

# Rotary Table/ Rack & Pinion Type

Size: 10, 20, 30, 50

RoHS

**New**

- An external shock absorber option has been added.



## Height

Max. **28%** reduction<sup>\*1</sup>  
54 mm → **39 mm**

Reduced by **15 mm**

**39 mm**



## Weight

Max. **28%** reduction<sup>\*1</sup>  
940 g → **680 g**

<sup>\*1</sup> Compared with the existing model (MSQ20)

Enlarged center  
hole diameter for  
piping

Ø9 mm → **Ø12 mm**

Compared with the existing model  
(MSQ20)



## MSQ Series

**SVC**

CAT.ES20-256C

## Compact and lightweight

### Reduced Height

| Size | New MSQ (H <sub>1</sub> ) | MSQ (H <sub>2</sub> ) | Reduction rate [%] |
|------|---------------------------|-----------------------|--------------------|
| 10   | 35.5                      | 47                    | 24                 |
| 20   | 39                        | 54                    | 28                 |
| 30   | 46                        | 57                    | 19                 |
| 50   | 51.5                      | 66                    | 22                 |

### Reduced Weight

| Size | New MSQ | MSQ  | Reduction rate [%] |
|------|---------|------|--------------------|
| 10   | 375     | 500  | 25                 |
| 20   | 680     | 940  | 28                 |
| 30   | 930     | 1230 | 24                 |
| 50   | 1500    | 1990 | 25                 |

\* For the MSQ□A



## Improved workability

The end ports and the angle adjustment mechanisms are located on the same surface.

**End ports**

**Angle adjustment mechanism**  
(Cushion pad, Bumper)

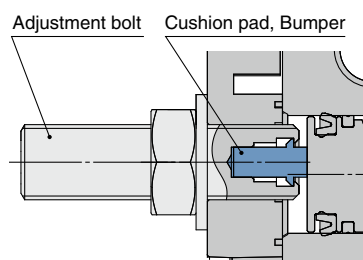
**Side port**

(Same for the opposite side, With plug)

## 5 types of cushions are available.

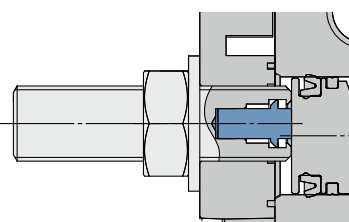
### Cushion pad, bumper construction

When impact is absorbed

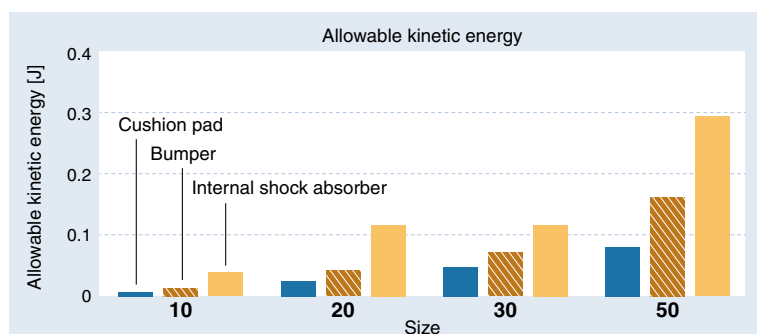


Initially, the cushion pad or the bumper absorbs the impact.

When stopped at the end surface



The cushion pad or the bumper enters and stops at the adjustment bolt end surface.



**Internal shock absorber**

\* Refer to page 2 for the internal shock absorber.



**Bumper**

The max. allowable kinetic energy is up to 2 times higher than that of the cushion pad.



**Internal shock absorber**

The max. allowable kinetic energy is up to 5 times higher than that of the cushion pad.



**Cushion pad**

Reduces the metal noise that occurs when the piston stops

## The adjustable rotation time range is expanded.

Can be used at lower speeds compared with the existing model

**New MSQ** 0.2 to 2.0 s/90°  
MSQ 0.2 to 1.0 s/90°

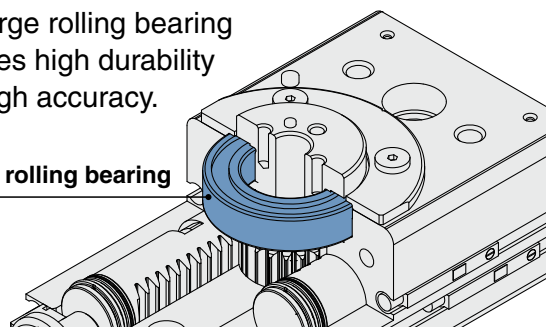
\* For the MSQ□<sup>A</sup><sub>D</sub>



## High durability and high accuracy

The large rolling bearing provides high durability and high accuracy.

Large rolling bearing



## Compact auto switches are mountable.



Solid state auto switch  
D-M9□



Reed auto switch  
D-A9□

## **New** An external shock absorber option has been added.

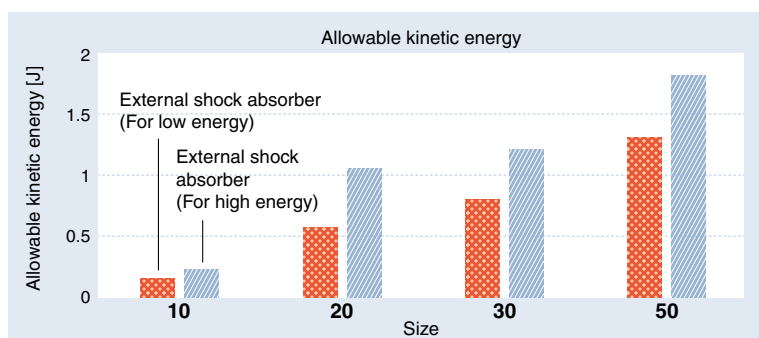
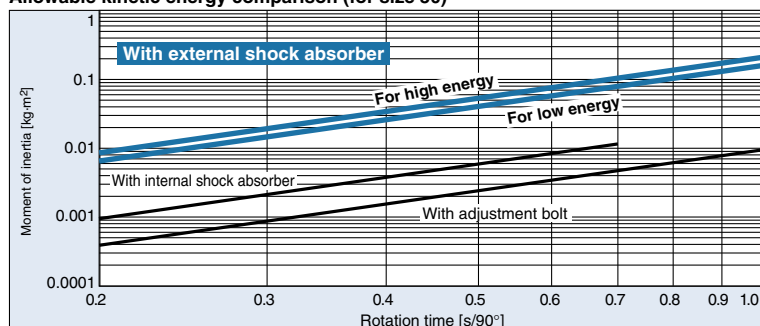


### 4 to 10 times more allowable kinetic energy

(Compared with the internal shock absorber type)

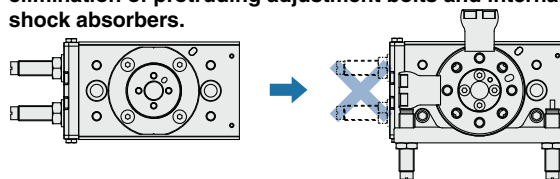
2 types of shock absorbers are available: 1 for low energy and 1 for high energy.

Allowable kinetic energy comparison (for size 30)

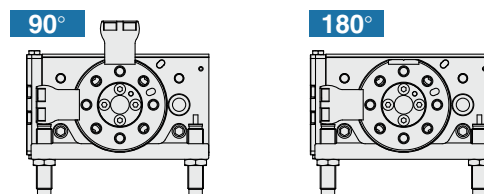


### Total length shortened

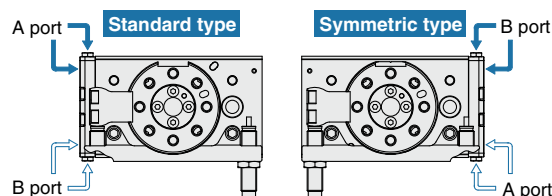
The lengthwise mounting space is reduced due to the elimination of protruding adjustment bolts and internal shock absorbers.



### Rotating angle: 90°, 180°

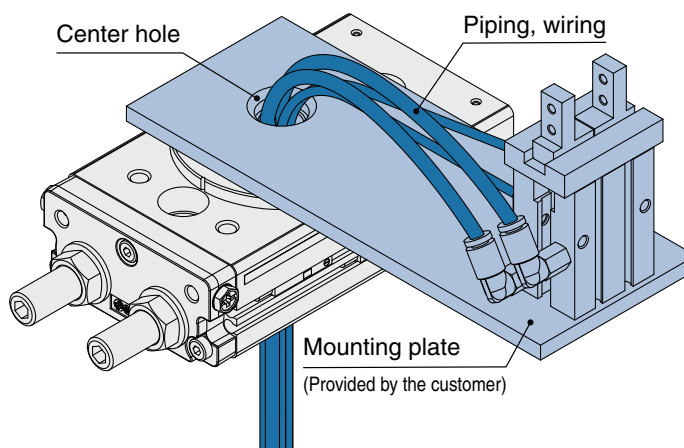
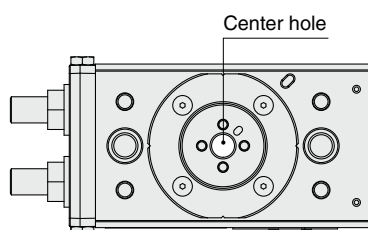


### Left / Right symmetric type



## Enlarged center hole diameter for piping

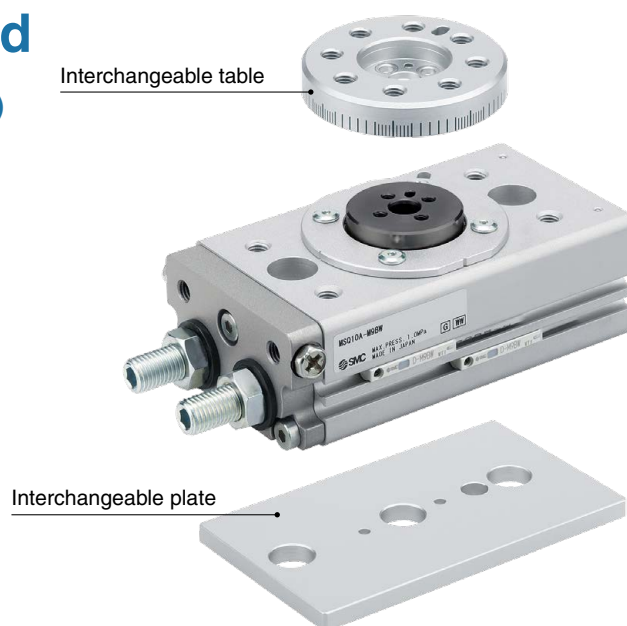
| Size | <b>New MSQ</b> | MSQ |
|------|----------------|-----|
| 10   | ø7             | ø6  |
| 20   | ø12            | ø9  |
| 30   | ø13            | ø12 |
| 50   | ø14            | ø13 |



## An interchangeable table and plate are available. (Made to order)

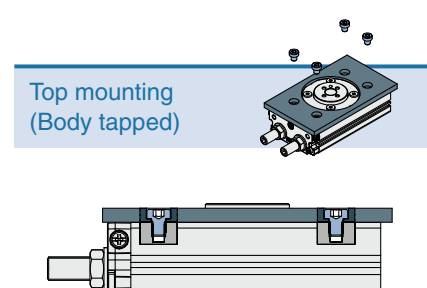
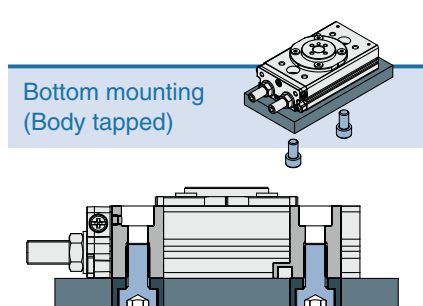
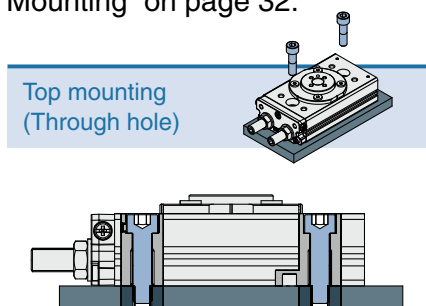
The new model is only fully interchangeable with the existing model when the optional interchangeable plate and table are utilized.

\* For details, refer to pages 21 and 27.



## Select from 3 mounting methods.

Mounting dimensions are interchangeable with the existing MSQ series model. For mounting, refer to "Mounting" on page 32.





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|                                                           |       |
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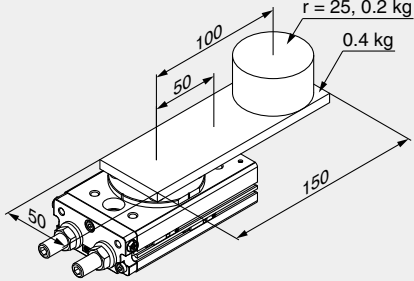
### ● Made to Order

|                                                             |       |
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# Rotary Actuator Model Selection

| Selection Procedures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Note                                                                                                                                                                                                  | Selection Example                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>◆ <b>List of Operating Conditions</b></p> <ul style="list-style-type: none"> <li>Initially selected models</li> <li>Operating pressure [MPa]</li> <li>Mounting orientation</li> <li>Load type <ul style="list-style-type: none"> <li>Static load</li> <li>Resistance load</li> <li>Inertial load</li> </ul> </li> <li>Load dimensions [m]</li> <li>Load mass [kg]</li> <li>Rotation time [s]</li> <li>Rotating angle [rad]</li> </ul>                                                                       | <p>Refer to page 10 for the load type.</p> <p>The unit for the rotating angle is radian.<br/> <math>180^\circ = \pi \text{ rad}</math><br/> <math>90^\circ = \pi/2 \text{ rad}</math></p>             |  <p>Initially selected model: MSQ30A<br/> Operating pressure: 0.3 MPa<br/> Mounting orientation: Vertical Load type: Inertial load<br/> Rotation time: <math>t = 1.5 \text{ s}</math> Rotating angle: <math>\theta = \pi \text{ rad}</math> (<math>180^\circ</math>)</p>                                                                                                                              |
| <p><b>1 Calculation of Moment of Inertia</b></p> <p>Calculate the inertial moment of load.</p>                                                                                                                                                                                                                                                                                                                                                                                                                 | <p>Loads are generated from multiple parts. The inertial moment of each load is calculated, and then totaled.</p>                                                                                     | <p>Inertial moment of load 1: <math>I_1</math><br/> <math display="block">I_1 = 0.4 \times \frac{0.15^2 + 0.05^2}{12} + 0.4 \times 0.05^2 = 0.001833</math> Inertial moment of load 2: <math>I_2</math><br/> <math display="block">I_2 = 0.2 \times \frac{0.025^2}{2} + 0.2 \times 0.1^2 = 0.002063</math> Total inertial moment: <math>I</math><br/> <math display="block">I = I_1 + I_2 = 0.003896 \text{ [kg} \cdot \text{m}^2\text{]}</math></p>                                     |
| <p><b>2 Calculation of Required Torque</b></p> <p>Calculate the required torque for each load type and confirm whether the values fall in the effective torque range.</p> <ul style="list-style-type: none"> <li>Static load (<math>T_s</math>)<br/>Required torque <math>T = T_s</math></li> <li>Resistance load (<math>T_f</math>)<br/>Required torque <math>T = T_f \times (3 \text{ to } 5)</math></li> <li>Inertial load (<math>T_a</math>)<br/>Required torque <math>T = T_a \times 10</math></li> </ul> | <p>When the resistance load is rotated, the required torque calculated from the inertial load must be added.</p> <p>Required torque <math>T = T_f \times (3 \text{ to } 5) + T_a \times 10</math></p> | <p>Inertial load: <math>T_a</math><br/> <math>T_a = I \cdot \dot{\omega}</math><br/> <math display="block">\dot{\omega} = \frac{2\theta}{t^2} \text{ [rad/s}^2\text{]}</math> Required torque: <math>T</math><br/> <math display="block">T = T_a \times 10</math> <math display="block">= 0.003896 \times \frac{2 \times \pi}{1.5^2} \times 10 = 0.109 \text{ [N} \cdot \text{m]}</math> <math display="block">0.109 \text{ N} \cdot \text{m} &lt; \text{Effective torque OK}</math></p> |
| <p><b>3 Confirmation of Rotation Time</b></p> <p>Confirm whether the time falls in the rotation time adjustment range.</p>                                                                                                                                                                                                                                                                                                                                                                                     | <p>Consider the time after converted in the time per <math>90^\circ</math>.<br/> (<math>1.0 \text{ s}/180^\circ</math> is converted in <math>0.5 \text{ s}/90^\circ</math>.)</p>                      | <p><math>0.2 \leq t \leq 2.0</math><br/> <math>t = 0.75 \text{ s}/90^\circ \text{ OK}</math></p>                                                                                                                                                                                                                                                                                                                                                                                         |
| <p><b>4 Calculation of Kinetic Energy</b></p> <p>Calculate the kinetic energy of the load and confirm whether the energy is below the allowable range.</p> <p>Can confirm referring to the inertial moment and rotation time graph (p. 12)</p>                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                       | <p>Kinetic energy: <math>E</math><br/> <math display="block">E = \frac{1}{2} \cdot I \cdot \omega^2</math> <math display="block">\omega = \frac{2 \cdot \theta}{t}</math> <math display="block">E = \frac{1}{2} \times 0.003896 \times \left( \frac{2 \times \pi}{1.5} \right)^2 = 0.03418 \text{ [J]}</math> <math display="block">0.03418 \text{ [J]} &lt; \text{Allowable energy OK}</math></p>                                                                                       |
| <p><b>5 Confirmation of Allowable Load</b></p> <p>Confirm whether the load applied to the product is within the allowable range.</p>                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                       | <p>Moment load: <math>M</math><br/> <math display="block">M = 0.4 \times 9.8 \times 0.05 + 0.2 \times 9.8 \times 0.1</math> <math display="block">= 0.392 \text{ [N} \cdot \text{m]}</math> <math display="block">0.392 \text{ [N} \cdot \text{m]} &lt; \text{Allowable moment load OK}</math></p>                                                                                                                                                                                       |
| <p><b>6 Calculation of Air Consumption and Required Air Flow Capacity</b></p> <p>Air consumption and required air flow capacity are calculated when necessary.</p>                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

## 1 Calculation of Moment of Inertia

The moment of inertia is a value indicating the inertia of a rotating body, and expresses the degree to which the body is difficult to rotate, or difficult to stop.

It is necessary to know the moment of inertia of the load in order to determine the value of required torque or kinetic energy when selecting a rotary actuator.

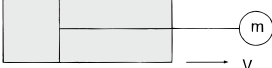
Moving the load with the actuator creates kinetic energy in the load. When stopping the moving load, it is necessary to absorb the kinetic energy of the load with a stopper or a shock absorber.

The kinetic energy of the load can be calculated using the formulas shown in **Fig. 1** (for linear motion) and **Fig. 2** (for rotation motion).

In the case of the kinetic energy for linear motion, the formula (1) shows that when the velocity  $V$  is constant, it is proportional to the mass  $m$ . In the case of rotation motion, the formula (2) shows that when the angular velocity  $\omega$  is constant, it is proportional to the moment of inertia.

### Linear motion

**Fig. 1 Linear motion**

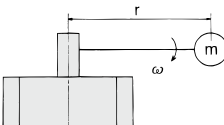


$$E = \frac{1}{2} \cdot m \cdot V^2 \dots\dots\dots (1)$$

$E$ : Kinetic energy  
 $m$ : Load mass  
 $V$ : Velocity

### Rotation motion

**Fig. 2 Rotation motion**



$$E = \frac{1}{2} \cdot I \cdot \omega^2 = \frac{1}{2} \cdot m \cdot r^2 \cdot \omega^2 \dots\dots\dots (2)$$

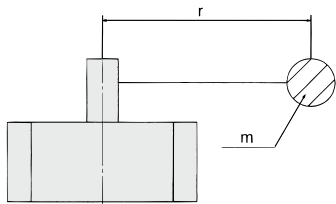
$E$ : Kinetic energy  
 $I$ : Moment of inertia (=  $m \cdot r^2$ )  
 $\omega$ : Angular velocity  
 $m$ : Mass  
 $r$ : Radius of rotation

As the moment of inertia is proportional to the squares of the mass and the radius of rotation, even when the load mass is the same, the moment of inertia will be squared as the radius of rotation grows bigger. This will create greater kinetic energy, which may result in damage to the product.

When there is rotation motion, product selection should be based not on the load mass of the load, but on the moment of inertia.

### Moment of Inertia Formula

The basic formula for finding a moment of inertia is shown below.



$$I = m \cdot r^2$$

$m$ : Mass  
 $r$ : Radius of rotation

This formula represents the moment of inertia for the shaft with mass  $m$ , which is located at distance  $r$  from the shaft.

For actual loads, the values of the moment of inertia are calculated depending on configurations, as shown below.

- ⇒ p. 7, 8 Calculation example of moment of inertia
- ⇒ p. 9 Graph for calculating the moment of inertia

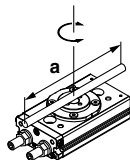
## Equation Table of Moment of Inertia

$I$ : Moment of inertia       $m$ : Load mass

### 1. Thin shaft

Position of rotational axis: Perpendicular to the shaft through the center of gravity

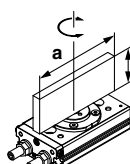
$$I = m \cdot \frac{a^2}{12}$$



### 2. Thin rectangular plate

Position of rotational axis: Parallel to side  $b$  and through the center of gravity

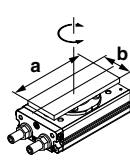
$$I = m \cdot \frac{a^2}{12}$$



### 3. Thin rectangular plate (Including rectangular parallelepiped)

Position of rotational axis: Perpendicular to the plate through the center of gravity

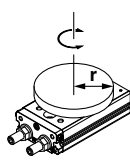
$$I = m \cdot \frac{a^2 + b^2}{12}$$



### 4. Round plate (Including column)

Position of rotational axis: Through the center axis

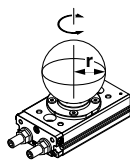
$$I = m \cdot \frac{r^2}{2}$$



### 5. Solid sphere

Position of rotational axis: Through the center of diameter

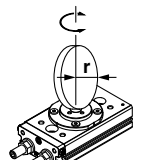
$$I = m \cdot \frac{2r^2}{5}$$



### 6. Thin round plate

Position of rotational axis: Through the center of diameter

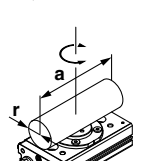
$$I = m \cdot \frac{r^2}{4}$$



### 7. Cylinder

Position of rotational axis: Through the center of diameter and gravity

$$I = m \cdot \frac{3r^2 + a^2}{12}$$

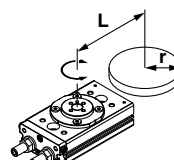


### 8. When the rotational axis and load center of gravity are not consistent

$$I = K + m \cdot L^2$$

$K$ : Moment of inertia around the load center of gravity

4. Round plate  $K = m \cdot \frac{r^2}{2}$

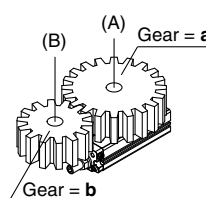


### 9. Gear transmission

1. Find the moment of inertia  $I_B$  for the rotation of shaft (B).

2.  $I_B$  is converted to the moment of inertia  $I_A$  for the rotation of the shaft (A).

$$I_A = \left(\frac{a}{b}\right)^2 \cdot I_B$$



# Rotary Actuator Model Selection

## ● Calculation Example of Moment of Inertia

### ■ If the shaft is located at a desired point of the load:

Example: ① If the load is the thin rectangular plate:

Find the center of gravity of the load as  $I_1$ , a provisional shaft.

$$I_1 = m \cdot \frac{a^2 + b^2}{12}$$

② Find the actual moment of inertia  $I_2$  around the shaft, with the premise that the mass of the load itself is concentrated in the load's center of gravity point.

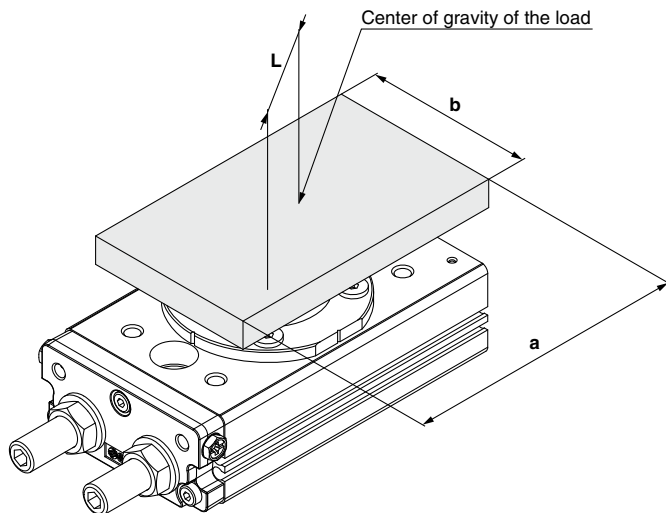
$$I_2 = m \cdot L^2$$

③ Find the actual moment of inertia  $I$ .

$$I = I_1 + I_2$$

( $m$ : Load mass

$L$ : Distance from the shaft to the load's center of gravity)



#### Calculation Example

$$a = 0.2 \text{ m}, b = 0.1 \text{ m}, L = 0.05 \text{ m}, m = 1.5 \text{ kg}$$

$$I_1 = 1.5 \times \frac{0.2^2 + 0.1^2}{12} = 6.25 \times 10^{-3} \text{ kg} \cdot \text{m}^2$$

$$I_2 = 1.5 \times 0.05^2 = 3.75 \times 10^{-3} \text{ kg} \cdot \text{m}^2$$

$$I = (6.25 + 3.75) \times 10^{-3} = 0.01 \text{ kg} \cdot \text{m}^2$$

### ■ If the load is divided into multiple loads:

Example: ① If the load is divided into the 2 cylinders:

{ The center of gravity of load 1 matches the shaft  
The center of gravity of load 2 differs from the shaft }

Find the moment of inertia of load 1:

$$I_1 = m_1 \cdot \frac{r_1^2}{2}$$

② Find the moment of inertia of load 2:

$$I_2 = m_2 \cdot \frac{r_2^2}{2} + m_2 \cdot L^2$$

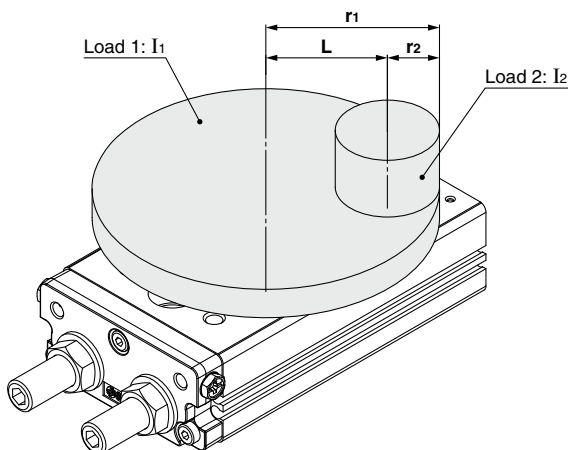
③ Find the actual moment of inertia  $I$ :

$$I = I_1 + I_2$$

( $m_1, m_2$ : Mass of loads 1 and 2

$r_1, r_2$ : Radius of loads 1 and 2

$L$ : Distance from the shaft to the center of gravity of load 2)



#### Calculation Example

$$m_1 = 2.5 \text{ kg}, m_2 = 0.5 \text{ kg}, r_1 = 0.1 \text{ m}, r_2 = 0.02 \text{ m}, L = 0.08 \text{ m}$$

$$I_1 = 2.5 \times \frac{0.1^2}{2} = 1.25 \times 10^{-2} \text{ kg} \cdot \text{m}^2$$

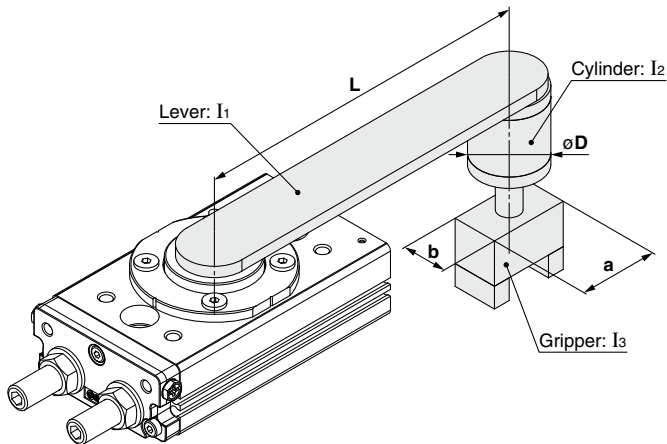
$$I_2 = 0.5 \times \frac{0.02^2}{2} + 0.5 \times 0.08^2 = 0.33 \times 10^{-2} \text{ kg} \cdot \text{m}^2$$

$$I = (1.25 + 0.33) \times 10^{-2} = 1.58 \times 10^{-2} \text{ kg} \cdot \text{m}^2$$



# Rotary Actuator Model Selection

## ■ If a lever is attached to the shaft and a cylinder and a gripper are mounted to the tip of the lever:



Example: ① Find the lever's moment of inertia:

$$I_1 = m_1 \cdot \frac{L^2}{12} + m_1 \cdot \left(\frac{L}{2}\right)^2$$

② Find the cylinder's moment of inertia:

$$I_2 = m_2 \cdot \frac{(D/2)^2}{2} + m_2 \cdot L^2$$

③ Find the gripper's moment of inertia:

$$I_3 = m_3 \cdot \frac{a^2 + b^2}{12} + m_3 \cdot L^2$$

④ Find the actual moment of inertia:

$$I = I_1 + I_2 + I_3$$

( $m_1$ : Mass of lever  
 $m_2$ : Mass of cylinder  
 $m_3$ : Mass of gripper)

### Calculation Example

$L = 0.2 \text{ m}$ ,  $\phi D = 0.06 \text{ m}$ ,  $a = 0.06 \text{ m}$ ,  $b = 0.03 \text{ m}$ ,  $m_1 = 0.5 \text{ kg}$ ,  $m_2 = 0.4 \text{ kg}$ ,  $m_3 = 0.2 \text{ kg}$

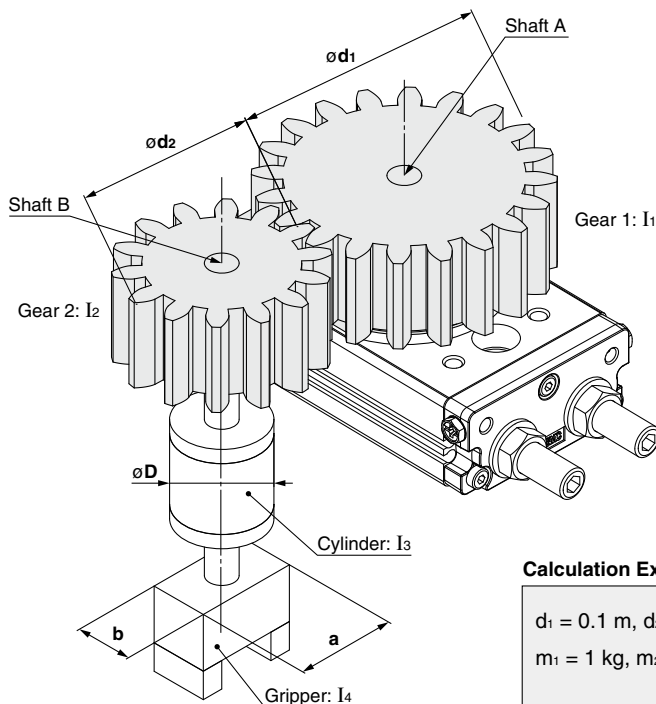
$$I_1 = 0.5 \times \frac{0.2^2}{3} = 0.67 \times 10^{-2} \quad \text{kg} \cdot \text{m}^2$$

$$I_2 = 0.4 \times \frac{(0.06/2)^2}{2} + 0.4 \times 0.2^2 = 1.62 \times 10^{-2} \quad \text{kg} \cdot \text{m}^2$$

$$I_3 = 0.2 \times \frac{0.06^2 + 0.03^2}{12} + 0.2 \times 0.2^2 = 0.81 \times 10^{-2} \quad \text{kg} \cdot \text{m}^2$$

$$I = (0.67 + 1.62 + 0.81) \times 10^{-2} = 3.1 \times 10^{-2} \quad \text{kg} \cdot \text{m}^2$$

## ■ If a load is rotated through the gears:



Example: ① Find the moment of inertia  $I_1$  around shaft A:

$$I_1 = m_1 \cdot \frac{(d_1/2)^2}{2}$$

② Find moment of inertias  $I_2$ ,  $I_3$ , and  $I_4$  around shaft B:

$$I_2 = m_2 \cdot \frac{(d_2/2)^2}{2} \quad I_3 = m_3 \cdot \frac{(D/2)^2}{2}$$

$$I_4 = m_4 \cdot \frac{a^2 + b^2}{12} \quad I_B = I_2 + I_3 + I_4$$

③ Replace the moment of inertia  $I_B$  around shaft B with the moment of inertia  $I_A$  around shaft A.

$$I_A = (A/B)^2 \cdot I_B \quad [A/B: \text{Ratio of the number of teeth}]$$

④ Find the actual moment of inertia:

$$I = I_1 + I_A$$

( $m_1$ : Mass of gear 1  
 $m_2$ : Mass of gear 2  
 $m_3$ : Mass of cylinder  
 $m_4$ : Mass of gripper)

### Calculation Example

$d_1 = 0.1 \text{ m}$ ,  $d_2 = 0.05 \text{ m}$ ,  $D = 0.04 \text{ m}$ ,  $a = 0.04 \text{ m}$ ,  $b = 0.02 \text{ m}$

$m_1 = 1 \text{ kg}$ ,  $m_2 = 0.4 \text{ kg}$ ,  $m_3 = 0.5 \text{ kg}$ ,  $m_4 = 0.2 \text{ kg}$ , Ratio of the number of teeth = 2

$$I_1 = 1 \times \frac{(0.1/2)^2}{2} = 1.25 \times 10^{-3} \text{ kg} \cdot \text{m}^2$$

$$I_2 = 0.4 \times \frac{(0.05/2)^2}{2} = 0.13 \times 10^{-3} \text{ kg} \cdot \text{m}^2$$

$$I_3 = 0.5 \times \frac{(0.04/2)^2}{2} = 0.1 \times 10^{-3} \text{ kg} \cdot \text{m}^2$$

$$I_4 = 0.2 \times \frac{0.04^2 + 0.02^2}{12} = 0.03 \times 10^{-3} \text{ kg} \cdot \text{m}^2$$

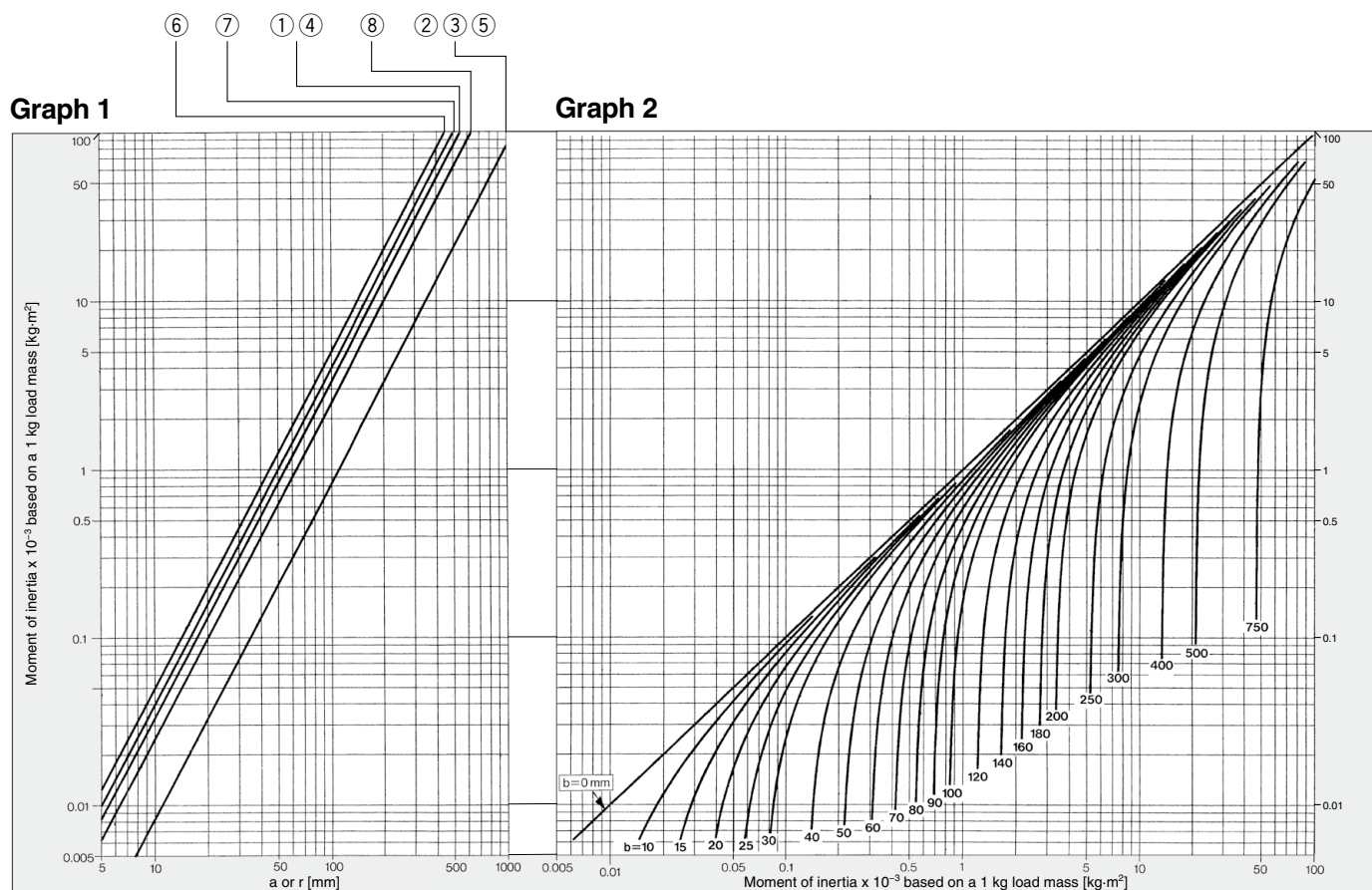
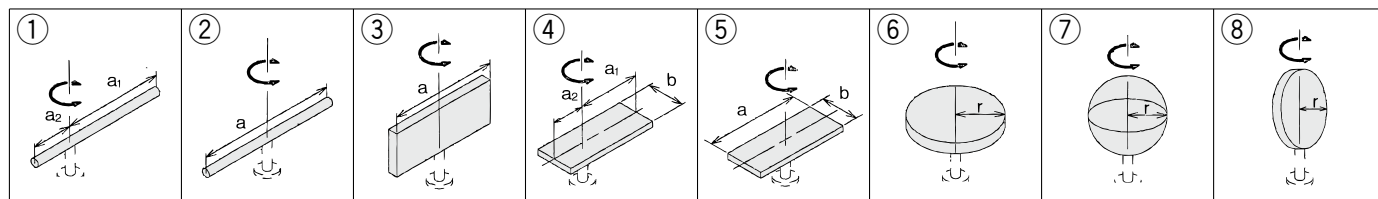
$$I_B = (0.13 + 0.1 + 0.03) \times 10^{-3} = 0.26 \times 10^{-3} \text{ kg} \cdot \text{m}^2$$

$$I_A = 2^2 \times 0.26 \times 10^{-3} = 1.04 \times 10^{-3} \text{ kg} \cdot \text{m}^2$$

$$I = (1.25 + 1.04) \times 10^{-3} = 2.29 \times 10^{-3} \text{ kg} \cdot \text{m}^2$$

# Rotary Actuator Model Selection

## ● Graph for Calculating the Moment of Inertia



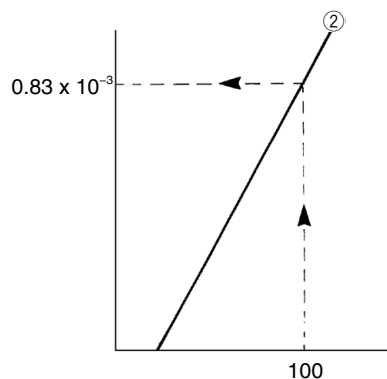
### How to read the graph: Only when the dimension of the load is “a” or “r”

[Example] When the load shape is ②,  $a = 100$  mm, and the load mass is  $0.1$  kg

In graph 1, the point at which the vertical line of  $a = 100$  mm and the line of the load shape ② intersect indicates that the moment of inertia of the  $1$  kg mass is  $0.83 \times 10^{-3} \text{ kg}\cdot\text{m}^2$ .

Since the load mass is  $0.1$  kg, the actual moment of inertia is  $0.83 \times 10^{-3} \times 0.1 = 0.083 \times 10^{-3} \text{ kg}\cdot\text{m}^2$

(Note: If “a” is divided into “a<sub>1</sub>a<sub>2</sub>”, the moment of inertia can be found by calculating them separately.)

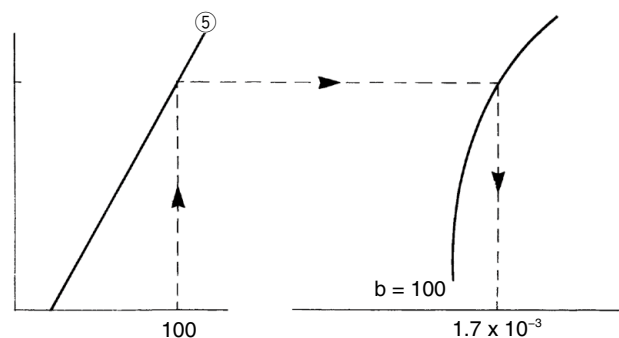


### How to read the graph: When the dimension of the load contains both “a” and “b”

[Example] When the load shape is ⑤,  $a = 100$  mm,  $b = 100$  mm, and the load mass is  $0.5$  kg

In graph 1, find the point at which the vertical line of  $a = 100$  mm and the line of the load shape ⑤ intersect. Move this intersection point to graph 2, and the point at which it intersects with the curve of  $b = 100$  mm indicates that the moment of inertia of the  $1$  kg mass is  $1.7 \times 10^{-3} \text{ kg}\cdot\text{m}^2$ .

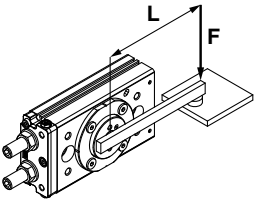
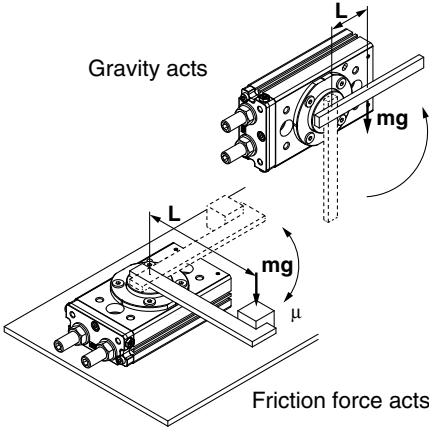
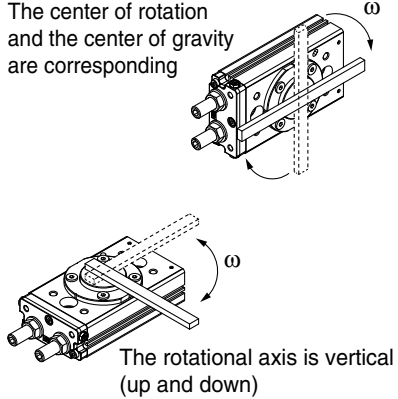
Since the load mass is  $0.5$  kg, the actual moment of inertia is  $1.7 \times 10^{-3} \times 0.5 = 0.85 \times 10^{-3} \text{ kg}\cdot\text{m}^2$



## 2 Calculation of Required Torque

### ● Load Type

The calculation method of required torque varies depending on the load type. Find the required torque referring to the table below.

| Load type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Static load: $T_s$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Resistance load: $T_f$                                                                                                                                                                                                                                                                                                                                                                                                        | Inertial load: $T_a$                                                                                                                                                                                                                                                     |
| When the pressing force is necessary (clamp, etc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | When friction force or gravity is applied to the rotation direction                                                                                                                                                                                                                                                                                                                                                           | When the load with inertia is rotated                                                                                                                                                                                                                                    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                       |
| $T_s = F \cdot L$<br>$T_s$ : Static load [N·m]<br>$F$ : Clamp force [N]<br>$L$ : Distance from the center of rotation to clamp [m]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | When gravity acts to the rotation direction<br>$T_f = m \cdot g \cdot L$<br>When friction force acts to the rotation direction<br>$T_f = \mu \cdot m \cdot g \cdot L$<br>$T_f$ : Resistance load [N·m]<br>$m$ : Load mass [kg]<br>$g$ : Gravitational acceleration 9.8 [m/s <sup>2</sup> ]<br>$L$ : Distance from the center of rotation to the gravity or friction force acting point [m]<br>$\mu$ : Coefficient of friction | $T_a = I \cdot \ddot{\theta} = I \cdot \frac{2\theta}{t^2}$<br>$T_a$ : Inertial load [N·m]<br>$I$ : Moment of inertia [kg·m <sup>2</sup> ]<br>$\ddot{\theta}$ : Angular acceleration [rad/s <sup>2</sup> ]<br>$\theta$ : Rotating angle [rad]<br>$t$ : Rotation time [s] |
| Required torque $T = T_s$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Required torque $T = T_f \times (3 \text{ to } 5)^{*1}$                                                                                                                                                                                                                                                                                                                                                                       | Required torque $T = T_a \times 10^{*1}$                                                                                                                                                                                                                                 |
| <ul style="list-style-type: none"> <li>Resistance loads → Gravity or friction applies in the rotation direction.<br/>               Example 1) The axis of rotation is in a horizontal (lateral) direction, and the center of rotation and center of gravity of the load are not the same.<br/>               Example 2) The load slips against the floor while rotating.<br/>               * The required torque equals the total of the resistance load and inertial load.<br/> <math>T = T_f \times (3 \text{ to } 5) + T_a \times 10</math> </li> <li>Non-resistance loads → Gravity or friction does not apply in the rotation direction.<br/>               Example 1) The axis of rotation is in a perpendicular (vertical) direction.<br/>               Example 2) The axis of rotation is in a horizontal (lateral) direction, and the center of rotation and center of gravity of the load are the same.<br/>               * The required torque equals the inertial load only.<br/> <math>T = T_a \times 10</math> </li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                          |

### ● Effective Torque

| Size | Operating pressure [MPa] |      |      |      |      |      |      |      |      |      | [N·m] |
|------|--------------------------|------|------|------|------|------|------|------|------|------|-------|
|      | 0.1                      | 0.2  | 0.3  | 0.4  | 0.5  | 0.6  | 0.7  | 0.8  | 0.9  | 1.0  |       |
| 10   | 0.18                     | 0.36 | 0.53 | 0.71 | 0.89 | 1.07 | 1.25 | 1.42 | 1.60 | 1.78 |       |
| 20   | 0.37                     | 0.73 | 1.10 | 1.47 | 1.84 | 2.20 | 2.57 | 2.93 | 3.29 | 3.66 |       |
| 30   | 0.55                     | 1.09 | 1.64 | 2.18 | 2.73 | 3.19 | 3.82 | 4.37 | 4.91 | 5.45 |       |
| 50   | 0.93                     | 1.85 | 2.78 | 3.71 | 4.64 | 5.57 | 6.50 | 7.43 | 8.35 | 9.28 |       |

## 3 Confirmation of Rotation Time

For stable operation, check that each product is used within the allowable rotation time range.

**MSQ□<sub>L</sub>** (Cushion pad, Bumper, External shock absorber): 0.2 to 2.0 s/90° **MSQ□<sub>R</sub>** (Internal shock absorber): 0.2 to 0.7 s/90°

# Rotary Actuator Model Selection

## 4 Calculation of Kinetic Energy

Kinetic energy is generated when the load rotates. Kinetic energy applies on the product at the operating end as inertial force, and may cause the product to damage. In order to avoid this, the value of allowable kinetic energy is determined for each product. Find the kinetic energy of the load, and verify that it is within the allowable range for the product in use.

### Kinetic Energy

Use the following formula to calculate the kinetic energy of the load.

$$E = \frac{1}{2} \cdot I \cdot \omega^2$$

$E$  : Kinetic energy [J]

$I$  : Moment of inertia [kg·m<sup>2</sup>]

$\omega$  : Angular velocity [rad/s]

⇒ p. 12 Moment of inertia and rotation time

### Angular Velocity

$$\omega = \frac{2\theta}{t}$$

$\omega$  : Angular velocity [rad/s]

$\theta$  : Rotating angle [rad]

$t$  : Rotation time [s]

To find the rotation time when kinetic energy is within the allowable range for the product, use the following formula.

$$\text{When the angular velocity is } \omega = \frac{2\theta}{t}$$

$$t \geq \sqrt{\frac{2 \cdot I \cdot \theta^2}{E}}$$

$t$  : Rotation time [s]

$I$  : Moment of inertia [kg·m<sup>2</sup>]

$\theta$  : Rotating angle [rad]

$E$  : Allowable kinetic energy [J]

## ● Allowable Kinetic Energy and Rotation Time Adjustment Range

### Allowable Kinetic Energy and Rotation Time Adjustment Range

| Size | Allowable kinetic energy [J] |        |                         |                         |       | Adjustable range of rotation time safe in operation [s/90°] |        |                         |                         |
|------|------------------------------|--------|-------------------------|-------------------------|-------|-------------------------------------------------------------|--------|-------------------------|-------------------------|
|      | Cushion pad                  | Bumper | Internal shock absorber | External shock absorber |       | Cushion pad                                                 | Bumper | Internal shock absorber | External shock absorber |
| 10   | 0.007                        | 0.014  | 0.039                   | 0.161                   | 0.231 | 0.2 to 2.0                                                  |        | 0.2 to 0.7              | 0.2 to 2.0              |
| 20   | 0.025                        | 0.042  | 0.116                   | 0.574                   | 1.060 |                                                             |        |                         |                         |
| 30   | 0.048                        | 0.072  | 0.116                   | 0.805                   | 1.210 |                                                             |        |                         |                         |
| 50   | 0.081                        | 0.162  | 0.294                   | 1.310                   | 1.820 |                                                             |        |                         |                         |

### Calculation Example

Load form: Round rod

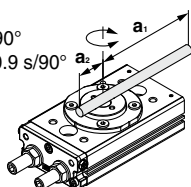
Length of  $a_1$  part : 0.12 m Rotating angle: 90°

Length of  $a_2$  part : 0.04 m Rotation time : 0.9 s/90°

Mass of  $a_1$  part (=  $m_1$ ): 0.09 kg

Mass of  $a_2$  part (=  $m_2$ ): 0.03 kg

$$I = m_1 \cdot \frac{a_1^2}{3} + m_2 \cdot \frac{a_2^2}{3}$$



(Step 1) Find the angular velocity  $\omega$ .

$$\omega = \frac{2\theta}{t} = \frac{2}{0.9} \left( \frac{\pi}{2} \right) = 3.489 \text{ rad/s}$$

(Step 2) Find the moment of inertia  $I$ .

$$I = \frac{m_1 \cdot a_1^2}{3} + \frac{m_2 \cdot a_2^2}{3} = \frac{0.09 \times 0.12^2}{3} + \frac{0.03 \times 0.04^2}{3} = 4.48 \times 10^{-4} \text{ kg·m}^2$$

(Step 3) Find the kinetic energy  $E$ .

$$E = \frac{1}{2} \cdot I \cdot \omega^2 = \frac{1}{2} \times 4.48 \times 10^{-4} \times 3.489^2 = 0.00273 \text{ J}$$

### Calculation Example

If the model to be used has been determined, find the threshold rotation time in which the rotary actuator can be used in accordance with the allowable kinetic energy of that model.

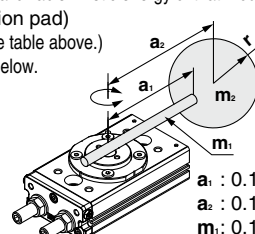
Model used : MSQ50A (Cushion pad)

Allowable kinetic energy : 0.081 J (Refer to the table above.)

Load form : Refer to the figure below.

Rotating angle : 90°

$$I = m_1 \cdot \frac{a_1^2}{3} + m_2 \cdot a_2^2 + m_2 \cdot \frac{2r^2}{5}$$



$a_1$  : 0.12 m  
 $a_2$  : 0.15 m  
 $m_1$  : 0.09 kg  
 $m_2$  : 0.03 kg  
 $r$  : 0.03 m

(Step 1) Find the moment of inertia.

$$I = \frac{m_1 \cdot a_1^2}{3} + m_2 \cdot a_2^2 + \frac{m_2 \cdot 2r^2}{5} = \frac{0.09 \times 0.12^2}{3} + 0.03 \times 0.15^2 + \frac{0.03 \times 2 \times 0.03^2}{5} = 4.6 \times 10^{-3} \text{ kg·m}^2$$

(Step 2) Find the rotation time.

$$t \geq \sqrt{\frac{2 \cdot I \cdot \theta^2}{E}} = \sqrt{\frac{2 \times 4.6 \times 10^{-3} \times (\pi/2)^2}{0.081}} = 0.53 \text{ s}$$

It is therefore evident that there will be no problem if it is used with a rotation time of less than 0.53 s. However, according to the table above, the max. value of rotation time for stable operation is 2 s. Thus, the rotation time should be within the range of  $0.53 \leq t \leq 2$ .

## ● Moment of Inertia and Rotation Time

### How to read the graph

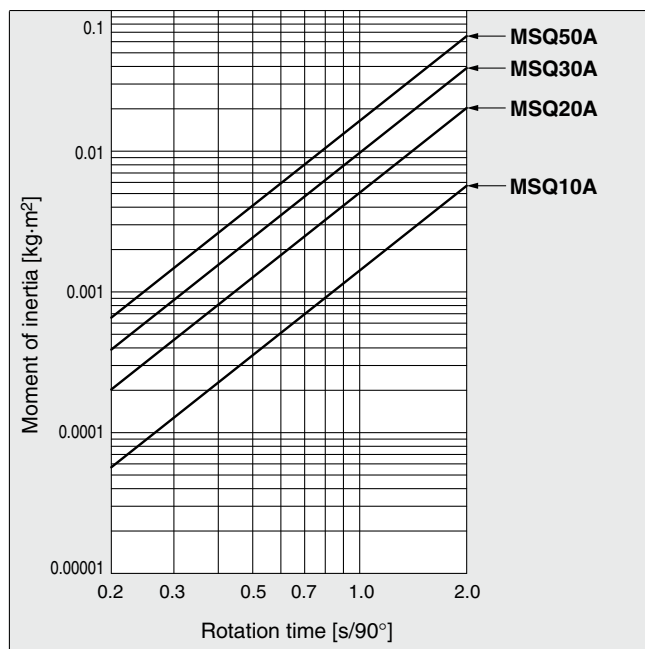
Example 1) When there are constraints on the moment of inertia of the load and the rotation time:  
When the load's moment of inertia is  $1 \times 10^{-3} \text{ kg}\cdot\text{m}^2$  and the rotation time is set at  $0.3 \text{ s}/90^\circ$ , we can see from graphs 3 to 6 that the size of the product suitable to each cushion type is as follows.

Cushion pad : MSQ50A  
Bumper : MSQ30, 50D  
Internal shock absorber : MSQ20 to 50R  
External shock absorber: MSQ10 to 50L(H)

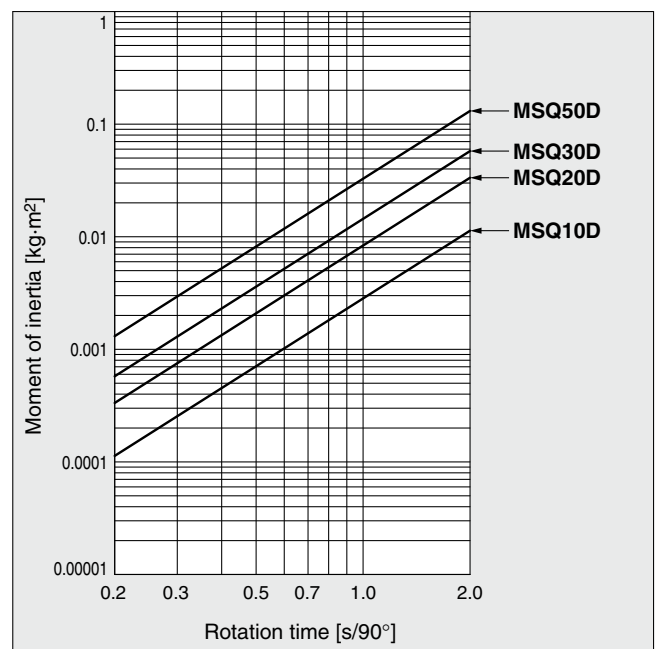
Example 2) When there are constraints on the moment of inertia of the load but not the rotation time:  
We can see from graphs 3 to 6 that to operate the load at a  $1 \times 10^{-2} \text{ kg}\cdot\text{m}^2$  moment of inertia:

MSQ50A will be  $0.8$  to  $2 \text{ s}/90^\circ$ .  
MSQ50D will be  $0.55$  to  $2 \text{ s}/90^\circ$ .  
MSQ50R will be  $0.4$  to  $0.7 \text{ s}/90^\circ$ .  
MSQ50L will be  $0.2$  to  $2 \text{ s}/90^\circ$ .

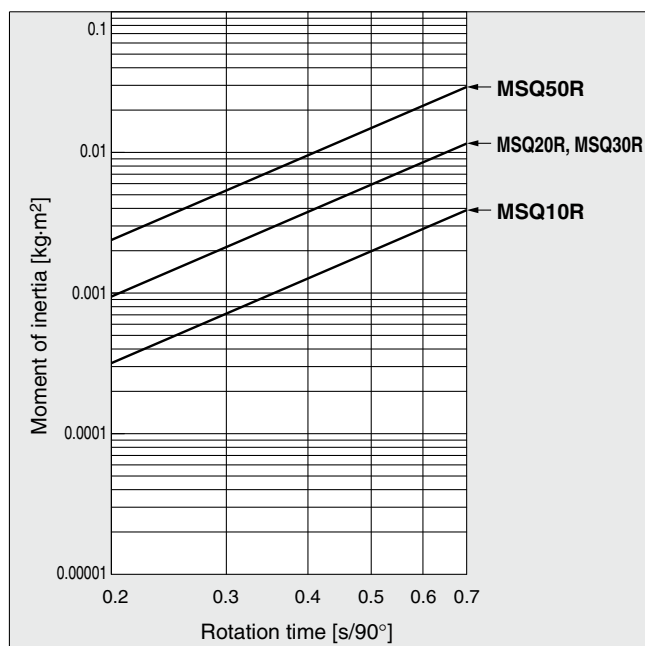
**Graph 3 Cushion Pad**



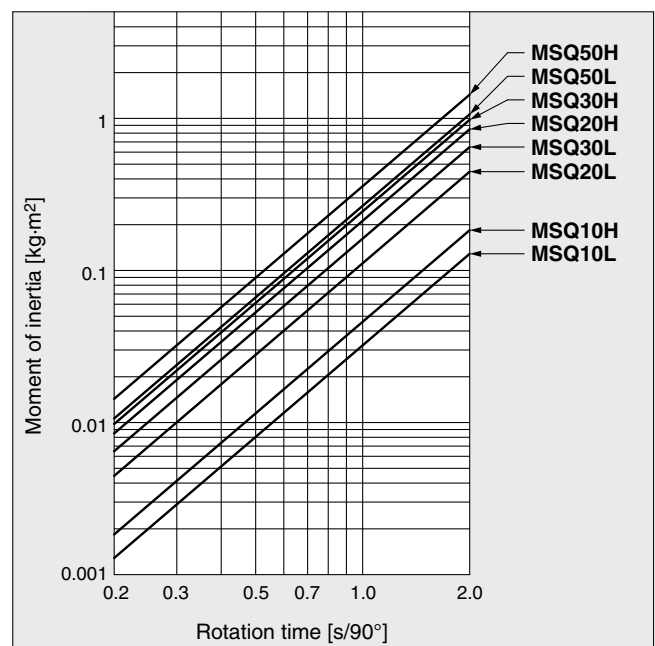
**Graph 4 Bumper**



**Graph 5 Internal Shock Absorber**



**Graph 6 External Shock Absorber**

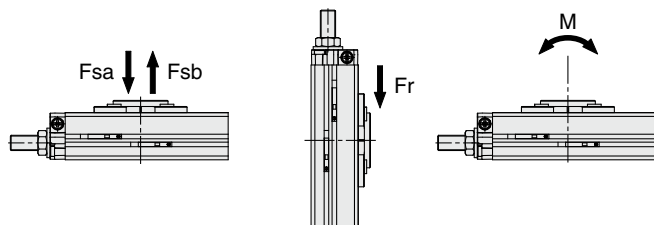




# Rotary Actuator Model Selection

## 5 Confirmation of Allowable Load

Provided that a dynamic load is not generated, a load in the axial direction can be applied up to the value that is indicated in the table to the right. However, applications in which the load is applied directly to the shaft should be avoided as much as possible.



| Size | Load direction |         |        |         |
|------|----------------|---------|--------|---------|
|      | Fsa [N]        | Fsb [N] | Fr [N] | M [N·m] |
| 10   | 78             | 74      | 78     | 2.4     |
| 20   | 137            | 137     | 147    | 4.0     |
| 30   | 363            | 197     | 196    | 5.3     |
| 50   | 451            | 296     | 314    | 9.7     |

## 6 Calculation of Air Consumption and Required Air Flow Capacity

Air consumption is the volume of air which is expended by the rotary actuator's reciprocal operation inside the actuator and in the piping between the actuator and the switching valve, etc. This is necessary for selection of a compressor and for calculation of its running cost. Required air volume is the air volume necessary to make a rotary actuator operate at a required speed. It requires calculation when selecting the upstream piping diameter from the switching valve and air line equipment.

\* For the air consumption calculation graph, refer to graphs 7 and 8 on page 14.

### ① Air consumption volume

Formula

$$Q_{CR} = V \times \left( \frac{P+0.1}{0.1} \right) \times 10^{-3} \dots (1)$$

$$Q_{CP} = 2 \times a \times L \times \left( \frac{P}{0.1} \right) \times 10^{-6} \dots (2)$$

$$Q_c = Q_{CR} + Q_{CP} \dots (3)$$

$Q_{CR}$  = Amount of air consumption of rotary actuator [L (ANR)]

$Q_{CP}$  = Amount of air consumption of tube or piping [L (ANR)]

$V$  = Inner volume of the rotary actuator (1 cycle) [cm<sup>3</sup>]

$P$  = Operating pressure [MPa]

$L$  = Length of piping [mm]

$a$  = Inner sectional area of piping [mm<sup>2</sup>]

$Q_c$  = Amount of air consumption required for one cycle of the rotary actuator [L (ANR)]

To select a compressor, it is important to select one that has plenty of margin to accommodate the total air volume that is consumed by the pneumatic actuators that are located downstream. The total air consumption volume is affected by the leakage in the tube, the consumption in the drain valves and pilot valves, as well as by the reduction in air volume due to reduced temperature.

Formula

$$Q_{c2} = Q_c \times n \times \text{No. of actuators} \times \text{Safety factor} \dots (4)$$

$Q_{c2}$  = Amount of air from a compressor [L/min (ANR)]

$n$  = Actuator reciprocations per minute

Safety factor: From 1.5

### ② Required air flow capacity

Formula

$$Q_r = \left\{ \frac{V}{2} \times \left( \frac{P+0.1}{0.1} \right) \times 10^{-3} + a \times L \times \left( \frac{P}{0.1} \right) \times 10^{-6} \right\} \times \frac{60}{t} \dots (5)$$

$Q_r$  = Consumed air volume for rotary actuator [L/min (ANR)]

$V$  = Inner volume of the rotary actuator (1 cycle) [cm<sup>3</sup>]

$P$  = Operating pressure [MPa]

$L$  = Length of piping [mm]

$a$  = Inner sectional area of piping [mm<sup>2</sup>]

$t$  = Total time for rotation [S]

### Internal Cross Section of Tubing and Steel Tube

| Nominal | O.D. [mm] | I.D. [mm] | Internal cross section<br>$a$ [mm <sup>2</sup> ] |
|---------|-----------|-----------|--------------------------------------------------|
| T□ 0425 | 4         | 2.5       | 4.9                                              |
| T□ 0604 | 6         | 4         | 12.6                                             |
| TU 0805 | 8         | 5         | 19.6                                             |
| T□ 0806 | 8         | 6         | 28.3                                             |

# Rotary Actuator Model Selection

## Air Consumption Calculation Graph

**Step 1** Using graph 7, air consumption volume of the rotary actuator is found. From the point of intersection between the inner volume and the operating pressure (slanted line) and then looking to the side (left side) direction, the air consumption volume for 1 cycle operation of a rotary actuator is found.

**Step 2** Using graph 8, the air consumption volume for 1 cycle operation of tubing or steel tube is found.

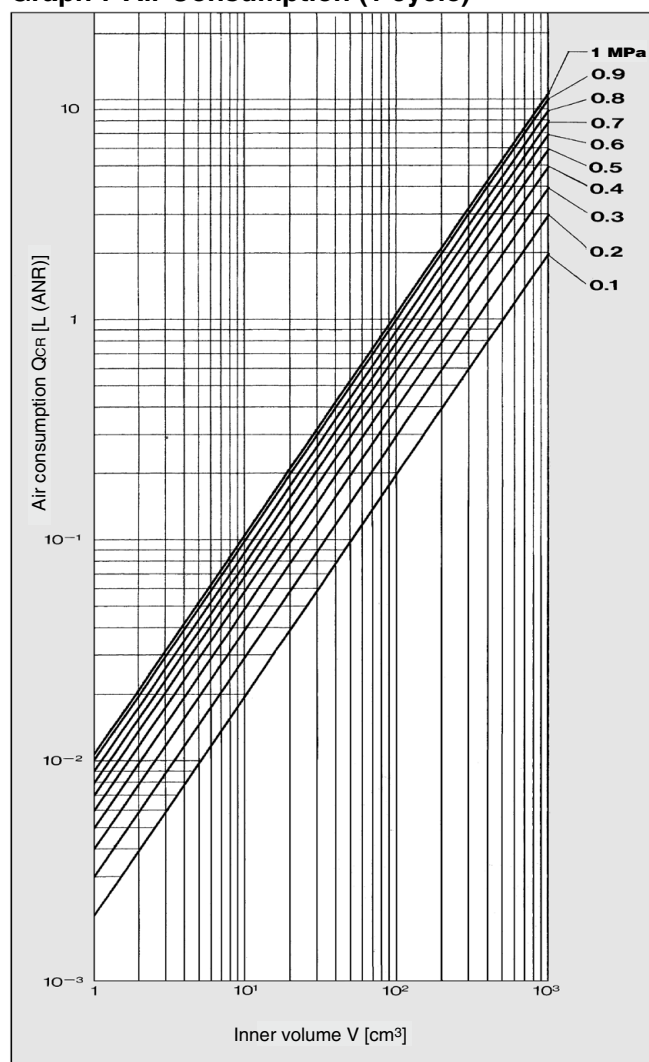
- (1) First determine the point of intersection between the operating pressure (slanted line) and the piping length, and then go up the vertical line perpendicularly from there.
- (2) From the point of intersection of an operating piping tube inside diameter (slanted line), then look to the side (left or right) to find the required air consumption volume for piping.

**Step 3** Total air consumption volume per minute is found as follows:  
(Air consumption volume of a rotary actuator [unit: L (ANR)] + Tubing or steel tube's air consumption volume) x Cycle times per minute x Number of rotary actuators = Total air consumption volume

Example) When 10 units of an MSQ30A are used at a pressure of 0.5 MPa, what is the air consumption of their 5 cycles per minute? (Piping between the actuator and switching valve is a tube with an inside diameter of 6 mm and length of 2 m.)

1. Operating pressure 0.5 MPa → Inner volume of MSQ30A 47.4 cm<sup>3</sup>  
→ Air consumption volume 0.25 L (ANR)
2. Operating pressure 0.5 MPa → Piping length 2 m → Inside diameter 6 mm → Air consumption volume 0.56 L (ANR)
3. Total air consumption volume = (0.25 + 0.56) x 5 x 10 = 40.5 L/min (ANR)

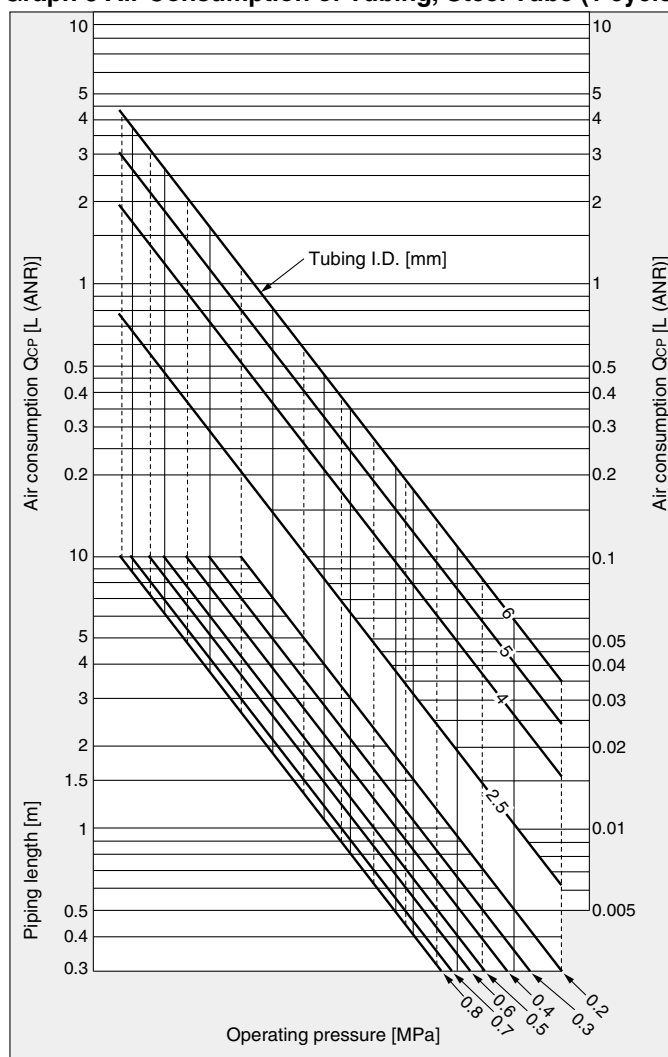
**Graph 7 Air Consumption (1 cycle)**



**Inner Volume** 1 cycle [cm<sup>3</sup>]

| Size | Rotating angle |
|------|----------------|
|      | 190°           |
| 10   | 15.6           |
| 20   | 30.8           |
| 30   | 47.4           |
| 50   | 76.0           |

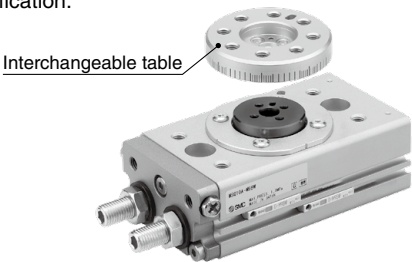
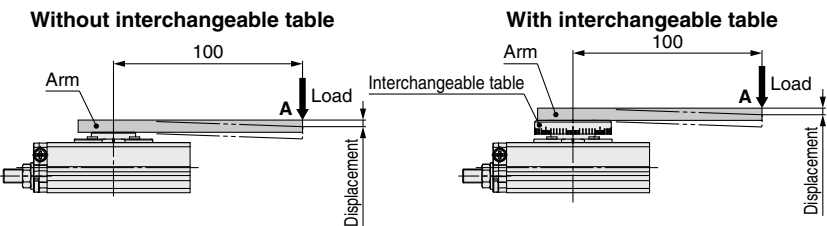
**Graph 8 Air Consumption of Tubing, Steel Tube (1 cycle)**



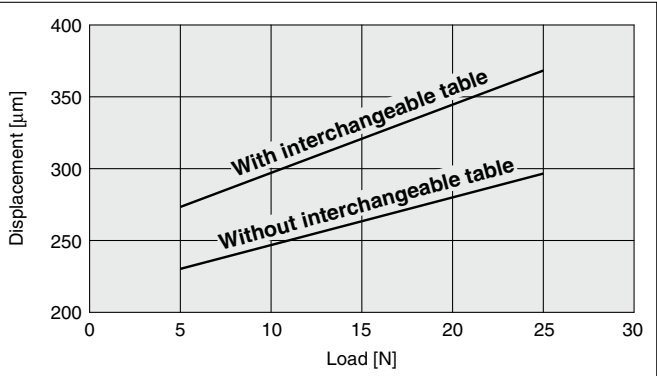
- \* "Piping length" indicates the length of steel tube or tubing which connects rotary actuator and switching valves (solenoid valves, etc.).
- \* Refer to page 13 for the size of tubing and steel tube (inside diameter and outside diameter).

Table Displacement (Reference values)

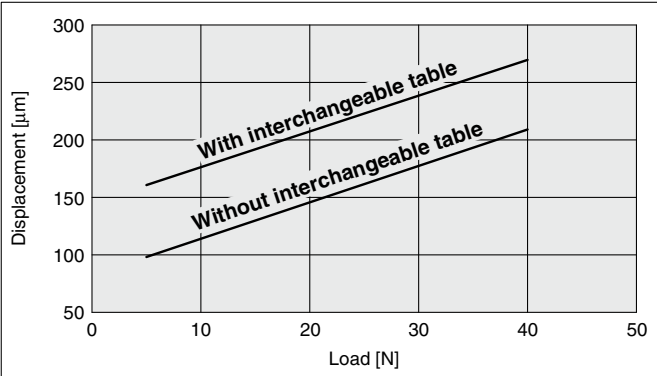
The following graphs show the displacement at point A, which is 100 mm away from the center of rotation, where the load is applied. Refer to the displacement for “with interchangeable table” for the external shock absorber specification.



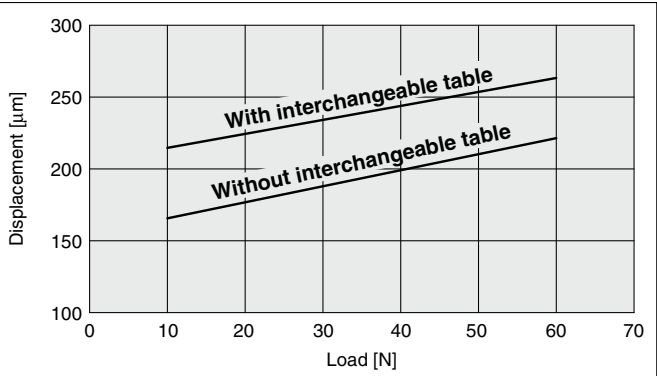
Size 10



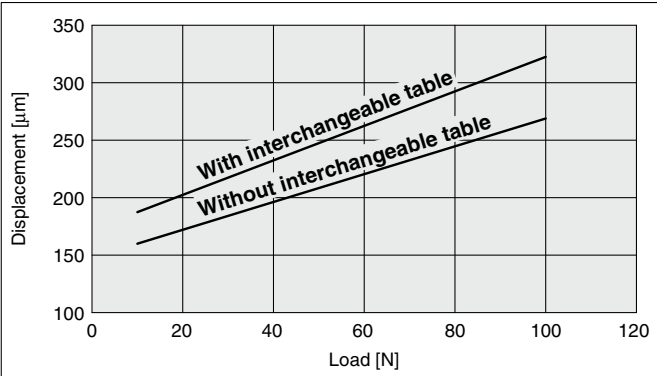
Size 20



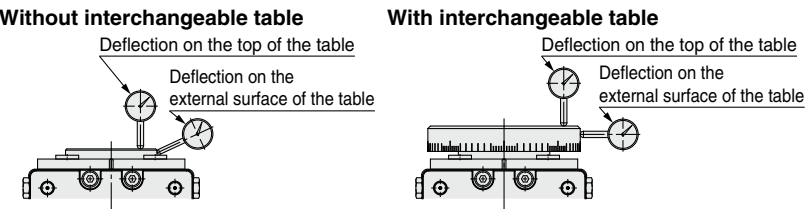
Size 30



Size 50



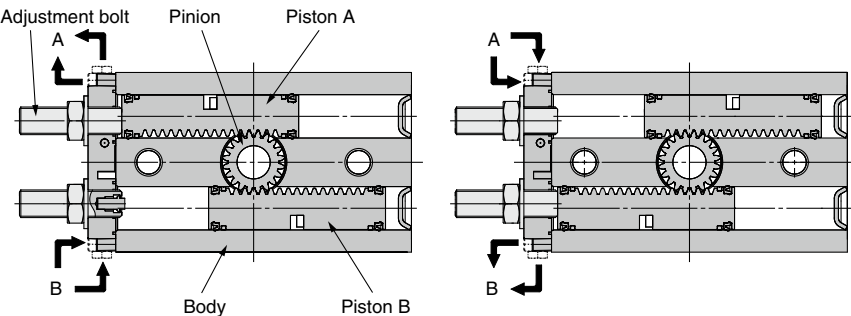
Deflection Accuracy: Displacement at 180° Rotation (Guide)



| Measured part                                   | [mm]                          |                            |
|-------------------------------------------------|-------------------------------|----------------------------|
|                                                 | Without interchangeable table | With interchangeable table |
| Deflection on the top of the table              | 0.1                           | 0.1                        |
| Deflection on the external surface of the table | 0.1                           | 0.1                        |

The values in the table are actual values and not guaranteed values.

Working Principle



1. It consists of a rack that slides in 2 parallel cylinders, 2 pistons that are integrated with the rack, and a pinion.
2. The air that is supplied from port B pushes the left side of piston A; at the same time, it passes through the air passage of the body, pushing the right side of piston B, thus creating in the shaft an amount of torque that is equivalent to 2 pistons.
3. The air in the exhaust chamber discharges via port A and rotates clockwise.
4. The pinion stops when piston B comes in contact with the adjustment bolt and stops.
5. Similarly, when air is supplied from port A, it rotates counterclockwise.

# Rotary Table/Rack & Pinion Type

# MSQ Series

Size: 10, 20, 30, 50

RoHS

## How to Order

Basic type

MSQ 10 A - M9BW - - -

Size

|    |
|----|
| 10 |
| 20 |
| 30 |
| 50 |

Made to order

For details, refer to the next page.

Port type

| End port type | Size    |
|---------------|---------|
| Nil           | M5      |
| Nil           | Rc1/8   |
| -XF           | G1/8    |
| -XN           | NPT1/8  |
| -XT           | NPTF1/8 |

\* Side ports are all M5.

For details, refer to the specifications on page 17.

Number of auto switches

|     |   |
|-----|---|
| Nil | 2 |
| S   | 1 |
| n   | n |

Auto switch

|     |                                       |
|-----|---------------------------------------|
| Nil | Without auto switch (Built-in magnet) |
|-----|---------------------------------------|

\* For applicable auto switches, refer to the table below.

|   |                         |                                                                                     |
|---|-------------------------|-------------------------------------------------------------------------------------|
| A | Cushion pad             |    |
| D | Bumper                  |  |
| R | Internal shock absorber |  |

Applicable Auto Switches/Refer to the Web Catalog for further information on auto switches.

| Type                    | Special function                          | Electrical entry | Indicator light | Wiring (Output)     | Load voltage |           | Auto switch model |         | Lead wire length [m] |       |       |       | Pre-wired connector | Applicable load |            |            |            |
|-------------------------|-------------------------------------------|------------------|-----------------|---------------------|--------------|-----------|-------------------|---------|----------------------|-------|-------|-------|---------------------|-----------------|------------|------------|------------|
|                         |                                           |                  |                 |                     | DC           | AC        | Perpendicular     | In-line | 0.5 (Nil)            | 1 (M) | 3 (L) | 5 (Z) |                     |                 |            |            |            |
| Solid state auto switch | —                                         | Grommet          | Yes             | 3-wire (NPN)        | 24 V         | 5 V, 12 V | —                 | M9NV    | M9N                  | ●     | ●     | ●     | ○                   | ○               | IC circuit | Relay, PLC |            |
|                         | 3-wire (PNP)                              |                  |                 | 12 V                |              | M9PV      |                   | M9P     | ●                    | ●     | ●     | ○     | ○                   |                 |            |            |            |
|                         | 2-wire                                    |                  |                 | 5 V, 12 V           |              | M9BV      |                   | M9B     | ●                    | ●     | ●     | ○     | ○                   |                 |            |            |            |
|                         | Diagnostic indication (2-color indicator) |                  |                 | 3-wire (NPN)        | 24 V         | 5 V, 12 V |                   | M9NWV   | M9NW                 | ●     | ●     | ●     | ○                   | ○               | IC circuit |            |            |
|                         |                                           |                  |                 | 3-wire (PNP)        |              | 12 V      |                   | M9PWV   | M9PW                 | ●     | ●     | ●     | ○                   | ○               |            |            |            |
|                         |                                           |                  |                 | 2-wire              |              | 5 V, 12 V |                   | M9BWV   | M9BW                 | ●     | ●     | ●     | ○                   | ○               |            |            |            |
|                         |                                           |                  |                 | 3-wire (NPN)        |              | 5 V, 12 V |                   | M9NAV*1 | M9NA*1               | ○     | ○     | ●     | ○                   | ○               |            |            | IC circuit |
|                         | 3-wire (PNP)                              |                  |                 | 12 V                | M9PAV*1      |           |                   | M9PA*1  | ○                    | ○     | ●     | ○     | ○                   |                 |            |            |            |
|                         | Water resistant (2-color indicator)       |                  |                 | 2-wire              | 12 V         | M9BAV*1   |                   | M9BA*1  | ○                    | ○     | ●     | ○     | ○                   | ○               | —          |            |            |
|                         |                                           |                  |                 |                     |              |           |                   |         |                      |       |       |       |                     |                 |            |            |            |
| Reed auto switch        | —                                         | Grommet          | Yes             | 3-wire (NPN equiv.) | —            | 5 V       | —                 | A96V    | A96                  | ●     | —     | ●     | —                   | —               | IC circuit | —          |            |
|                         |                                           |                  |                 | No                  | 2-wire       | 24 V      | 12 V              | 100 V   | A93V*2               | A93   | ●     | ●     | ●                   | ●               | —          | —          | IC circuit |
|                         |                                           |                  | 100 V or less   |                     |              |           | A90V              | A90     | ●                    | —     | ●     | —     | —                   | —               |            |            |            |

\*1 Although it is possible to mount water-resistant type auto switches, note that the rotary actuator itself is not of water-resistant construction.

\*2 The 1 m lead wire is only applicable to the D-A93.

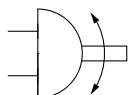
\* Lead wire length symbols: 0.5 m..... Nil (Example) M9NW  
1 m..... M (Example) M9NWM  
3 m..... L (Example) M9NWL  
5 m..... Z (Example) M9NWZ

\* Solid state auto switches marked with a "○" are produced upon receipt of order.

\* Auto switches are shipped together with the product but do not come assembled.



## Symbol



**Made to Order**  
(For details, refer to page 21.)

| Symbol   | Specifications                       |
|----------|--------------------------------------|
| <b>A</b> | With interchangeable table and plate |
| <b>B</b> | With interchangeable table           |
| <b>C</b> | With interchangeable plate           |

Refer to page 29 for models with auto switches.

· Auto Switch Proper Mounting Position  
(at Rotation End Detection)

## Specifications

| Size                           |                         | 10                            | 20  | 30                              | 50  |
|--------------------------------|-------------------------|-------------------------------|-----|---------------------------------|-----|
| Fluid                          |                         | Air (Non-lube)                |     |                                 |     |
| Max. operating pressure        | Cushion pad             | 1 MPa                         |     |                                 |     |
|                                | Bumper                  |                               |     |                                 |     |
|                                | Internal shock absorber |                               |     |                                 |     |
| Min. operating pressure        |                         | 0.6 MPa*1<br>0.1 MPa*2        |     |                                 |     |
| Ambient and fluid temperatures |                         | 0 to 60°C (No freezing)       |     |                                 |     |
| Cushion                        | Cushion pad*3           | Rubber bumper                 |     |                                 |     |
|                                | Bumper                  |                               |     |                                 |     |
|                                | Internal shock absorber |                               |     |                                 |     |
| Angle adjustment range*4       |                         | Shock absorber<br>0 to 190°*5 |     |                                 |     |
| Max. rotating angle*4          |                         | 190°                          |     |                                 |     |
| Cylinder bore size             |                         | ø13                           | ø16 | ø20                             | ø22 |
| Port size                      | End port                | M5 x 0.8                      |     | Rc1/8, G1/8,<br>NPT1/8, NPTF1/8 |     |
|                                | Side port               |                               |     |                                 |     |

\*1 The max. operating pressure of the actuator is restricted by the max. allowable thrust of the shock absorber.

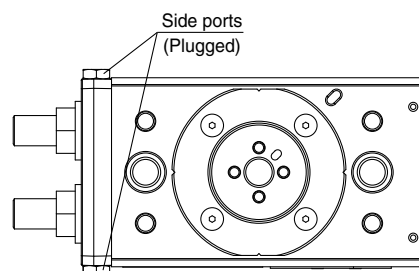
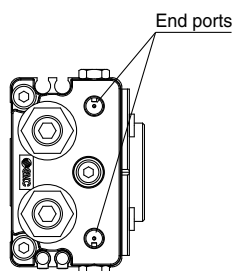
\*2 Refer to page 31 for the min. operating pressure with a bumper.

\*3 Reduces noise when the piston and adjustment bolt collide.

\*4 For details, refer to page 18.

\*5 If the rotating angle of the type with an internal shock absorber is set below the value in the table below, the piston stroke will be smaller than the shock absorber's effective stroke, resulting in decreased energy absorption ability.

| Size                                                                                  | 10  | 20  | 30  | 50  |
|---------------------------------------------------------------------------------------|-----|-----|-----|-----|
| Min. rotating angle that will not result in decrease of the energy absorption ability | 40° | 35° | 35° | 47° |



## Allowable Kinetic Energy and Rotation Time Adjustment Range

| Size      | Allowable kinetic energy [J]* <sup>1</sup> |        |                         | Adjustable range of rotation time safe in operation [s/90°] |        |                                       |
|-----------|--------------------------------------------|--------|-------------------------|-------------------------------------------------------------|--------|---------------------------------------|
|           | Cushion pad                                | Bumper | Internal shock absorber | Cushion pad                                                 | Bumper | Internal shock absorber* <sup>2</sup> |
| <b>10</b> | 0.007                                      | 0.014  | 0.039                   | 0.2 to 2.0                                                  |        | 0.2 to 0.7                            |
| <b>20</b> | 0.025                                      | 0.042  | 0.116                   |                                                             |        |                                       |
| <b>30</b> | 0.048                                      | 0.072  | 0.116                   |                                                             |        |                                       |
| <b>50</b> | 0.081                                      | 0.162  | 0.294                   |                                                             |        |                                       |

\*1 If operated so that the kinetic energy exceeds the allowable value, damage to the internal parts or product failure may result. Please pay special attention to the kinetic energy levels when designing and during operation to avoid exceeding the allowable limit.

\*2 If the rotation time of the type with an internal shock absorber is set longer than the time shown in the table above, the energy absorption ability of the shock absorber will greatly decrease.

## Weight

| Size       |                         | 10  | 20  | 30   | 50   |
|------------|-------------------------|-----|-----|------|------|
| Basic type | Cushion pad             | 375 | 680 | 930  | 1500 |
|            | Bumper                  |     |     |      |      |
|            | Internal shock absorber |     |     |      |      |
|            |                         | 440 | 795 | 1130 | 1810 |

\* The values above do not include the auto switch weight.

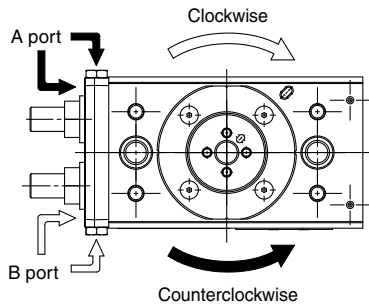
\* For made-to-order options, add the weight in the table below to the weight of the base model.

| Size                                 | 10 | 20  | 30  | 50  |
|--------------------------------------|----|-----|-----|-----|
| With interchangeable table and plate | 70 | 160 | 120 | 220 |
| With interchangeable table           | 30 | 60  | 80  | 130 |
| With interchangeable plate           | 40 | 100 | 40  | 90  |



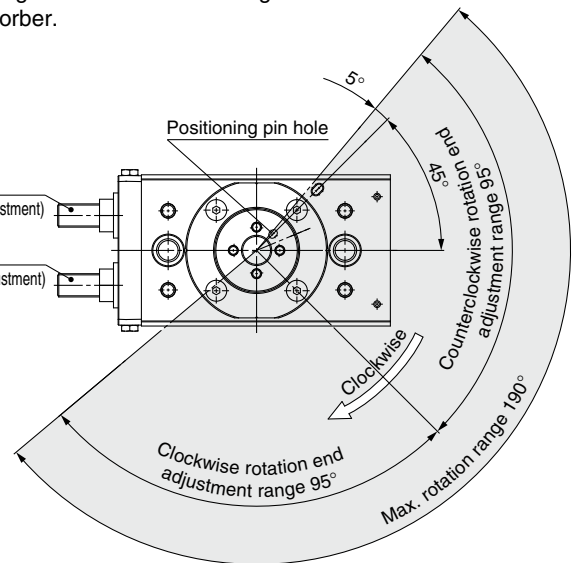
## Rotation Direction and Rotating Angle

- The rotary table turns in the counterclockwise direction where the A port is pressurized, and in the clockwise direction when the B port is pressurized. (Please note that the rotation direction is different from the existing MSQ.)
- By adjusting the adjustment bolt, the rotation end can be set within the ranges shown in the drawing.
- The rotating angle can also be set on the type with an internal shock absorber.
- Refer to page 31 for the tightening torques for setting the rotating angle.



Adjustment bolt A  
(For counterclockwise rotation end adjustment)

Adjustment bolt B  
(For clockwise rotation end adjustment)

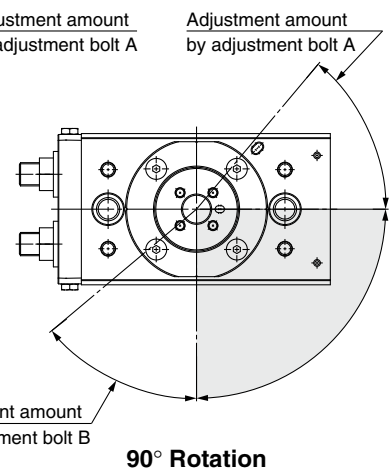
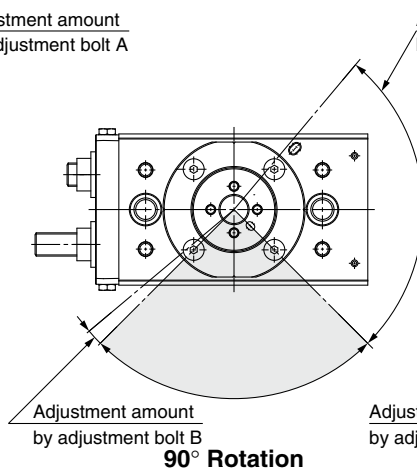
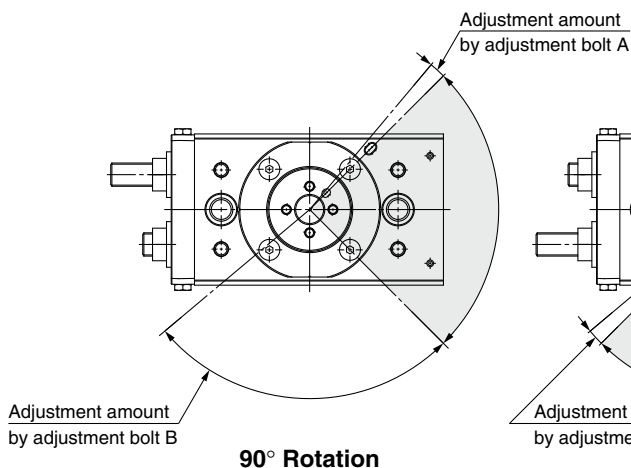
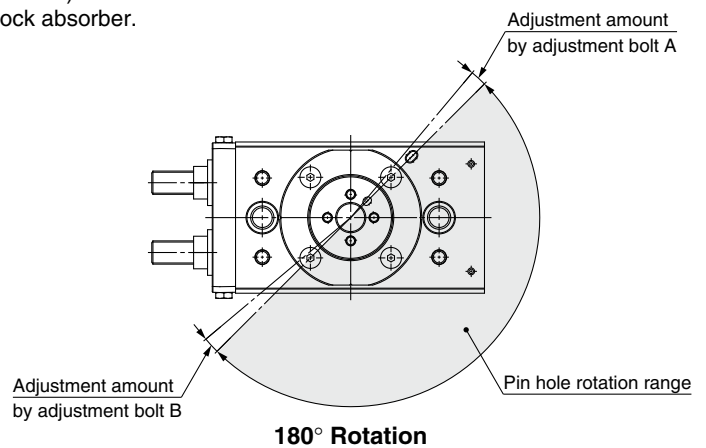
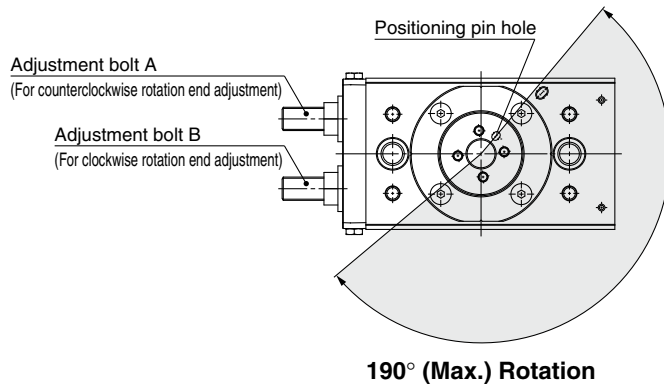


### Rotation Direction and Rotating Angle (Cushion pad, Bumper, Internal shock absorber)

| Size | Adjustment angle per rotation of adjustment bolt |
|------|--------------------------------------------------|
| 10   | 8.0°                                             |
| 20   | 5.7°                                             |
| 30   | 5.7°                                             |
| 50   | 6.4°                                             |

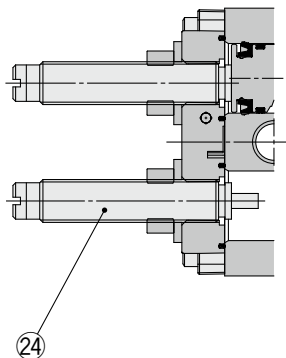
## Rotating Angle Range Examples

- Various rotation ranges are possible as shown in the drawings below using adjustment bolts A and B. (The drawings also show the rotation ranges of the positioning pin hole.)
- The rotating angle can also be set on the type with an internal shock absorber.

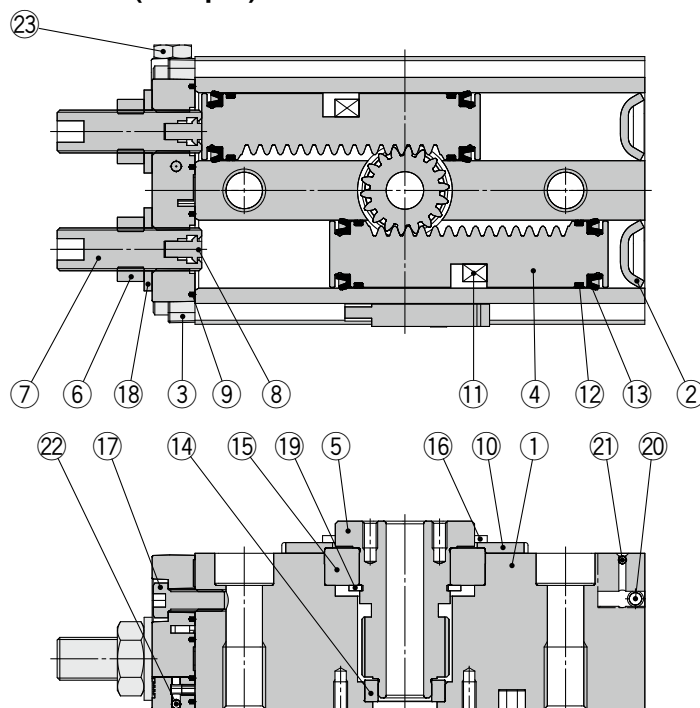


## Construction

### MSQ□R (Internal shock absorber)



### MSQ□A (Cushion pad) MSQ□D (Bumper)



### Component Parts

| No. | Description                              | Material                | Note                    |
|-----|------------------------------------------|-------------------------|-------------------------|
| 1   | Body                                     | Aluminum alloy          | Anodized                |
| 2   | Head cap                                 | Aluminum alloy          | Anodized                |
| 3   | End cover                                | Aluminum alloy          | Painted                 |
| 4   | Piston                                   | Cushion pad             | Anodized                |
|     |                                          | Bumper                  | Anodized                |
|     |                                          | Internal shock absorber | Stainless steel         |
| 5   | Table pinion                             | Chrome molybdenum steel |                         |
| 6   | Compact hexagon nut                      | Steel wire              | Chromating              |
| 7   | Adjustment bolt                          | Cushion pad             | Chromating              |
|     |                                          | Bumper                  | Chrome molybdenum steel |
| 8   | Cushion pad                              | Rubber material         |                         |
| 9   | Bumper                                   | Rubber material         |                         |
| 10  | Gasket                                   | NBR                     |                         |
| 11  | Bearing retainer                         | Aluminum alloy          | Anodized                |
| 12  | Magnet                                   | —                       |                         |
| 13  | Wear ring                                | Resin                   |                         |
| 14  | Piston seal                              | NBR                     |                         |
| 15  | Bearing                                  | Bearing steel           |                         |
| 16  | Bearing                                  | Bearing steel           |                         |
| 17  | Hexagon socket super thin head cap screw | Steel wire              | Chromating              |
| 18  | Hexagon socket thin head cap screw       | Steel wire              | Chromating              |
| 19  | Seal washer                              | Steel wire + NBR        |                         |
| 20  | Round type S retaining ring              | Steel wire              | Phosphate coating       |
| 21  | Steel ball                               | Stainless steel         |                         |
| 22  | Steel ball                               | Stainless steel         |                         |
| 23  | M5 plug assembly                         | Steel wire              | Nickel plating          |
| 24  | Shock absorber                           | —                       |                         |

### Replacement Parts

#### Seal Kit

| Size | Part no.  | Contents           |
|------|-----------|--------------------|
|      |           | Description (Qty.) |
| 10   | P891010-5 | ⑨ Gasket (1)       |
| 20   | P891020-5 | ⑫ Wear ring (4)    |
| 30   | P891030-5 | ⑬ Piston seal (4)  |
| 50   | P891040-5 | ⑮ Seal washer (2)  |

A grease pack (10 g) is included. Order with the following part number when only the grease pack is needed.

**Grease pack part number: GR-L-010 (10 g)**

#### Adjustment bolt assembly (Cushion pad)

| Size | Part no.  | Contents              |
|------|-----------|-----------------------|
|      |           | Description (Qty.)    |
| 10   | P391010-3 |                       |
| 20   | P391020-3 | ⑦ Adjustment bolt (1) |
| 30   |           | ⑧ Cushion pad (1)     |
| 50   | P391040-3 |                       |

Two sets are required for each product.

#### Adjustment bolt assembly (Bumper)

| Size | Part no.  | Contents              |
|------|-----------|-----------------------|
|      |           | Description (Qty.)    |
| 10   | P891010-3 |                       |
| 20   | P891020-3 | ⑦ Adjustment bolt (1) |
| 30   |           | ⑧ Bumper (1)          |
| 50   | P891040-3 |                       |

Two sets are required for each product.

#### Shock absorber (Internal shock absorber)

| Size | Part no.     |
|------|--------------|
| 10   | RBA0805-X692 |
| 20   | RBA1006-X692 |
| 30   |              |
| 50   | RBA1411-X692 |

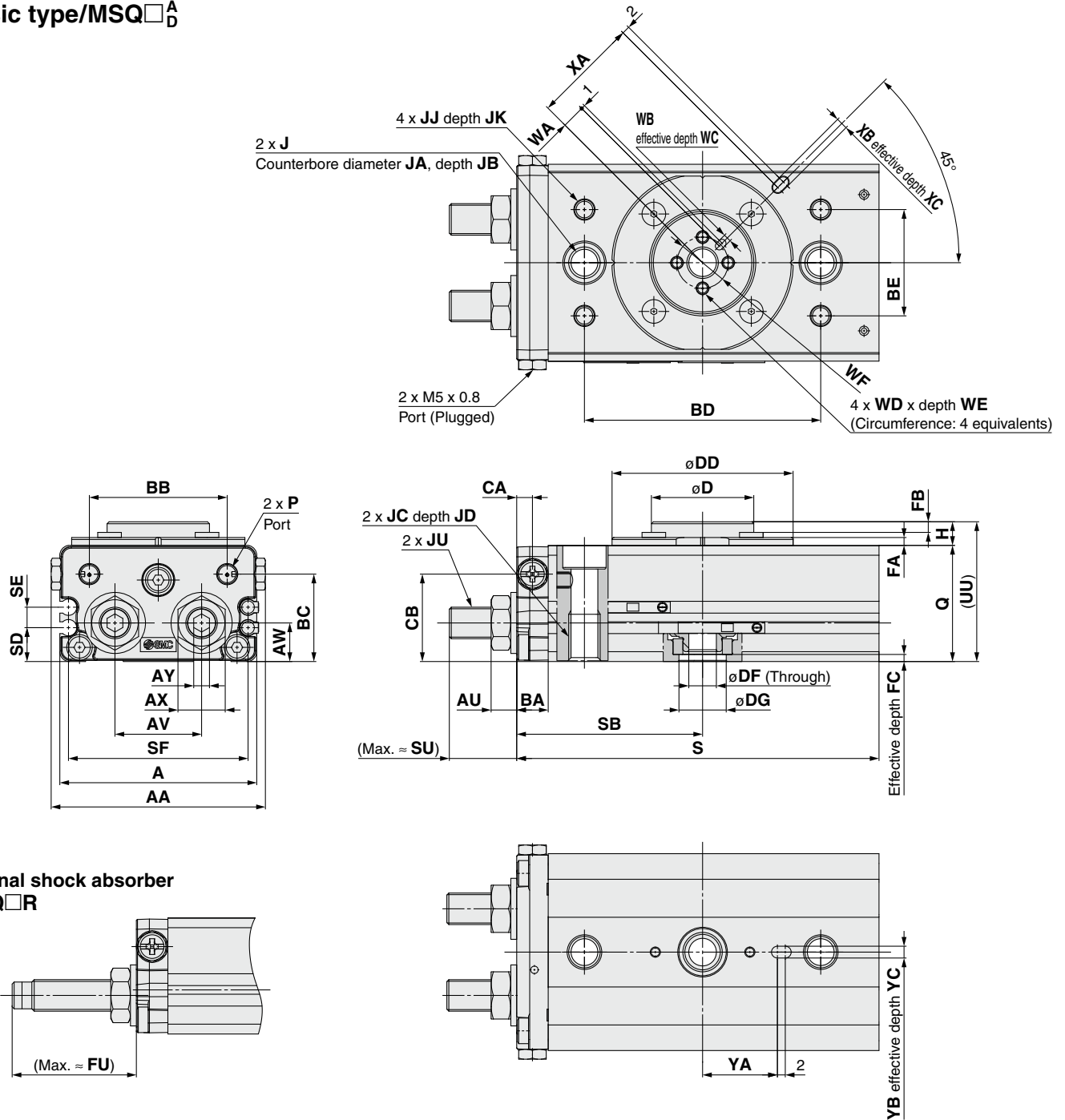
Two units are required for each product.

## ⚠ Caution

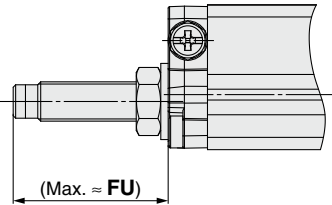
The piston material differs between the types with a cushion pad, a bumper, and an internal absorber. Do not install a shock absorber on a product with a cushion pad or bumper as this may damage the piston.

## Dimensions: Sizes 10, 20, 30, 50

### Basic type/MSQ□<sup>A</sup><sub>D</sub>



### Internal shock absorber MSQ□R



| Size | AA   | A  | AU  | AV   | AW   | AX | AY | BA | BB   | BC   | BD  | BE | CA | CB   | D    | DD   | DF | DG   | FA  | FB  | FC  | FU | H   | J    | JA | JB   | JC         | JD |
|------|------|----|-----|------|------|----|----|----|------|------|-----|----|----|------|------|------|----|------|-----|-----|-----|----|-----|------|----|------|------------|----|
| 10   | 54.4 | 50 | 6.6 | 22   | 9.8  | 12 | 4  | 8  | 35   | 22.2 | 60  | 27 | 4  | 22.2 | 26h9 | 46h9 | 7  | 12H9 | 2   | 2.7 | 1.3 | 32 | 6   | 6.8  | 11 | 6    | M8 x 1.25  | 12 |
| 20   | 69.4 | 65 | 7.6 | 30   | 11.1 | 14 | 5  | 10 | 50.2 | 23.6 | 76  | 34 | 5  | 23.6 | 36h9 | 61h9 | 12 | 20H9 | 4   | 2.5 | 1.3 | 36 | 8   | 8.6  | 14 | 8.5  | M10 x 1.5  | 15 |
| 30   | 74.4 | 70 | 7.6 | 36.5 | 13.8 | 14 | 5  | 12 | 49   | 30   | 84  | 37 | 6  | 31   | 41h9 | 67h9 | 13 | 20H9 | 4   | 2.5 | 2.3 | 34 | 8   | 8.6  | 14 | 8.5  | M10 x 1.5  | 15 |
| 50   | 84.4 | 80 | 10  | 42   | 17.5 | 19 | 6  | 12 | 62   | 35   | 100 | 50 | 6  | 35   | 46h9 | 77h9 | 14 | 21H9 | 4.5 | 2.5 | 2.7 | 54 | 8.5 | 10.5 | 18 | 10.5 | M12 x 1.75 | 18 |

| Size | JJ        | JK | JU        | P                   | Q    | S   | SB   | SD   | SE  | SF   | SU <sup>*1</sup> | UU   | WA   | WB  | WC  | WD       | WE | WF | XA | XB  | XC  | YA | YB  | YC  |
|------|-----------|----|-----------|---------------------|------|-----|------|------|-----|------|------------------|------|------|-----|-----|----------|----|----|----|-----|-----|----|-----|-----|
| 10   | M5 x 0.8  | 6  | M8 x 1    | M5 x 0.8            | 29.5 | 92  | 47.2 | 8.6  | 5.2 | 45.6 | 18               | 35.5 | 6    | 2H9 | 2.5 | M3 x 0.5 | 5  | 13 | 27 | 3H9 | 3.5 | 19 | 3H9 | 3.5 |
| 20   | M6 x 1    | 6  | M10 x 1   | M5 x 0.8            | 31   | 117 | 59.9 | 10.1 | 5.2 | 59.4 | 26               | 39   | 9.5  | 3H9 | 3.5 | M4 x 0.7 | 7  | 20 | 36 | 4H9 | 4.5 | 24 | 4H9 | 4.5 |
| 30   | M6 x 1    | 6  | M10 x 1   | Rc1/8 <sup>*2</sup> | 38   | 127 | 65.3 | 10.3 | 14  | 65   | 24               | 46   | 10.5 | 4H9 | 3.5 | M5 x 0.8 | 9  | 22 | 39 | 4H9 | 4.5 | 28 | 4H9 | 4.5 |
| 50   | M8 x 1.25 | 8  | M14 x 1.5 | Rc1/8 <sup>*2</sup> | 43   | 152 | 77.7 | 11.3 | 16  | 75   | 34               | 51.5 | 11.5 | 4H9 | 3.5 | M6 x 1   | 10 | 24 | 45 | 5H9 | 5.5 | 33 | 5H9 | 5.5 |

\*1 SU dimension is not the dimension at the time of shipment, since its dimension is for adjustment parts.

\*2 In addition to Rc1/8, G1/8, NPT1/8, and NPTF1/8 are also available.

# MSQ Series

## Made to Order

Please contact SMC for detailed dimensions, specifications, and delivery times.



### 1 With Interchangeable Table and Plate

Symbol  
-A, -B, -C

#### How to Order

Standard model no. - **A**

#### Made to order

|          |                                      |                                                                                                          |
|----------|--------------------------------------|----------------------------------------------------------------------------------------------------------|
| <b>A</b> | With interchangeable table and plate | * The interchangeable table and plate can be ordered separately. For details, refer to the tables below. |
| <b>B</b> | With interchangeable table           |                                                                                                          |
| <b>C</b> | With interchangeable plate           | * The interchangeable table and plate are assembled before shipment.                                     |

#### Part Nos. of Interchangeable Parts

##### Interchangeable A Unit (With Interchangeable Table and Plate)

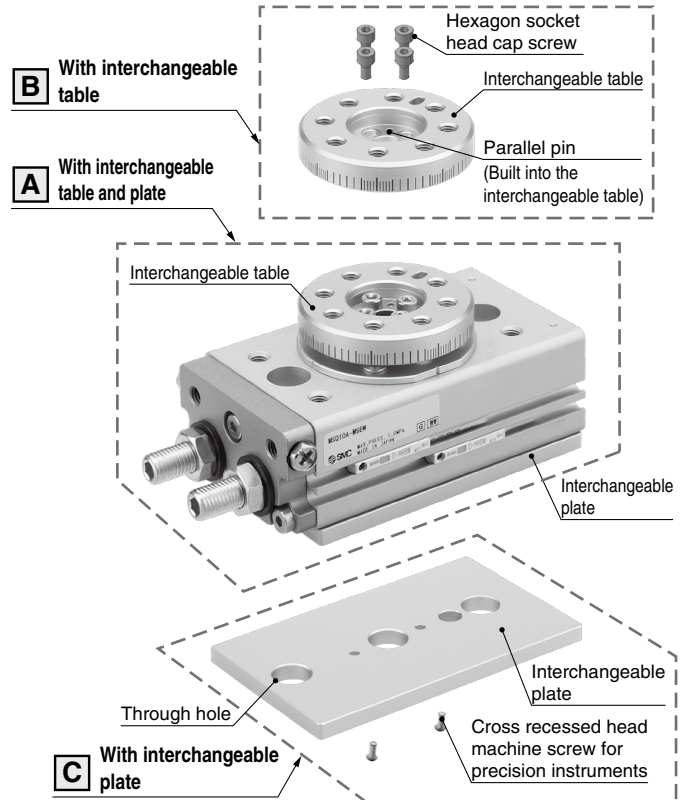
| Size | Part no.   | Contents<br>Description (Qty.)                                    |
|------|------------|-------------------------------------------------------------------|
| 10   | P891010-50 | • Interchangeable table (1)<br>• Parallel pin (1)                 |
| 20   | P891020-50 | • Hexagon socket head cap screw (4)                               |
| 30   | P891030-50 | • Interchangeable plate (1)                                       |
| 50   | P891040-50 | • Cross recessed head machine screw for precision instruments (2) |

##### Interchangeable B Unit (With Interchangeable Table)

| Size | Part no.   | Contents<br>Description (Qty.)      |
|------|------------|-------------------------------------|
| 10   | P891010-51 | • Interchangeable table (1)         |
| 20   | P891020-51 | • Parallel pin (1)                  |
| 30   | P891030-51 | • Hexagon socket head cap screw (4) |
| 50   | P891040-51 |                                     |

##### Interchangeable C Unit (With Interchangeable Plate)

| Size | Part no.   | Contents<br>Description (Qty.)                                    |
|------|------------|-------------------------------------------------------------------|
| 10   | P891010-52 | • Interchangeable plate (1)                                       |
| 20   | P891020-52 | • Cross recessed head machine screw for precision instruments (2) |
| 30   | P891030-52 |                                                                   |
| 50   | P891040-52 |                                                                   |



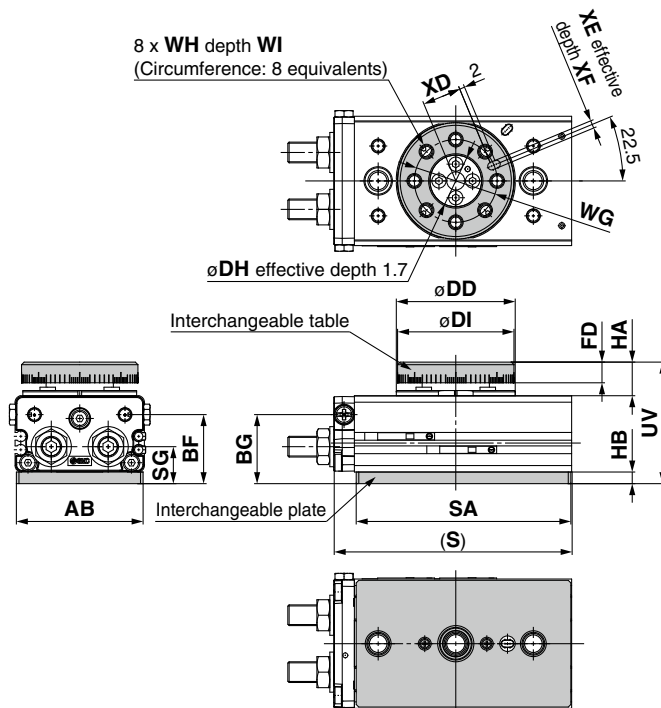
\* To position the product, use the knock pin holes on the body instead of the through holes that are empty in the interchangeable plate.

\* Refer to page 31 for the tightening torque of the interchangeable parts.

#### Dimensions

\* Mounting diagram of the interchangeable table and plate

Dimensions other than those shown below are the same as those of the basic type. Refer to page 20.



| Size | AB | SG   | BF   | BG   | DD   | DH   | DI   | FD   | HA | HB  |
|------|----|------|------|------|------|------|------|------|----|-----|
| 10   | 49 | 14.3 | 26.7 | 26.7 | 46h9 | 20H9 | 45h9 | 8    | 13 | 4.5 |
| 20   | 64 | 17.1 | 29.6 | 29.6 | 61h9 | 28H9 | 60h9 | 10   | 17 | 6   |
| 30   | 69 | 15.8 | 32   | 33   | 67h9 | 32H9 | 65h9 | 10   | 17 | 2   |
| 50   | 79 | 20.5 | 38   | 38   | 77h9 | 35H9 | 75h9 | 12.5 | 20 | 3   |

| Size | S   | SA  | UV | WG | WH        | WI   | XD   | XE  | XF  |
|------|-----|-----|----|----|-----------|------|------|-----|-----|
| 10   | 92  | 83  | 47 | 32 | M5 x 0.8  | 8    | 15   | 3H9 | 3.5 |
| 20   | 117 | 106 | 54 | 43 | M6 x 1    | 10   | 20.5 | 4H9 | 4.5 |
| 30   | 127 | 114 | 57 | 48 | M6 x 1    | 10   | 23   | 4H9 | 4.5 |
| 50   | 152 | 139 | 66 | 55 | M8 x 1.25 | 12.5 | 26.5 | 5H9 | 5.5 |

# Rotary Table/Rack & Pinion Type

# MSQ Series

With External Shock Absorber  
Size: 10, 20, 30, 50

## How to Order

MSQ 10 L 2 - M9BW - - -

Size

|    |
|----|
| 10 |
| 20 |
| 30 |
| 50 |

### Shock absorber type

|   |                                |
|---|--------------------------------|
| L | Shock absorber for low energy  |
| H | Shock absorber for high energy |

### Port location/Rotation

|   |                |      |
|---|----------------|------|
| 2 | Standard type  | 180° |
| 3 |                | 90°  |
| 4 | Symmetric type | 180° |
| 5 |                | 90°  |

Refer to the table to the right.

### Auto switch

|     |                                       |
|-----|---------------------------------------|
| Nil | Without auto switch (Built-in magnet) |
|-----|---------------------------------------|

\* For applicable auto switches, refer to the table below.

### Number of auto switches

|     |   |
|-----|---|
| Nil | 2 |
| S   | 1 |
| n   | n |

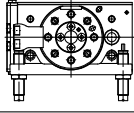
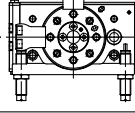
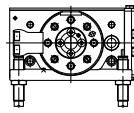
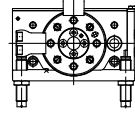
• Made to order  
For details, refer to page 23.

### Port type

| End port type | Size    |
|---------------|---------|
| Nil           | M5      |
| Nil           | Rc1/8   |
| -XF           | G1/8    |
| -XN           | NPT1/8  |
| -XT           | NPTF1/8 |

\* Side ports are all M5.  
For details, refer to the specifications on page 23.

### Port location/Rotation

|                          |                | Rotation                                                                                                        |                                                                                                                 |
|--------------------------|----------------|-----------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|
|                          |                | 180°                                                                                                            | 90°                                                                                                             |
| Connecting port position | Standard type  | 2: Standard type, 180°<br>  | 3: Standard type, 90°<br>  |
|                          | Symmetric type | 4: Symmetric type, 180°<br> | 5: Symmetric type, 90°<br> |

## Applicable Auto Switches/Refer to the Web Catalog for further information on auto switches.

| Type                    | Special function                          | Electrical entry | Indicator light | Wiring (Output) | Load voltage  |           |        | Auto switch model |                     | Lead wire length [m] |       |       |       | Pre-wired connector | Applicable load |            |
|-------------------------|-------------------------------------------|------------------|-----------------|-----------------|---------------|-----------|--------|-------------------|---------------------|----------------------|-------|-------|-------|---------------------|-----------------|------------|
|                         |                                           |                  |                 |                 | DC            |           | AC     | Perpendicular     | In-line             | 0.5 (Nil)            | 1 (M) | 3 (L) | 5 (Z) |                     |                 |            |
| Solid state auto switch | —                                         | Grommet          | Yes             | 3-wire (NPN)    | 24 V          | 5 V, 12 V | —      | M9NV              | M9N                 | ●                    | ●     | ●     | ○     | ○                   | IC circuit      | Relay, PLC |
|                         | Diagnostic indication (2-color indicator) |                  |                 | 3-wire (PNP)    |               | 12 V      |        | M9PV              | M9P                 | ●                    | ●     | ●     | ○     | ○                   |                 |            |
|                         |                                           |                  |                 | 2-wire          |               | 12 V      |        | M9BV              | M9B                 | ●                    | ●     | ●     | ○     | ○                   |                 |            |
|                         |                                           |                  |                 | 3-wire (NPN)    |               | 5 V, 12 V |        | M9N WV            | M9N W               | ●                    | ●     | ●     | ○     | ○                   | IC circuit      |            |
|                         |                                           |                  |                 | 3-wire (PNP)    |               | 12 V      |        | M9P WV            | M9P W               | ●                    | ●     | ●     | ○     | ○                   |                 |            |
|                         |                                           |                  |                 | 2-wire          |               | 12 V      |        | M9B WV            | M9B W               | ●                    | ●     | ●     | ○     | ○                   | —               |            |
|                         |                                           |                  |                 | 3-wire (NPN)    |               | 5 V, 12 V |        | M9NA V*1          | M9NA*1              | ○                    | ○     | ●     | ○     | ○                   | IC circuit      |            |
|                         | 3-wire (PNP)                              |                  |                 | 12 V            |               | M9PA V*1  |        | M9PA*1            | ○                   | ○                    | ●     | ○     | ○     |                     |                 |            |
|                         | 2-wire                                    |                  |                 | 12 V            |               | M9BA V*1  |        | M9BA*1            | ○                   | ○                    | ●     | ○     | ○     | —                   |                 |            |
|                         | Reed auto switch                          |                  |                 | —               |               | Grommet   |        | Yes               | 3-wire (NPN equiv.) | —                    | 5 V   | —     | A96V  | A96                 | ●               |            |
| 2-wire                  |                                           | 24 V             | 12 V            |                 | 100 V         |           | A93V*2 |                   | A93                 | ●                    | ●     | ●     | ●     | —                   | —               |            |
|                         |                                           |                  |                 |                 | 100 V or less |           | A90V   |                   | A90                 | ●                    | —     | ●     | —     | —                   | —               | IC circuit |

\*1 Although it is possible to mount water-resistant type auto switches, note that the rotary actuator itself is not of water-resistant construction.

\*2 The 1 m lead wire is only applicable to the D-A93.

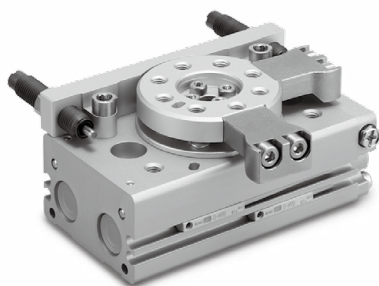
\* Lead wire length symbols: 0.5 m..... Nil (Example) M9NW  
1 m..... M (Example) M9NWM  
3 m..... L (Example) M9NWL  
5 m..... Z (Example) M9NWZ

\* Solid state auto switches marked with a "○" are produced upon receipt of order.

\* Refer to the **Web Catalog** for the details of solid state auto switch with pre-wired connector.

\* Auto switches are shipped together with the product but do not come assembled.





## Specifications

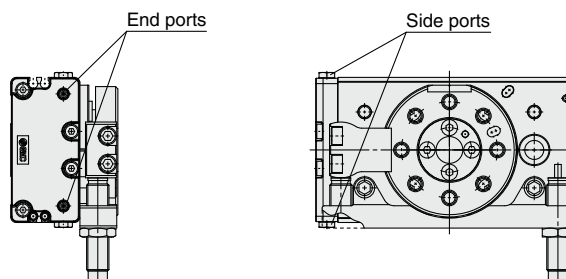
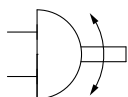
| Size                           |                 | 10                     | 20     | 30                           | 50     |
|--------------------------------|-----------------|------------------------|--------|------------------------------|--------|
| Fluid                          |                 | Air (Non-lube)         |        |                              |        |
| Max. operating pressure        |                 | 1 MPa                  |        |                              |        |
| Min. operating pressure        |                 | 0.2 MPa                |        |                              |        |
| Ambient and fluid temperatures |                 | 0 to 60°C(No freezing) |        |                              |        |
| Cushion                        |                 | Shock absorber         |        |                              |        |
| Shock absorber type            | For high energy | RB0805                 | RB1006 |                              | RB1411 |
|                                | For low energy  | RB0806                 | RB1007 |                              | RB1412 |
| Rotation                       |                 | 90°, 180°              |        |                              |        |
| Angle adjustment range*1       |                 | Each rotation end ±3°  |        |                              |        |
| Cylinder bore size             |                 | ø13                    | ø16    | ø20                          | ø22    |
| Port size                      | End port        | M5 x 0.8               |        | Rc1/8, G1/8, NPT1/8, NPTF1/8 |        |
|                                | Side port       | M5 x 0.8               |        |                              |        |

\*1 For details, refer to page 24.

The service life of the shock absorber may be different from the rotary table body depending on the operating conditions.

Refer to Specific Product Precautions for the suitable replacement period.

## Symbol



## Made to Order

(For details, refer to pages 27 and 28.)

| Symbol | Specifications             |
|--------|----------------------------|
| -C     | With interchangeable plate |
| -X232  | With external stopper      |

Refer to page 29 for models with auto switches.

· Auto Switch Proper Mounting Position  
(at Rotation End Detection)

## Allowable Kinetic Energy and Rotation Time Adjustment Range

| Size | Allowable kinetic energy [J]*1 |                                | Adjustable range of rotation time safe in operation [s/90°] |
|------|--------------------------------|--------------------------------|-------------------------------------------------------------|
|      | Shock absorber for low energy  | Shock absorber for high energy |                                                             |
| 10   | 0.161                          | 0.231                          | 0.2 to 2.0*2                                                |
| 20   | 0.574                          | 1.060                          |                                                             |
| 30   | 0.805                          | 1.210                          |                                                             |
| 50   | 1.310                          | 1.820                          |                                                             |

\*1 If operated so that the kinetic energy exceeds the allowable value, damage to the internal parts or product failure may result. Please pay special attention to the kinetic energy levels when designing and during operation to avoid exceeding the allowable limit.

\*2 Values above indicate the time between the start of rotation and the deceleration caused by the shock absorber. Although the time required by the rotary table to reach the rotation end after deceleration differs depending on the operating conditions (inertial moment of the load, rotation speed, and operating pressure), approximately 0.2 to 2 seconds are required. The range of angles within which the shock absorber operates is between the rotation end and the values shown below.

| Size            | 10   | 20   | 30   | 50    |
|-----------------|------|------|------|-------|
| For low energy  | 7.3° | 7.1° | 6.4° | 9.6°  |
| For high energy | 8.8° | 8.3° | 7.5° | 10.5° |

## Weight

| Size       |      | 10  | 20  | 30   | 50   |
|------------|------|-----|-----|------|------|
| Basic type | 90°  | 480 | 910 | 1205 | 2000 |
|            | 180° | 455 | 860 | 1145 | 1880 |

\*1 The values above do not include the auto switch weight.

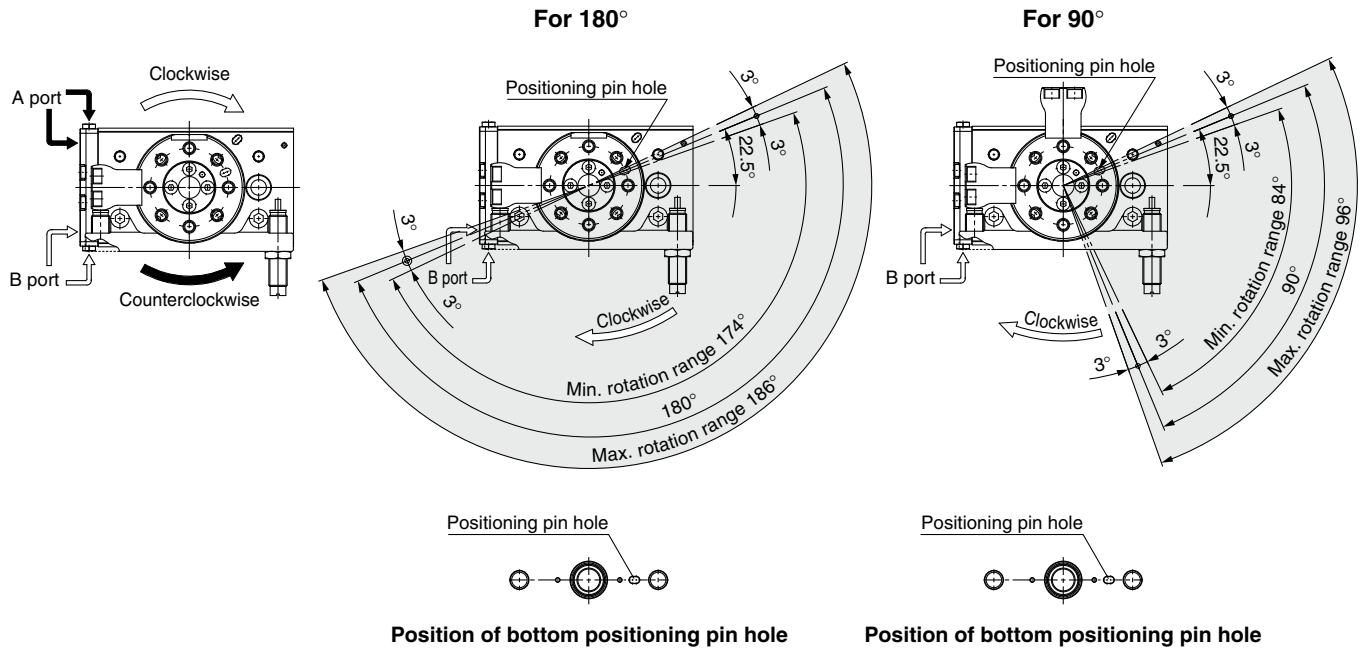
\*2 For made-to-order options, add the weight in the table below to the weight of the base model.

| Size                       | 10 | 20  | 30 | 50 |
|----------------------------|----|-----|----|----|
| With interchangeable plate | 40 | 100 | 40 | 90 |

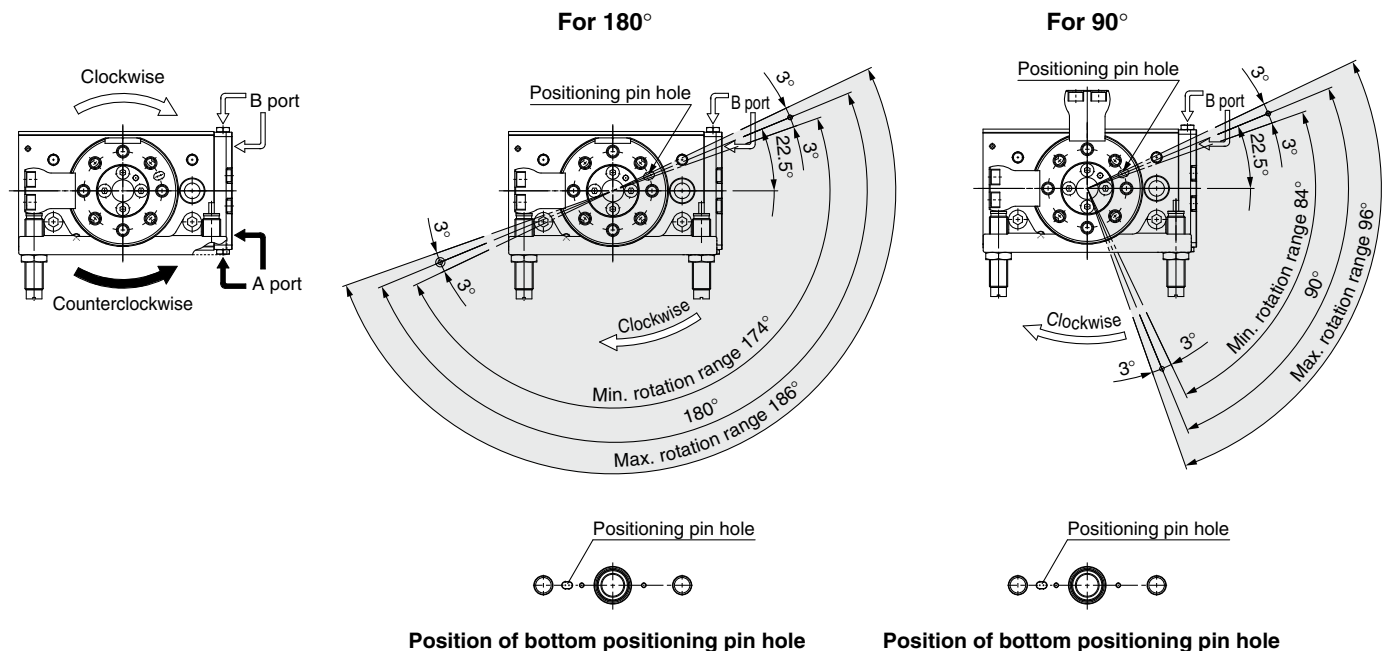
## Rotation Direction and Rotating Angle

- The rotary table turns in the counterclockwise direction when the A port is pressurized, and in the clockwise direction when the B port is pressurized.
- By adjusting the shock absorber, the rotation end can be set within the range shown in the drawing.

### Standard type



### Symmetric type



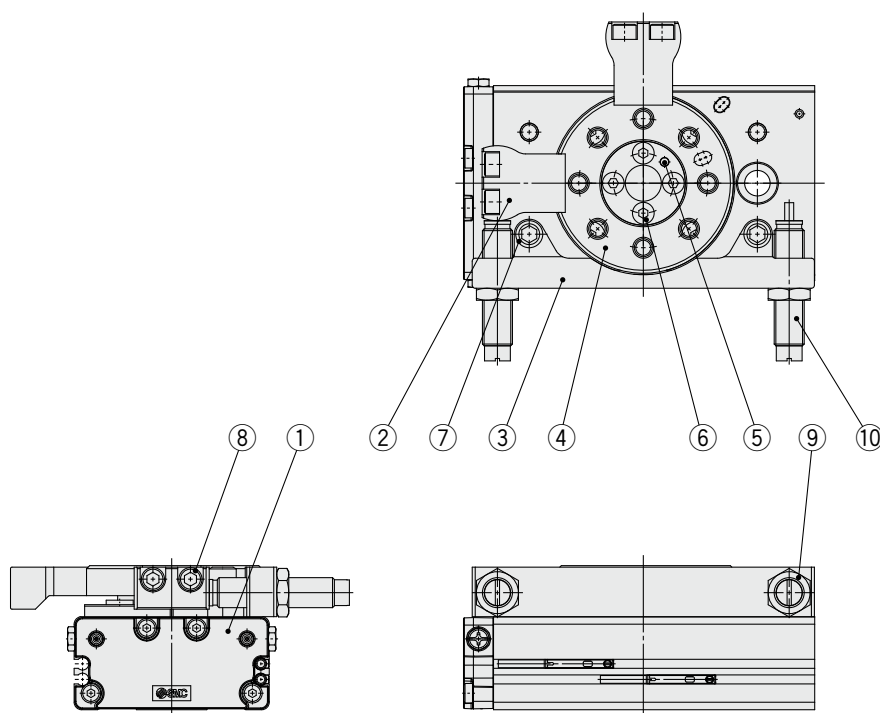
### With external shock absorber

| Size | Adjustment angle per rotation of angle adjustment screw |
|------|---------------------------------------------------------|
| 10   | 1.5°                                                    |
| 20   | 1.2°                                                    |
| 30   | 1.1°                                                    |
| 50   | 1.3°                                                    |

The rotation adjustment range for the external shock absorber is  $\pm 3^\circ$  at each rotation end. When adjusted beyond this range, note that the shock absorber's durability may decrease.

- \* · The drawings show the rotation range for the top positioning pin hole of the table.
- The pin hole position in the drawing shows the counterclockwise rotation end when the shock absorbers are tightened equally and the rotation is adjusted to 180° and 90°.

## Construction



## Component Parts

| No. | Description                       | Material                | Note           |
|-----|-----------------------------------|-------------------------|----------------|
| 1   | End cover                         | Aluminium alloy         | Painted        |
| 2   | Arm                               | Chrome molybdenum steel | Nickel plating |
| 3   | Shock absorber holder             | Aluminium alloy         | Anodized       |
| 4   | Table for external shock absorber | Aluminium alloy         | Anodized       |
| 5   | Parallel pin                      | Carbon steel            |                |
| 6   | Hexagon socket head cap screw     | Stainless steel         |                |
| 7   | Hexagon socket head cap screw     | Stainless steel         |                |
| 8   | Hexagon socket head cap screw     | Stainless steel         |                |
| 9   | Hexagon nut                       | Steel wire              |                |
| 10  | Shock absorber                    | —                       |                |

\* The component parts cannot be shipped individually.

## Replacement Parts/Seal Kit

| Size | Part no.   | Contents                                                   |
|------|------------|------------------------------------------------------------|
|      |            | Description (Qty.)                                         |
| 10   | P891010-10 | ⑨ Gasket (1)*1<br>⑫ Wear ring (4)*1<br>⑬ Piston seal (4)*1 |
| 20   | P891020-10 |                                                            |
| 30   | P891030-10 |                                                            |
| 50   | P891040-10 |                                                            |

A grease pack (10 g) is included. Order with the following part number when only the grease pack is needed.

**Grease pack part number: GR-L-010 (10 g)**

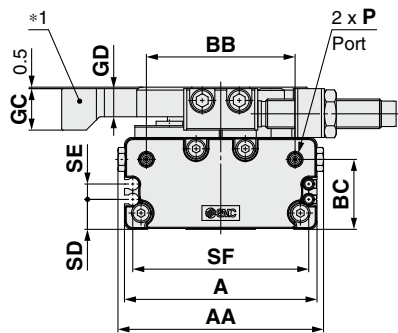
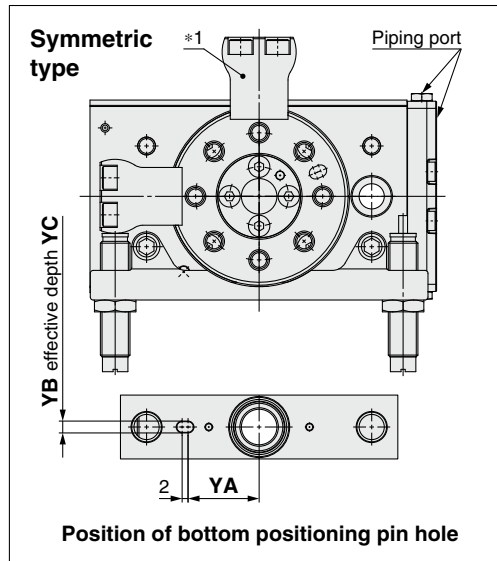
\*1 Parts ⑨, ⑫, and ⑬ are the component part numbers shown in the construction on page 19.

## Shock absorber (With external shock absorber)

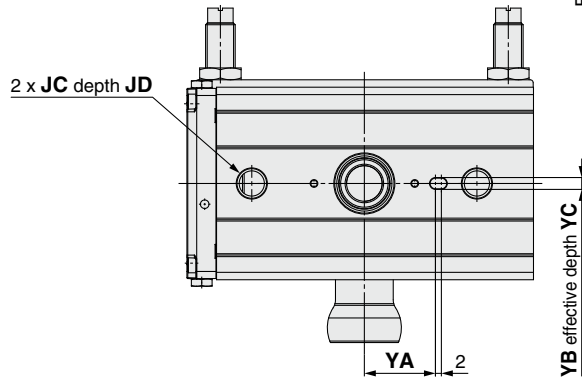
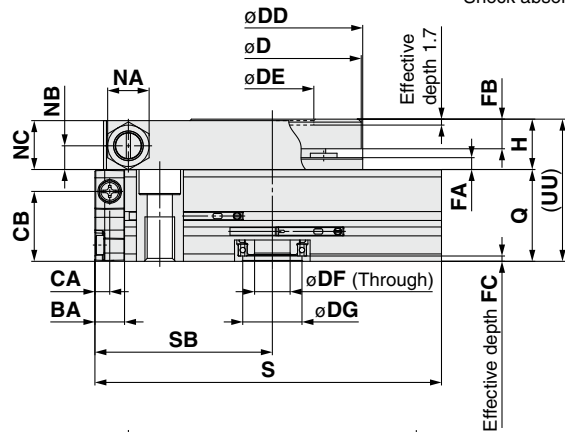
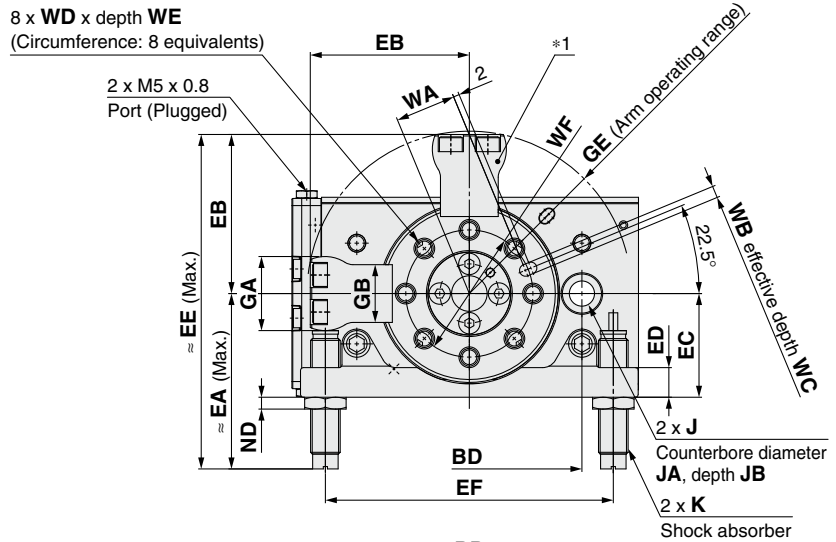
| Size | Part no.        | Shock absorber model |
|------|-----------------|----------------------|
| 10   | For low energy  | RB0805               |
|      | For high energy | RB0806               |
| 20   | For low energy  | RB1006               |
|      | For high energy | RB1007               |
| 30   | For low energy  | RB1006               |
|      | For high energy | RB1007               |
| 50   | For low energy  | RB1411               |
|      | For high energy | RB1412               |

## Dimensions: With External Shock Absorber Sizes 10, 20, 30, 50

### Basic type/MSQ $\square_L$ $\square_H$



\*1 This part is not available with 180° specification.



| Size | AA   | A  | BA | BB   | BC   | BD  | CA | CB   | D  | DD | DE   | DF | DG   | EA*1 | EB   | EC   | ED | EE*1  | EF    | FA  | FB   | FC  | GA | GB   | GC | GD   | GE   | H  | J    |
|------|------|----|----|------|------|-----|----|------|----|----|------|----|------|------|------|------|----|-------|-------|-----|------|-----|----|------|----|------|------|----|------|
| 10   | 54.4 | 50 | 8  | 35   | 22.2 | 60  | 4  | 22.2 | 45 | 46 | 20H9 | 7  | 12H9 | 52.9 | 43.3 | 27.5 | 8  | 96.2  | 78.2  | 2   | 8    | 1.3 | 20 | 15.6 | 11 | 7.5  | 44.3 | 13 | 6.8  |
| 20   | 69.4 | 65 | 10 | 50.2 | 23.6 | 76  | 5  | 23.6 | 60 | 61 | 28H9 | 12 | 20H9 | 61.8 | 53.7 | 35   | 10 | 115.5 | 97.2  | 4   | 10   | 1.3 | 25 | 19.5 | 14 | 9.5  | 54.9 | 17 | 8.6  |
| 30   | 74.4 | 70 | 12 | 49   | 30   | 84  | 6  | 31   | 65 | 67 | 32H9 | 13 | 20H9 | 63.1 | 58.6 | 38.5 | 12 | 121.7 | 106.4 | 4   | 10   | 2.3 | 27 | 21.5 | 14 | 9.5  | 59.9 | 17 | 8.6  |
| 50   | 84.4 | 80 | 12 | 62   | 35   | 100 | 6  | 35   | 75 | 77 | 35H9 | 14 | 21H9 | 86.8 | 71.4 | 46   | 12 | 158.2 | 129.6 | 4.5 | 12.5 | 2.7 | 32 | 28   | 18 | 11.5 | 73   | 20 | 10.5 |

| Size | JA | JB   | JC         | JD | K         | NA | NB  | NC   | ND | P        | Q    | S   | SB   | SD   | SE  | SF   | UU   | WA   | WB  | WC  | WD        | WE   | WF | YA | YB  | YC  |
|------|----|------|------------|----|-----------|----|-----|------|----|----------|------|-----|------|------|-----|------|------|------|-----|-----|-----------|------|----|----|-----|-----|
| 10   | 11 | 6    | M8 x 1.25  | 12 | M8 x 1    | 10 | 5.5 | 12.5 | 4  | M5 x 0.8 | 29.5 | 92  | 47.2 | 8.6  | 5.2 | 45.6 | 42.5 | 15   | 3H9 | 3.5 | M5 x 0.8  | 8    | 32 | 19 | 3H9 | 3.5 |
| 20   | 14 | 8.5  | M10 x 1.5  | 15 | M10 x 1   | 14 | 8   | 16.5 | 4  | M5 x 0.8 | 31   | 117 | 59.9 | 10.1 | 5.2 | 59.4 | 48   | 20.5 | 4H9 | 4.5 | M6 x 1    | 10   | 43 | 24 | 4H9 | 4.5 |
| 30   | 14 | 8.5  | M10 x 1.5  | 15 | M10 x 1   | 14 | 8   | 16.5 | 4  | Rc1/8*2  | 38   | 127 | 65.3 | 10.3 | 14  | 65   | 55   | 23   | 4H9 | 4.5 | M6 x 1    | 10   | 48 | 28 | 4H9 | 4.5 |
| 50   | 18 | 10.5 | M12 x 1.75 | 18 | M14 x 1.5 | 17 | 8.5 | 19.5 | 6  | Rc1/8*2  | 43   | 152 | 77.7 | 11.3 | 16  | 75   | 63   | 26.5 | 5H9 | 5.5 | M8 x 1.25 | 12.5 | 55 | 33 | 5H9 | 5.5 |

\*1 EA dimension is not the dimension at the time of shipment, since its dimension is for adjustment parts.

\*2 In addition to Rc1/8, G1/8, NPT1/8, and NPTF1/8 are also available.

# MSQ Series

## Made to Order

Please contact SMC for detailed dimensions, specifications, and delivery times.



### 1 With Interchangeable Plate

Symbol

-C

#### How to Order

Standard model no.

- C

● Made to order

C With interchangeable plate

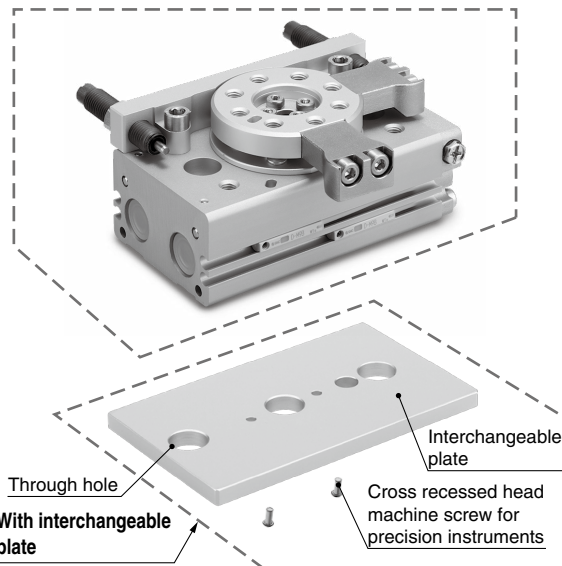
- \* The interchangeable plate can be ordered separately. For details, refer to the tables below.
- \* The interchangeable plate is assembled before shipment.

#### Part Nos. of Interchangeable Parts

##### Interchangeable C Unit (With Interchangeable Plate)

| Size | Part no.   | Contents<br>Description (Qty.)                                  |
|------|------------|-----------------------------------------------------------------|
| 10   | P891010-52 | Interchangeable table (1)                                       |
| 20   | P891020-52 | Cross recessed head machine screw for precision instruments (2) |
| 30   | P891030-52 |                                                                 |
| 50   | P891040-52 |                                                                 |

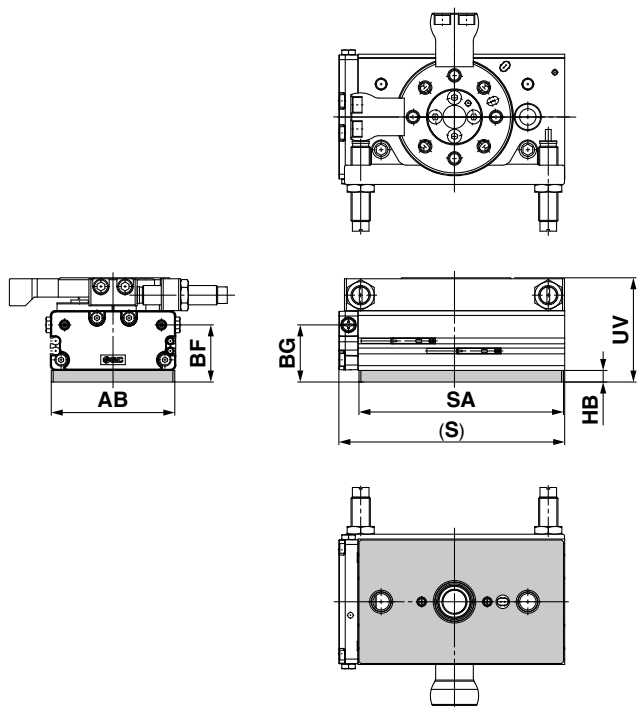
\* Refer to page 31 for the tightening torque of the interchangeable parts.



\* To position the product, use the knock pin holes on the body instead of the through holes that are empty in the interchangeable plate.

#### Dimensions

\* Mounting diagram of the interchangeable plate  
Dimensions other than those shown below are the same as those of the basic type. Refer to page 26.



| Size | AB | BF   | BG   | HB  | S   | SA  | UV |
|------|----|------|------|-----|-----|-----|----|
| 10   | 49 | 26.7 | 26.7 | 4.5 | 92  | 83  | 47 |
| 20   | 64 | 29.6 | 29.6 | 6   | 117 | 106 | 54 |
| 30   | 69 | 32   | 33   | 2   | 127 | 114 | 57 |
| 50   | 79 | 38   | 38   | 3   | 152 | 139 | 66 |

[mm]



# MSQ Series

## Made to Order

Please contact SMC for detailed dimensions, specifications, and delivery times.



### 2 With External Stopper

Symbol  
**-X232**

By reducing the effective stroke of the shock absorber, the absorption time will be reduced, enabling the cycle time to be improved.

### How to Order

**MSQ 10 L 2 - M9BW - C - X232**

Size

|    |
|----|
| 10 |
| 20 |
| 30 |
| 50 |

Shock absorber type

|   |                                |
|---|--------------------------------|
| L | Shock absorber for low energy  |
| H | Shock absorber for high energy |

Port location/Rotation

|   |                |      |
|---|----------------|------|
| 2 | Standard type  | 180° |
| 3 |                | 90°  |
| 4 | Symmetric type | 180° |
| 5 |                | 90°  |

Auto Switch

\* Refer to page 29 for auto switch.

With external stopper

Interchangeable plate

|     |                               |
|-----|-------------------------------|
| Nil | Without interchangeable plate |
| C   | With interchangeable plate    |

Port type

| End port type | Size    |
|---------------|---------|
| Nil           | M5      |
| Nil           | Rc1/8   |
| -XF           | G1/8    |
| -XN           | NPT1/8  |
| -XT           | NPTF1/8 |

\* Side ports are all M5.  
For details, refer to the specifications on page 23.

Number of auto switches

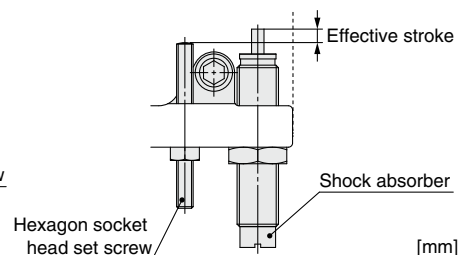
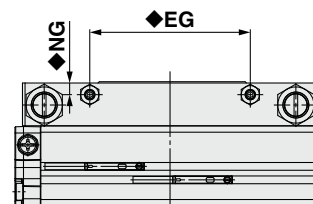
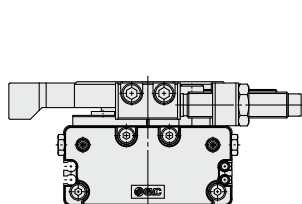
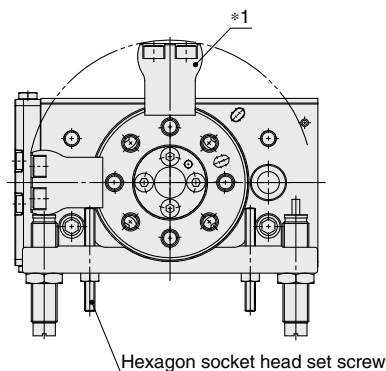
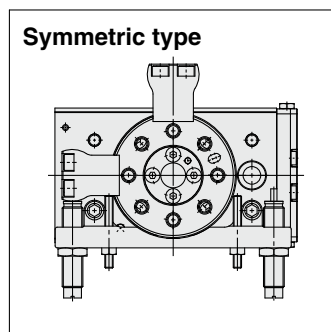
|     |   |
|-----|---|
| Nil | 2 |
| S   | 1 |
| n   | n |

### Specifications

| Size | Allowable kinetic energy [J]  |                                |
|------|-------------------------------|--------------------------------|
|      | Shock absorber for low energy | Shock absorber for high energy |
| 10   | 0.161                         | 0.231                          |
| 20   | 0.574                         | 1.060                          |
| 30   | 0.805                         | 1.210                          |
| 50   | 1.310                         | 1.820                          |

- \* The allowable kinetic energy indicated in the table is the value for the case where the full stroke of the shock absorber is used. Note that if the effective stroke of the shock absorber is shortened using the hexagon socket head set screw, the allowable energy will be lower than the value in the table.
- \* If you wish to adjust the stroke of the shock absorber in order to reduce the cycle time, first set the shock absorber to the position where the shock absorber is to be used in the full stroke, then while observing the operating condition of the product, gradually adjust the stroke in the direction such that the effective stroke decreases.
- \* The shock absorber is a consumable part. If there are signs, such as the bounding of the shock absorber at the motion end point, that the energy absorption performance of the shock absorber has deteriorated, readjust the position of the shock absorber so as to increase its effective stroke. If bounding still occurs even when the full stroke is used, it is necessary to replace the shock absorber with a new one.

### Dimensions



| Size | EG   | NG  |
|------|------|-----|
| 10   | 47.4 | 4.5 |
| 20   | 62   | 4.5 |
| 30   | 67.6 | 4.8 |
| 50   | 80   | 7   |

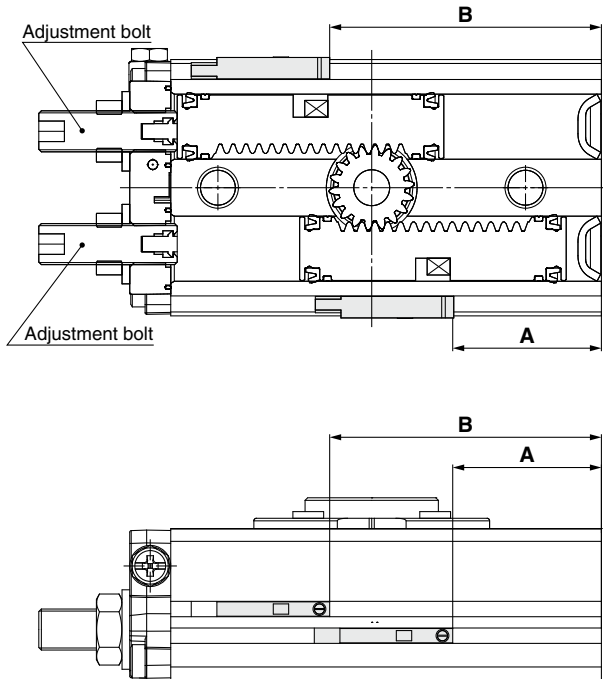
\* Dimensions other than the above are the same as standard.

\*1 This part is not available with 180° specification.

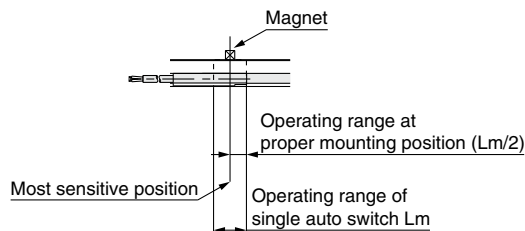
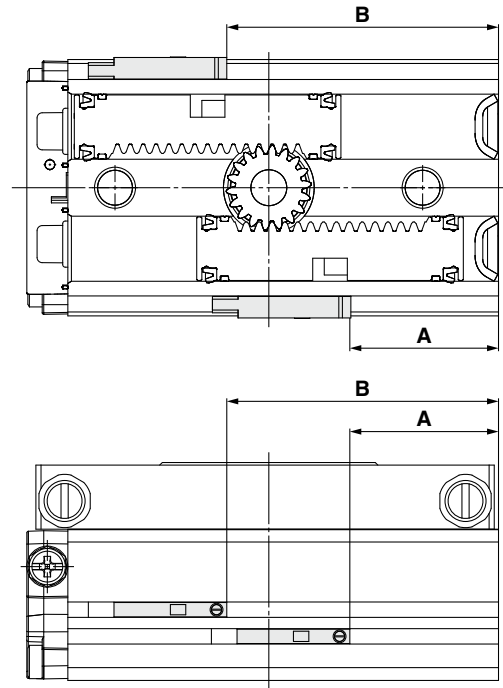
# MSQ Series Auto Switch Mounting

## Auto Switch Proper Mounting Position (at Rotation End Detection): Basic Type, With External Shock Absorber

### Basic Type



### With External Shock Absorber



[mm]

| Size | Rotating angle | Solid state auto switch<br>D-M9□(V), D-M9□W(V) |          |                               |                  | Reed auto switch<br>D-A9□, D-A9□V |          |                               |                  |
|------|----------------|------------------------------------------------|----------|-------------------------------|------------------|-----------------------------------|----------|-------------------------------|------------------|
|      |                | A                                              | B        | Operating angle<br>$\theta$ m | Hysteresis angle | A                                 | B        | Operating angle<br>$\theta$ m | Hysteresis angle |
| 10   | 180°           | 26 to 29                                       | 49 to 51 | 27°                           | 3°               | 22 to 25                          | 45 to 47 | 50°                           | 4°               |
| 20   | 180°           | 34 to 37                                       | 66 to 68 | 21°                           | 2°               | 30 to 33                          | 62 to 64 | 42°                           | 4°               |
| 30   | 180°           | 39 to 41                                       | 70 to 73 | 24°                           | 2°               | 35 to 37                          | 66 to 69 | 44°                           | 4°               |
| 50   | 180°           | 46 to 48                                       | 88 to 91 | 19°                           | 2°               | 42 to 44                          | 84 to 87 | 31°                           | 3°               |

Operating angle  $\theta$  m: Value of the operating range Lm of a single auto switch converted to an axial rotating angle

Hysteresis angle : Value of auto switch hysteresis converted to an angle

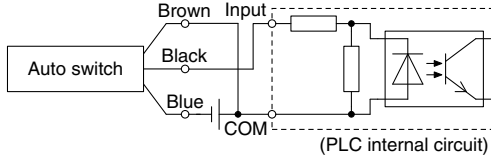
- \* Since the values in the table above are provided as a guideline only, they cannot be guaranteed. Adjust the auto switch after confirming the operating conditions in the actual setting.
- The values in the table above are the positions when the adjustment bolts (shock absorbers) are tightened in the same amount and adjusted to 180°.
- For the tightening torque of the set screw of the auto switch, refer to the operation manual of each auto switch.

# Prior to Use

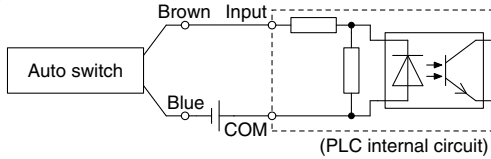
## Auto Switch Connections and Examples

### Sink Input Specifications

#### 3-wire, NPN

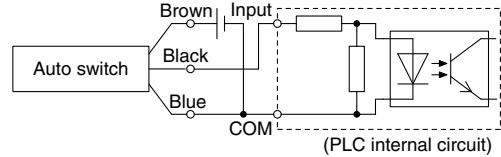


#### 2-wire

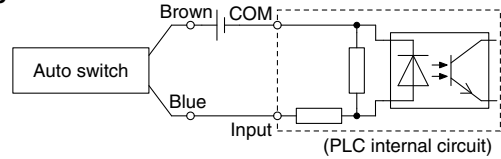


### Source Input Specifications

#### 3-wire, PNP



#### 2-wire

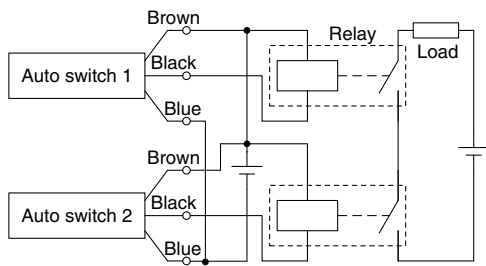


Connect according to the applicable PLC input specifications, as the connection method will vary depending on the PLC input specifications.

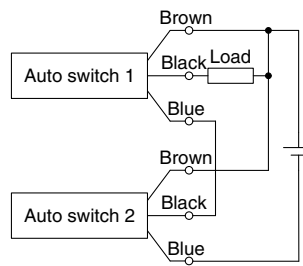
### Examples of AND (Series) and OR (Parallel) Connections

\* When using solid state auto switches, ensure the application is set up so the signals for the first 50 ms are invalid. Depending on the operating environment, the product may not operate properly.

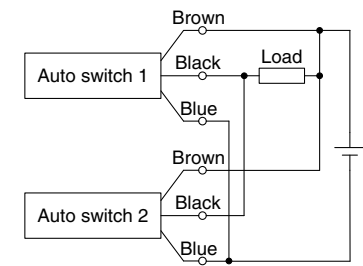
#### 3-wire AND connection for NPN output (Using relays)



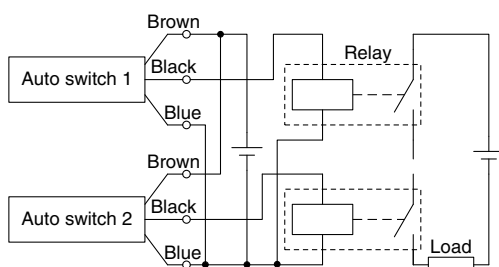
#### (Performed with auto switches only)



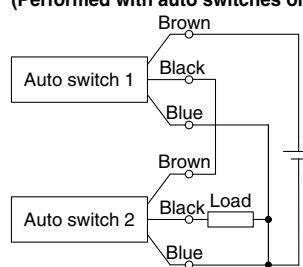
#### 3-wire OR connection for NPN output



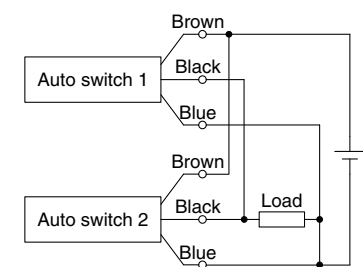
#### 3-wire AND connection for PNP output (Using relays)



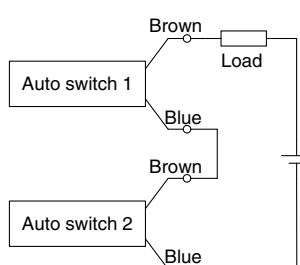
#### (Performed with auto switches only)



#### 3-wire OR connection for PNP output



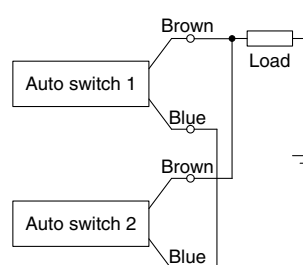
#### 2-wire AND connection



When two auto switches are connected in series, a load may malfunction because the load voltage will decline when in the ON state. The indicator lights will light up when both of the auto switches are in the ON state. Auto switches with a load voltage less than 20 V cannot be used. Please contact SMC if using AND connection for a heat-resistant solid state auto switch or a trimmer switch.

Example) Load voltage at ON  
Power supply voltage: 24 VDC  
Internal voltage drop: 4 V  
Load voltage at ON = Power supply voltage – Internal voltage drop x 2 pcs.  
= 24 V – 4 V x 2 pcs.  
= 16 V

#### 2-wire OR connection



Example) Load voltage at OFF  
Leakage current: 1 mA  
Load impedance: 3 kΩ  
Load voltage at OFF = Leakage current x 2 pcs. x Load impedance  
= 1 mA x 2 pcs. x 3 kΩ  
= 6 V

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

(Reed)  
Because there is no current leakage, the load voltage will not increase when turned OFF. However, depending on the number of auto switches in the ON state, the indicator lights may sometimes grow dim or not light up, due to the dispersion and reduction of the current flowing to the auto switches.



# MSQ Series

## Specific Product Precautions 1

Be sure to read this before handling the products. Refer to the back cover for safety instructions. For rotary actuator and auto switch precautions, refer to the “Handling Precautions for SMC Products” and the “Operation Manual” on the SMC website: <https://www.smcworld.com>

### Speed Adjustment

#### ⚠ Warning

1. To make a speed adjustment, gradually adjust starting from the low-speed end.

If the speed adjustment is performed from the high-speed end, damage to the product may result. This could pose a hazard to humans or damage the machinery and equipment.

#### ⚠ Caution

1. When operating at a high speed with a large load, a large amount of energy is applied to the actuator, which can result in damage. Calculate the appropriate operation time by referencing the model selection procedure on page 5.
2. Do not machine the fixed orifice of the port to enlarge its size. If the fixed orifice size is enlarged, the actuator operating speed and impact force will increase, resulting in damage.
3. When using the product at the max. speed (around 0.2 s/90°), set the supply pressure to 0.3 MPa or more.

### Lubrication

#### ⚠ Caution

1. Use the product without lubrication.

This product is lubricated with grease at the factory, and further lubrication will result in a failure to meet the product's specifications.

### Effective Torque

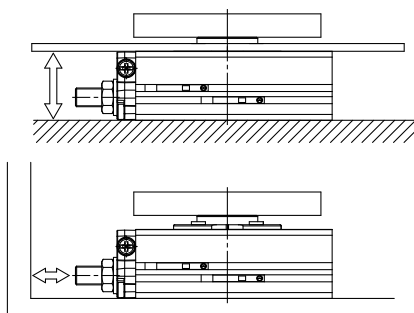
#### ⚠ Caution

1. The effective torque at the end of the rotation is half the effective torque generated during rotation. This is because one of the pistons of the double rack mechanism determines the angle by coming into contact with an adjustment bolt or shock absorber at the rotating end. (Excludes the external shock absorber option)

### Rotating Angle Adjustment

#### ⚠ Caution

1. As a standard feature, the rotary table is equipped with an angle adjustment mechanism (adjustment bolt or shock absorber) that can be used to adjust the rotating angle. Refer to the following pages for the rotation direction and rotating angle.  
MSQ10 to 50 → p. 18  
External shock absorber → p. 24
2. It might be difficult to adjust the angle using a tool due to the installation location of the product.  
If a special tool is required, refer to the operation manual.



### Rotating Angle Adjustment

#### ⚠ Caution

3. Consider the full compression force when adjusting the rotating angle with bumper specifications.

You can use the bumper without fully compressing it, but if you need accuracy at the rotating end, consider the following methods:

1. Use at a min. operating pressure of 0.3 MPa or higher.
2. Use an external stopper (shock absorber) separate from this product.

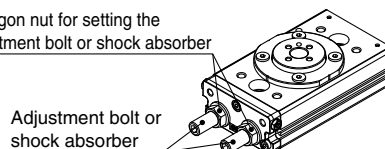
The table below shows the angle at which the piston hits the bumper and compresses it completely. Note that the angle should only be used as a guide.

| Size | Angle |
|------|-------|
| 10   | 16°   |
| 20   | 12°   |
| 30   | 12°   |
| 50   | 15°   |

### Tightening Torque

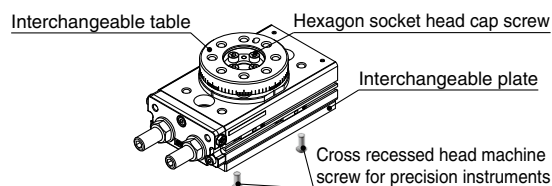
1. Tighten the adjustment bolt or the hexagon nut for setting the shock absorber with the tightening torque shown in the table below.

Hexagon nut for setting the adjustment bolt or shock absorber



| Size | Proper tightening torque [N·m] |
|------|--------------------------------|
| 10   | 1.00 to 1.67                   |
| 20   | 1.88 to 3.14                   |
| 30   |                                |
| 50   | 6.48 to 10.8                   |

2. Tighten the screw for setting the interchangeable table and plate with the tightening torque shown in the table below.



| Size | Proper tightening torque [N·m]          |                                         |
|------|-----------------------------------------|-----------------------------------------|
|      | Screw for setting interchangeable table | Screw for setting interchangeable plate |
| 10   | 1.1 to 3.1                              | 0.4 to 0.5                              |
| 20   | 2.9 to 4.9                              |                                         |
| 30   | 4.9 to 6.9                              |                                         |
| 50   | 7.4 to 9.8                              |                                         |

\* Refer to the operation manual for assembly procedures.

### Kinetic Energy Absorption

#### ⚠ Caution

1. This product has 3 types of cushion: a cushion pad, a bumper, and a shock absorber. They are not meant to achieve a smooth stopping operation but to absorb the load's kinetic energy and prevent damage to the product. If the load has to be stopped smoothly, a shock absorber of the optimum size meeting the operating requirements must be installed externally.



# MSQ Series

## Specific Product Precautions 2

Be sure to read this before handling the products. Refer to the back cover for safety instructions. For rotary actuator and auto switch precautions, refer to the “Handling Precautions for SMC Products” and the “Operation Manual” on the SMC website: <https://www.smcworld.com>

### Mounting

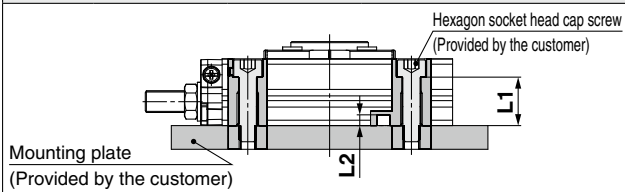
#### ⚠ Caution

1. When mounting the body, use screws of the appropriate length.

##### • Basic type

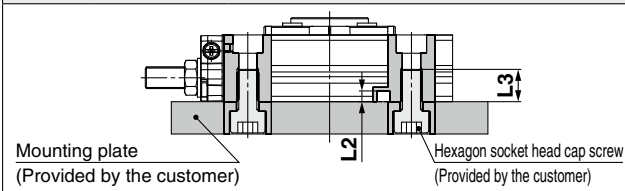


#### 1. Top mounting (Through hole)



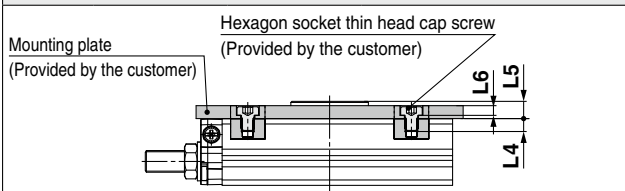
| Size | L1        |             | L2       |                      |
|------|-----------|-------------|----------|----------------------|
|      | Screw     | Length [mm] | Pin [mm] | Effective depth [mm] |
| 10   | M6 x 1    | 23.5        | ø3       | 3.5                  |
| 20   | M8 x 1.25 | 22.5        | ø4       | 4.5                  |
| 30   | M8 x 1.25 | 29.5        | ø4       | 4.5                  |
| 50   | M10 x 1.5 | 32.5        | ø5       | 5.5                  |

#### 2. Bottom mounting (Body tapped)



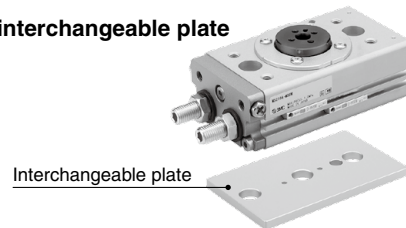
| Size | L2       |                      | L3         |                          |
|------|----------|----------------------|------------|--------------------------|
|      | Pin [mm] | Effective depth [mm] | Screw      | Max. screw-in depth [mm] |
| 10   | ø3       | 3.5                  | M8 x 1.25  | 12                       |
| 20   | ø4       | 4.5                  | M10 x 1.5  | 15                       |
| 30   | ø4       | 4.5                  | M10 x 1.5  | 15                       |
| 50   | ø5       | 5.5                  | M12 x 1.75 | 18                       |

#### 3. Top mounting (Body tapped)

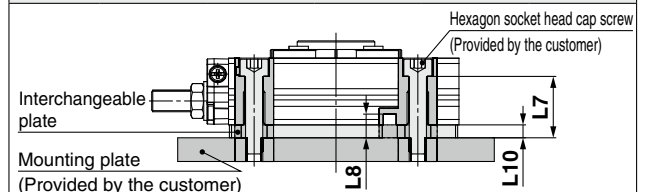


| Size | L4        |                          | L5          | L6                     |
|------|-----------|--------------------------|-------------|------------------------|
|      | Screw     | Max. screw-in depth [mm] | Height [mm] | Counterbore depth [mm] |
| 10   | M5 x 0.8  | 6                        | 6           | 3.9                    |
| 20   | M6 x 1    | 6                        | 8           | 4.5                    |
| 30   | M6 x 1    | 6                        | 8           | 4.5                    |
| 50   | M8 x 1.25 | 8                        | 8.5         | 5.6                    |

##### • With interchangeable plate



#### 4. Top mounting (Through hole)

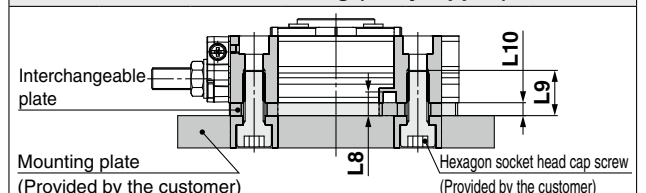


| Size | L7        |             | L8       |              | L10                  |
|------|-----------|-------------|----------|--------------|----------------------|
|      | Screw     | Length [mm] | Pin [mm] | Depth*1 [mm] | Plate thickness [mm] |
| 10   | M6 x 1    | 28          | ø3       | 8            | 4.5                  |
| 20   | M8 x 1.25 | 28.5        | ø4       | 10.5         | 6                    |
| 30   | M8 x 1.25 | 31.5        | ø4       | 6.5          | 2                    |
| 50   | M10 x 1.5 | 35.5        | ø5       | 8.5          | 3                    |

\*1 The effective depth of the pin is the depth found by subtracting the plate thickness (L10) from the L8 depth.

\* Refer to page 31 for the tightening torque of the interchangeable parts.

#### 5. Bottom mounting (Body tapped)



| Size | L8       |              | L9         |                          | L10                  |
|------|----------|--------------|------------|--------------------------|----------------------|
|      | Pin [mm] | Depth*1 [mm] | Screw      | Max. screw-in depth [mm] | Plate thickness [mm] |
| 10   | ø3       | 8            | M8 x 1.25  | 16.5                     | 4.5                  |
| 20   | ø4       | 10.5         | M10 x 1.5  | 21                       | 6                    |
| 30   | ø4       | 6.5          | M10 x 1.5  | 17                       | 2                    |
| 50   | ø5       | 8.5          | M12 x 1.75 | 21                       | 3                    |

\*1 The effective depth of the pin is the depth found by subtracting the plate thickness (L10) from the L8 depth.

\* Refer to page 31 for the tightening torque of the interchangeable parts.



## MSQ Series

# Specific Product Precautions 3

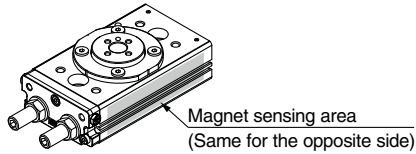
Be sure to read this before handling the products. Refer to the back cover for safety instructions. For rotary actuator and auto switch precautions, refer to the “Handling Precautions for SMC Products” and the “Operation Manual” on the SMC website: <https://www.smcworld.com>

### Mounting

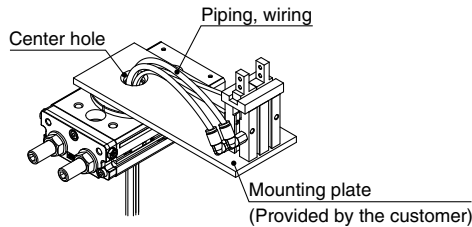
#### ⚠ Caution

1. Keep away from objects which are influenced by magnets.

Since this product has a built-in magnet, do not allow close contact with magnetic disks, cards, or tapes. Data may be erased.



2. When using the center hole for piping, take care that the tube O.D., auto switch lead wire, etc., do not contact the mounting plate.

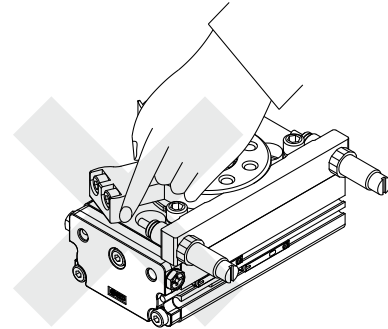


### External Shock Absorber

#### ⚠ Warning

1. Never place your hands or fingers between the arm and the shock absorber.

Be very careful to prevent your hands or fingers from getting caught in the gap between the arm and the shock absorber when air is applied.



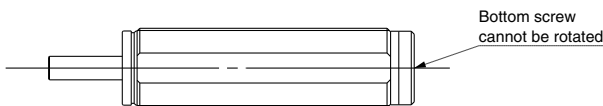
#### ⚠ Caution

Abrasion powder may be generated from the part where the shock absorber collides with the arm. Do not use the product in a place where abrasion powder may affect adversely.

### Shock Absorber

#### ⚠ Caution

1. Never rotate the bottom screw of the shock absorber. (It is not an adjustment screw.) Failure to do so may result in oil leakage.



### Service Life and Replacement Period of Shock Absorber

#### ⚠ Caution

1. Shock absorbers are consumable parts.

When a decrease in energy absorption capacity is noticed, it must be replaced. Allowable operation time under the specifications set in this catalog is 1 million.

\* Specified service life (suitable replacement period) is the value at room temperature (20 to 25°C). The period may vary depending on the temperature and other conditions. In some cases, the absorber may need to be replaced before the allowable operation time above.



## 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.

 **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.

\*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 10218-1: Manipulating industrial robots – Safety.  
etc.

### 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.

### 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 regulations 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.

### Revision History

|           |                                                     |    |
|-----------|-----------------------------------------------------|----|
| Edition B | * A bumper (cushion) has been added.                | JP |
| Edition C | * An external shock absorber option has been added. | AT |

 **Safety Instructions** Be sure to read the “Handling Precautions for SMC Products” (M-E03-3) and “Operation Manual” before use.

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and any obligation on the part of the manufacturer.

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