



# Operation Manual

PRODUCT NAME

ROTARY CLAMP CYLINDER

MODEL / Series / Product Number

MK\*\* -\*\* Z

**SMC Corporation**

# Contents

Safety Instructions	2-3
1. Specifications	4
1-1 Specifications	
2. Installation and Handling	5
2-1 Air supply	
2-2 Design	6
2-3 Mounting and Installation	7-8
2-4 Operating environment	9
2-5 Speed control	
2-6 Clamp arm	10
2-7 Safty	
2-8 Mounting and removal of the clamp arm	11
2-9 Mounting of the head side flange	
2-10 Directional control	
2-11 uto switches	12-14
3. Maintenance	15
3-1 Checks	
3-2 Consumables	16
4. Basic Circuit for Cylinder Operation	
5. Troubleshooting	17-18
6. Construction and material	19



# 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 10218-1992: 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.\*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.**

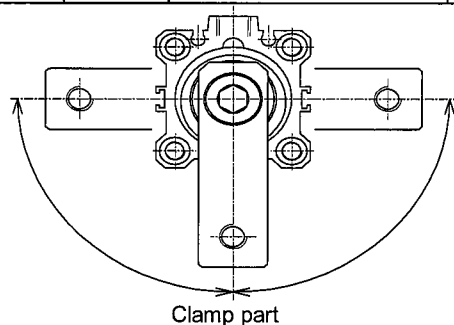
**2. The exports of SMC products or technology from one country to another are governed by the relevant security laws and regulation of the countries involved in the transaction. Prior to the shipment of a SMC product to another country, assure that all local rules governing that export are known and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

# 1. Specifications

## 1-1. Specifications

Bore size (mm)	12	16	20	25	32	40	50	63
Action	Double acting							
Rotary angle <sup>Note 1)</sup>	90°±10°							
Fluid	Air							
Rotary Direction <sup>Note 2)</sup>	Clockwise, Counterclockwise							
Proof pressure	1.5MPa							
Operating pressure range	0.1 to 1.0 MPa							0.1 to 0.6Mpa <sup>Note4)</sup>
Ambient and fluid temperature	Without auto switch: -10 to +70°C (No freezing) With auto switch: -10 to +60°C (No freezing)							
Lubrication	Non-lube							
Mounting	Through-hole/Both ends tapped common, Head flange							
Cushion	Rubber bumper							
Piston speed <sup>Note 5)</sup>	50 to 200mm/s							
Stroke length tolerance	+0.6 , -0.4mm							
Theoretical clamp force (N) <sup>Note 3)</sup>	40	75	100	185	300	525	825	1400
Rotary stroke (mm)	7.5		9.5		15		19	
Clamp stroke (mm)	10 , 20 , 30				10 ,20 ,30 , 50			
Piping port size	M5×0.8				Rc1/8 NPT1/8 G1/8		Rc1/4 NPT1/4 G1/4	
Non-rotation accuracy (Clamp part) <sup>Note 1</sup>	± 1.4°		± 1.2°		± 0.9°		± 0.7°	

During unclamping (Extension end)  
80° to 100° (90° to ±10°)  
L type  
(Counterclockwise)



During unclamping (Extension end)  
80° to 100° (90° to ±10°)  
R type  
(Clockwise)

Non-rotating accuracy ±0.7° to 1.4°  
During clamping (Retraction end)

Note 1) Refer to Rotary Angle figure.

Note 2) Direction of rotation viewed from the rod end when the piston rod is retracting

Note 3) Clamp force at 0.5 MPa

Note 4) when using the cylinder within a pressure range from 0.61 to 1 MPa, please use -X2071.

Note 5) Be sure to install a speed controller to the cylinder, and adjust the cylinder speed to make it within the range from 50 to 200 mm/s. To adjust the speed, start with the needle in the completely closed position, and then adjust it by opening gradually.



## Warning

### - Confirm the specifications.

The product is designed only for use in industrial compressed air systems.

Do not operate at pressures or temperatures, etc., beyond the range of specifications, as this can cause damage or malfunction. (Refer to the specifications.)

Contact SMC in advance for non-industrial uses, or if using with a fluid other than compressed air. We do not guarantee against any damage if the product is used outside of the specification range.

## 2. Installation and Handling

### 2-1. Air supply

The compressed air supplied to the cylinder should be filtered by SMC AF series air filter and regulated to the specified set pressure by SMC AR series regulator.



## Warning

### - Use clean air.

Do not use compressed air that contains chemicals, synthetic oils including organic solvents, salts or corrosive gases, etc., as this can cause damage or malfunction.



## Caution

### 1) Install an air filter.

Install an air filter upstream near the valve. Select an air filter with a filtration size of 5 $\mu$ m or smaller.

### 2) Take measure to ensure air quality, such as by installing an after cooler, air dryer or water separator.

Compressed air that contains a large amount of drainage can cause malfunction of pneumatic equipment such as valves. Therefore, take appropriate measures to ensure air quality, such as providing an after cooler, air dryer, or water separator.

### 3) Ensure that the fluid and ambient temperature are within the specified range.

If the fluid temperature is 5°C or less, the moisture in the circuit could freeze, causing damage to the seals and equipment malfunction. Therefore, take appropriate measures to prevent freezing.

For compressed air quality, refer to best pneumatics No.5.

### 4) Lubricating the non-Lubricating Cylinder

The cylinder has been lubricated for life at the factory and can be used without any further lubrication. However, in the event that it is additionally lubricated be sure to use class 1 turbine oil (with no additive) ISO VG32. Do not use machine oil or spindle oil. Stopping lubrication later may lead to malfunction because the new lubricant will displace the original lubricant. Therefore, lubrication must be continued once it has been started. If turbine oil is used, refer to the corresponding Material Safety Data Sheet (MSDS).

## 2-2. Design



### Warning

- 1) **There is a danger of sudden action by cylinders if sliding parts of machinery are twisted, etc., and changes in forces occur.**

In such cases, human injury may occur; e.g., by catching hands or feet in the machinery, or damage to the machinery itself may occur. Therefore, the machine should be designed to operate smoothly and avoid such dangers.

- 2) **If there is a chance that the product will pose a hazard to humans, install a protective cover.**

If the moving portion of the product will pose a hazard to humans or will damage machinery or equipment, provide a construction that prevents direct contact with those areas.

- 3) **Be certain that the secured portions will not loosen.**

Be certain to adopt a reliable connecting method if the cylinder is used very frequently or if it is used in a location that is exposed to a large amount of vibration.

- 4) **Design the system so that it will not apply any external force over the maximum force to the product.**

The product can break, causing a risk of injury or damage to equipment.

- 5) **The cylinder generates a large force. Install the cylinder on a sufficiently rigid mounting base, taking this force into consideration.**

There is a risk of human injury or damage to equipment.

- 6) **When a cylinder is used in a clamping, suspending and lifting mechanism**

There is a danger of work pieces dropping if there is a decrease of thrust due to a drop in circuit pressure caused by a power outage, etc. Therefore, safety equipment should be installed to prevent damage to machinery and/or human injury.

- 7) **Consider the possibility of power source related malfunction that could occur.**

For the equipment that rely on power sources such as compressed air, electricity, or hydraulic pressure, adopt a countermeasure to prevent the equipment from causing a hazard to humans or damage to the equipment in the event of malfunction.

- 8) **Consider the behavior of the cylinder in the event of an emergency stop.**

Devise a safe system so that if a person engages the emergency stop, or if a safety device is tripped during a system malfunction such as a power outage, the movement of the cylinder will not cause a hazard to humans or damage the equipment.

### **9) Consider the action of the cylinder when restarting after an emergency stop.**

Devise a safe design so that the restarting of the cylinder will not pose a hazard to humans or damage the equipment. Install manually controlled equipment for safety when the actuator has to be reset to the starting position.

### **10) Holding of the clamp**

It is difficult for this product to hold a clamp accurately and precisely such as by hydraulic product by a 3-position closed center type directional control valve, due to the compressibility of air. Furthermore, since valves and cylinders are not guaranteed for zero air leakage, it may not be possible to hold a clamp for extended periods of time. Contact SMC if it is necessary to hold the clamp for extended periods of time.

## **2 -3. Mounting and Installation**



### **Caution**

#### **1) Do not use the cylinder under following environments:**

- 1) An area in which fluids such as cutting oil splash on the piston rod.
- 2) An area in which foreign matter such as particles, cutting chips, dust, or spatter is present.
- 3) An area in which the ambient temperature exceeds the operating range.
- 4) An area exposed to direct sunlight.
- 5) An environment that poses the risk of corrosion.

**A cylinder could malfunction or the non-rotating accuracy could be affected if a rotational force is applied to the piston rod. Therefore, observe the particulars given below before operating the cylinder.**

- (1) Make sure to mount the cylinder in a vertical direction. (See Figure 1.) (MK, MK2 only)
- (2) Do not perform any work (such as clamping or acting as a stopper, etc.) in the rotary direction. (See Figure 2.)
- (3) To clamp, make sure to do so within the clamp stroke (straight-line stroke) (See Figure 3.)
- (4) Make sure that the clamping surface of the work piece is perpendicular to the cylinders axial. (See Figure 4.)
- (5) Do not operate the cylinder in such a way that an external force causes the work piece to move while being clamped. (See Figure 5.)
- (6) Furthermore, do not operate the cylinder in an application in which a rotational force will be applied to the piston rod.



- (1) Do not operate in the horizontal direction.  
MK2T Series is recommended for operation in a horizontal direction.

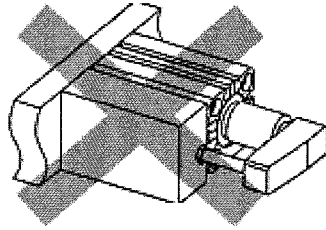


Figure 1

- (2) Do not operate in the rotating direction.

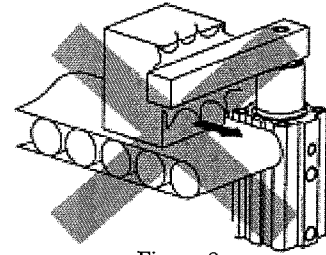
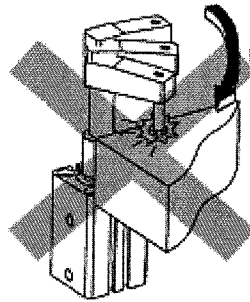
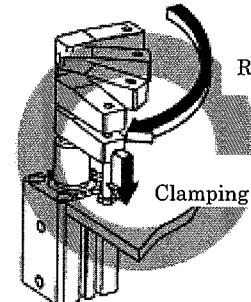


Figure 2

- (3) Do not perform a clamping operation while it is in the rotation stroke. Clamp should be performed within the clamping stroke.



Rotating stroke



Rotating stroke

Clamping stroke

Figure 3

- (4) Do not perform a clamping operation on an inclined plane.

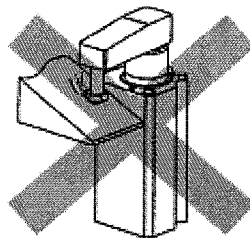


Figure 4

- (5) Do not allow the work piece to move while it is clamped.

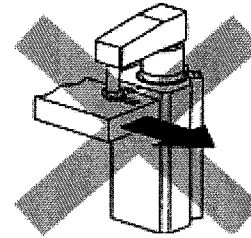


Figure 5

**3) Do not scratch or gouge the sliding parts of the cylinder tube or piston rod etc., by striking or grasping them with other objects. Cylinder bores are manufactured to precise tolerances, so that even a slight deformation may cause malfunction. Also, scratches or gouges, etc., in the piston rod may lead to damaged seals and cause air leakage.**

**4) Do not use the product until you have verified that the equipment can operate properly.**

Verify correct mounting by function and leak tests properly after compressed air and power are connected following mounting or repair.

**5) Do not let foreign matter such as cutting chips get into the product**

When the product is installed on a machine on site, the debris from drilled mounting holes can get in the supply port of the product. Take sufficient care to prevent this.

## 2-4. Operating environment



### Warning

#### 1) Do not use in environments where there is a danger of corrosion.

Refer to the construction drawings regarding cylinder materials.

#### 2) Install a cover over the rod if it is used in an area that is dusty, or in an environment in which water or oil splashes on the cylinder.

Contact SMC if the operating location contains particles.

#### 3) Avoid storing the product in humid conditions.

Store the product with the piston rod retracted and avoid humidity, in order to prevent the occurrence of rust.



### Caution

#### 1) Before piping

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

#### 2) Sealant tape

When screwing piping or fittings into ports, ensure that chips from the pipe threads or sealing material do not enter the piping. Also, if pipe tape is used, leave 1.5 to 2 thread ridges exposed at the end of the threads.

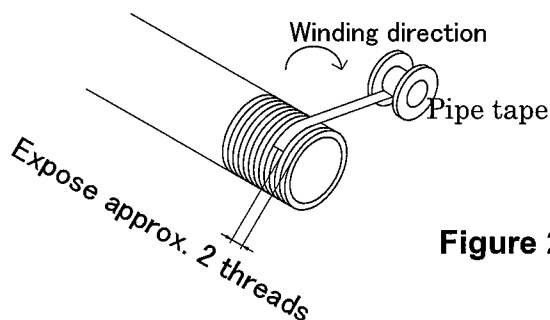


Figure 2 Sealant tape

## 2-5. Speed control

When the piston speed is adjusted, install SMC AS series speed controller near the air supply port to adjust to the specified speed. There are two methods of speed adjustment, one is to restrict air supplied to the product, and the other is to restrict air exhausted from the product. Normally, the latter method should be adopted.



### Caution

Use a speed controller to adjust the cylinder drive speed, gradually increasing the from a low speed to the desired speed setting.

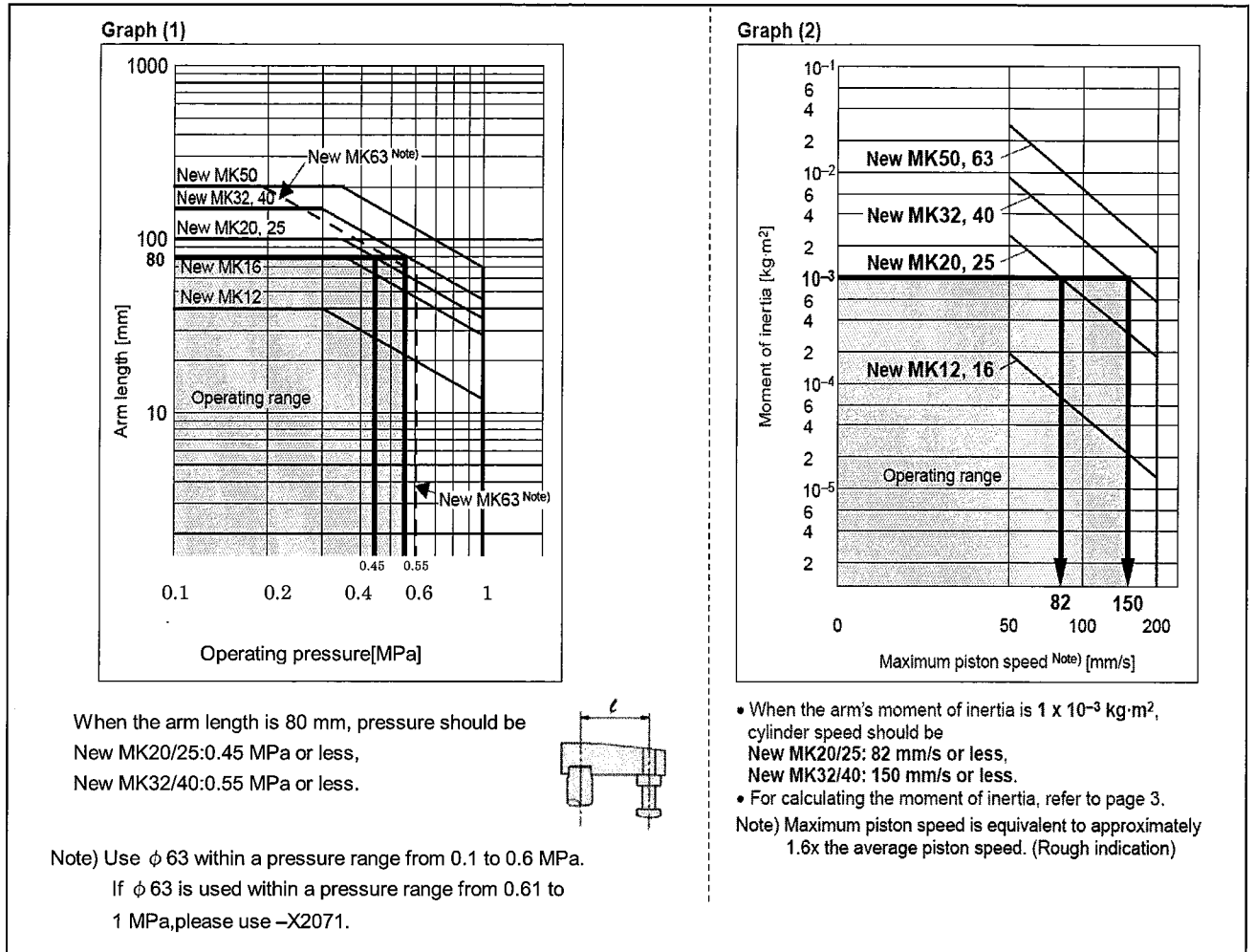
## 2-6. Clamp arm



### Caution

The SMC optional clamp arm should be used.

For manufacture of a clamp arm, there are some restrictions with the length and the weight etc. The clamp arm should be manufactured so that they will be within the specified range of the allowable bending moment and the moment of inertia shown below.



## 2-7. Safety



### Caution

If one side of the piston is pressurized by supplying air with the clamp arm attached, the piston will move vertically while the clamp arm rotates. This operation could be hazardous to personnel, as their hands or feet could get caught by the clamp arm, or could lead to equipment damage. Therefore, it is important to secure as a danger zone a cylindrical area with the length of the clamp arm as its radius, and the stroke plus 20 mm as its height.

## 2-8. Mounting and removal of the clamp arm



### Caution

When the clamp arm is mounted onto or removed from the piston rod, do not fix the cylinder body, but hold the arm with a spanner when tightening or loosening the bolt. (See Figure 1.)

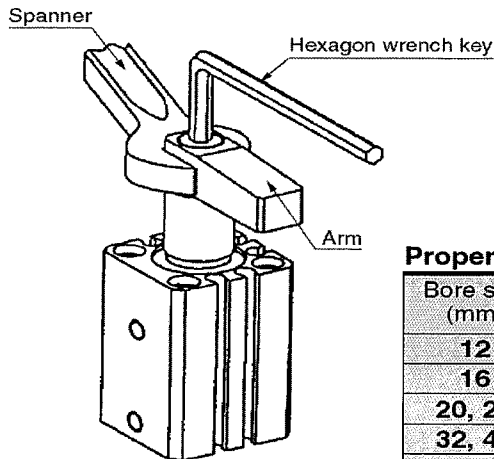


Fig. 1

#### Proper Tightening Torque

Bore size (mm)	Proper tightening torque (N·m)
12	0.5 to 0.7
16	2.8 to 3.5
20, 25	11.5 to 14.0
32, 40	24 to 30
50, 63	75 to 90

During the removal or reinstallation of the clamp arm, make sure to use a wrench or a vise to secure the clamp arm before removing or tightening the bolt. This is to prevent the bolt tightening torque from being applied to the piston rod, which could damage the cylinder's internal mechanism.

## 2-9. Mounting of the head side flange



### Caution

The mounting bolt for the head side flange should be tightened to the torque shown in the table below.

Bore size	Thread size	Tightening torque
ø12, 16	M4 x 0.7	1.4 to 2.6 N·m
ø20 to 40	M6 x 1.0	9.0 to 12.0 N·m
ø50	M8 x 1.25	11.4 to 22.4 N·m
ø63	M10 x 1.5	25.0 to 44.9 N·m

## 2-10. Directional control

To switch the operating direction of the cylinder, mount an applicable solenoid valve selected from SMC's range of solenoid valves.



### Warning

#### 1) Design the circuitry to prevent sudden lurching of driven objects.

When a cylinder is driven by an exhaust center type directional control valve or when starting up after residual pressure is exhausted from the circuit, etc., the piston and its driven object will lurch at high speed if pressure is applied to one side of the cylinder because of the absence of air pressure inside the cylinder. Therefore, select equipment and design circuits to prevent sudden lurching, because there is a danger of human injury and/or damage to equipment when this occurs.

## 2-11. Auto switches

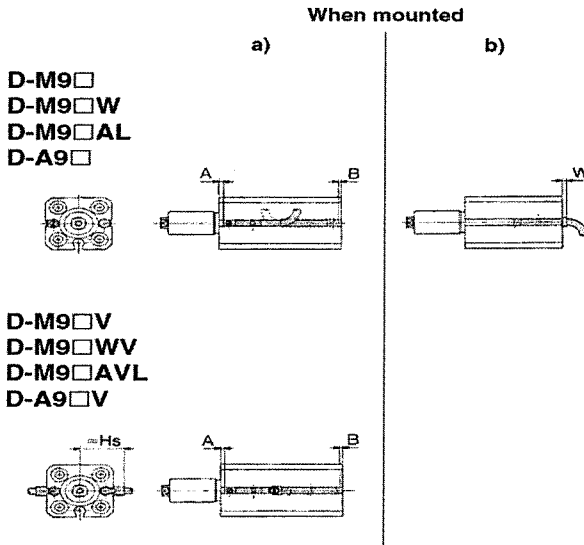
When an auto switch is mounted or its set position is changed, refer to pages 12 to 14.

### ! Caution

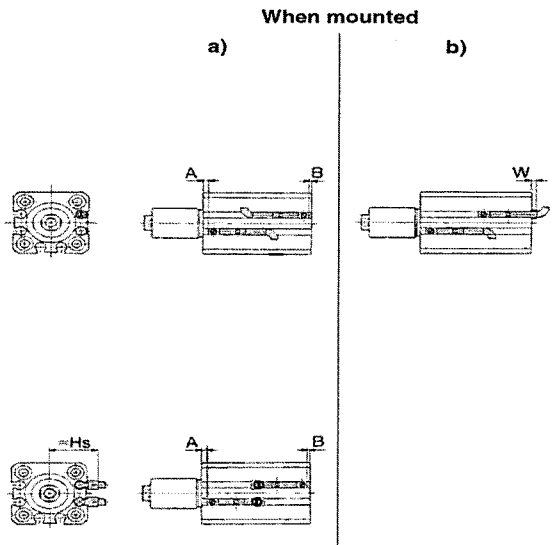
Refer to the Precautions shown below when the cylinder is operated with auto switches.

#### Auto Switch Proper Mounting Position (Detection at Stroke End) and its Mounting Height

ø12



ø16



Auto Switch Proper Mounting Position (mm)

Bore size (mm)	D-M9□ D-M9□W D-M9□AL			D-M9□V D-M9□WV			D-M9□AL			D-A9□ D-A9□V		
	A	B	W	A	B	W	A	B	W	A	B	W
12	12	4	6	12	4	4	12	4	8	8	0	4.5 (2)
16	12	4	6	12	4	4	12	4	8	8	0	4.5 (2)

Note 1) ( ): D-A96, A9□V

Note 2) When setting an auto switch, confirm the operation and adjust its mounting position.

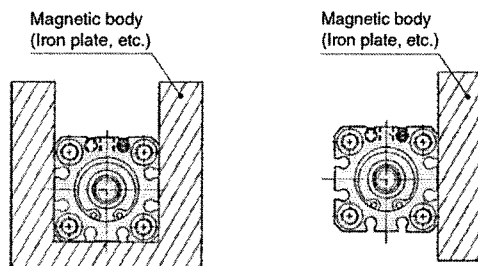
Auto Switch Mounting Height (mm)

Auto switch model	D-M9□V D-M9□WV D-M9□AVL	D-A9□V
	Hs	Hs
Bore size 12	19	17
16	21	19

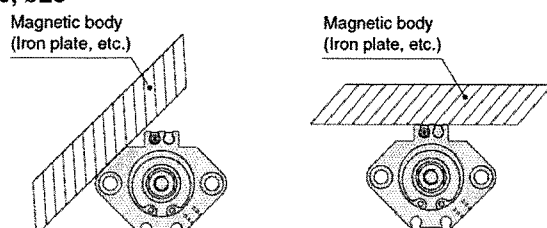
### When a Magnetic Body Surrounds the Cylinder

- When a magnetic body surrounds the cylinder as shown in the figure below (including when the magnetic body is only on one side of the cylinder), the movement of the auto switch may become unstable, so please contact SMC.

ø12 to ø16  
ø32 to ø63



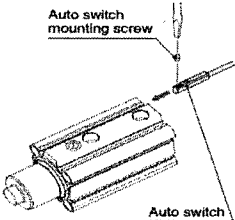
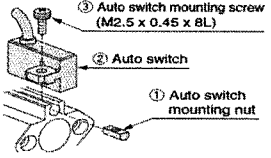
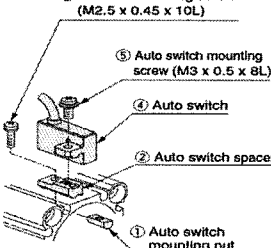
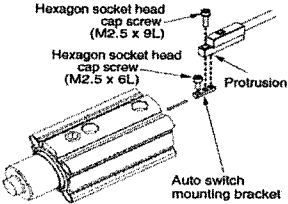
ø20, ø25



### With Magnetic Field Resistant Auto Switch D-P3DWL

- If welding cables or welding gun electrodes are in the vicinity of the cylinder, the magnets in the cylinder could be affected by the external magnetic fields. (Please contact SMC if the welding amperage exceeds 16000 A.) If the source of strong magnetism comes in contact with the cylinder or an auto switch, make sure to install the cylinder away from the source of the magnetism. If the cylinder is to be used in an environment in which spatter will come in direct contact with the lead wires, cover the lead wires with a protective tube. For the protective tube, use a tube I.D. ø7 or more, which excels in heat resistance and flexibility. Please contact SMC if an inverter welder or a DC welder will be used.

## Auto Switch Mounting Bracket/Parts No.

Applicable auto switch	D-M9□/M9□V D-M9□W/M9□WV D-M9□AL/M9□AVL D-A9□/A9□V	D-F7□/F7□V/J79J79C/F7□W/J79W/F7□WV D-F7BAL/F7BAVL/F79F/F7NTL D-A7□/A80/A7□H/A80H/A73C/A80C/A79W	D-P3DW□											
Bore size (mm)	ø12 to ø63	ø20, ø25	ø32 to ø63											
Auto switch mounting bracket part no.	—	BQ4-012	BQ5-032											
Auto switch mounting bracket fitting parts lineup/weight	—	① Auto switch mounting screw (M2.5 x 8L) ② Auto switch mounting nut Weight: 1.5 g	① Auto switch fixing screw (M2.5 x 10L) ② Auto switch mounting screw (M3 x 8L) ③ Auto switch spacer ④ Auto switch mounting nut Weight: 3.5 g											
		When requesting the enclosure of the auto switch mounting bracket with the cylinder for shipment, add "BQ" to the end of the cylinder part number. Standard model no. +BQ Example: MKB20-10LZ-BQ												
Auto switch mounting surface	Surfaces with auto switch mounting slot ø12, ø16 ø20 ø25 ø32 to ø63	Auto switch mounting rail side only ø20, ø25	A/B/C side except port side Surfaces with auto switch mounting slot											
Mounting of auto switch	 <p>Auto switch mounting screw</p> <p>Auto switch</p> <ul style="list-style-type: none"> <li>When tightening the auto switch mounting screw, use a watchmakers' screwdriver with a handle 5 to 6 mm in diameter.</li> </ul> <p><b>Tightening torque of auto switch mounting screw (N-m)</b></p> <table border="1"> <thead> <tr> <th>Auto switch model</th> <th>Tightening torque</th> </tr> </thead> <tbody> <tr> <td>D-M9□(V)</td> <td>0.05 to 0.15</td> </tr> <tr> <td>D-M9□W(V)</td> <td>0.05 to 0.15</td> </tr> <tr> <td>D-M9□A(V)L</td> <td>0.10 to 0.20</td> </tr> <tr> <td>D-A9□(V)</td> <td>0.10 to 0.20</td> </tr> </tbody> </table>	Auto switch model	Tightening torque	D-M9□(V)	0.05 to 0.15	D-M9□W(V)	0.05 to 0.15	D-M9□A(V)L	0.10 to 0.20	D-A9□(V)	0.10 to 0.20	<ol style="list-style-type: none"> <li>Insert the nut into the auto switch mounting slot on the cylinder tube, and place it in the roughly estimated setting position.</li> <li>Engage the ridge on the auto switch mounting arm with the recess in the cylinder tube rail, and slide it to the position of the nut.</li> <li>Gently screw the auto switch mounting screw into the thread of the auto switch mounting nut through the mounting hole on the auto switch mounting arm.</li> <li>Confirm where the mounting position is, and tighten the auto switch mounting screw to fix the auto switch. The tightening torque of the M2.5 screw must be 0.25 to 0.35 N·m.</li> <li>The detection position can be changed under the conditions in step ③.</li> </ol> 	<ol style="list-style-type: none"> <li>Insert the nut into the auto switch mounting slot on the cylinder tube, and place it in the roughly estimated setting position.</li> <li>With the lower tapered part of the auto switch spacer facing the outside of the cylinder tube, line up the M2.5 through hole with the M2.5 female of the auto switch mounting nut.</li> <li>Gently screw the auto switch mounting nut fixing screw (M2.5) into the thread of the auto switch mounting nut through the mounting hole.</li> <li>Engage the ridge on the auto switch mounting arm with the recess in the auto switch spacer.</li> <li>Tighten the auto switch mounting screw (M3) to fix the auto switch. The tightening torque of the M3 screw must be 0.35 to 0.45 N·m.</li> <li>Confirm where the mounting position is, and tighten the auto switch fixing screw (M2.5) to fix the auto switch mounting nut. The tightening torque of the M2.5 screw must be 0.25 to 0.35 N·m.</li> <li>The detection position can be changed under the conditions in step ⑤.</li> </ol> 	<ol style="list-style-type: none"> <li>Insert the protrusion on the bottom of the auto switch into the mating part of the auto switch mounting bracket and fix the auto switch and the auto switch mounting bracket temporarily by tightening the hexagon socket head cap screw (M2.5 x 9L) 1 to 2 turns.</li> <li>Insert the temporarily tightened mounting bracket into the mating groove of the cylinder tube, and slide the auto switch onto the cylinder tube through the groove.</li> <li>Check the detecting position of the auto switch and fix the auto switch firmly with the hexagon socket head cap screw (M2.5 x 6L, M2.5 x 9L).*</li> <li>If the detecting position is changed, go back to step ②.</li> </ol> <p>* The hexagon socket head cap screw (M2.5 x 6L) is used to fix the mounting bracket and cylinder tube. This enables the replacement of the auto switch without adjusting the auto switch position.</p> <p>Note 1) Ensure that the auto switch is covered with the mating groove to protect the auto switch.</p> <p>Note 2) The tightening torque of the hexagon socket head cap screw (M2.5 x 6L, M2.5 x 9L) is 0.2 to 0.3 N·m.</p> <p>Note 3) Tighten the hexagon socket head cap screws evenly.</p> 
Auto switch model	Tightening torque													
D-M9□(V)	0.05 to 0.15													
D-M9□W(V)	0.05 to 0.15													
D-M9□A(V)L	0.10 to 0.20													
D-A9□(V)	0.10 to 0.20													

Note) The auto switch mounting bracket and auto switch are enclosed with the cylinder for shipment.

Other than the models listed in "How to Order", the following auto switches are applicable. For detailed specifications, refer to Best Pneumatics No. 3.

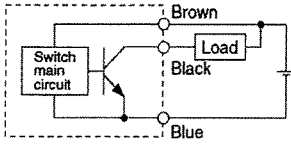
Auto switch type	Model	Electrical entry	Features	Applicable bore size
Reed	D-A72, A73	Grommet (Perpendicular)	—	ø20 to ø63
	D-A80		Without indicator light	
	D-A79W		Diagnostic indication (2-color indication)	
	D-A73C	Connector (Perpendicular)	—	
	D-A80C		Without indicator light	
	D-A72H, A73H, A76H		—	
	D-A80H		Without indicator light	
Solid state	D-F7NV, F7PV, F7BV	Grommet (Perpendicular)	—	ø20 to ø63
	D-F7NWV, F7BWV		Diagnostic indication (2-color indication)	
	D-F7BAVL		Water resistant (2-color indication)	
	D-J79C	Connector (Perpendicular)	—	
	D-F79, F7P, J79		—	
	D-F79W, F7PW, J79W		Diagnostic indication (2-color indication)	
	D-F7BAL		Water resistant (2-color indication)	
	D-F79F		With diagnostic output (2-color indication)	
D-F7NTL	Grommet (In-line)	With timer		

\* With pre-wired connector is also available for solid state auto switches. For details, refer to Best Pneumatics No. 3.

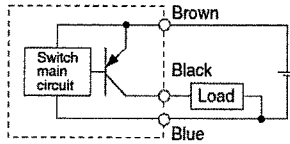
# Wiring method and example of auto switch

## Basic Wiring

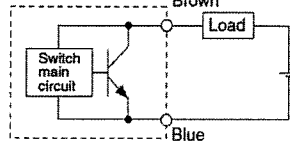
### Solid state 3-wire, NPN



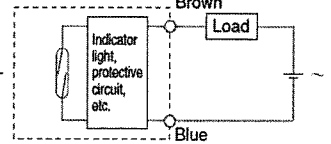
### Solid state 3-wire, PNP



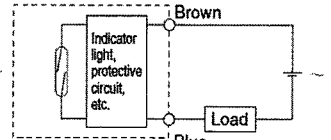
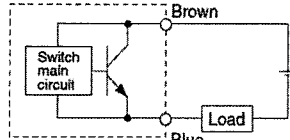
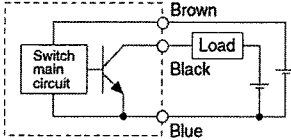
### 2-wire (Solid state)



### 2-wire (Reed)

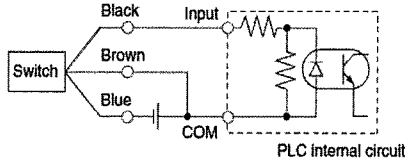


(Power supplies for switch and load are separate.)

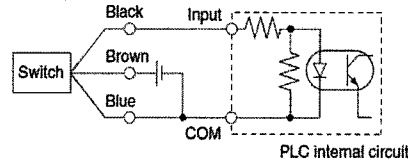


## Example of Connection to PLC (Programmable Logic Controller)

### • Sink input specification 3-wire, NPN

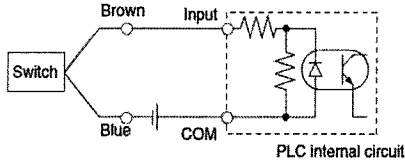


### • Source input specification 3-wire, PNP

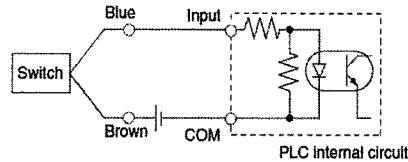


Connect according to the PLC input specifications, since the connection method will differ depending on the PLC input specifications.

### 2-wire



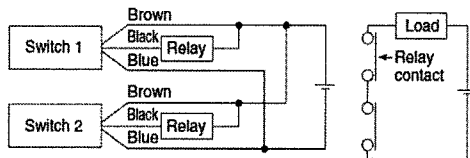
### 2-wire



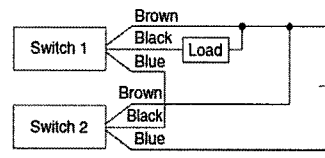
## Example of AND (Serial) and OR (Parallel) Connection

### • 3-wire

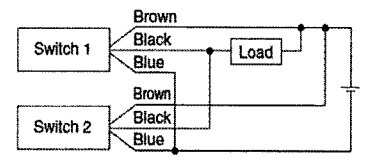
#### AND connection for NPN output (using relays)



#### AND connection for NPN output (performed with switches only)



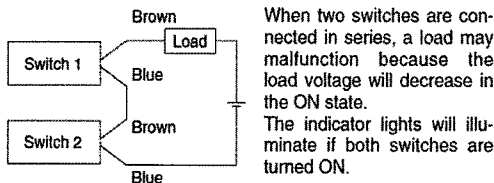
#### OR connection for NPN output



The indicator lights will illuminate when both switches are turned ON.

### • 2-wire

#### 2-switch AND connection

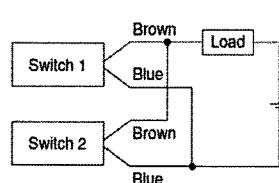


When two switches are connected in series, a load may malfunction because the load voltage will decrease in the ON state. The indicator lights will illuminate if both switches are turned ON.

$$\begin{aligned} \text{Load voltage at ON} &= \text{Power supply} - \text{Residual voltage} \times 2 \text{ pcs.} \\ &= 24 \text{ V} - 4 \text{ V} \times 2 \text{ pcs.} \\ &= 16 \text{ V} \end{aligned}$$

Example) Power supply voltage: 24 VDC  
Auto switch internal voltage drop: 4 V

#### 2-switch OR connection



#### (Solid state)

When two switches are connected in parallel, malfunction may occur because the load voltage will increase in the OFF state.

$$\begin{aligned} \text{Load voltage at OFF} &= \text{Leakage current} \times 2 \text{ pcs.} \\ &\quad \times \text{Load impedance} \\ &= 1 \text{ mA} \times 2 \text{ pcs.} \times 3 \text{ k}\Omega \\ &= 6 \text{ V} \end{aligned}$$

Example) Load impedance: 3 kΩ  
Auto switch leakage current: 1 mA

#### (Reed)

Because there is no leakage current, the load voltage will not increase in the OFF state. However, depending on the number of switches in the ON state, the indicator lights may sometimes dim or not light because of the dispersion and reduction of the current flowing to the switches.

### 3. Maintenance

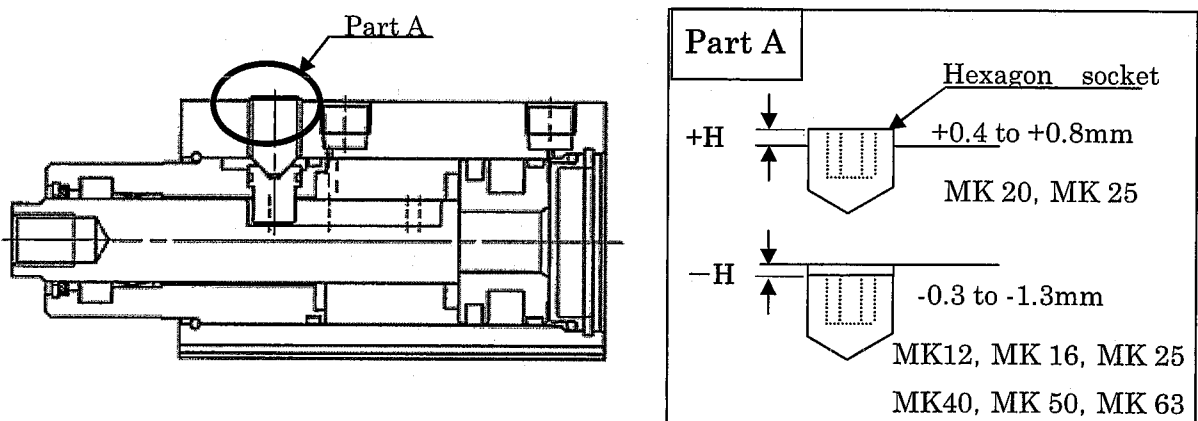
#### Caution

The hexagon socket head set screw on the external surface of the cylinder tube of the MK Series needs to be securely fixed in order to maintain the rotating function of the piston rod, so **NEVER** loosen it, except when disassembling the cylinder for maintenance.

After loosening the hexagon socket head set screw for maintenance or inspection, be sure to check that the hexagon socket head set screw is tightened to the proper position.

If the product is used without the hexagon socket head set screw tightened to the proper position, the piston rod rotating mechanism will be damaged.

If the hexagon socket head set screw or the guide pin is deformed or damaged, do not use the product.



Height	MK12	MK16	MK20	MK25	MK32	MK40	MK50	MK63
H	-0.8	-1.3	+0.4	-0.5	+0.8	-0.3	-1.0	-1.0

#### 3-1 Checks

##### 3-1-1. Daily check

- 1) Smoothness of the operation
- 2) Changes in piston speed and cycle time
- 3) Proper extending and retracting.



### 3-1-2. Regular check

- 1) Looseness of the mounting nuts and the clamp arm holding bolt
- 2) Looseness of the mounting frame and excessive deflection
- 3) Smoothness of the operation
- 4) Changes in piston speed and cycle time
- 5) External leakage
- 6) Proper extending and retracting.
- 7) Damage to the piston rod
- 8) Whether drainage in the air filter is regularly discharged or not.

Check the points above as a minimum. If any failure is found, retighten mounting nuts, clamp arm or mounting frame or contact your sales representative.

### 3-2. Consumables

**Use grease recommended by SMC.**

Grease pack part number: GR-S-010 (10g), GR-S-020 (20g)



#### Warning

##### 1) Maintenance should be performed according to the procedure above.

Improper handling can cause damage and malfunction of equipment and machinery.

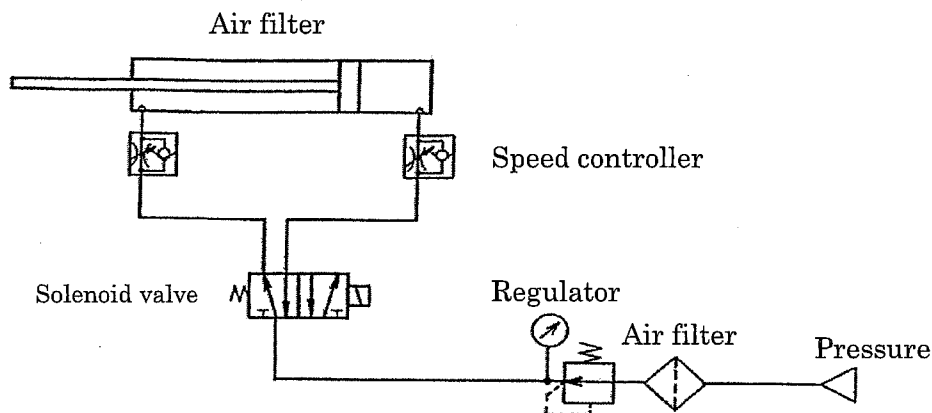
##### 2) Removal of equipment, and supply/ exhaust of compressed air

Ensure that drop prevention and safe lock out of the moving parts are performed, the power of the facility and supply air is shut off and the compressed air in the system is exhausted before removing the equipment.

Confirm that measures are in place that prevent sudden movement before restarting the cylinder.

## 4. Basic Circuit for Cylinder Operation

The basic circuit (meter-out) for operating the product with air filter, regulator, solenoid valve and speed controller is shown in the following figure.



**Figure 3 Basic circuit**

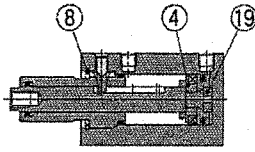
## 5. Troubleshooting

Phenomenon	Major causes	Countermeasures
Operation is no longer smooth.	1. Shortage of grease at the sliding part of the piston rod	Apply the specified grease. GR-S-010 (10g), GR-S-020 (20g)
	2. Rotational play has increased.	Replace the cylinder with a new one. When reinstalling the product, adjust the load and mounting position.
	3. Insufficient pressure	Supply appropriate pressure.
	4. Operation at a low speed outside of the limit.	Consult SMC.
Lamping force has decreased.	1. Air leakage from piston seal	Replace the cylinder with a new one.
	2. Air leakage from rod seal	Replace the cylinder with a new one.
	3. Decreased pressure	Secure sufficient pressure and review margin of air supply source.
	4. Insufficient flow rate	The resistance in the fluid path may have increased due to deformation or foreign matter entering the product. Perform repair or cleaning.
	5. Incorrect mounting position of the product	Mount in a proper position without any force applied to the product.
	6. Insufficient holding of the clamp arm	Check the clamp arm. When remounting the product, adjust the tightening torque and angle etc.
	7. Lubricating failure	Refer to the countermeasure for "Operation is no longer smooth."
Piston speed is too fast.	1. Lack of speed controller	Use a speed controller suitable for the size of the product.
	2. Insufficient fine adjustment of the speed controller	Select an adjustable speed controller to obtain the required piston speed referring to the flow-rate characteristics curve.
Piston speed is too slow.	1. Too small directional control valve.	Use a valve of a larger size.
	2. Too large resistance of equipment used in the piping route	Use a valve and equipment of an appropriate size. In particular, attention should be paid to the piping and fittings because they are often missed. Equipment and piping at the exhaust side should also be of an appropriate size.

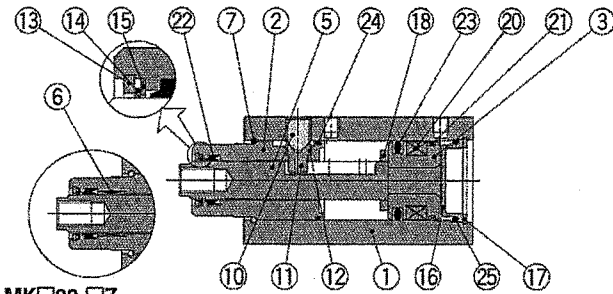
<b>Phenomenon</b>	<b>Major causes</b>	<b>Countermeasures</b>
The product sometimes does not operate.	1. Operation at a very low speed	Operation at a very low speed can create a condition with almost no pressure difference between the supply side and exhaust side and lower sealing effect, which can cause operation failure. Keep the specified speed for operation.
	2. Problem of equipment other than the product	Check all items in the system one by one to find the cause.
The product has become unable to operate.	1. Damage of the piston seal	Check that the exhaust port of the valve is exhausting all the time. Replace the cylinder with a new one.
	2. Problem of equipment other than the product	Check all items in the system one by one to find the cause.
	3. Insufficient pressure	Supply appropriate pressure.
Rotational play of the piston rod has increased or the piston rod does not rotate.	1. Operation at a high speed	Operation at a high speed can cause impact, and deform and damage the product. Keep the specified piston speed.
	2. Excessive external force	It may cause damage and deformation of the cylinder if the mechanism interferes or eccentric load or over load is applied to it. Remove such causes.
Piston speed cannot be adjusted with the speed controller.	1. Incorrect speed controller selection	Use a speed controller of a suitable size for the required speed.
	2. Problem of the speed controller	Replace the speed controller with a new one.
The product has stick and slip movement.	1. Speed too slow	Consult SMC.
	2. Insufficient margin of force	Increase operating pressure. Replace with a product of a larger bore size.
	3. Use of a meter-in circuit	Operation at a low pressure or low speed with a meter-in circuit can cause unstable motion. Use a meter-out circuit for speed adjustment.
The product shows sudden and fast movement after being stopped for extended periods of time.	Fluctuation of residual pressure in the product between continuous operation and operation after stoppage for extended periods of time	Consider the use of a valve to prevent sudden action of the product.

## 6. Construction and material

New MK12, 16

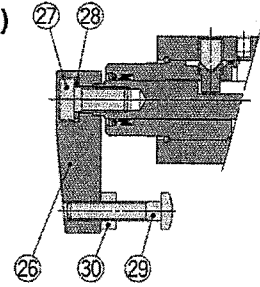


New MK20 to 32

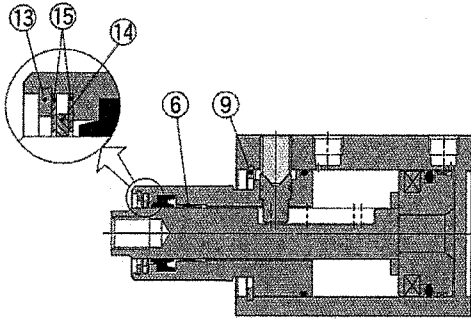


MK□32-□Z

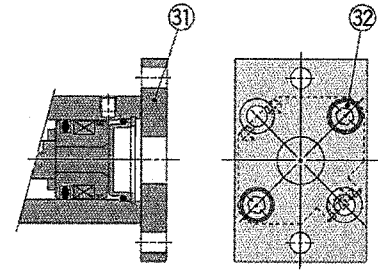
With arm (N)



New MK40 to 63



Head flange (G)



### Component Parts

No.	Description	Material	Note
1	Cylinder tube	Aluminum alloy	Hard anodized
2	Rod cover	Aluminum alloy	Hard anodized
3	Piston	Aluminum alloy	Chromated
4	Magnet holder	Aluminum alloy	Chromated
5	Piston rod	Stainless steel	ø12 to ø25 Nitriding
		Carbon steel	ø32 to ø63 Heated, Nickel plated
6	Bushing	Copper bearing material	ø32 to ø63 only
7	Stop ring	Stainless steel	ø20 to ø32 only
8	Round R-type retaining ring	Carbon tool steel	ø12, ø16 only
9	C-type retaining ring	Carbon tool steel	ø40 to ø63 only
10	Hexagon socket head set screw	Chromium molybdenum steel	Sharp end section: 90°
11	Guide pin	Stainless steel	Nitriding
12	O-ring	NBR	
13	Round R-type retaining ring	Carbon tool steel	Except ø12, ø16
14	Coil scraper	Phosphor bronze	Except ø12, ø16
15	Scraper pressure	Stainless steel	Except ø12, ø16
16	Head cover	Rolled steel	Electroless nickel plated
17	C-type retaining ring	Carbon tool steel	ø20 to ø32 only

### Component Parts

No.	Description	Material	Note
18	Bumper	Urethane	
19	Bumper B	Urethane	ø12, ø16 only
20	Magnet	—	
21	Wear ring	Resin	Except ø12, ø16
22	Rod seal	NBR	
23	Piston seal	NBR	
24	Gasket	NBR	
25	O-ring	NBR	ø20 to ø32 only
26	Arm	Rolled steel	
27	Hexagon socket head cap screw	Chromium molybdenum steel	
28	Spring washer	Hard steel	
29	Clamp bolt	Chromium molybdenum steel	
30	Hexagon nut	Rolled steel	
31	Flange	Rolled steel	
32	Hexagon socket head cap screw	Chromium molybdenum steel	Qty. ø12, ø16, ø32 to ø40: 4 pcs.
			ø20, ø25: 2 pcs.

### Replacement Parts/Seal Kit

Bore size (mm)	ø12	ø16	ø20	ø25	ø32	ø40	ø50	ø63
Kit no.	CQSB12-PS	CQSB16-PS	MK20Z-PS	MK25Z-PS	MK32Z-PS	MK2T40-PS	MK2T50-PS	MK63Z-PS
Contents	Set of nos. above ② ③ ④			Set of nos. above ① ② ③ ④				

\* Seal kit includes numbers in the table. Order the seal kit, based on each bore size.

\* Since the seal kit does not include a grease pack, order it separately. Grease pack part no.: GR-S-010 (10 g)

### Replacement Parts/Guide Pin Kit

Bore size (mm)	ø12	ø16	ø20	ø25	ø32	ø40	ø50	ø63
Kit no.	MK12Z-GS	MK16Z-GS	MK20Z-GS	MK25Z-GS	MK32Z-GS	MK40Z-GS	MK50Z-GS	MK63Z-GS
Contents	Set of nos. above ⑩ ⑪ ⑫							

\* Guide pin kit includes numbers in the table. Order the guide pin kit, based on each bore size.

\* For the replacement procedure of the replacement parts/seal and guide pin kits, refer to the Operation Manual.

Revision history

## SMC Corporation

4-14-1, Sotokanda, Chiyoda-ku, Tokyo 101-0021 JAPAN  
Tel: + 81 3 5207 8249 Fax: +81 3 5298 5362  
URL <http://www.smcworld.com>

Note) This manual is subject to change without prior notice.  
© 2012 SMC Corporation All Rights Reserved

