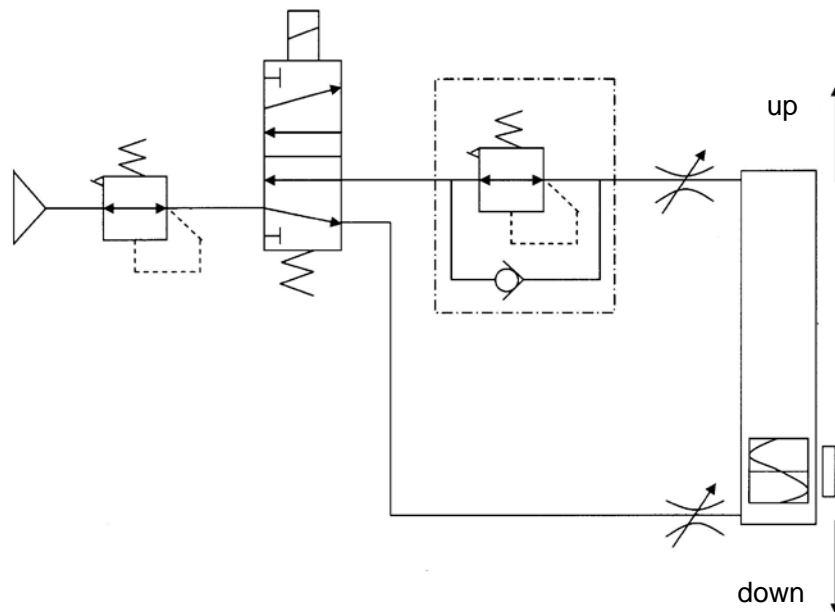


Fig. 5

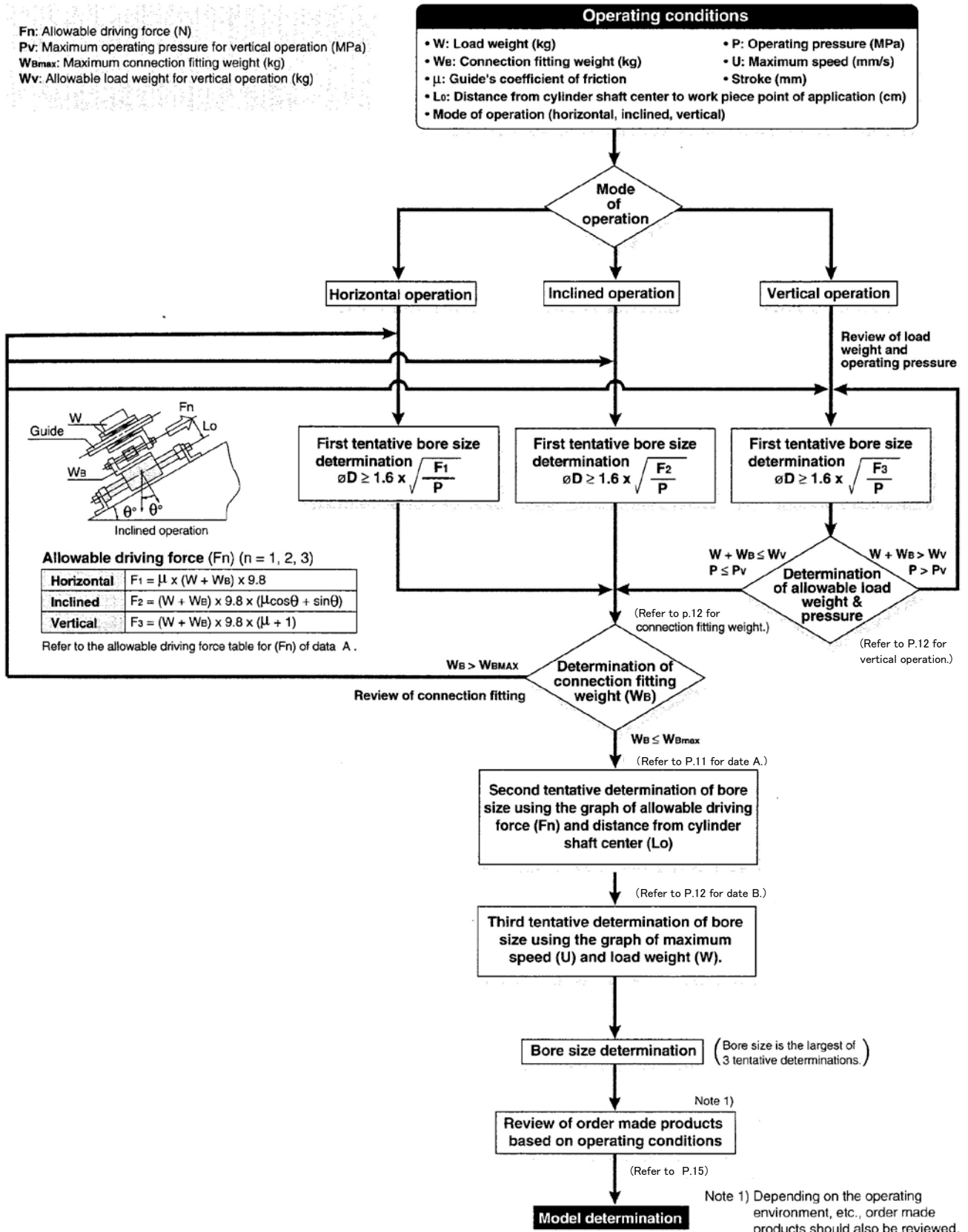
### 1-4) Adjustment of cushion effect

The cushion can not be adjusted.

There is no cushion needle adjustment of the kind found on conventional cushion mechanisms.

## 2. Model Selection

2-1) Select the model according to the selection flow chart below.



## 2-2) Actuating force

The actuating force of sine rodless cylinder is ideally equal to thrust at center of axis of piston but normally, as shown on Fig.6-1, it is taken as  $F_n$  at the part away from the center by  $L_o$  cm.

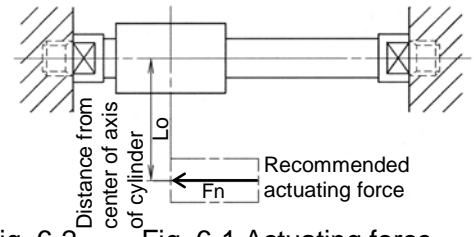
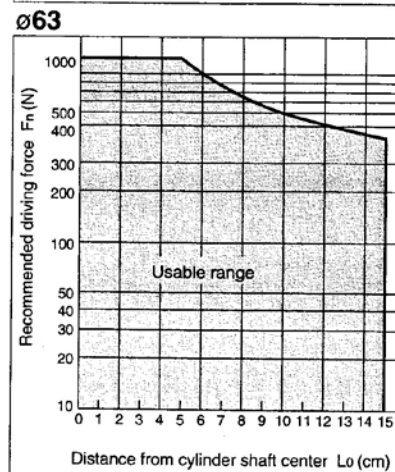
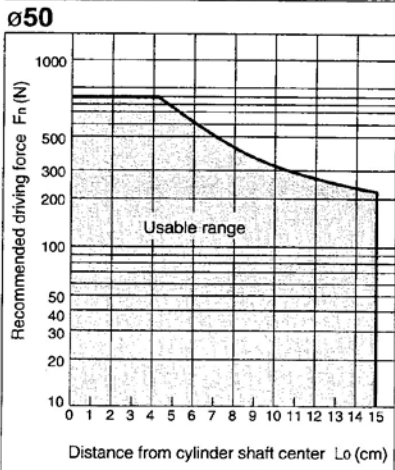
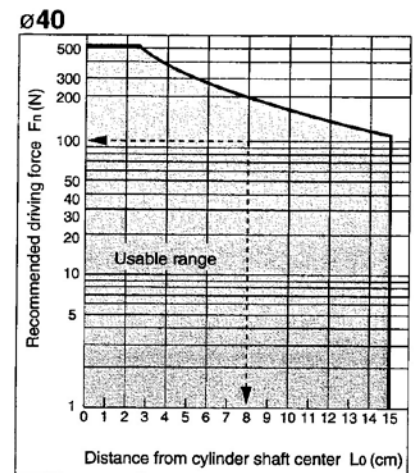
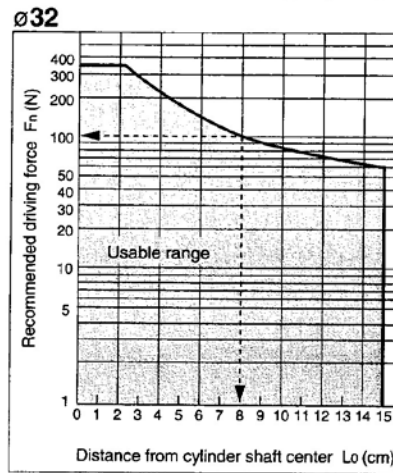
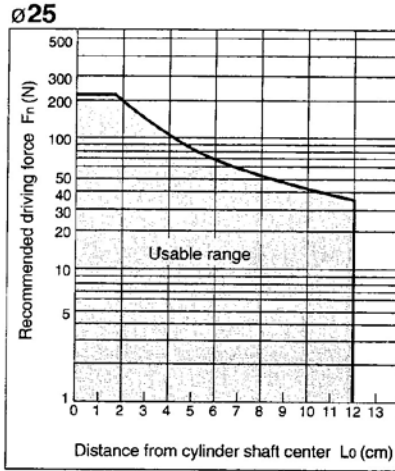


Fig. 6-1 Actuating force

The relationship between  $L_o$  and  $F_n$  can be figured from Fig. 6-2.

<Data A: Distance from cylinder shaft center — Allowable driving capacity>



### Sizing

Ex) Sliding resistance of load : 100N  
Distance between center of axis and point of application : 8cm

In each graph, find the point where 8 of X axis crosses with 100 of Y axis. If the point is covered with applicable operating range of the graph, the size making the graph is applicable to exemplified requirements. In this case, REA32 or larger are applicable.

### 2-3) Relation between Maximum speed and load weight

Maximum operating speed limits the load weight. Applied load weight shall be suitable for maximum operating speed or lower than that.

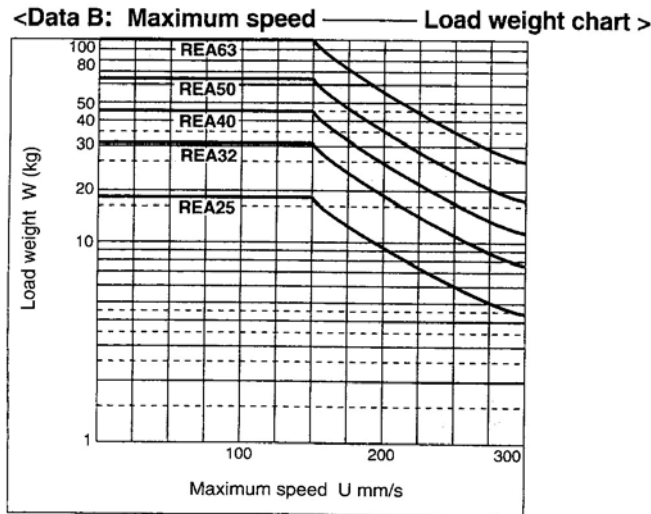


Fig. 7

### 2-4) Maximum weight of the connect bracket to the body

REA (basic type) is not directly connected to the load, and is guided by another shaft (LM guide etc.). Load connection fittings should be designed so that they do not exceed the weights given in the Table. 2 below.

Model	Max.connect bracket weight
REA25	1.2
REA32	1.5
REA40	2.0
REA50	2.5
REA63	3.0

Table. 2 Max.connect bracket weight WBmax(kg)

Please consult if used load weight exceed the value in the table.

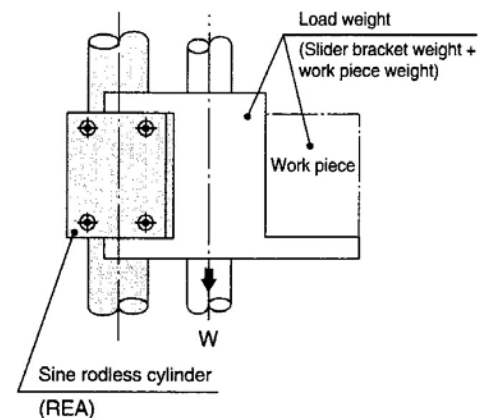
## 3. Vertical operation

### 3-1) Allowable load

Vertical operation makes the load act to holding force of magnet and allows the load less than horizontal operation. Table. 3 shows the allowable load for each size.

Cylinder tube I.D.(mm)	Model	Allowable load(kg)	Max. Operating Pressure (MPa)
φ 25	REA25	18.5	0.65
φ 32	REA32	30.0	0.65
φ 40	REA40	47.0	0.65
φ 50	REA50	75.0	0.65
φ 63	REA63	115.0	0.65

Table. 3



#### 4. Intermediate stop

4-1) The cushion effect (smooth start-up, soft stop) exists only before the stroke end in the stroke ranges indicated in the table below.

The cushion effect (smooth start-up, soft stop) can not be obtained in an intermediated stop or a return from an intermediate stop using an external stopper, etc.

Cushion stroke

Model	Stroke(mm)
REA25	30
REA32	30
REA40	35
REA50	40
REA63	40

4-2) Stroke adjustment

① This mechanism is not intended for adjustment of the cushion effect (smooth start-up, soft stop).

This mechanism is for matching of the cylinder's stroke end position to the mechanical stopper, etc. ,of a machine. (Adjustment range from 0 to -2mm)

② Before adjustment is performed, shut off the drive air, release any residual pressure and implement measure to prevent dropping of workpieces, etc.

4-3) Stroke end adjustment

(To ensure safety, implement with air shut down)

① Loosen lock nut A.

② Insert a wrench into the hexagon socket of the adjusting screw, and turn it to the left and right, matching the cushion ring holder (stroke end) with the position of the external stopper by moving it backward or forward.

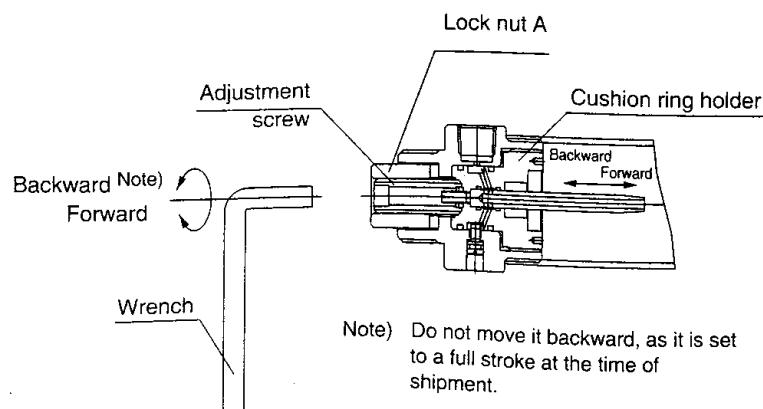
③ After the stroke end adjustment is completed, retighten lock nut A, and apply high strength Loctite No.262 or another comparable locking agent.

Adjustment screw hexagon socket

Model	Width across flats (mm)
<b>REA25</b>	5
<b>REA32</b>	5
<b>REA40</b>	6
<b>REA50</b>	8
<b>REA63</b>	8

Lock nut A fastening torque

Model	Fastening torque (N·m)
<b>REA25</b>	1.2
<b>REA32</b>	1.2
<b>REA40</b>	2.1
<b>REA50</b>	3.4
<b>REA63</b>	3.4



## 5 . Operating air and piping

### 5-1) Install air filter

The rodless cylinder is non-lubrication type. Install air filter toupstream near the valve and Adjust pneumatic pressure decreased to desired set pressure by regulator.

### 5-2) Lubrication to compressed air

The rodless cylinder can be operated only by initial lubrication at shipment. But if the lubrication Needs to be added due to specifications, use Turbin oil class 1 (no additive) ISO VG32. If the operation without supply of additional lubrication is required again, the cylinder needs to be sent to SMC factory to enable re-application of adequate amount of lubrication (grease).

## 6 . Maintenance

The cushion ring and the cushion packig are assembled so that the Sine rodless cylinder realize the optimum cushion effect.

Therefore, the equipment shall be returned to SMC factory for maintenance.

If the equipment has to be disassembled out of the factory, refer "Replacement Procedure of consumables of Sine rodless cylinder", and attention should be taken on followings.

- ( 1 ) When removing the external slider or piston slider from the cylinder tube, first force the sliders out of their magnetically coupled positions, and then remove them individually when there is no longer any holding force, If they are removed while still magnetically coupled, they will be directly attracted to one another and will not come apart.
- ( 2 ) When disassembling, hold the spanner flat of the head cover with vise, and hold the other head cover spanner flat a spanner flat or small wrench to remove the head cover. When retightening, remove dust on the thread and degrease it. Apply Loctite (No.542 Red), and tighten the head cover 3 to 5 degree more than its original position.
- ( 3 ) Magnet component of the piston slider and external slider are assembled with specified direction. Do not disassemble them.
- ( 4 ) When handling the piston slider and the piston, take off the watch (especially finger type).
- ( 5 ) Handle the piston and the piston slider with care not to drop them. Magnet is broken when is dropped.
- ( 6 ) Cushion ring is accurately assembled to the head cover. Do not remove it and attention should be taken not to deform nor gouge.



## 7. Other Cautions for Operation

### 7-1) Environment

- a) The piston slider has iron part inside. Keep the cylinder tube away from the water.
- b) Do not use in atmosphere or place where might corrode the cylinder.
- c) Protect the cylinder with cover where it is exposed to dust and particle, drop of water/oil.

Consult SMC if the cylinder is operated in place like that.

7-2) Before piping, perform flashing inside the piping to prevent intrusion of dust and cutting chip inside the cylinder.

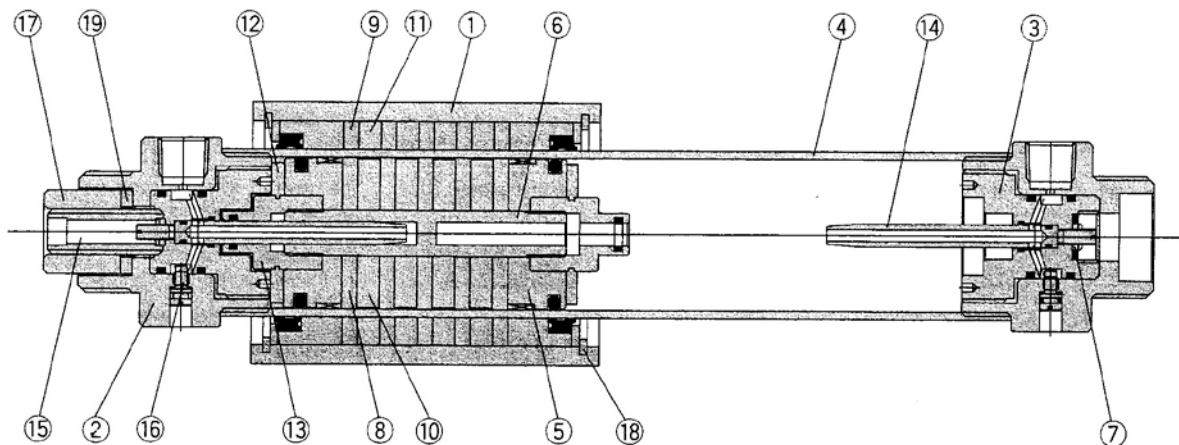
7-3) Do not give any damage including flaw and gouge on external face of cylinder tube. These damage may be followed by the damage or soft wiper, packing and wearing and finally operating failure may be caused.

## 8. Made to Order

The made to order of the rodless cylinder is available depending on operating environment and Conditions. The following shows relation between a certain operating environment or conditions And applicable type of made to order.

Suffix	Spec.	Operative environment and conditions	Applicable cylinder Tube I.D.
—XB11	Long stroke	The stroke between 2001 and max. manufacturable stroke is required.	$\phi 25 \sim \phi 63$
—X168	With helisert screw	Mounting screw of external slider needs to be reinforced.	$\phi 25 \sim \phi 63$
—X206	With additional mounting screw hole on external slider	Mounting screw of external slider needs to be added on the opposite of standard side.	$\phi 25 \sim \phi 63$
—X210	Without external lubrication	The grease is not needed on external face of cylinder (for food and industry and environment with exposure to water/vapor)	$\phi 25 \sim \phi 63$
—X324	Without external lubrication (with dust seal)	The grease is not needed on external face of cylinder (for food and electronics industry and environment with exposure to water/vapor)	$\phi 25 \sim \phi 63$
—XC24	With magnetic shield board	To reduce leakage flux to the outside of the cylinder	$\phi 25 \sim \phi 63$
—XC57	With floating joint	The time to connect cylinder with guide on other axis (load side) needs to be reduced.	$\phi 25 \sim \phi 63$

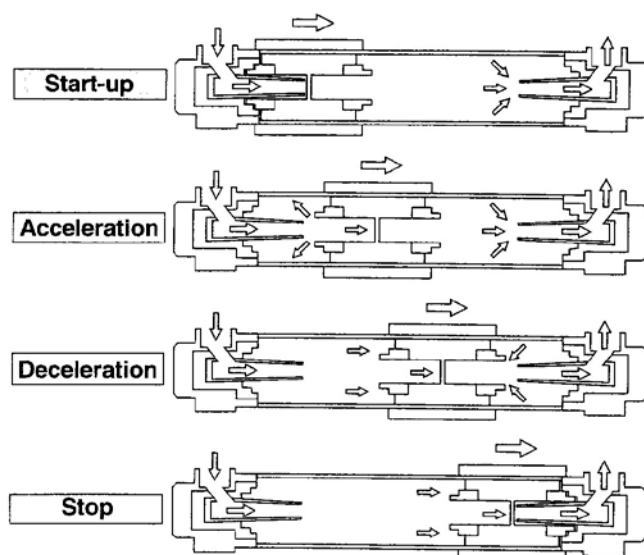
## 9. Internal Construction and Parts List



### Parts list

No.	Description	Material	Note
1	Body	Aluminum alloy	Anodized
2	Head cover	Aluminum alloy	Anodized
3	Cushion ring holder	Aluminum alloy	Chromated
4	Cylinder tube	Stainless steel	
5	Piston	Aluminum alloy	Chromated
6	Shaft	Stainless steel	
7	Lock nut B	Carbon steel	Nickel plated
8	Piston side yoke	Rolled steel	Zinc chromated
9	External slider side yoke	Rolled steel	Zinc chromated
10	Magnet A	Rare earth magnet	

No.	Description	Material	Note
11	Magnet B	Rare earth magnet	
12	Bumper	Urethane rubber	
13	Cushion seal holder	Aluminum alloy	Chromated
14	Cushion ring	Brass	Electroless nickel plated
15	Adjustment screw	Carbon steel	Nickel plated
16	Stopper bolt	Carbon steel	Nickel plated
17	Lock nut A	Carbon steel	Nickel plated
18	Snap ring	Carbon tool steel	
19	Spring washer	Steel wire	



### Operating Principle

#### Start-up/Acceleration

The driving air from the cylinder port passes through the inside of the cushion ring, and flows into the left chamber of the drive piston from the clearance between the cushion seal and the U-shaped groove in the outer surface of the cushion ring. Further, the exhaust air in the right chamber of the drive piston passes from inside the hollow cushion ring through the cylinder port and is released to the atmosphere by the drive solenoid valve.

When the differential pressure (thrust) generated on either side of the drive piston becomes larger than the starting resistance of the machinery, the drive piston begins to move to the right. As the drive piston moves to the right, the U-shaped groove in the outer surface of the cushion ring gradually becomes deeper, a flow corresponding to the drive speed of the drive piston flows into the left chamber of the drive piston, and the drive piston proceeds to accelerate. The U-shaped groove is machined into the cushion ring in such a way that this acceleration process can proceed smoothly (as a sine function).

#### Deceleration/Stop

In conventional cushion mechanisms, when the cushion seal installed on the drive piston is pushed into the cushion ring at the right stroke end, the drive piston's right chamber is pressurized and a sudden braking force is generated. However, in a sine rodless cylinder, due to the U-shaped groove provided on the outer surface of the cushion ring, whose depth changes as a sine function, a large quantity of the air in the cushion chamber is discharged when the cushion seal is pushed in, and a sudden braking force is not generated. With the progression of the cushion stroke, the discharge flow from the cushion chamber is restricted, and therefore, a soft stop is achieved at the stroke end.

Revision

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Note: Specifications are subject to change without prior notice and any obligation on the part of the manufacturer.  
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