CAT.ES20-92 E

SMC

Rotary Table/ Rack-and-Pinion Type

Series MSQ now includes smaller sizes 1, 2, 3 and 7.

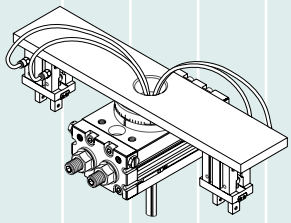
Series MSQ

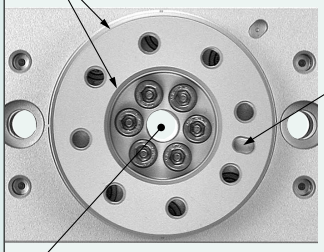
Size: 1, 2, 3, 7, 10, 20, 30, 50, 70, 100, 200

Compact rotary table

Easy mounting of work piece.

- **Table I.D/O.D tolerances**
  Basic type: **MSQB** **H9/h9**
  High precision type: **MSQA** **H8/h8**
- **Positioning pin hole**
- **Hollow axis**
  Accommodates wiring and piping for equipment mounted on the table





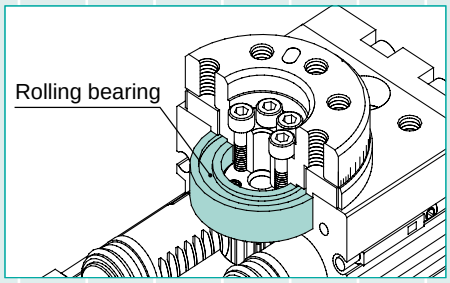
Hollow axis

Size	1	2	3	7
Hollow axis	ø3.5	ø3.8	ø5	ø6

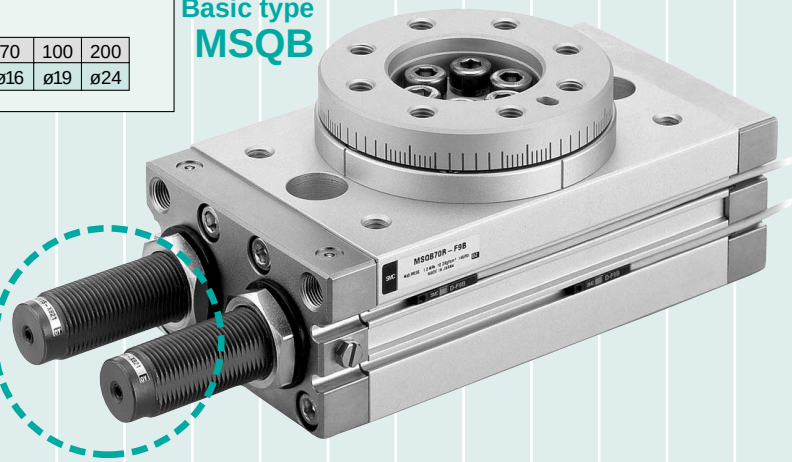
Size	10	20	30	50	70	100	200
Hollow axis	ø5	ø9	ø9	ø10	ø16	ø19	ø24

Large rolling element bearing

3 to 4 times higher axial load
(compared with series CRQ)



Basic type
MSQB



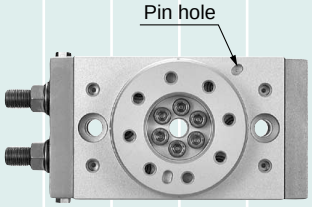
Pivoting angle adjustment range: 0 to 190°

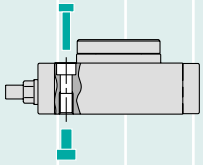
With internal shock absorber

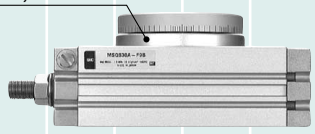
2 to 5 times more kinetic energy
(compared with an adjustment bolt)

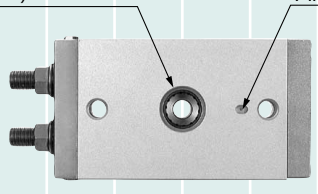
Easy mounting of body

- **Reference dia: Boss, Hole**
- **Mounting from 2 directions**
- **Positioning pin hole**

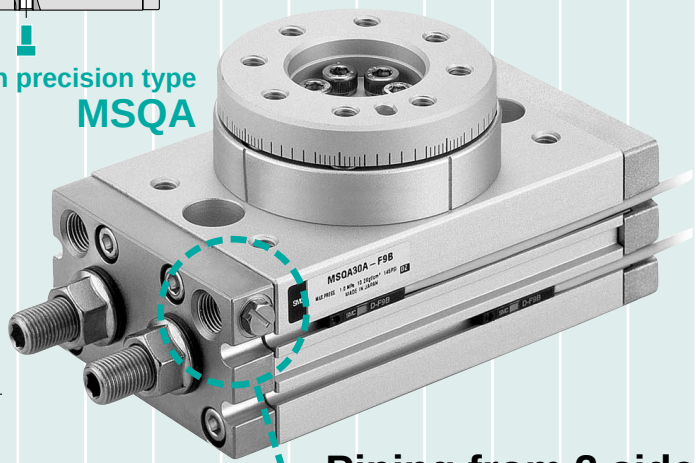






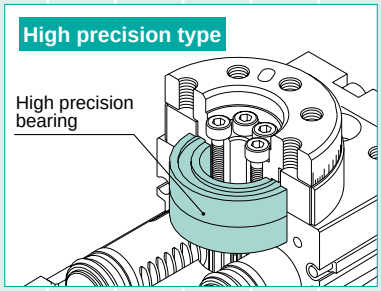


High precision type
MSQA



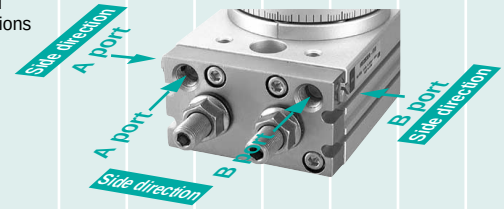
Movement in direction of table's radial thrust: 0.01mm or less

By using a combination of angular ball bearings the movement in the direction of table's radial thrust is reduced.



Piping from 2 sides is possible

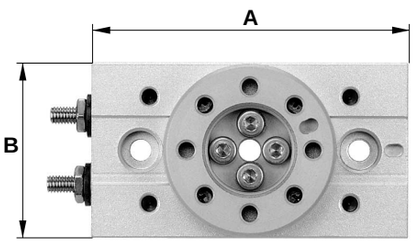
Piping position can be selected accommodate mounting conditions



SMC

New Small sizes 1, 2, 3, and 7 are newly introduced to the series!

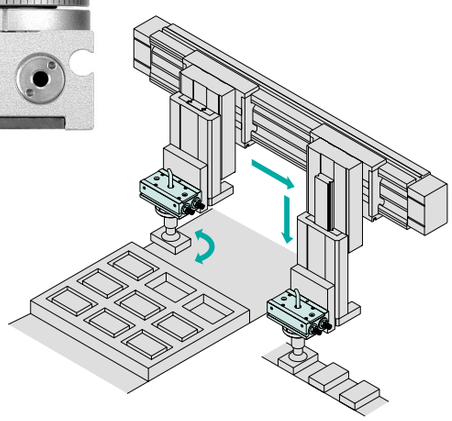
Small size and light weight



Full size (Picture of MSQB1A)

Measure mm

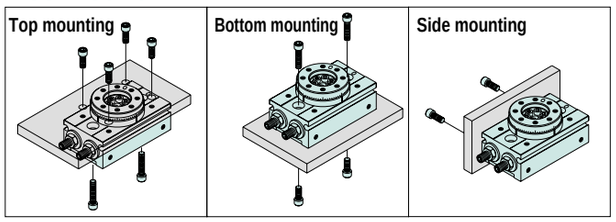
Size	Model	A	B	C	D	Mass (g)
1	MSQB1A	50.5	28	25	16	70
2	MSQB2A	56	30	28	18	105
3	MSQB3A	60	34.5	30.5	20.5	150
7	MSQB7A	73.5	41	34.5	23	250



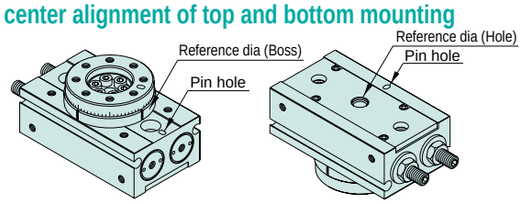
Excellent mounting and piping options

The reduction of footprint with compact body and space saving wiring and piping allow a space saving installation!

Free mount

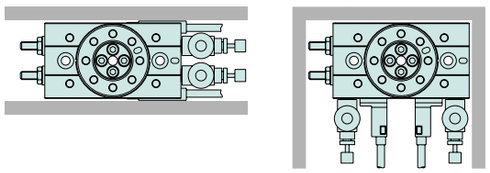


Easy center alignment of top and bottom mounting

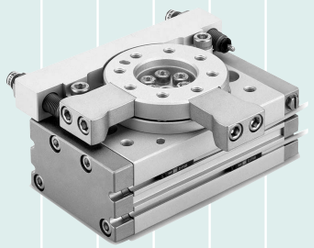


Wiring and piping can be selected according to mounting conditions

Example of auto switch and speed controller mounting



External shock absorber types are newly introduced to the series!

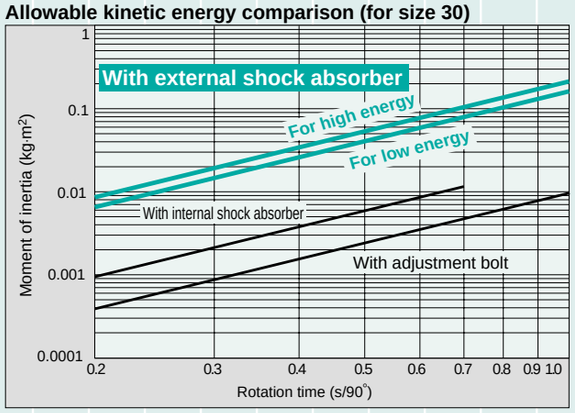


4 to 10 times more allowable kinetic energy

(Compared with internal shock absorber type)

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

Allowable kinetic energy comparison (for size 30)



Total length shortened

Longitudinal mounting space is reduced because there is no protrusion from adjustment bolts or internal shock absorbers.

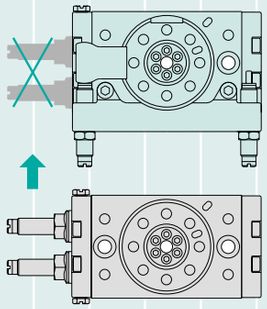
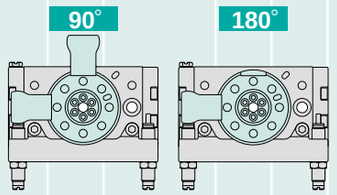
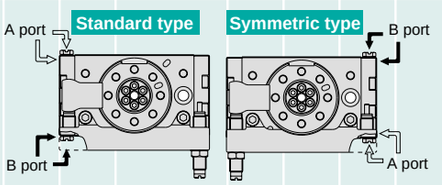


Table height is the same for both types with adjustment bolts or internal shock absorbers.

Rotation angle: 90°, 180°



Left / Right symmetric type



Series MSQ
Model Selection

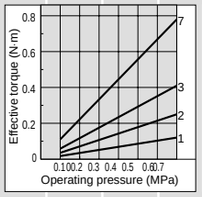
11 sizes of MSQ series now available!

Size	Standard MSQB			High precision MSQA		
	With adjustment bolt	With internal shock absorber	With external shock absorber	With adjustment bolt	With internal shock absorber	With external shock absorber
1	●	—	—	—	—	—
2	●	—	—	—	—	—
3	●	—	—	—	—	—
7	●	—	—	—	—	—
10	●	●	●	●	●	●
20	●	●	●	●	●	●
30	●	●	●	●	●	●
50	●	●	●	●	●	●
70	●	●	—	—	—	—
100	●	●	—	—	—	—
200	●	●	—	—	—	—
Note) Clean series	●	●	—	●	●	—

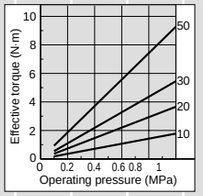
Note) Only sizes 10, 20, 30 and 50 are available in clean series.

Effective torque

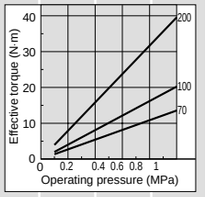
Size: 1 to 7



Size: 10 to 50



Size: 70 to 200



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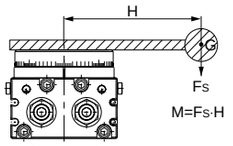
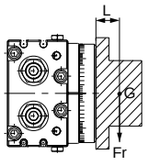
Model selection Procedure

1 Operating conditions

Enumerate the operating conditions according to the mounting position.

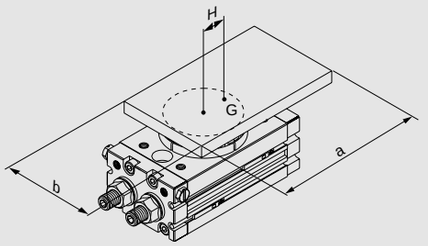




Formulae/Data

- Model used
- Operating pressure
- Mounting orientation
- Load type
  - Ts (N·m)
  - Tf (N·m)
  - Ta (N·m)
- Load configuration
- Rotation time t (s)
- Rotation angle
- Load mass m (kg)
- Distance between central axis and center of gravity H (mm)
- Mass point distance L (mm)

Selection Examples



Rotary table: MSQB50A, Pressure: 0.5MPa
Mounting orientation: Vertical
Load type: Inertial load Ta
Load configuration: 100 mm x 60 mm (Rectangular plate)
Rotation time t: 0.3s, Rotation angle: 90°
Load mass m: 0.4kg
Distance between central axis and center of gravity H: 40mm

2 Required torque

Confirm the type of load as shown below, and select an actuator that satisfies the required torque.
- Static load: Ts
- Resistance load: Tf **Load types**
- Inertial load: Ta

Formulae/Data

Effective torque ≥ Ts
Effective torque ≥ (3 to 5) · Tf
Effective torque ≥10 · Ta
Effective torque

Selection Examples

Inertial load
$10 \times Ta = 10 \times I \times \dot{\omega}$
$= 10 \times 0.00109 \times (2 \times (\pi / 2) / 0.3^2)$
$= 0.380 N{\cdot}m$ < Effective torque OK
Note) I substitutes for ⑤ the value for inertial moment.

3 Rotation time

Confirm that it is within the adjustable range of rotation time.

Formulae/Data

0.2 to 1.0s / 90°

Selection Examples

0.3s / 90° OK

4 Allowable load

Confirm that the radial load, thrust load and moment are within the allowable ranges.

Formulae/Data

Thrust load: m x 9.8 ≤ Allowable load
Moment: m x 9.8 x H ≤ Allowable moment
Allowable load

Selection Examples

0.4 x 9.8 = 3.92N < Allowable load OK
0.4 x 9.8 x 0.04 = 0.157N·m
0.157N·m < Allowable moment OK

5 Inertial moment

Find the load's inertial moment "I" for the energy calculation.

Formulae/Data

$I = m \times (a^2 + b^2) / 12 + m \times H^2$
Inertial moment

Selection Examples

$I = 0.4 \times (0.10^2 + 0.06^2) / 12 + 0.4 \times 0.04^2$
$= 0.00109 kg{\cdot}m^2$

6 Kinetic energy

Confirm that the load's kinetic energy is within the allowable value.

Formulae/Data

$1/2 \times I \times \omega^2 \leq$ allowable energy
$\omega = 2\theta / t$ (ω: Terminal angular velocity)
θ: Rotation angle (rad)
t: Rotation time (s)
Allowable kinetic energy/Rotation time

Selection Examples

$1/2 \times 0.00109 \times (2 \times (\pi / 2) / 0.3)^2$
$= 0.060J$ < Allowable energy OK

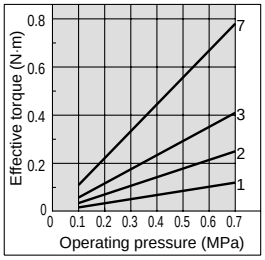
Effective Torque

Unit: N·m

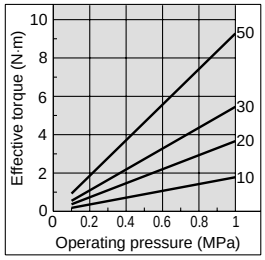
Size	Operating pressure (MPa)									
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
1	0.017	0.035	0.052	0.070	0.087	0.10	0.12	–	–	–
2	0.035	0.071	0.11	0.14	0.18	0.21	0.25	–	–	–
3	0.058	0.12	0.17	0.23	0.29	0.35	0.41	–	–	–
7	0.11	0.22	0.33	0.45	0.56	0.67	0.78	–	–	–
10	0.18	0.36	0.53	0.71	0.89	1.07	1.25	1.42	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
70	1.36	2.72	4.07	5.43	6.79	8.15	9.50	10.9	12.2	13.6
100	2.03	4.05	6.08	8.11	10.1	12.2	14.2	16.2	18.2	20.3
200	3.96	7.92	11.9	15.8	19.8	23.8	27.7	31.7	35.6	39.6

Note) Effective torque values are representative values and not to be considered as guaranteed values. Use them as a guide.

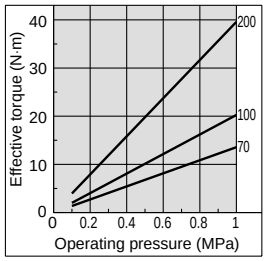
Size: 1 to 7



Size: 10 to 50

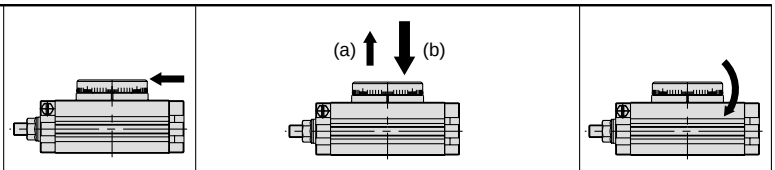


Size: 70 to 200



Allowable Load

Do not allow the load and moment applied to the table to exceed the allowable values shown in the table below.
(Operation beyond the allowable values can cause adverse effects on service life, such as play in the table and loss of accuracy.)



Size	Allowable radial load (N)		Allowable thrust load (N)				Allowable moment (N·m)	
			(a)		(b)			
	Basic type	High precision type	Basic type	High precision type	Basic type	High precision type	Basic type	High precision type
1	31	–	41	–	41	–	0.56	–
2	32		45		45		0.82	
3	33		48		48		1.1	
7	54		71		71		1.5	
10	78	86	74	74	78	107	2.4	2.9
20	147	166	137	137	137	197	4.0	4.8
30	196	233	197	197	363	398	5.3	6.4
50	314	378	296	296	451	517	9.7	12.0
70	333	–	296	–	476	–	12.0	–
100	390		493		708		18.0	
200	543		740		1009		25.0	

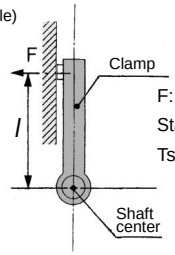
Load types

●Static load: Ts

A load as represented by the clamp which requires pressing force only

(During examination if it is decided to consider the mass of the clamp itself in the drawing below, it should be regarded as an inertial load.)

(Example)



F: Pressing force (N)

Static torque calculation

Ts = F x *l* (N·m)

●Resistance load: Tf

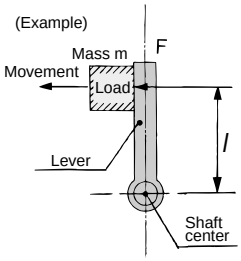
A load that is affected by external forces such as friction or gravity

Since the object is to move the load, and speed adjustment is necessary, allow an extra margin of 3 to 5 times in the effective torque.

∗Actuator effective torque ≥ (3 to 5) Tf

(During examination if it is decided to consider the mass of the lever itself in the drawing below, it should be regarded as an inertial load.)

(Example)



Friction coefficient μ

F = μ mg

Static torque calculation

Tf = F x *l* (N·m)

g = 9.8m/s²

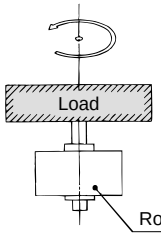
●Inertial load: Ta

The load which must be rotated by the actuator

Since the object is to rotate the load, and speed adjustment is necessary, allow an extra margin of 10 times or more in the effective torque.

∗Actuator effective torque ≥ S · Ta
(S is 10 times or more)

Accelerating torque calculation



Ta = I · $\dot{\omega}$ (N·m)

I: Inertial moment

Refer to page 3.

$\dot{\omega}$: Angular acceleration

$\dot{\omega} = \frac{2\theta}{t^2}$ (rad/s²)

θ: Rotation angle (rad)

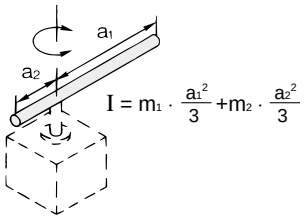
t: Rotation time (s)

Inertial Moment Formulae (Calculation of Inertial Moment I)

I: Inertial moment kg·m² m: Load mass kg

①Thin shaft

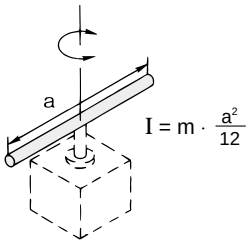
Position of rotational axis: Perpendicular to the shaft through one end



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

②Thin shaft

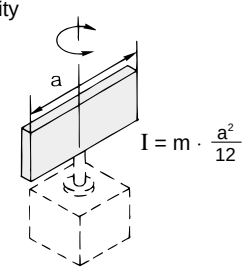
Position of rotational axis: Through the shaft's center of gravity



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

③Thin rectangular plate (Rectangular parallelopiped)

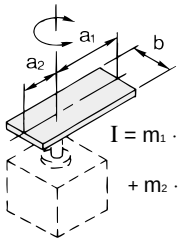
Position of rotational axis: Through the plate's center of gravity



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

④Thin rectangular plate (Rectangular parallelopiped)

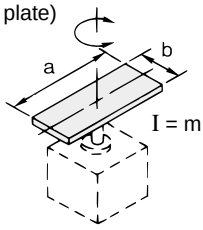
Position of rotational axis: Perpendicular to the plate through one of its points (also the same in case of a thicker plate)



$$I = m_1 \cdot \frac{4a_1^2 + b^2}{12} + m_2 \cdot \frac{4a_2^2 + b^2}{12}$$

⑤Thin rectangular plate (Rectangular parallelopiped)

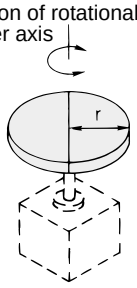
Position of rotational axis: Through the center of gravity and perpendicular to the plate (also the same in case of a thicker plate)



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

⑥Cylinder (Including thin round plate)

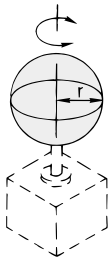
Position of rotational axis: Center axis



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

⑦Solid sphere

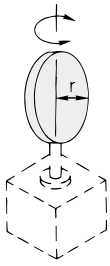
Position of rotational axis: Diameter



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

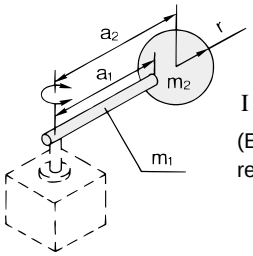
⑧Thin round plate

Position of rotational axis: Diameter



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

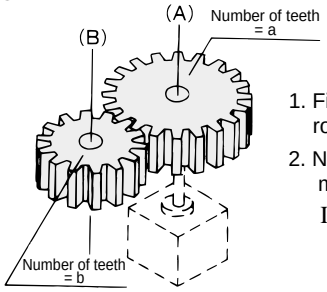
⑨Load at lever end



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

(Example) When shape of m_2 is a sphere, refer to 7, and $K = m_2 \cdot \frac{2r^2}{5}$

⑩Gear transmission



1. Find the inertial moment I_B for the rotation of shaft (B).
2. Next, I_B is entered to find I_A the inertial moment for the rotation of shaft (A) as $I_A = (\frac{a}{b})^2 \cdot I_B$

Kinetic Energy/Rotation Time

Even in cases where the torque required for rotation of the load is small, damage to internal parts may result from the inertial force of the load.
Select models giving consideration to the load's inertial moment and rotation time during operation.
(The inertial moment and rotation time charts can be used for your convenience in making model selections.)

①Allowable kinetic energy and rotation time adjustment range

From the table below, set the rotation time within the adjustment range for stable operation. Note that operation exceeding the rotation time adjustment range, may lead to sticking or stopping of operation.

Size	Allowable kinetic energy (mJ)				Rotation time adjustment range for stable operation s/90°		
	With adjustment bolt	With internal shock absorber	With external shock absorber		With adjustment bolt	With internal shock absorber	With external shock absorber
			For low energy	For high energy			
1	1	–	–	–	0.2 to 0.7	–	–
2	1.5						
3	2						
7	6				0.2 to 1.0	0.2 to 0.7	0.2 to 1.0 Note)
10	7	39	161	231			
20	25	116	574	1060			
30	48	116	805	1210			
50	81	294	1310	1820			
70	240	1100	–	–	0.2 to 1.5	0.2 to 1.0	–
100	320	1600			0.2 to 2.0		
200	560	2900			0.2 to 2.5		

Note) Refer to the note regarding the rotation time adjustment range on page 22.

②Inertial moment calculation

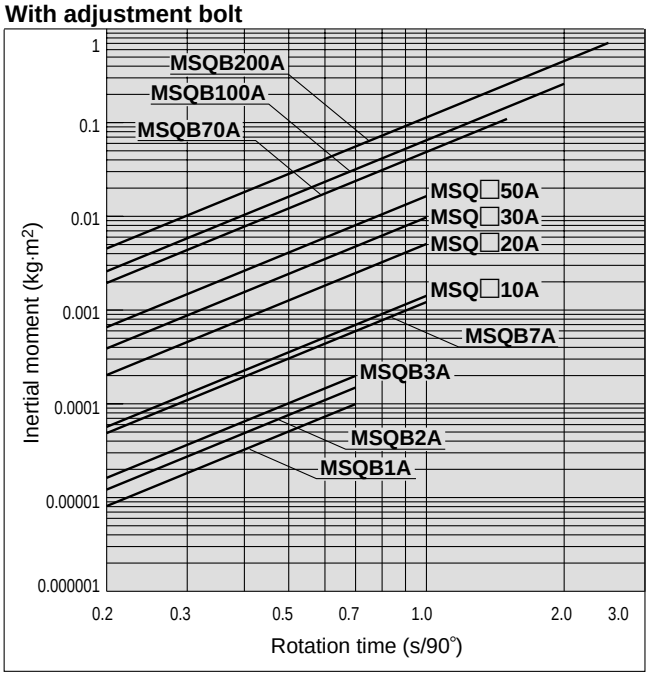
Since the formulae for inertial moment differ depending on the configuration of the load, refer to the inertial moment calculation formulae on this page.

Kinetic Energy/Rotation Time

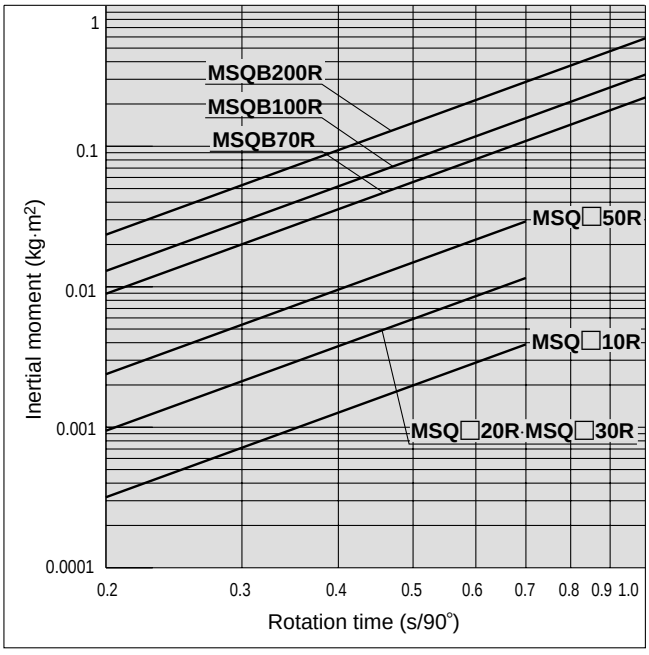
③Model selection

Select models by applying the inertial moment and rotation time which have been found to the charts below.

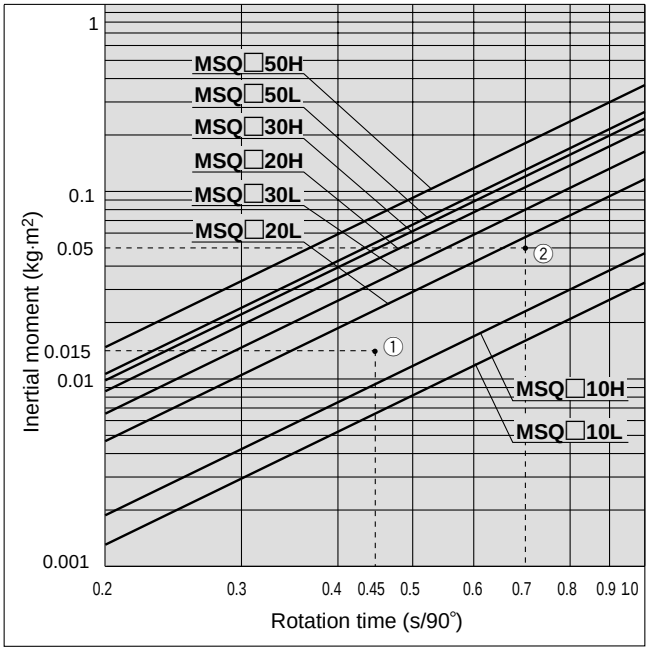
With adjustment bolt



With internal shock absorber



With external shock absorber



①**<Viewing the charts>**

· **Inertial moment** ····· 0.015kg·m²

· **Rotation time** ·····0.45s/90°

MSQ□20L is selected for the above.

②**<Example>**

Load configuration: A cylinder of radius 0.5m and mass 0.4kg

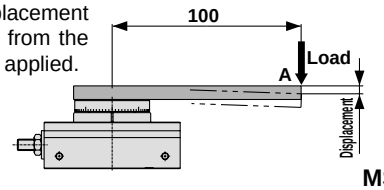
Rotation time: 0.7s/90°

$$I = 0.4 \times \frac{0.5^2}{2} = 0.05 \text{kg·m}^2$$

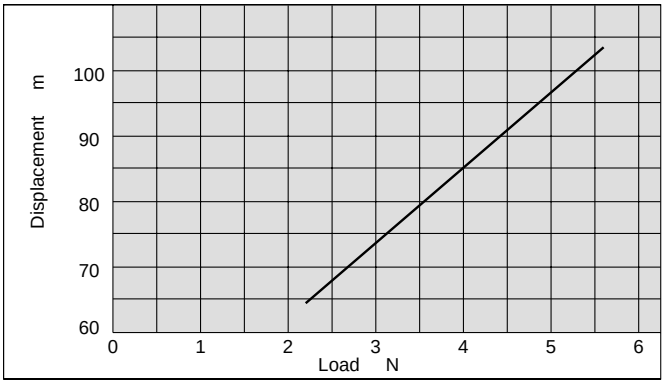
In the inertial moment and rotation time chart, find the intersection of the lines extended from the points corresponding to 0.5kg·m² on the vertical axis (inertial moment) and 0.7s/90° on the horizontal axis (rotation time). Since the resulting intersection point lines within the MSQ□20L selection range, MSQ□20L can be selected.

Table Displacement (Reference Values)

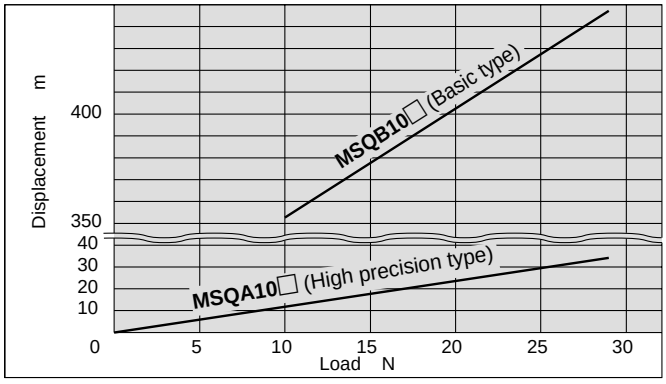
· The following graphs show the displacement at point A, which is 100 mm apart from the center of rotation, where the load is applied.



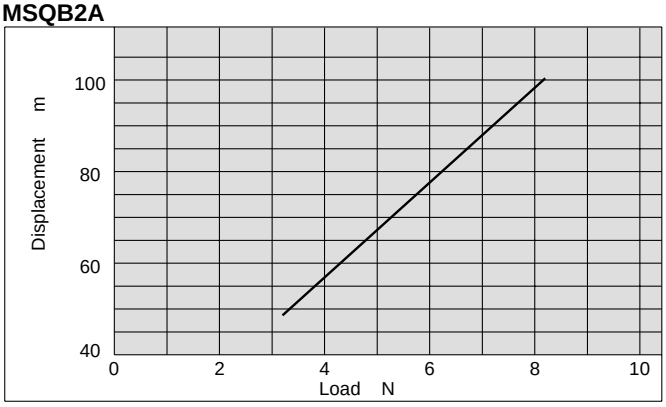
MSQB1A



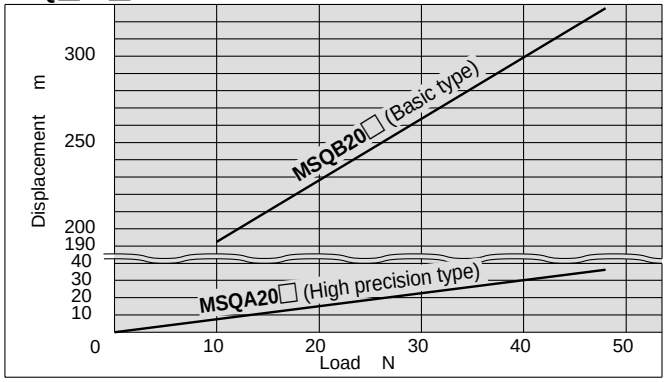
MSQ□10□



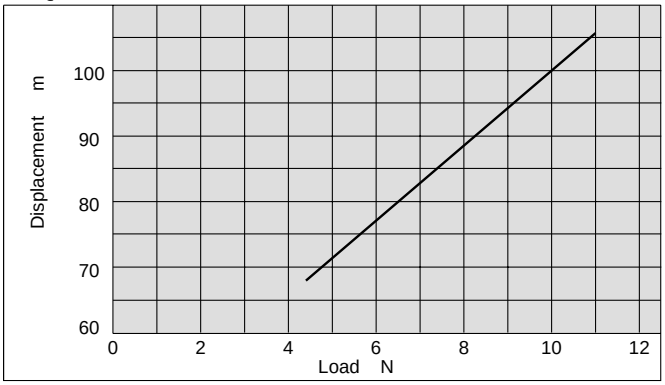
MSQB2A



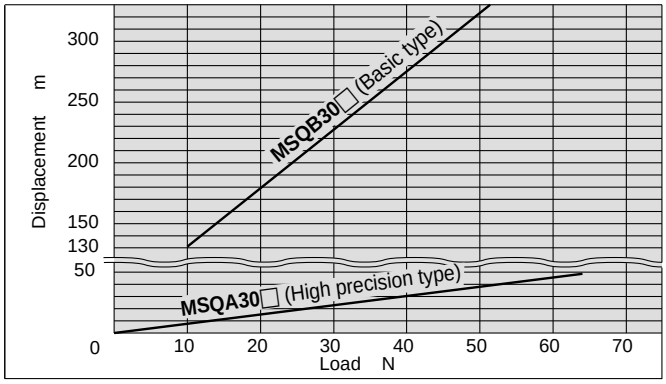
MSQ□20□



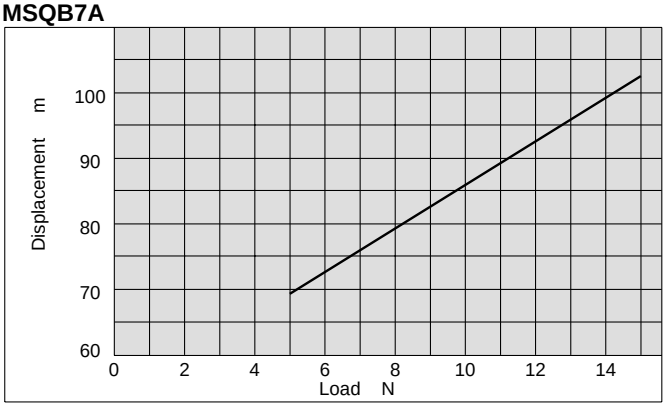
MSQB3A



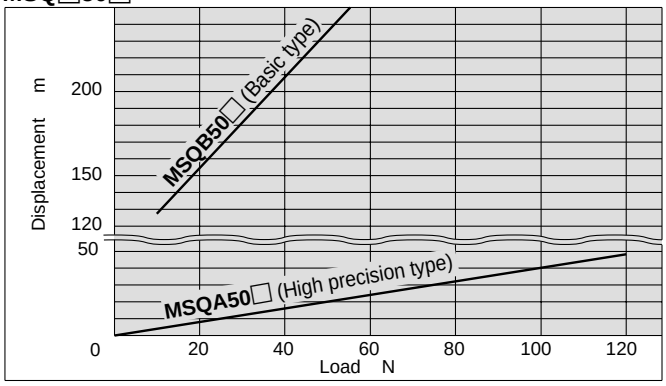
MSQ□30□



MSQB7A



MSQ□50□



Rotary Table
Air Consumption

Air consumption is the volume of air which is expended by the rotary table'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.

∗The air consumption (Q_{CR}) required for one reciprocation of the rotary table alone is shown in the table below, and can be used to simplify the calculation.

Formulae

$$Q_{CR} = 2V \times \left(\frac{P+0.1}{0.1} \right) \times 10^{-3}$$

$$Q_{CP} = 2 \times a \times l \times \frac{P}{0.1} \times 10^{-6}$$

$$Q_C = Q_{CR} + Q_{CP}$$

Q_{CR} =	Air consumption of rotary table	[*l* (ANR)]
Q_{CP} =	Air consumption of tubing or piping	[*l* (ANR)]
V =	Internal volume of rotary table	[cm^3]
P =	Operating pressure	[MPa]
l =	Length of piping	[mm]
a =	Internal cross section of piping	[mm^2]
Q_C =	Air consumption required for one reciprocation of rotary table	[*l* (ANR)]

When selecting a compressor, it is necessary to choose one which has sufficient reserve for the total air consumption of all pneumatic actuators downstream. This is affected by factors such as leakage in pipping, consumption by drain valves and pilot valves, etc., and reduction of air volume due to drops in temperature.

Formula

$Qc_2 = Qc \times n \times$ Number of actuators $\times$ Reserve factor

Qc_2 = Compressor discharge flow rate [*l* /min(ANR)]
n = Actuator reciprocations per minute

Internal cross section of tubing and steel piping

Nominal size	O. D. (mm)	I. D. (mm)	Internal cross section a (mm^2)
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
1/8B	–	6.5	33.2
T□1075	10	7.5	44.2
TU 1208	12	8	50.3
T□1209	12	9	63.6
1/4B	–	9.2	66.5
TS 1612	16	12	113
3/8B	–	12.7	127
T□1613	16	13	133
1/2B	–	16.1	204
3/4B	–	21.6	366
1B	–	27.6	598

Air consumption

Air consumption of rotary table: Q_{CR} *l* (ANR)

Size	Rotation angle	Internal volume (cm^3)	Operating pressure (MPa)									
			0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
1	190°	0.66	0.0026	0.0039	0.0052	0.0065	0.0078	0.0091	0.010	–	–	–
2		1.3	0.0052	0.0077	0.010	0.013	0.015	0.018	0.021	–	–	–
3		2.2	0.0087	0.013	0.017	0.022	0.026	0.030	0.035	–	–	–
7		4.2	0.017	0.025	0.033	0.042	0.050	0.058	0.066	–	–	–
10		6.6	0.026	0.040	0.053	0.066	0.079	0.092	0.106	0.119	0.132	0.145
20		13.5	0.054	0.081	0.108	0.135	0.162	0.189	0.216	0.243	0.270	0.297
30		20.1	0.080	0.121	0.161	0.201	0.241	0.281	0.322	0.362	0.402	0.442
50		34.1	0.136	0.205	0.273	0.341	0.409	0.477	0.546	0.614	0.682	0.750
70		50.0	0.200	0.300	0.400	0.500	0.600	0.700	0.800	0.900	1.000	1.100
100		74.7	0.299	0.448	0.598	0.747	0.896	1.046	1.195	1.345	1.494	1.643
200		145.9	0.584	0.875	1.167	1.459	1.751	2.043	2.334	2.626	2.918	3.210

Rotary Table/Rack-and-Pinion Type

Series MSQ

Size: 1, 2, 3, 7

How to Order

Basic Type **MSQB** **1** **A** **□** — **F9B** **□**

Size

1
2
3
7

A	With adjustment bolt

Number of auto switches

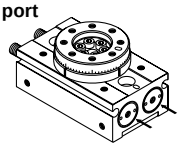
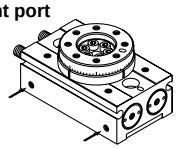
Nil	2 pcs.
S	1 pc.
n	n pcs.

Auto switch type

Nil	Without auto switch (built-in magnet)

∗Refer to the table below for auto switch types.
∗The auto switch is included in the package (unmounted).

Port location

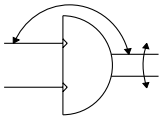
Nil	**Side port** 
E	**Front port** 

Applicable auto switches: Refer to pages 27 through 32 for detailed auto switch specifications.

Type	Special function	Electrical entry	Indicator light	Wiring (Output)	Load voltage			Auto switch type		Lead wire length (m)∗			Applicable load	
					DC		AC	Electrical entry direction		0.5 (Nil)	3 (L)	5 (Z)		
								Perpendicular	In-line					
Solid state switch	–	Grommet	Yes	3-wire (NPN)	24V	12V	–	–	**F9N**	●	●	–	–	Relay, PLC
								F8N	–	●	●	○		
				3-wire (PNP)				–	**F9P**	●	●	–		
								F8P	–	●	●	○		
				2-wire				–	**F9B**	●	●	–		
								F8B	–	●	●	○		
	Diagnostic indication (2-color display)			3-wire (NPN)				–	**F9NW**	●	●	○	IC circuit	
				3-wire (PNP)				–	**F9PW**	●	●	○		
				2-wire				–	**F9BW**	●	●	○	–	
	Product with improve water resistance (2-color display)							–	**F9BA**∗∗	–	●	○		

∗∗Though it is possible to install an auto switch with improved water resistance, the rotary table itself is not an improved water resistance type.
∗Lead wire length symbols: 0.5m ·····Nil (Example) F9N
3m ····· L (Example) F9NL
5m ····· Z (Example) F9NWZ
∗Solid state switches marked "○" are produced upon receipt of order.

JIS symbol



Specifications

Size	1	2	3	7
Fluid	Air (non-lube)			
Maximum operating pressure	0.7MPa			
Minimum operating pressure	0.1MPa			
Ambient and fluid temperature	0 to 60°C (with no condensation)			
Cushion	None		Rubber bumper	
Angle adjustment range	0 to 190°			
Maximum rotation	190°			
Cylinder bore size	ø6	ø8	ø10	ø12
Port size	M3 x 0.5			M5 x 0.8

Allowable Kinetic Energy and Rotation Time Adjustment Range

Size	Allowable kinetic energy (mJ)	Rotation time adjustment range for suitable operation (s/90°)
1	1	0.2 to 0.7
2	1.5	
3	2	
7	6	0.2 to 1.0

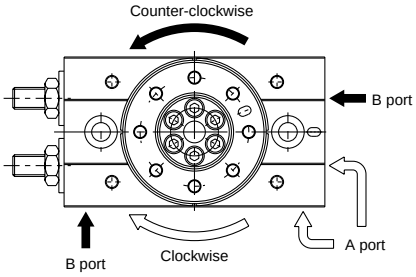
Weight

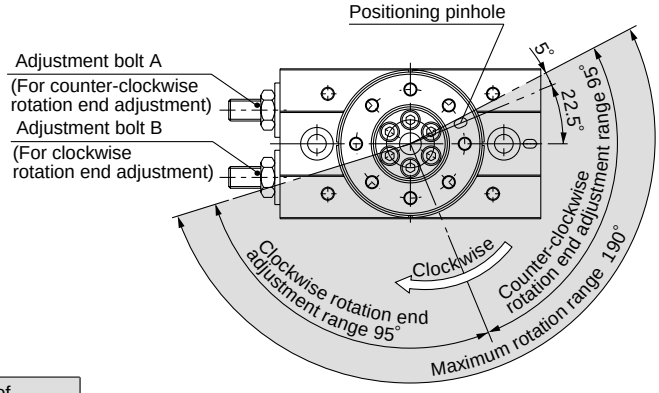
(g)

Size	1	2	3	7
Basic type	75	105	150	250

Rotation Direction and Rotation Angle

· The rotary table turns in the clockwise direction when the A port is pressurized, and in the counter-clockwise direction when the B port is pressurized.
· By adjusting the adjustment bolt, the rotation end can be set within the range shown in the drawing for the desired rotation angle.





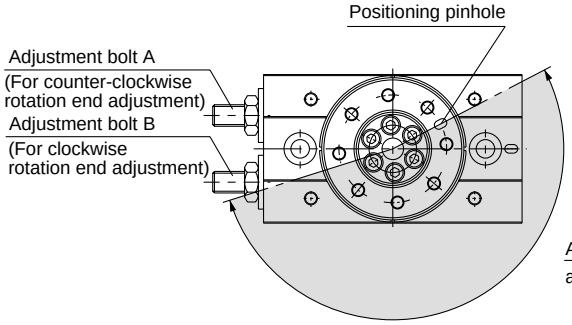
With adjust bolt, internal shock absorber

Size	Adjustment angle per rotation of angle adjustment screw
1	8.2°
2	10.0°
3	10.9°
7	10.2°

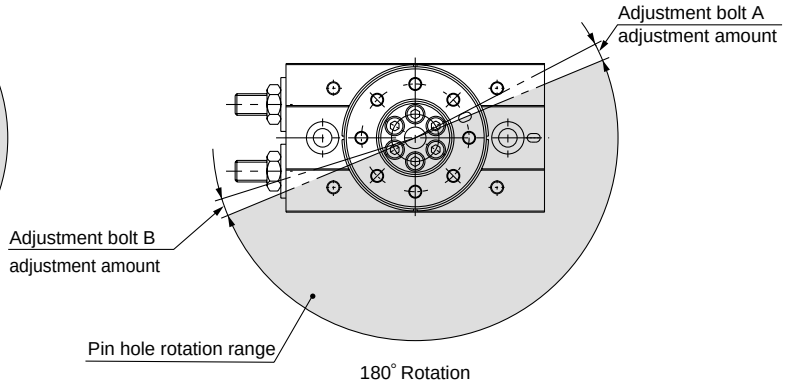
Note) · The drawing shows the rotation range of the positioning pin hole.
· The pin hole position in the drawing shows the counter-clockwise rotation end when the adjustment bolts A and B are tightened equally and the rotation is adjusted 180°.

Rotation Range Examples

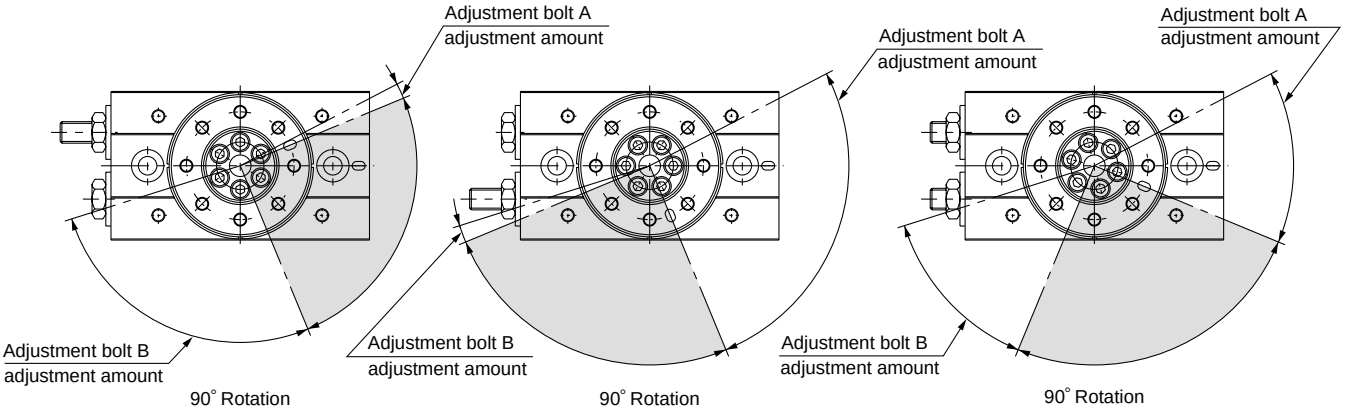
· Various rotation ranges are possible as shown in the drawings below using adjustment bolts A and B.
(The drawings also show the rotation ranges of the positioning pin hole.)



190° (maximum) Rotation

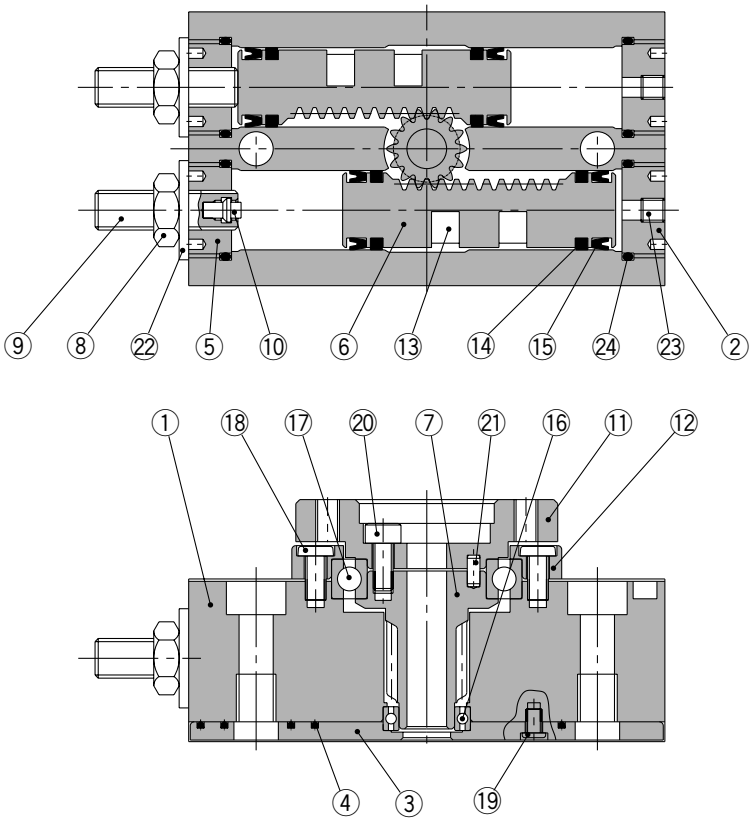


180° Rotation



90° Rotation　90° Rotation　90° Rotation

Construction



Parts list

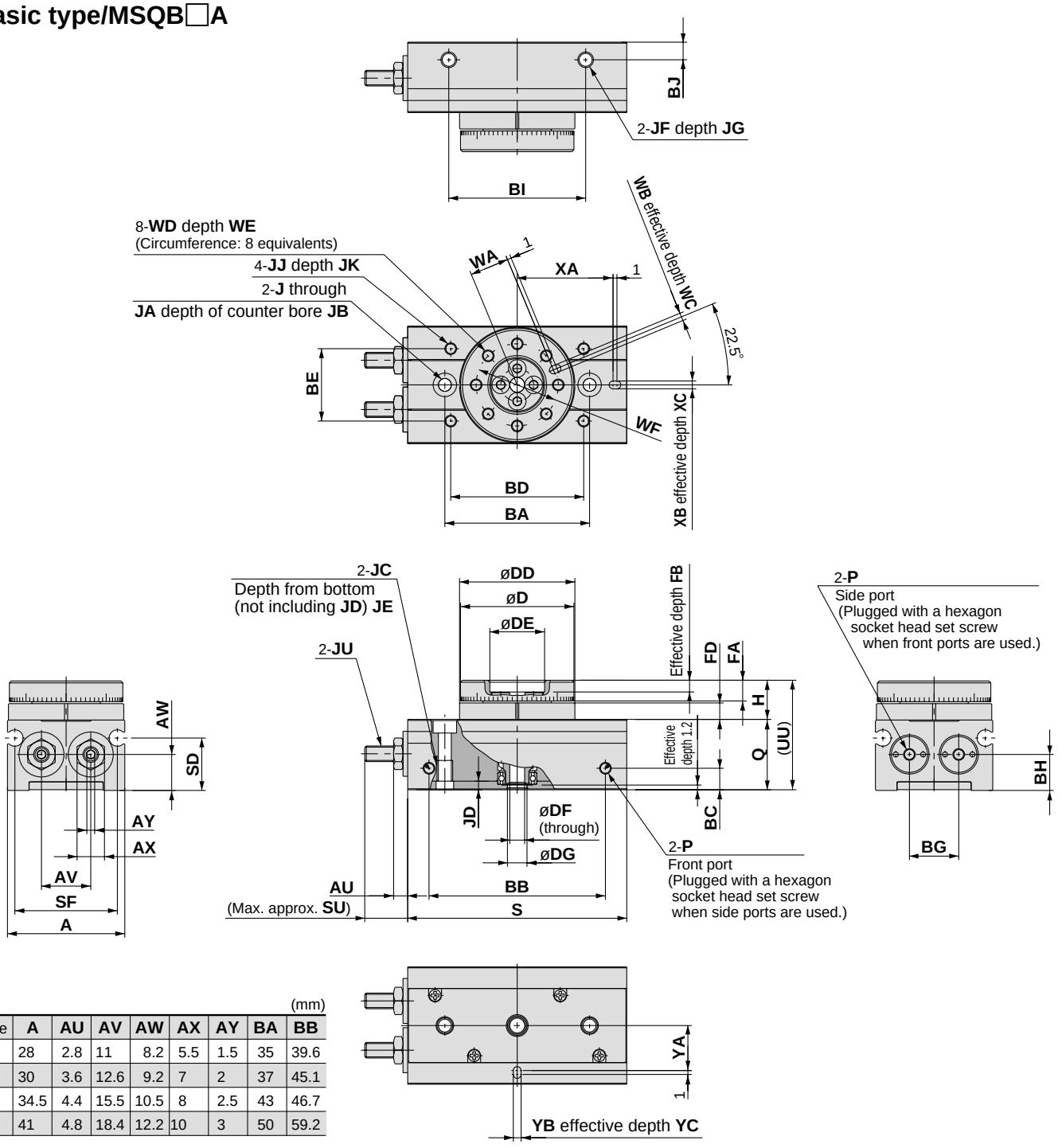
No.	Description		Material
1	**Body**		Aluminium alloy
2	**Cover**		Aluminium alloy
3	**Plate**		Aluminium alloy
4	**Seal**		NBR
5	**End cover**		Aluminium alloy
6	**Piston**		Stainless steel
7	**Pinion**		Chrome molybdenum steel
8	**Hexagon nut**		Steel wire
9	**Adjustment bolt**		Steel wire
10	**Size: 3, 7**	**Cushion pad**	Rubber material
11	**Table**		Aluminium alloy
12	**Bearing retainer**		Aluminium alloy
13	**Magnet**		Magnetic material

∗23 The hexagon socket head set screws are tightened at different positions depending on the position of the connecting port.

No.	Description		Material
14	**Wear ring**		Resin
15	**Piston seal**		NBR
16	**Deep groove ball bearing**		Bearing steel
17	**Deep groove ball bearing**		Bearing steel
18	**Size: 1 to 3**	**Round head Philips screw No.0**	Steel wire
	Size: 7	**Round head Philips screw**	
19	**Round head Philips screw No.0**		Steel wire
20	**Hexagon socket head set bolt**		Stainless steel
21	**Parallel pin**		Carbon steel
22	**Seal washer**		NBR
23	**Hexagon socket head set screw**		Stainless steel
24	**O-ring**		NBR

Dimensions/Size 1, 2, 3, 7

Basic type/MSQB□A



(mm)

Size	A	AU	AV	AW	AX	AY	BA	BB
1	28	2.8	11	8.2	5.5	1.5	35	39.6
2	30	3.6	12.6	9.2	7	2	37	45.1
3	34.5	4.4	15.5	10.5	8	2.5	43	46.7
7	41	4.8	18.4	12.2	10	3	50	59.2

(mm)

Size	BC	BD	BE	BG	BH	BI	BJ	D	DD	DE	DF	DG	FA	FB	FD	H	J	JA	JB	JC	JD	JE	JF	JG
1	4.5	32	17	11	8.2	30	4.5	27h9	27.5h9	14H9	3.5	4.5H9	4.8	2	3.7	9	3.3	6	3.5	M4 x 0.7	2.2	5.3	M4 x 0.7	4
2	5.5	34	18.5	12.6	9.2	35	4.5	29h9	29.5h9	14H9	3.8	5H9	5.3	2.5	4.2	10	3.3	6	3.5	M4 x 0.7	2.2	5.3	M4 x 0.7	4
3	5.5	38	23	15.5	10.5	40	4.5	33h9	34h9	17H9	5	6H9	5.3	2.5	4.2	10	4.2	7.5	4.5	M5 x 0.8	2.5	6	M4 x 0.7	4
7	5.5	45	30	18.4	12.2	50	5	39h9	40h9	20H9	6	7H9	6.5	2.5	4.5	11.5	4.2	7.5	4.5	M5 x 0.8	2.5	6	M5 x 0.8	5

(mm)

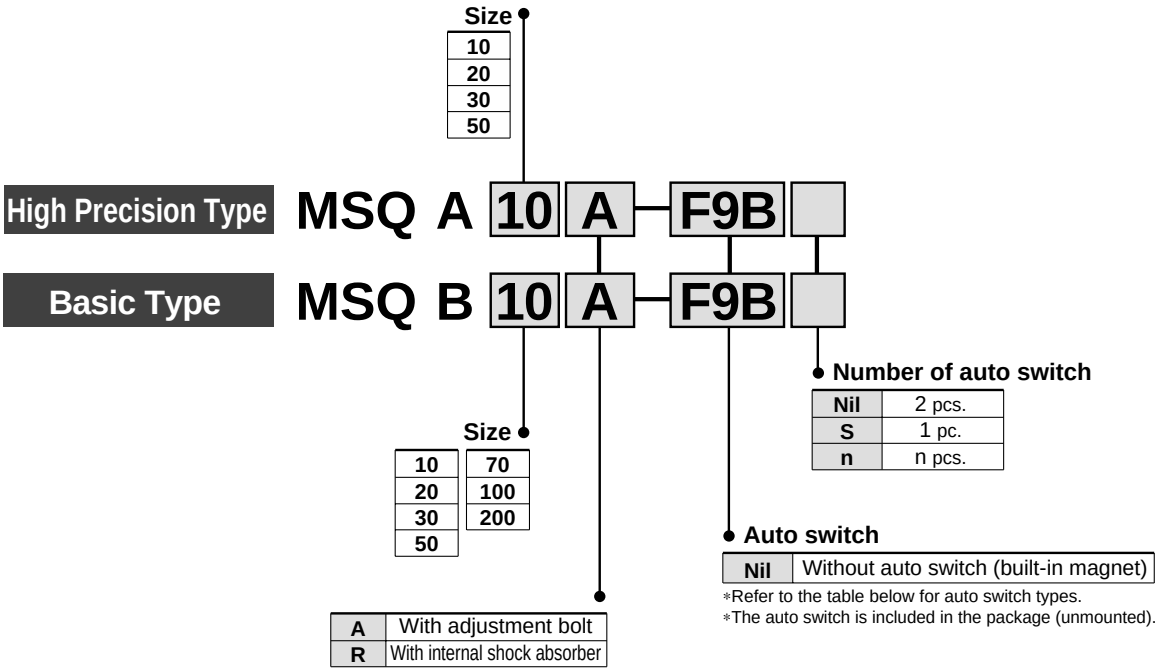
Size	JJ	JK	JU	P	Q	S	SD	SF	SU	UU	WA	WB	WC	WD	WE	WF	XA	XB	XC	YA	YB	YC
1	M3 x 0.5	3.5	M3 x 0.5	M3 x 0.5	16	50.5	10.8	24.4	9.4	25	9.5	2H9	2	M3 x 0.5	4.8	20	22.5	2H9	2	11	2H9	2
2	M3 x 0.5	3.5	M4 x 0.7	M3 x 0.5	18	56	13.4	26.2	11.3	28	10	2H9	2	M3 x 0.5	5.3	21	24.5	2H9	2	11.5	2H9	2
3	M3 x 0.5	3.5	M5 x 0.8	M3 x 0.5	20.5	60	15.2	31	11.8	30.5	12	2H9	2	M3 x 0.5	5.3	25	27	2H9	2	13.5	2H9	2
7	M4 x 0.7	4.5	M6 x 1	M5 x 0.8	23	73.5	15.4	37.4	14.9	34.5	14	3H9	3	M4 x 0.7	6.5	29	32.5	3H9	3	15.5	3H9	3

Rotary Table/Rack-and-Pinion Type

Series MSQ

Size: 10, 20, 30, 50, 70, 100, 200

How to Order



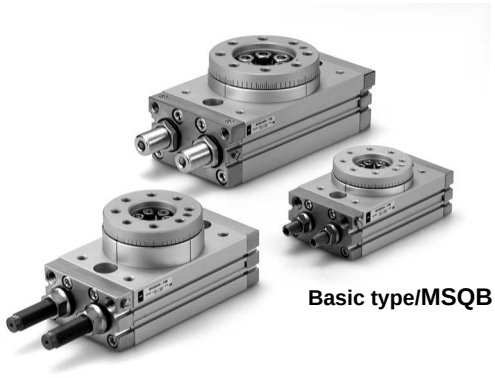
Applicable auto switches: Refer to pages 27 through 32 for detailed auto switch specifications.

Type	Special function	Electrical entry	Indicator light	Wiring (Output)	Load voltage			Auto switch type		Lead wire length (m)∗			Applicable load	
					DC		AC	Perpendicular	In-line	0.5 (Nil)	3 (L)	5 (Z)		
Reed switch	–	Grommet	No	2-wire	24V	5V, 12V	100V or less	**A90V**	**A90**	●	●	–	IC circuit	Relay, PLC
			Yes	3-wire (NPN equiv.)	–	5V	–	**A96V**	**A96**	●	●	–		–
				2-wire	24V	12V	100V	**A93V**	**A93**	●	●	–	–	Relay, PLC
Solid state switch	–	Grommet	Yes	3-wire (NPN)	24V	5V, 12V	–	**F9NV**	**F9N**	●	●	○	IC circuit	Relay, PLC
				3-wire (PNP)				**F9PV**	**F9P**	●	●	○		
				2-wire		12V		**F9BV**	**F9B**	●	●	○	–	
	Diagnostic indication (2-color display)			3-wire (NPN)		5V, 12V		**F9NWV**	**F9NW**	●	●	○	IC circuit	
				3-wire (PNP)				**F9PWV**	**F9PW**	●	●	○		
				2-wire		12V		**F9BWV**	**F9BW**	●	●	○	–	
	Product with improve water resistance (2-color display)							–	**F9BA**∗∗	–	●	○		

∗∗Though it is possible to install an auto switch with improved water resistance, the rotary table itself is not an improved water resistance type.

∗Lead wire length symbols: 0.5m ····· Nil (Example) A93
3m ····· L (Example) A93L
5m ····· Z (Example) F9NWZ

∗Solid state switches marked "○" are produced upon receipt order.



Basic type/MSQB

High precision type/MSQA

Specifications

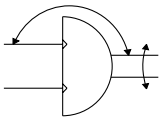
Size		10	20	30	50	70	100	200
Fluid		Air (non-lube)						
Maximum operating pressure	With adjustment bolt	1MPa						
	With internal shock absorber	0.6MPa Note 1)						
Minimum operating pressure	Basic type	0.1MPa						
	High precision type	0.2MPa	0.1MPa			—		
Ambient and fluid temperature		0 to 60°C (with no condensation)						
Cushion	With adjustment bolt	Rubber bumper						
	With internal shock absorber	Shock absorber						
	Shock absorber model	RBA0805 -X692	RBA1006-X692		RBA1411 -X692	RBA2015-X821		RBA2725 -X821
Angle adjustment range		0 to 190° Note2)						
Maximum rotation		190°						
Cylinder bore size		ø15	ø18	ø21	ø25	ø28	ø32	ø40
Port size	End ports	M5 x 0.8		Rc1/8				
	Side ports	M5 x 0.8						

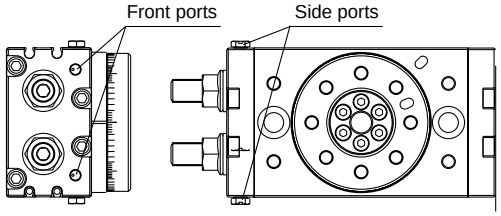
Note 1) The maximum operating pressure of the actuator is restricted by the maximum allowable thrust of the shock absorber.

Note 2) Be careful if the rotation angle of a type with 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	70	100	200
Minimum rotation that will not allow decrease of energy absorption ability	52°	43°	40°	60°	71°	62°	82°

JIS symbol





Allowable Kinetic Energy and Rotation Time Adjustment Range

Size	Allowable kinetic energy (mJ)		Rotation time adjustment range for stable operation (s/90°)	
	With adjustment bolt	With internal shock absorber	With adjustment bolt	With internal shock absorber Note1)
10	7	39	0.2 to 1.0	0.2 to 0.7
20	25	116		
30	48	116		
50	81	294		
70	240	1100	0.2 to 1.5	0.2 to 1.0
100	320	1600	0.2 to 2.0	
200	560	2900	0.2 to 2.5	

Note 1) Be careful if a type with internal absorber is used below the minimum speed, the energy absorption ability will decrease drastically.

Weight

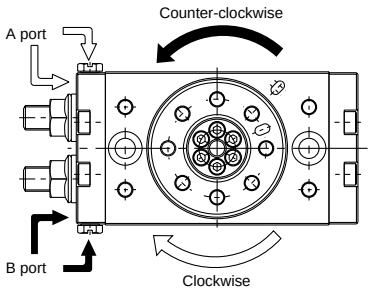
(g)

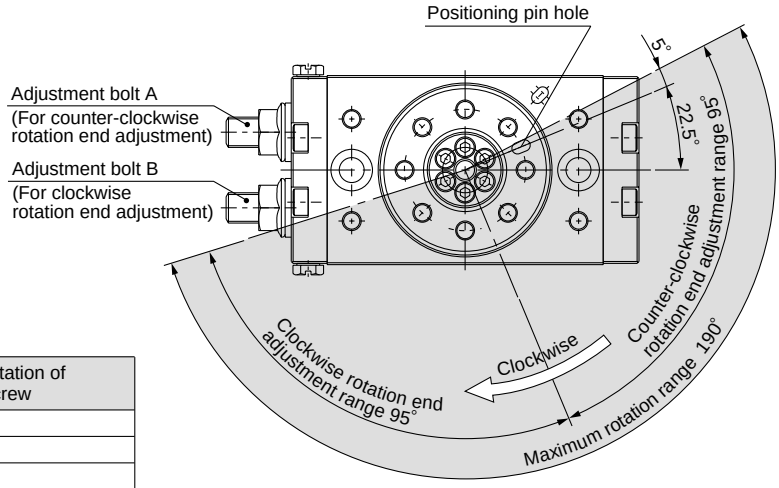
Size		10	20	30	50	70	100	200
Basic type	With adjustment bolt	530	990	1290	2080	2880	4090	7580
	With internal shock absorber	540	990	1290	2100	2890	4100	7650
High precision type	With adjustment bolt	560	1090	1410	2240	–		
	With internal shock absorber	570	1090	1410	2260			

Note) Values above do not include auto switch weights.

Rotation Direction and Rotation Angle

· The rotary table turns in the clockwise direction where the A port is pressurized, and in the counter-clockwise direction when the B port is pressurized.
· By adjusting the adjustment bolt, the rotation end can be set within the ranges shown in the drawing for the desired rotation angle.
· The rotation angle can also be set on a type with internal absorber.





With adjust bolt, internal shock absorber

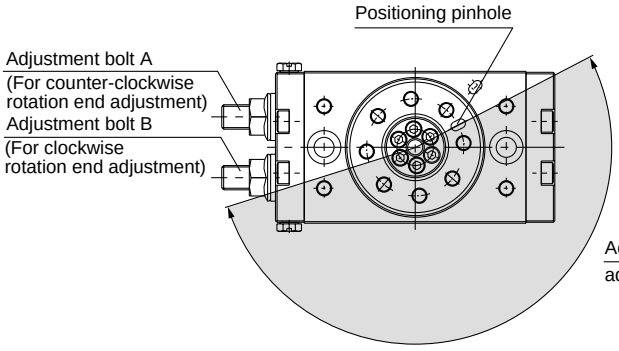
Size	Adjustment angle per rotation of angle adjustment screw
10	10.2°
20	7.2°
30	6.5°
50	8.2°
70	7.0°
100	6.1°
200	4.9°

Note) · The drawing shows the rotation range of the positioning pin hole.
· The pin hole position in the drawing shows the counter-clockwise rotation end when the adjustment bolts A and B are tightened equally and the rotation is adjusted to 180°.

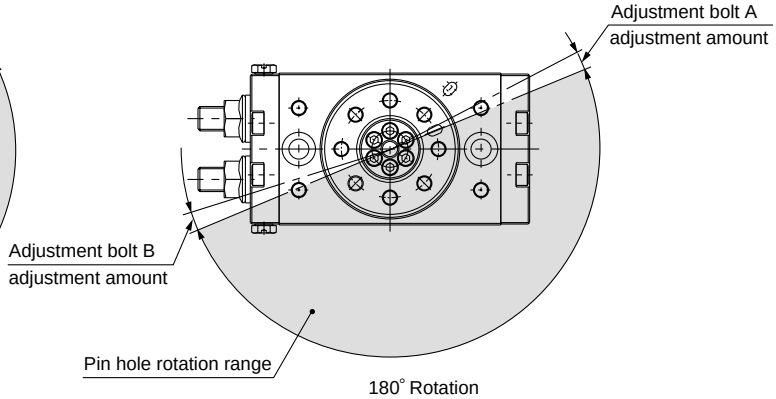
Rotation Range Examples

· 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.)

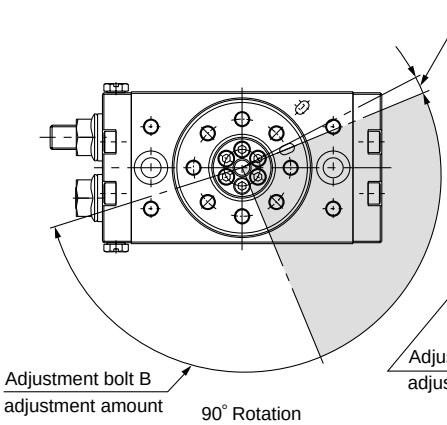
· The rotation angle can also be set on a type with inertial absorber.



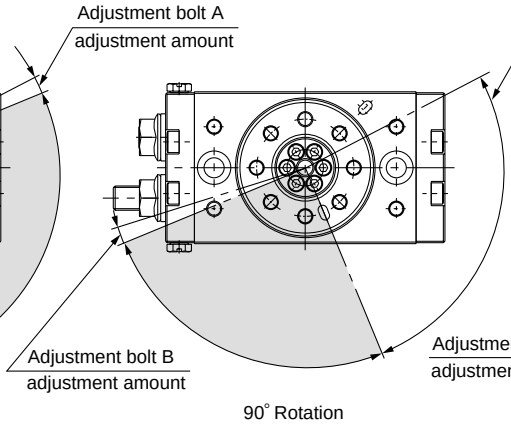
190° (maximum) Rotation



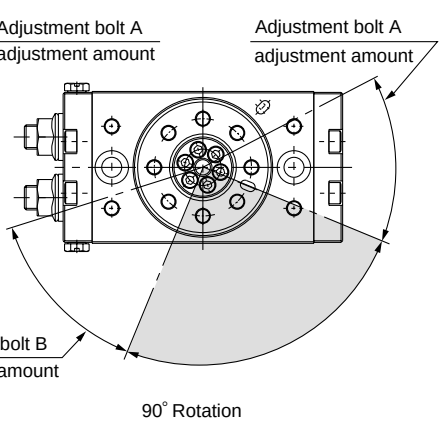
180° Rotation



90° Rotation



90° Rotation



90° Rotation

Clean Series

Prevents the particulates generated by the bearings from entering the clean room by vacuuming through the vacuum port on the side of the body.

How to Order

11 – MSQ B 10 A – A90 S

- **11**: Clean series Vacuum type
- **B**: A — High precision type; B — Basic type
- **10**: Size — 10, 20, 30, 50
- **A**: A — With adjustment bolt; R — Shock absorber
- **A90**: Auto switch type
- **S**: Number of auto switches

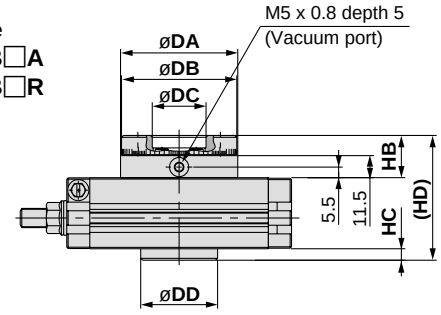
Specifications and Allowable Load

11-MSQA is identical to the high precision type and 11-MSQB is identical to the basic type.

Dimensions

Clean series products do not have empty holes.

Basic type
11-MSQB□A
11-MSQB□R

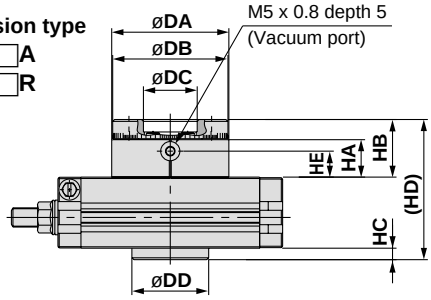


(mm)

Size	**DA**(h9)	**DB**(h9)	**DC**(h9)	**DD**(h9)	**HB**	**HC**	**HD**
10	46	45	20	35	20	5	59
20	61	60	28	40	22	6	65
30	67	65	32	48	22	6	68
50	77	75	35	54	24	7	77

Dimensions other than above are identical to the basic type.

High precision type
11-MSQA□A
11-MSQA□R

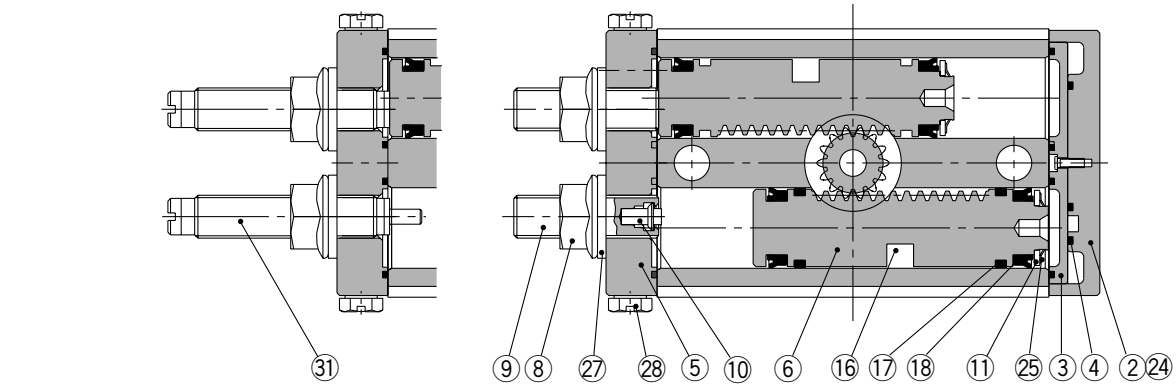


(mm)

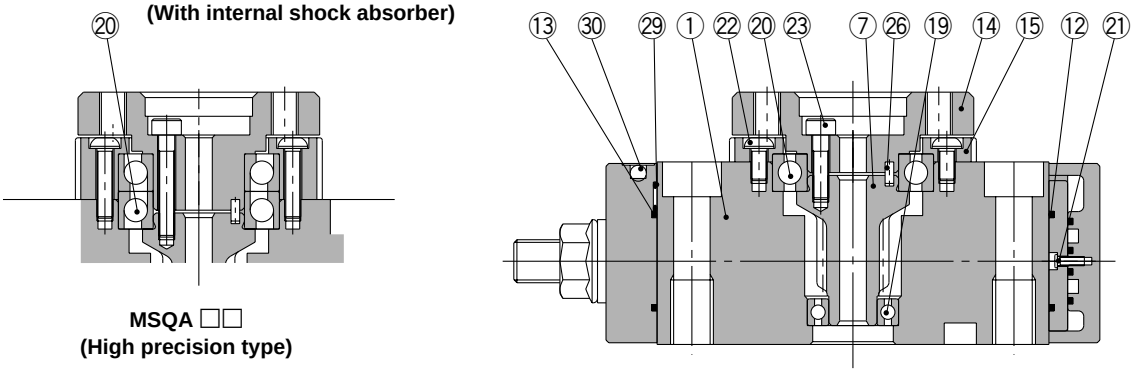
Size	**DA**(h8)	**DB**(h8)	**DC**(h8)	**DD**(h8)	**HA**	**HB**	**HC**	**HD**	**HE**
10	46	45	20	35	15.5	24	5	63	9.5
20	61	60	28	40	19.5	30	6	73	13.5
30	67	65	32	48	19.5	30	6	76	13.5
50	77	75	35	54	21.5	34	7	87	15.5

Dimensions other than above are identical to the high precision type.

Construction



MSQ ☐☐R
(With internal shock absorber)



MSQA ☐☐
(High precision type)

Parts list

No.	Description		Material
1	**Body**		Aluminium alloy
2	**Cover**		Aluminium alloy
3	**Plate**		Aluminium alloy
4	**Seal**		NBR
5	**End cover**		Aluminium alloy
6	**Piston**		Stainless steel
7	**Pinion**		Chrome molybdenum steel
8	**Size: 10 to 50**	**Hexagon nut with flange**	Steel wire
	Size: 70 to 200	**Hexagon nut**	
9	**Adjustment bolt**		Chrome molybdenum steel
10	**Cushion pad**		Rubber material
11	**Seal retainer**		Aluminium alloy
12	**Gasket**		NBR
13	**Gasket**		NBR
14	**Table**		Aluminium alloy
15	**Bearing retainer**		Aluminium alloy
16	**Magnet**		Magnetic material
17	**Wear ring**		Resin
18	**Piston seal**		NBR

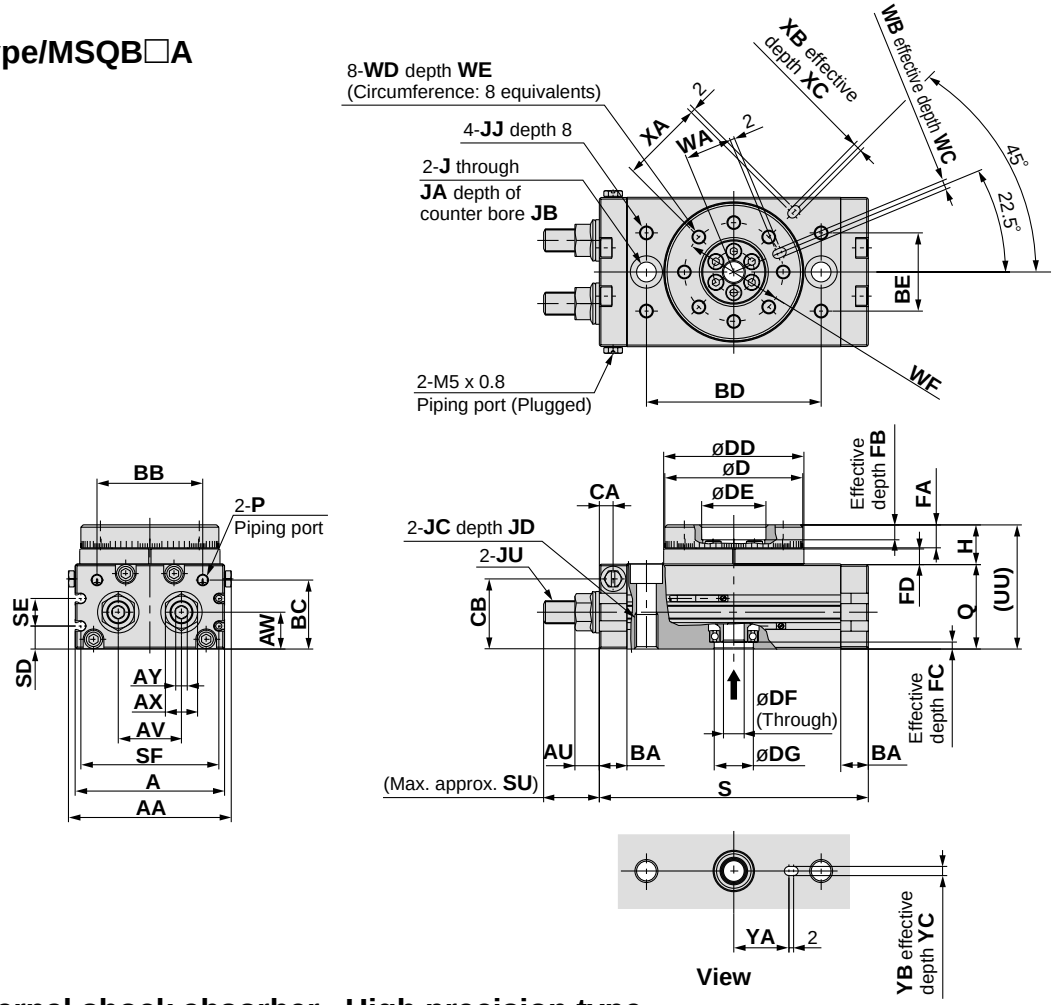
No.	Description		Material
19	**Size: 10 to 50**	**Deep groove ball bearing**	Bearing steel
	Size: 70 to 200	**Needle bearing**	
20	**Basic type**	**Deep groove ball bearing**	Bearing steel
	High precision type	**Angular contact ball bearing**	
21	**Round head Philips screw No.0**		Steel wire
22	**Size: 10**	**Round head philips screw**	Stainless steel
	Size: 20 to 50	**Low head cap screw**	Chrome molybdenum steel
	Size: 70 to 200	**Hexagon socket head set bolt**	
23	**Hexagon socket head set bolt**		Stainless steel
24	**Size: 10 to 50**	**Hexagon socket head set bolt**	Stainless steel
	Size: 70 to 200		Carbon steel
25	**CS types snap ring**		Spring steel
26	**Size: 10 to 50**	**Parallel pin**	Carbon steel
	Size: 70 to 200	**Parallel key**	
27	**Seal washer**		NBR
28	**Plug**		Brass
29	**Size: 70 to 200 only**	**O-ring**	NBR
30	**Size: 70 to 200 only**	**Steel balls**	Stainless steel
31	**Shock absorber**		–

Replacement parts

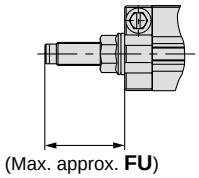
Description	Kit no.							Note
	10	**20**	**30**	**50**	**70**	**100**	**200**	
Seal kit	P523010-5	P523020-5	P523030-5	P523040-5	P391050-5	P391060-5	P391070-5	A set of above numbers ④, ⑫, ⑬, ⑰, ⑱ and ㉗

Dimensions/Size 10, 20, 30, 50

Basic type/MSQB□A



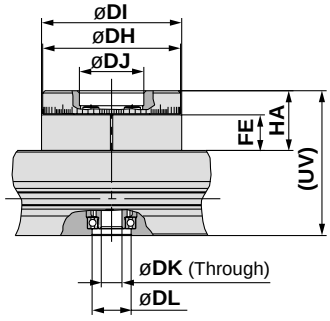
With internal shock absorber
MSQA□R
MSQB□R



(mm)

Size	FU
10	31.5
20	34.7
30	34.7
50	51.7

High precision type
MSQA□A/With adjustment bolt
MSQA□R/With internal shock absorber



(mm)

Size	DH	DI	DJ	DK	DL	FE	HA	UV
10	45h8	46h8	20H8	5	15H8	10	18.5	52.5
20	60h8	61h8	28H8	9	17H8	15.5	26	63
30	65h8	67h8	32H8	9	22H8	16.5	27	67
50	75h8	77h8	35H8	10	26H8	17.5	30	76

(mm)

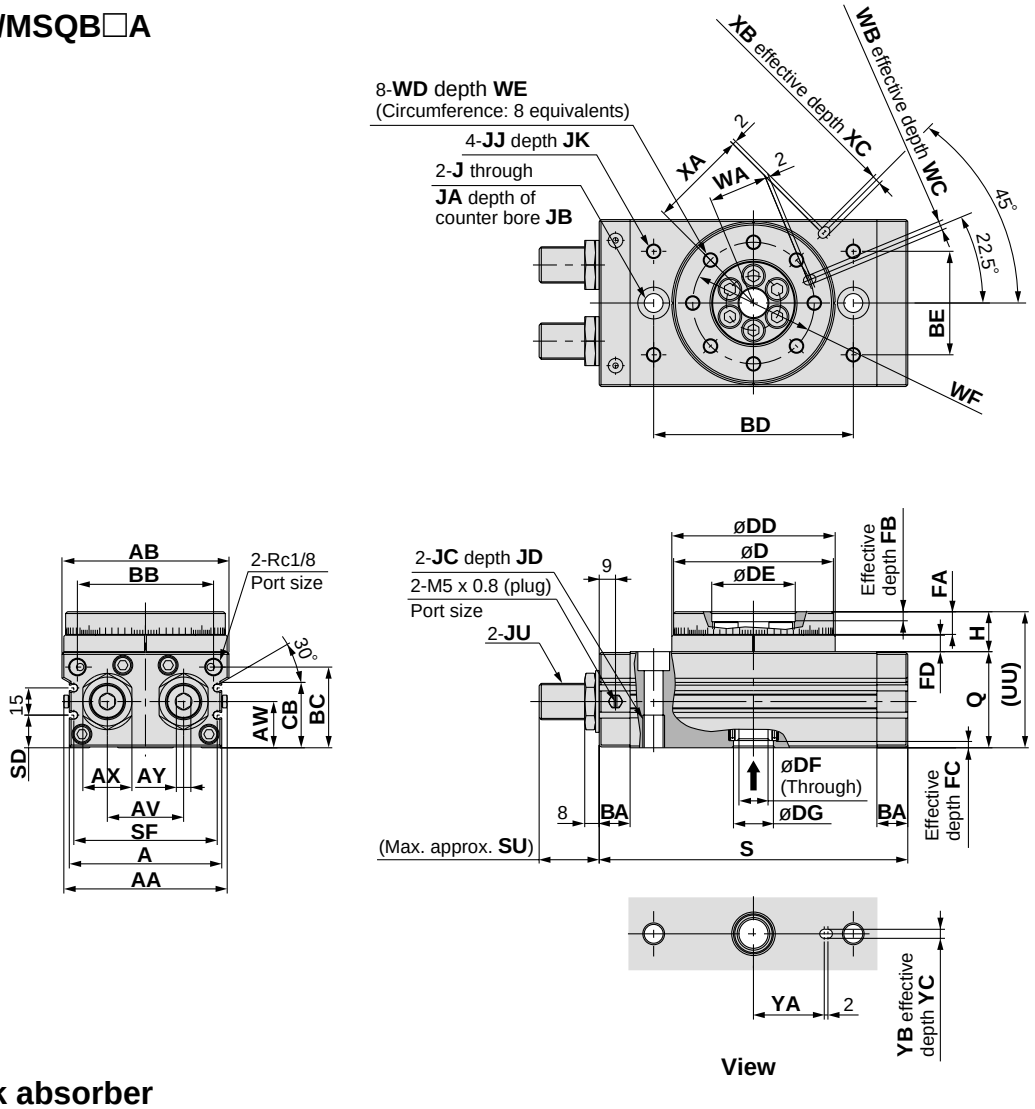
Size	AA	A	AU	AV	AW	AX	AY	BA	BB	BC	BD	BE	CA	CB	D	DD	DE	DF	DG	FA	FB	FC	FD	H	J	JA	JB
10	55.4	50	8.6	20	15.5	12	4	9.5	34.5	27.8	60	27	4.5	28.5	45h9	46h9	20H9	5	15H9	8	4	3	4.5	13	6.8	11	6.5
20	70.8	65	10.6	27.5	16	14	5	12	46	30	76	34	6	30.5	60h9	61h9	28H9	9	17H9	10	6	2.5	6.5	17	8.6	14	8.5
30	75.4	70	10.6	29	18.5	14	5	12	50	32	84	37	6.5	33.5	65h9	67h9	32H9	9	22H9	10	4.5	3	6.5	17	8.6	14	8.5
50	85.4	80	14	38	22	19	6	15.5	63	37.5	100	50	10	37.5	75h9	77h9	35H9	10	26H9	12	5	3	7.5	20	10.5	18	10.5

(mm)

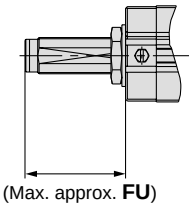
Size	JC	JD	JJ	JU	P	Q	S	SD	SE	SF	SU	UU	WA	WB	WC	WD	WE	WF	XA	XB	XC	YA	YB	YC
10	M8 x 1.25	12	M5 x 0.8	M8 x 1	M5 x 0.8	34	92	9	13	45	17.7	47	15	3H9	3.5	M5 x 0.8	8	32	27	3H9	3.5	19	3H9	3.5
20	M10 x 1.5	15	M6 x 1	M10 x 1	M5 x 0.8	37	117	10	12	60	25	54	20.5	4H9	4.5	M6 x 1	10	43	36	4H9	4.5	24	4H9	4.5
30	M10 x 1.5	15	M6 x 1	M10 x 1	Rc1/8	40	127	11.5	14	65	25	57	23	4H9	4.5	M6 x 1	10	48	39	4H9	4.5	28	4H9	4.5
50	M12 x 1.75	18	M8 x 1.25	M14 x 1.5	Rc1/8	46	152	14.5	15	75	31.4	66	26.5	5H9	5.5	M8 x 1.25	12	55	45	5H9	5.5	33	5H9	5.5

Dimensions/Size 70, 100, 200

Basic type/MSQB□A



With shock absorber MSQB□R



(mm)

Size	FU
70	55.4
100	55.5
200	74.7

(mm)

Size	AA	AB	A	AV	AW	AX	AY	BA	BB	BC	BD	BE	CB	D	DD	DE	DF	DG	FA	FB	FC	FD	H	J	JA	JB
70	90	92	84	42	25.5	27	8	17	75	44.5	110	57	36	88h9	90h9	46H9	16	22H9	12.5	5	3.5	9	22	10.4	17.5	10.5
100	101	102	95	50	29.5	27	8	17	85	50.5	130	66	42	98h9	100h9	56H9	19	24H9	14.5	6	3.5	12	27	10.4	17.5	10.5
200	119	120	113	60	36.5	36	10	24	103	65.5	150	80	57	116h9	118h9	64H9	24	32H9	16.5	9	5.5	15	32	14.2	20	12.5

(mm)

Size	JC	JD	JJ	JK	JU	Q	S	SD	SF	SU	UU	WA	WB	WC	WD	WE	WF	XA	XB	XC	YA	YB	YC
70	M12 x 1.75	18	M8 x 1.25	10	M20 x 1.5	53	170	18	79	34.2	75	32.5	5H9	5.5	M8 x 1.25	12.5	67	54	5H9	3.5	39	5H9	3.5
100	M12 x 1.75	18	M8 x 1.25	10	M20 x 1.5	59	189	22	90	34.3	86	37.5	6H9	6.5	M10 x 1.5	14.5	77	59	6H9	4.5	49	6H9	4.5
200	M16 x 2	25	M12 x 1.75	13	M27 x 1.5	74	240	29	108	40.2	106	44	8H9	8.5	M12 x 1.75	16.5	90	69	8H9	4.5	54	8H9	6.5

Rotary Table/Rack-and-Pinion Type

Series MSQ

With External Shock Absorber

Size: 10, 20, 30, 50

How to Order

MSQ B 10 L 2 — F9B S

Number of auto switch

Nil	2 pcs.
S	1 pc.
n	n pcs.

A	High precision type
B	Basic type

Size

10
20
30
50

Auto switch type

Nil	Without auto switch (Built-in magnet)

∗Refer to the table below for auto switch types.
∗The auto switch is included in the package (unmounted).

Shock absorber type

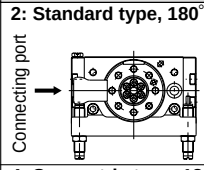
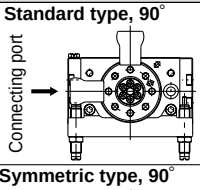
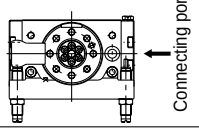
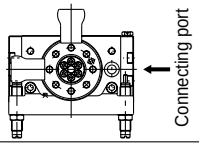
L	Low energy shock absorber
H	High energy shock absorber

Connecting port position and rotation

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

Refer to the table to the right.

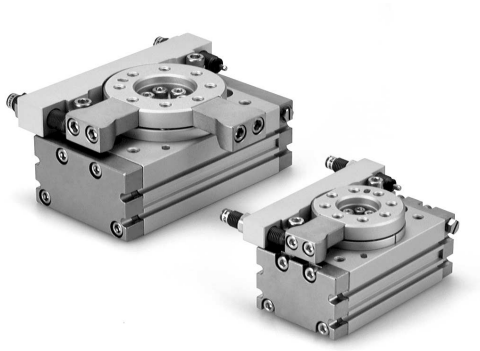
Port location/Rotation

Connecting port position	Rotation: 180°	Rotation: 90°
Standard type	**2: Standard type, 180°** 	**3: Standard type, 90°** 
Symmetric type	**4: Symmetric type, 180°** 	**5:Symmetric type, 90°** 

Applicable auto switches: Refer to pages 27 through 32 for detailed auto switch specifications.

Type	Special function	Electrical entry	Indicator light	Wiring (Output)	Load voltage: DC		Load voltage: AC	Auto switch type: Perpendicular	Auto switch type: In-line	Lead wire length (m)∗: 0.5 (Nil)	3 (L)	5 (Z)	Applicable load	
Reed switch	–	Grommet	No	2-wire	24V	5V, 12V	100V or less	**A90V**	**A90**	●	●	–	IC circuit	Relay, PLC
			Yes	3-wire (NPN equiv.)	–	5V	–	**A96V**	**A96**	●	●	–		–
				2-wire	24V	12V	100V	**A93V**	**A93**	●	●	–	–	Relay, PLC
Solid state switch	–	Grommet	Yes	3-wire (NPN)	24V	5V, 12V	–	**F9NV**	**F9N**	●	●	○	IC circuit	Relay, PLC
				3-wire (PNP)				**F9PV**	**F9P**	●	●	○		
				2-wire		12V		**F9BV**	**F9B**	●	●	○	–	
	Diagnostic indication (2-color display)			3-wire (NPN)		5V, 12V		**F9NWV**	**F9NW**	●	●	○	IC circuit	
				3-wire (PNP)				**F9PWV**	**F9PW**	●	●	○		
				2-wire		12V		**F9BWV**	**F9BW**	●	●	○	–	
	Product with improve water resistance (2-color display)							–	**F9BA**∗∗	–	●	○		

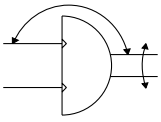
∗∗Though it is possible to install an auto switch with improved water resistance, the rotary table itself is not an improved water resistance type.
∗Lead wire length symbols: 0.5m ····· Nil (Example) A93
3m ····· L (Example) A93L
5m ····· Z (Example) F9NWZ
∗Solid state switches marked "○" are produced upon receipt of order.

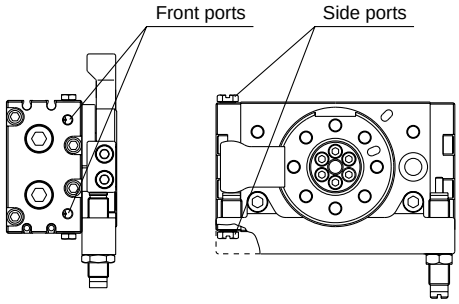


Specifications

Size		10	20	30	50
Fluid		Air (non-lube)			
Maximum operating pressure		1MPa			
Minimum operating pressure		0.2MPa			
Ambient and fluid temperature		0 to 60°C (with no condensation)			
Cushion		Shock absorber			
Shock absorber type	For low energy	RB0805	RB1006		RB1411
	For high energy	RB0806	RB1007		RB1412
Rotation		90°, 180°			
Angle adjusting range		Each rotation end ±3°			
Cylinder bore size		ø15	ø18	ø21	ø25
Port size	End ports	M5 x 0.8		Rc1/8	
	Side ports	M5 x 0.8			

JIS symbol





Allowable Kinetic Energy and Rotation Time Adjustment Range

Size	Allowable kinetic energy (mJ)		Rotation time adjustment range for stable operation (s/90°)
	Low energy shock absorber	High energy shock absorber	
10	161	231	0.2 to 1.0 Note)
20	574	1060	
30	805	1210	
50	1310	1820	

Note) 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	7.1°	6.9°	6.2°	9.6°
For high energy	8.6°	8.0°	7.3°	10.5°

Weights

(g)

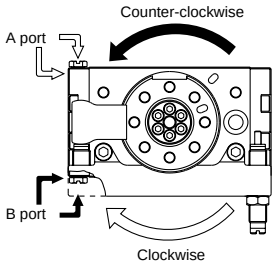
Size		10	20	30	50
Basic type	90° specification	630	1200	1520	2480
	180° specification	600	1140	1450	2370
High precision type	90° specification	700	1390	1750	2810
	180° specification	670	1340	1680	2690

Note) Values above do not include auto switch weights.

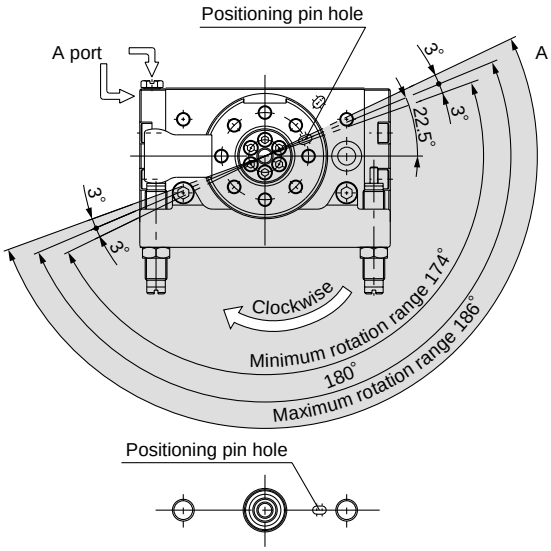
Rotation Direction and Rotation Angle

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

Standard type

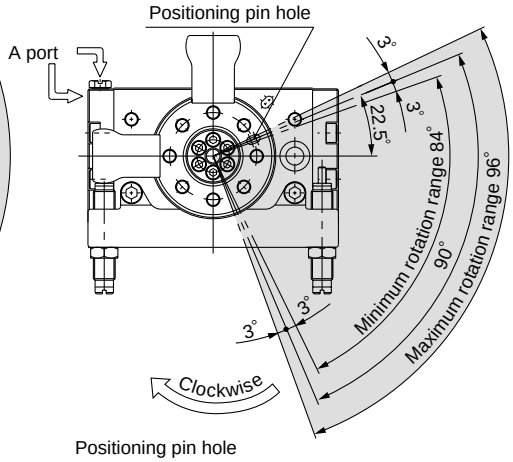


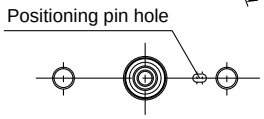
For 180°



Position of bottom positioning pin hole

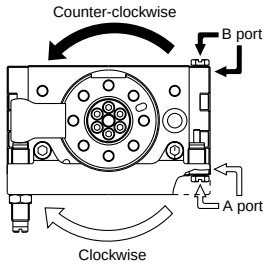
For 90°



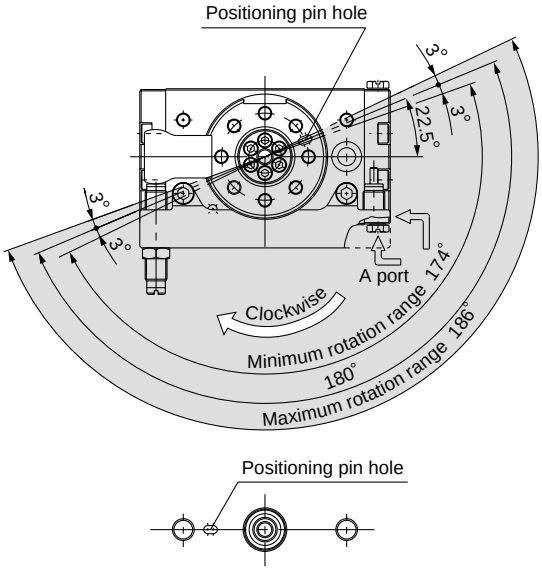


Position of bottom positioning pin hole

Symmetric type

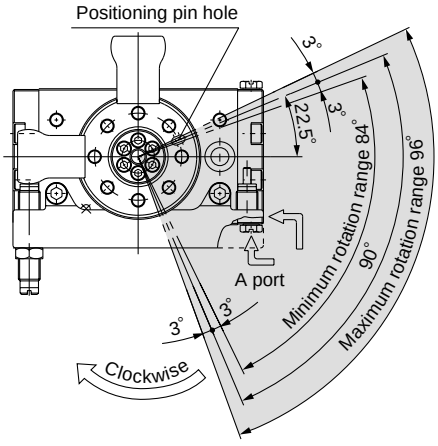


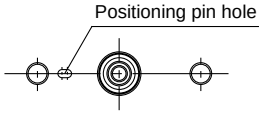
For 180°



Position of bottom positioning pin hole

For 90°





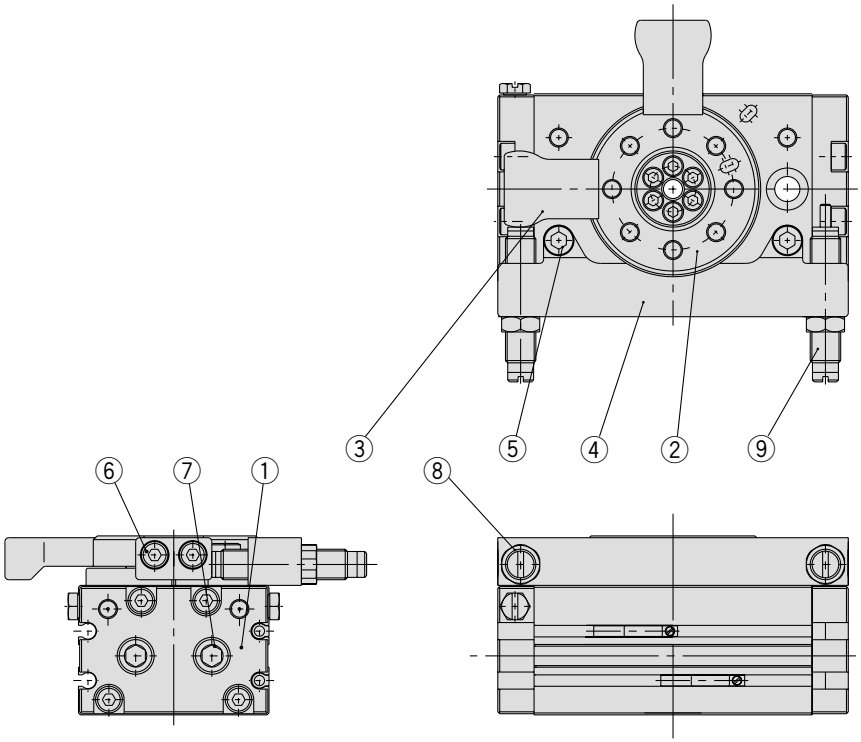
Position of bottom positioning pin hole

With external shock absorber

Size	Adjustment angle per rotation of angle adjustment screw
10	1.4°
20	1.2°
30	1.1°
50	1.3°

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

Parts Descriptions



Parts list

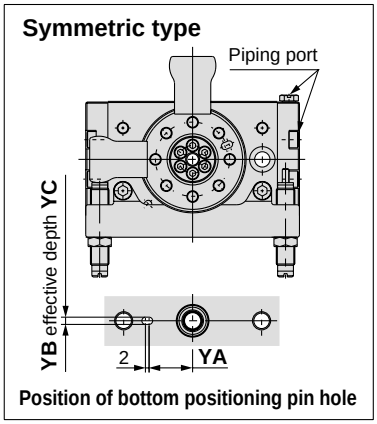
No.	Description	Material
1	**End cover**	Aluminium alloy
2	**Table**	Aluminium alloy
3	**Arm**	Chrome molybdenum steel
4	**Shock absorber holder**	Aluminium alloy
5	**Hexagon socket head set bolt**	Stainless steel
6	**Hexagon socket head set bolt**	Stainless steel
7	**Taper plug**	Steel wire
8	**Hexagon nut**	Steel wire
9	**Shock absorber**	—

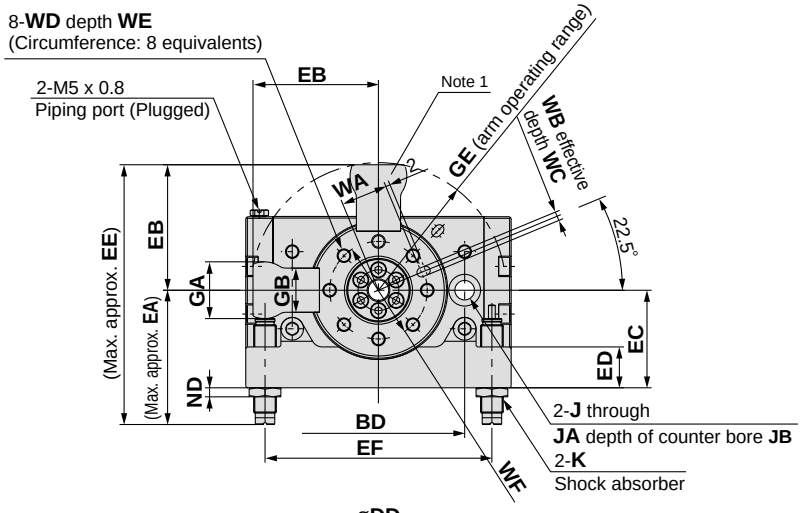
Replacement parts

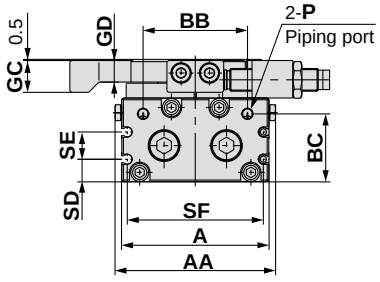
Description	Kit no.				Note
	10	**20**	**30**	**50**	
Seal kit	P523010-6	P523020-6	P523030-6	P523040-6	Seal washer ㉗ is excluded from the kit contents described on page 17.

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

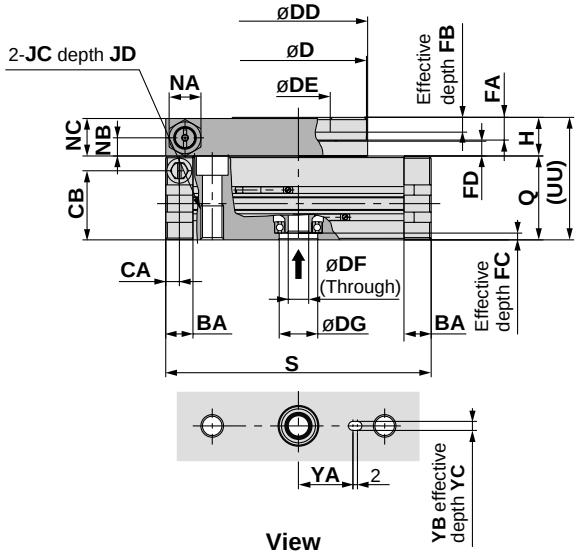
Basic type/MSQB□$^{L}_{H}$□



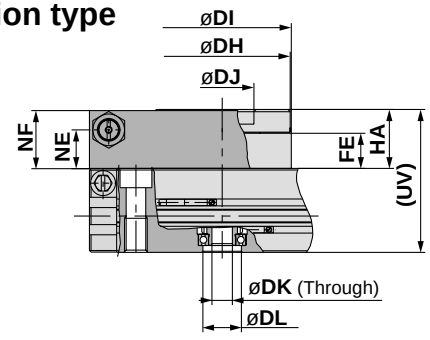




Note 1) This part is not available with 180° specification.



High precision type MSQA□$^{L}_{H}$□



(mm)

Size	DH	DI	DJ	DK	DL	FE	HA	NE	NF	UV
10	45	46	20H8	5	15H8	10	18.5	11	18	52.5
20	60	61	28H8	9	17H8	15.5	26	17	25.5	63
30	65	67	32H8	9	22H8	16.5	27	18	26.5	67
50	75	77	35H8	10	26H8	17.5	30	18.5	29.5	76

(mm)

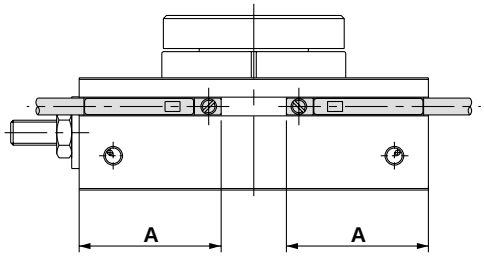
Size	AA	A	BA	BB	BC	BD	CA	CB	D	DD	DE	DF	DG	EA	EB	EC	ED	EE	EF	FA	FB	FC	FD	GA	GB	GC	GD	GE	H
10	55.4	50	9.5	34.5	27.8	60	4.5	28.5	45	46	20H9	5	15H9	52.9	44.3	33.5	14	97.2	80	8	4	3	4.5	20	15.6	11	7.5	45.2	13
20	70.8	65	12	46	30	76	6	30.5	60	61	28H9	9	17H9	61.8	55.3	43	18	117.1	100	10	6	2.5	6.5	25	19.5	14	9.5	56.4	17
30	75.4	70	12	50	32	84	6.5	33.5	65	67	32H9	9	22H9	63.1	60.3	46	19.5	123.4	110	10	4.5	3	6.5	27	21.5	14	9.5	61.5	17
50	85.4	80	15.5	63	37.5	100	10	37.5	75	77	35H9	10	26H9	86.7	71.4	56	22	158.1	130	12	5	3	7.5	32	28	18	11.5	72.9	20

(mm)

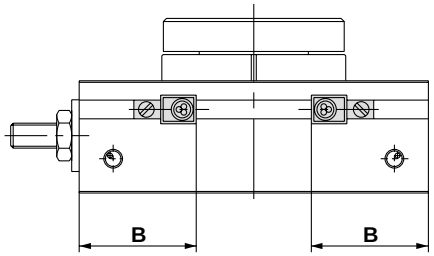
Size	J	JA	JB	JC	JD	K	NA	NB	NC	ND	P	Q	S	SD	SE	SF	UU	WA	WB	WC	WD	WE	WF	YA	YB	YC
10	6.8	11	6.5	M8 x 1.25	12	M8 x 1	10	5.5	12.5	4	M5 x 0.8	34	92	9	13	45	47	15	3H9	3.5	M5 x 0.8	8	32	19	3H9	3.5
20	8.6	14	8.5	M10 x 1.5	15	M10 x 1	14	8	16.5	4	M5 x 0.8	37	117	10	12	60	54	20.5	4H9	4.5	M6 x 1	10	43	24	4H9	4.5
30	8.6	14	8.5	M10 x 1.5	15	M10 x 1	14	8	16.5	4	Rc1/8	40	127	11.5	14	65	57	23	4H9	4.5	M6 x 1	10	48	28	4H9	4.5
50	10.5	18	10.5	M12 x 1.75	18	M14 x 1.5	19	8.5	19.5	6	Rc1/8	46	152	14.5	15	75	66	26.5	5H9	5.5	M8 x 1.25	12	55	33	5H9	5.5

Proper Auto Switch Mounting Position at Rotation End

• Size: 1 to 7



When D-F9 is used



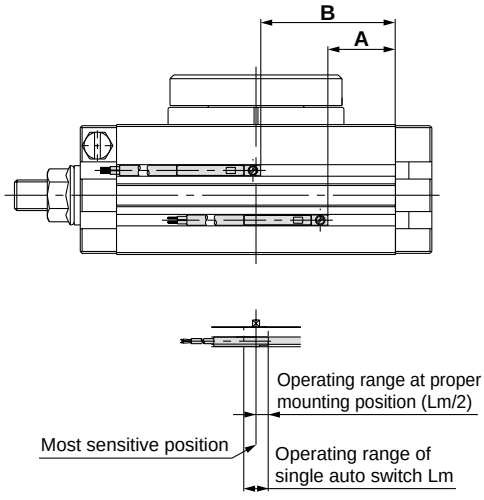
When D-F8 is used

Size	Rotation	Solid state switch					
		D-F9 auto switch			D-F8 auto switch		
		A	Rotation range θ m	Actuation range	B	Rotation range θ m	Actuation range
1	190°	20.9	40°	10°	16.9	20°	10°
2	190°	22.8	35°	10°	18.8	20°	10°
3	190°	24.4	30°	10°	20.4	15°	10°
7	190°	28.7	25°	10°	24.7	15°	10°

Rotation range θ m: Value of the operating range Lm of a single auto switch converted to an axial rotation angle.

Actuation range : Value of auto switch hysteresis converted to an angle.

• Size: 10 to 200



Size	Rotation	Reed switch				Solid state switch			
		A	B	Rotation range θ m	Actuation range	A	B	Rotation range θ m	Actuation range
10	190°	17	36	90°	10°	21	40	90°	10°
20	190°	23	50	80°	10°	27	54	80°	10°
30	190°	27	66	65°	10°	31	60	65°	10°
50	190°	33	68	50°	10°	37	72	50°	10°
70	190°	37	78	45°	10°	41	82	45°	10°
100	190°	44	91	40°	10°	48	95	40°	10°
200	190°	57	115	35°	10°	61	19	35°	10°

Rotation range θ m: Value of the operating range Lm of a single auto switch converted to an axial rotation angle.

Actuation range : Value of auto switch hysteresis converted to an angle.

Series MSQ

Auto Switch Specefications

Auto Switch Common Specifications

Type	Reed switch	Solid state switch
Leakage current	None	3-wire: 100eA or less, 2-wire: 0.8mA or less
Operating time	1.2ms	1ms or less
Impact resistance	300m/s^2	1000m/s^2
Insulation resistance	50MΩ or more at 500VDC (Between lead wire and case)	
Withstand voltage	1500VAC for 1 min. (Between lead wire and case)	1000VAC for 1 min. (Between lead wire and case)
Ambient temperature	−10 to 60°C	
Enclosure	IEC529 standard IP67, JISC0920 watertight construction	

Lead Wire Length

Lead wire length indication

(Example) **D-F9P L**

Lead wire length

Nil	0.5m
L	3m
Z	5m

Note 1) Lead wire length Z: Auto switch applicable to 5m length
Solid state switch: All types are produced upon receipt of order (standard procedure).
(Excluding D-F9, F-9□V)

Note 2) For solid state switches with flexible lead wire specification, add "-61" at the end of the lead wire length.

(Example) D-F9PL- 61

Flexible specification

Contact Protection Boxes/CD-P11, CD-P12

<Applicable switches>

D-A9/A9□V

The above auto switches do not have internal contact protection circuits.

1. The operating load is an induction load.
2. The length of wiring to the load is 5m or more.
3. The load voltage is 100 or 200VAC.

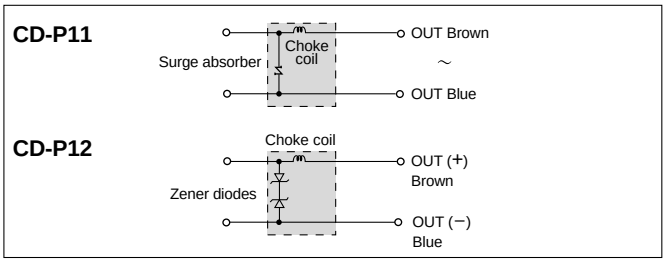
Use a contact protection box in any of the above situations.
The life of the contacts may otherwise be reduced. (They may stay ON all the time.)

Contact protection box specifications

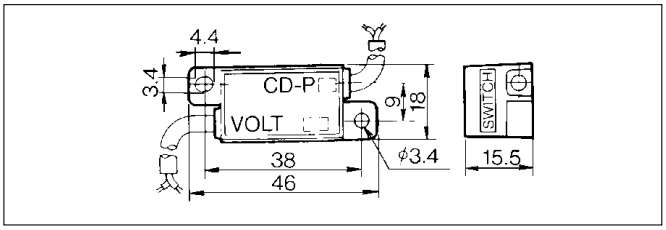
Part number	CD-P11		CD-P12
Load voltage	100VAC	200VAC	24VDC
Maximum load current	25mA	12.5mA	50mA

∗ Lead wire length —— Switch connection side 0.5m
Load connection side 0.5m

Internal circuits



Dimensions



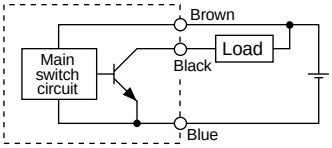
Connection

To connect a switch to a contact protection box, connect the lead wire from the side of the contact protection box marked SWITCH to the lead wire coming out of the switch. Furthermore, the switch unit should be kept as close as possible to the contact protection box, with a lead wire length of no more than 1 meter between them.

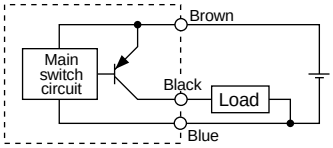
Auto Switches Connections and Examples

Basic Wiring

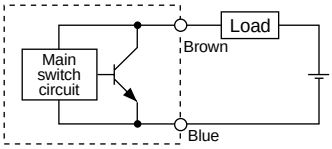
Solid state 3-wire, NPN



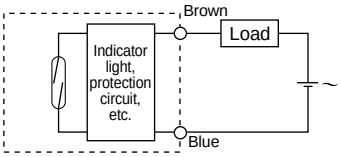
Solid state 3-wire, PNP



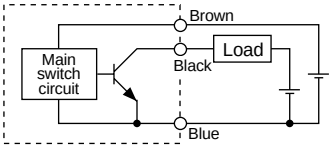
2-wire <Solid state switch>

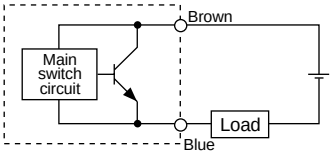


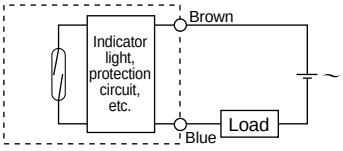
2-wire <Reed switch>



(Power supplies for switch and load are separate.)



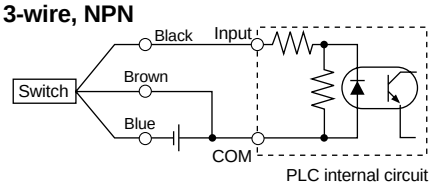




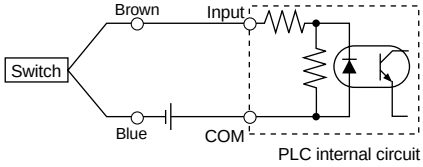
Examples of Connection to PLC

Sink input specifications

3-wire, NPN

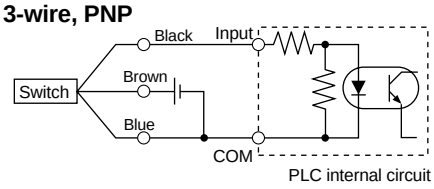


2-wire

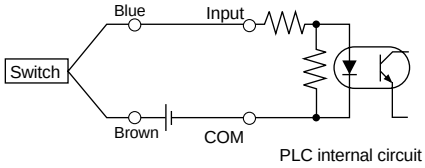


Source input specifications

3-wire, PNP



2-wire

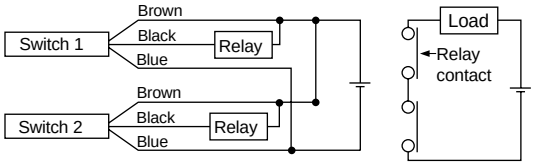


Connect according to the applicable PLC input specifications, as the connection method will vary depending on the PLC input specifications.

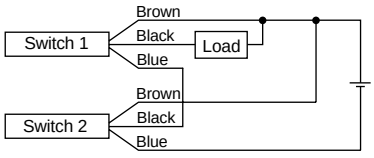
Connection Examples for AND (Series) and OR (Parallel)

3-wire

AND connection for NPN output (using relays)

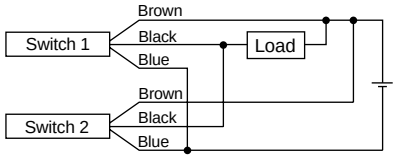


AND connection for NPN output (performed with switches only)

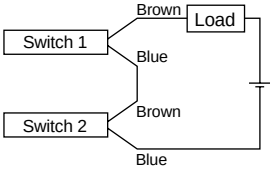


The indicator lights will light up when both switches are turned ON.

OR connection for NPN output



2-wire with 2 switch AND connection



When two 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 if both of the switches are in the ON state.

Load voltage at ON = $\frac{\text{Power supply voltage}}{} - \frac{\text{Voltage drop}}{} \times 2$ pcs.

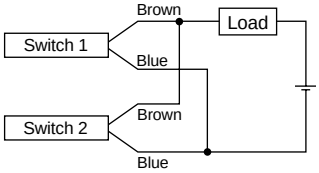
= 24V − 4V x 2 pcs.

= 16V

Example: Power supply is 24VDC

Voltage drop in switch is 4V

2-wire with 2 switch OR connection



<Solid state switch>

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

<Reed switch>

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

Load voltage at OFF = $\frac{\text{Leakage current}}{} \times 2$ pcs. $\times \frac{\text{Load impedance}}{}$

= 1mA x 2 pcs. x 3kΩ

= 6V

Example: Load impedance is 3kΩ

Leakage current from switch is 1mA

Reed Switches/Direct Mounting Type
D-A90(V), D-A93(V), D-A96(V)

Grommet
Electrical entry: In-line

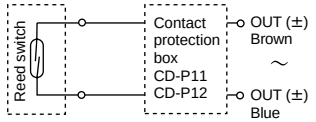
⚠Caution

Precautions

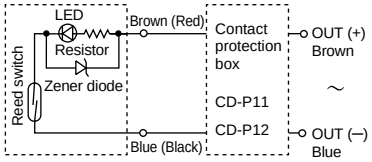
①When securing the switch, be sure to use the fixing screws attached to the auto switch body. The switch may be damaged if screws other than specified ones are used.

Auto Switch Internal Circuits

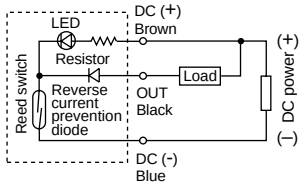
D-A90V



D-A93V



D-A96V



Note) ①The operating load is the induction load.
②The wiring length to the load is 5m or more.
③The load voltage is 100VAC
Under any of the above conditions, the life time of the contact may be shortened. Please use a contact protection box. (Please refer to page 27 for more information on the contact protection box.)

Auto Switch Specifications

D-A90, D-A90V (without indicator light)			
Auto switch part no.	D-A90, D-A90V		
Applicable load	IC circuit, Relay, PLC		
Load voltage	24V AC/DC or less	48V AC/DC or less	100V AC/DC or less
Max load current	50mA	40mA	20mA
Contact protection circuit	None		
Internal resistance	1Ω or less (Includes the lead wire length of 3m)		

D-A93, D-A93V, D-A96, D-A96V (with indicator light)			
Auto switch part no.	D-A93, D-A93V		D-A96, D-A96V
Applicable load	Relay, PLC		IC circuit
Load voltage	24VDC	100VAC	4 to 8VDC
Load current range and Max load current	5 to 40mA	5 to 20mA	20mA
Contact protection circuit	None		
Internal voltage drop	D-A93 — 2.4V or less (to 20mA)/3V or less (to 40mA) D-A93V — 2.7V or less		0.8V or less
Indicator light	Red LED lights when ON		

●Lead wire
D-A90(V), D-A93(V) — Oil proof heavy duty vinyl cable, ø2.7, 0.18mm² x 2 cores (brown, blue), 0.5m
D-A96(V) ———— Oil proof heavy duty vinyl cable, ø2.7, 0.15mm² x 3 cores (brown, black, blue), 0.5m
Note 1) Refer to page 27 for reed switch common specifications.
Note 2) Refer to page 27 lead wire length.

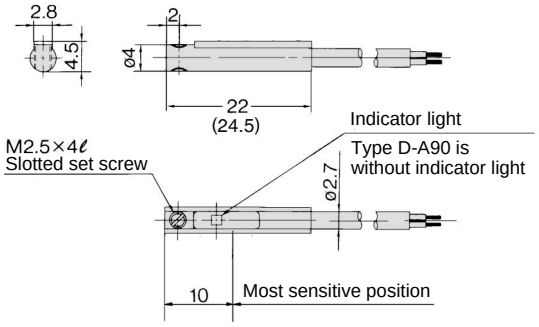
Auto Switch Weights

(g)

Model	D-A90	D-A90V	D-A93	D-A93V	D-A96	D-A96V
Lead wire length 0.5m	6	6	6	6	8	8
Lead wire length 3m	30	30	30	30	41	41

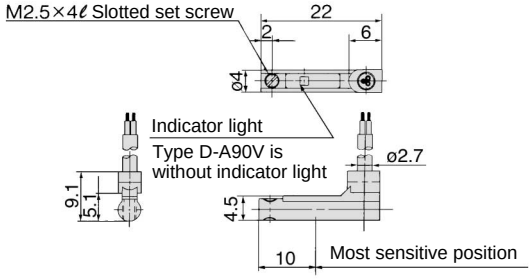
Auto Switch Dimensions

D-A90, D-A93, D-A96



Type D-A93 dimensions are shown inside ( ).

D-A90V, D-A93V, D-A96V



Reed Switches/Direct Mounting Type
D-F9N(V), D-F9P(V), D-F9B(V)

Grommet

⚠Caution

Precautions

When securing the switch, be sure to use the fixing screws attached to the auto switch body. The switch may be damaged if screws other than specified ones are used.

Auto Switch Specifications

D-F9□, D-F9□V (with indicator light)						
Auto switch part no.	D-F9N	D-F9NV	D-F9P	D-F9PV	D-F9B	D-F9BV
Electrical entry direction	In-line	Perpendicular	In-line	Perpendicular	In-line	Perpendicular
Wiring type	3-wire				2-wire	
Output type	NPN		PNP		–	
Applicable load	IC circuit, Relay, PLC				24VDC relay, PLC	
Power supply voltage	5, 12, 24VDC (4.5 to 28V)				–	
Current consumption	10mA or les				–	
Load voltage	28VDC or less		–		24VDC (10 to 28VDC)	
Load current	40mA or less		80mA or less		5 to 40mA	
Internal voltage drop	1.5V or less (0.8V or less at 10mA load current)		0.8V or less		4V or less	
Leakage voltage	100μA or less at 24VDC				0.8mA or less	
Indicator light	Red LED lights when ON					

●Lead wire – Oil proof heavy duty vinyl cable, ø2.7, 0.15mm^2 x 3 cores (brown, black, blue), 0.18mm^2 x 2 cores (brown, blue), 0.5m

Note 1) Refer to page 27 for reed switch common specifications.

Note 2) Refer to page 27 for lead wire length.

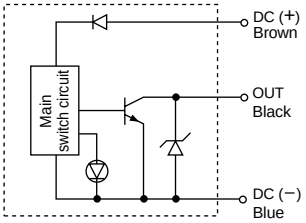
Auto Switch Weights

Unit: g

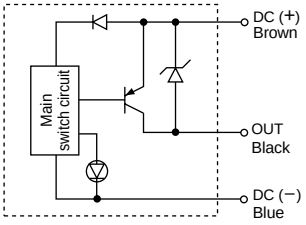
Model		D-F9N(V)	D-F9P(V)	D-F9B(V)
Lead wire length (m)	0.5	7	7	6
	3	37	37	31
	5	61	61	51

Auto Switch Internal Circuits

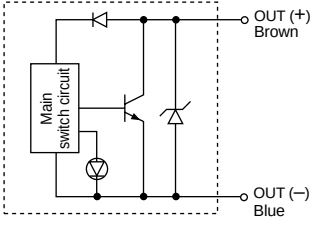
D-F9N, F9NV



D-F9P, F9PV

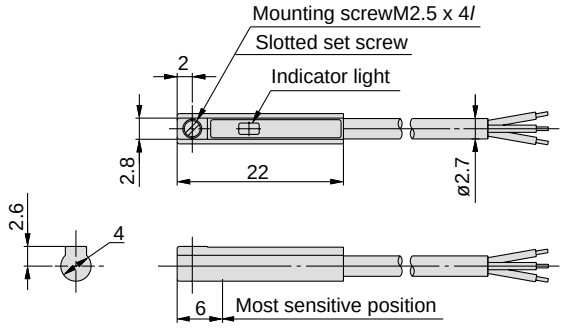


D-F9B, F9BV

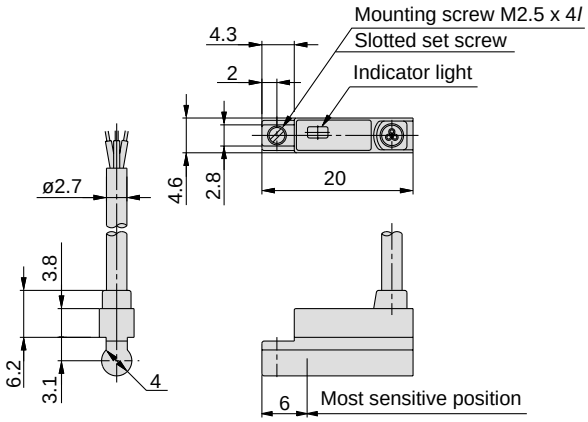


Auto Switch Dimensions

D-F9□

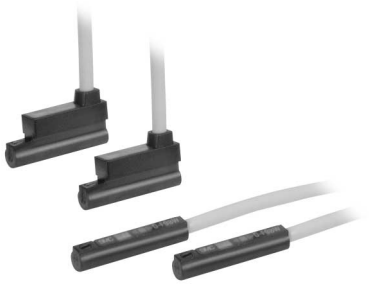


D-F9□V



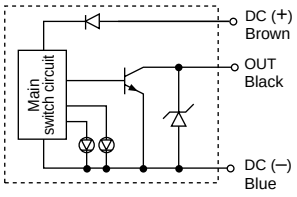
2-color Display
Solid State Switches/Direct Mounting Type
D-F9NW(V), D-F9PW(V), D-F9BW(V)

Grommet

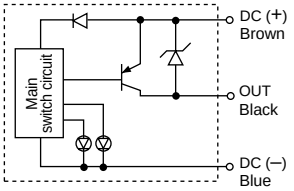


Auto Switch Internal Circuits

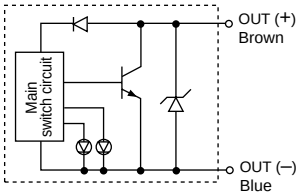
D-F9NW, F9NWV



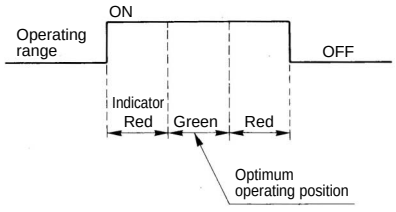
D-F9PW, F9PWV



D-F9BW, F9BWV



Indicator light/Display method



Auto Switch Specifications

D-F9□W, D-F9□WV (with indicator light)						
Auto switch part no.	D-F9NW	D-F9NWV	D-F9PW	D-F9PWV	D-F9BW	D-F9BWV
Electrical entry direction	In-line	Perpendicular	In-line	Perpendicular	In-line	Perpendicular
Wiring type	3 wire				2 wire	
Output type	NPN		PNP		–	
Applicable load	IC circuit, Relay, PLC				24VDC relay, PLC	
Power supply voltage	5, 12, 24VDC (4.5 to 28V)				–	
Current consumption	10mA or less				–	
Load voltage	28VDC or less		–		24VDC (10 to 28VDC)	
Load current	40mA or less		80mA or less		5 to 40mA	
Internal voltage drop	1.5V or less (0.8V or less at 10mA load current)		0.8V or less		4V or less	
Leakage voltage	100μA or less at 24VDC				0.8mA or less	
Indicator light	Actuated position.....Red LED light up Optimum operating position.....Green LED light up					

●Lead wire – Oil proof heavy duty vinyl cable, ø2.7, 0.15mm² x 3 cores (brown, black, blue), 0.18mm² x 2 cores (brown, blue), 0.5m

Note 1) Refer to page 27 for solid state switch common specifications.

Note 2) Refer to page 27 for lead wire length.

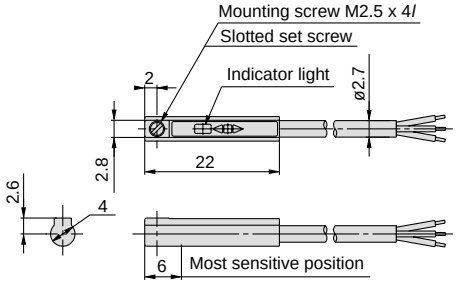
Auto Switch Weights

Unit: g

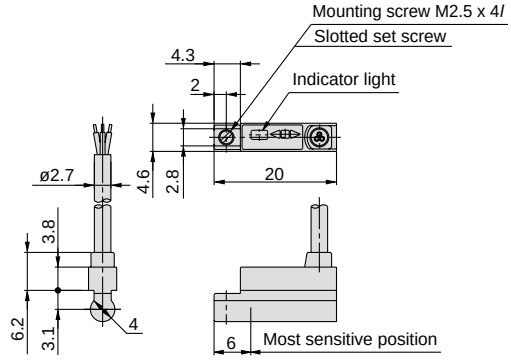
Model		D-F9NW(V)	D-F9PW(V)	D-F9BW(V)
Lead wire length (m)	0.5	7	7	7
	3	34	34	32
	5	56	56	52

Auto Switch Dimensions

D-F9□W



D-F9□WV



SMC

Solid State Switches/Direct Mounting Type
D-F8N, D-F8P, D-F8B

Grommet

⚠Caution

Precautions

When securing the switch, be sure to use the fixing screws attached to the auto switch body. The switch may be damaged if screws other than specified ones are used.

Auto Switch Specifications

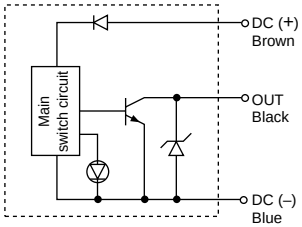
Auto switch part no.	D-F8N	D-F8P	D-F8B
Electrical entry direction	Perpendicular	Perpendicular	Perpendicular
Wiring type	3-wire		2-wire
Output type	NPN	PNP	–
Applicable load	IC circuit, 24VDC relay, PLC		24VDC relay, PLC
Power supply voltage	5, 12, 24VDC (4.5 to 28V)		–
Current consumption	10mA or less		–
Load voltage	28VDC or less	–	24V DC (10 to 28V)
Load current	40mA or less	80mA or less	2.5 to 40mA
Internal voltage drop	1.5V or less (0.8V or less at 10mA load current)	0.8V or less	4V or less
Leakage current	100μA or less at 24VDC		0.8mA or less at 24VDC
Indicator light	Red LED light when ON		

●Lead wire — Heavy duty oil resistant vinyl cable, ø2.7,0.5m
D-F8N, D-F8P 0.15mm² x 3 wire (Brown, Black, Blue)
D-F8B 0.18mm² x 2 wire (Brown,Blue)

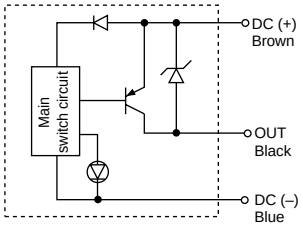
Note 1) Refer to page 27 for solid state switch common specifications.
Note 2) Refer to page 27 for lead wire length.

Auto Switch Internal Circuits

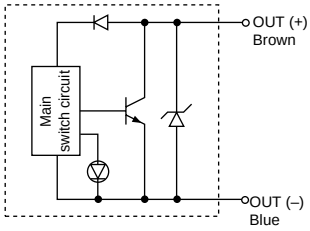
D-F8N



D-F8P



D-F8B



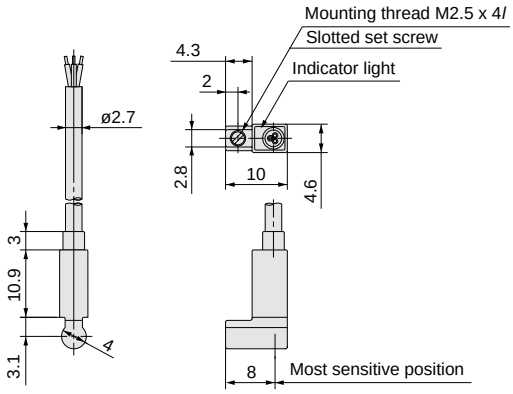
Auto Switch Weights

Unit: g

Model		D-F8N	D-F8P	D-F8B
Lead wire length (m)	0.5	7	7	7
	3	32	32	32
	5	52	52	52

Auto Switch Dimensions

D-F8N, D-F8P, D-F8B



Series MSQ
Safety Instructions

These safety instructions are intended to prevent a hazardous situation and/or equipment damage. These instructions indicate the level of potential hazard by a label of **"Caution", "Warning" or "Danger"**. To ensure safety, be sure to observe ISO 4414 Note 1), JIS B 8370 Note 2) and other safety practices.

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

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

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

Note 1) ISO 4414 : Pneumatic fluid power – Recommendations for the application of equipment to transmission and control systems.

Note 2) JIS B 8370 : General Rules for Pneumatic Equipment

⚠ Warning

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

Since the products specified here are used in various operating conditions, their compatibility for the specific pneumatic system must be based on specifications or after analysis and/or tests to meet your specific requirements.

2. Only trained personnel should operate pneumatically operated machinery and equipment.

Compressed air can be dangerous if an operator is unfamiliar with it. Assembly, handling or repair of pneumatic systems should be performed by trained and experienced operators.

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

1. Inspection and maintenance of machinery/equipment should only be performed after confirmation of safe locked-out control positions.
2. When equipment is to be removed, confirm the safety process as mentioned above. Cut the supply pressure for this equipment and exhaust all residual compressed air in the system.
3. Before machinery/equipment is restarted, take measures to prevent shooting-out of cylinder piston rod, etc. (Bleed air into the system gradually to create back pressure.)

4. Contact SMC if the product is to be used in any of the following conditions:

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

Series MSQ
Rotary Table Precations 1

Be sure to read before handling.

Design

⚠ Warning

1. **If the case involves load fluctuations, lifting or lowering operations or changes in frictional resistance, employ a safety design which allows for these factors.**
   Increases in operating speed can cause human injury as well as damage to equipment and machinery.
2. **Install a protective cover when there is a risk of human injury.**
   If a driven object and moving parts of a cylinder pose a danger of human injury, design the structure to avoid contact with the human body.
3. **Securely tighten all stationary parts and connected parts so that they will not become loose.**
   Especially when a cylinder operates with high frequency or is installed where there is a lot of vibration, ensure that all parts remain secure.
4. **A deceleration circuit or shock absorber, etc., may be required.**
   When a driven object is operated at high speed or the load is heavy, a cylinder's cushion will not be sufficient to absorb the impact. Install a deceleration circuit to reduce the speed before cushioning, or install an external shock absorber to relieve the impact. In this case, the rigidity of the machinery should also be examined.
5. **Consider a possible drop in operating pressure due to a power outage, etc.**
   When a cylinder is used in a clamping mechanism, there is a danger of work piece dropping if there is a decrease in clamping force due to a drop in circuit pressure caused by a power outage, etc. Therefore, safety equipment should be installed to prevent damage to machinery and/or human injury.
6. **Consider a possible loss of power source.**
   Measures should be taken to protect against human injury and equipment damage in the event that there is a loss of power to equipment controlled by air pressure, electricity or hydraulics, etc.
7. **When a speed controller is mounted on an exhaust throttle, employ a safety design which considers residual pressure.**
   If the air supply side is pressurized when there is no residual pressure on the exhaust side, operation will be abnormally fast and this can cause human injury as well as damage to equipment and machinery.
8. **Consider emergency stops.**
   Design so that human injury and/or damage to machinery and equipment will not be caused by operation of a rotary actuator when machinery is stopped by a safety device under abnormal conditions, a power outage or a manual emergency stop.
9. **Consider the action when operation is restarted after an emergency stop or abnormal stop.**
   Design the machinery so that human injury or equipment damage will not occur upon restart of operation. When the rotary actuator has to be reset at the starting position, install safe manual control equipment.
10. **Do not use the product as a shock absorbing mechanism.**
    If abnormal pressure or air leakage occurs, there may be a drastic loss of deceleration effectiveness, leading to a danger of human injury as well as damage to equipment and machinery.

Selection

⚠ Warning

1. **Keep the speed setting within the product's allowable energy value.**
   Operation with the kinetic energy of the load exceeding the allowable value can cause damage to the product, leading to human injury as well as damage to equipment and machinery.
2. **Provide a shock absorbing mechanism when kinetic energy applied to the product exceeds the allowable value.**
   Operation exceeding the allowable kinetic energy can cause damage to the product and lead to human injury and damage to equipment and machinery.
3. **Do not perform stops or holding operations by containing air pressure inside the product.**
   If intermediate stops are performed by containing air with a directional control valve when the product does not have an external stopping mechanism, the stopping position may not be held due to leakage, etc. This can cause human injury and damage to equipment and machinery.

⚠ Caution

1. **Do not operate the product at low speeds which are below the prescribed speed adjustment range.**
   If operated at low speeds below the speed adjustment range, this may cause sticking and slipping or stopping of operation.
2. **Do not apply external torque exceeds the product's rated output.**
   If external force is applied which exceeds the product's rated output, the product can be damaged.
3. **Rotation end holding torque for double piston type.**
   With a double piston type product, if the internal piston is stopped by contact with the angle adjustment screw or cover, the holding torque at the rotation end is half the effective output.
4. **When repeatability of the rotation angle is required, the load should be directly stopped externally.**
   The initial rotation angle may vary even in products equipped with angle adjustment.
5. **Avoid operation with oil hydraulics**
   Operation with oil hydraulics can cause damage to the product.

Series MSQ
Rotary Table Precations 2

Be sure to read before handling.

Mounting

⚠ Warning

1. When angle adjustment is performed while applying pressure, make advance preparations to keep equipment from rotating any more than necessary.

When adjustment is performed with pressure applied, there is a possibility of rotation and dropping during adjustment depending on the mounting position of the equipment, etc. This can cause human injury and damage to equipment and machinery.

2. Do not loosen the angle adjustment screw above the adjustment range.

If the angle adjustment screw is loosened above the adjustment range, it may come out causing human injury and damage to equipment and machinery.

3. Do not allow external magnetism close to the product.

Since the auto switches used are types sensitive to magnetism, external magnetism in close proximity to the product can cause malfunction leading to human injury and damage to equipment and machinery.

4. Do not perform additional machining to the product.

Additional machining of the product can result in insufficient strength and cause damage to the product leading to human injury and damage to equipment and machinery.

5. Do not enlarge the fixed throttle on the piping port by reworking, etc.

If the bore is enlarged, rotation speed and impact force will increase, which can cause damage to the product leading to human injury and damage to equipment and machinery.

6. When using a shaft coupling, use one with a sufficient degree of freedom.

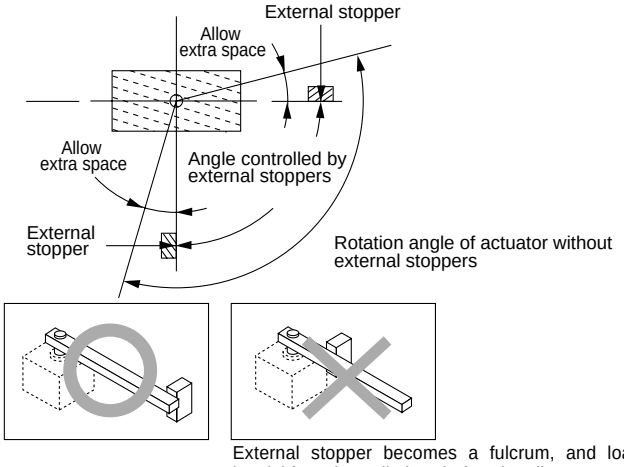
If a shaft coupling is used which does not have a sufficient degree of freedom, twisting will occur due to eccentricity, and this can cause malfunction and product damage leading to human injury and damage to equipment and machinery.

7. Do not apply loads to the rotary table exceeding the values shown on page 2 .

If loads exceeding the allowable values are applied to the product, this can cause malfunction and product damage leading to human injury and damage to equipment and machinery.

Precautions when using external stoppers

When the kinetic energy generated by the load exceeds the limit value of the actuator, an external shock absorbing mechanism must be provided to absorb the energy. The correct method for mounting external stopper is explained in the figure below.



External stopper becomes a fulcrum, and load's inertial force is applied to shaft as bending moment.

⚠ Caution

1. Do not secure the body and strike the rotary table or secure the rotary table and strike the body, etc.

This can bend the rotary table and cause damage to the bearing. When installing a load, etc., on the rotary table, secure the rotary table.

2. Do not step directly on the rotary table or the equipment installed on the rotary table.

Stepping directly on the rotary table can cause damage to the rotary table and bearing, etc.

3. Operate products equipped with the angle adjustment function within the prescribed adjustment range.

Operation outside the adjustment range can cause malfunction and product damage. Refer to product specifications for the adjustment range of each product.

4. When connecting pipes, thoroughly clean the pipes and fittings by blowing with clean air.

5. When screwing together pipes and fittings, etc., be certain that chips from the pipe threads and sealing material do not get inside the piping.

Also, when a pipe tape is used, leave 1.5 to 2 thread ridges exposed at the end of the threads.

Air Supply

⚠ Warning

1. Use clean air.

Do not use compressed air which includes chemicals, synthetic oils containing organic solvents, salt or corrosive gases, etc., as it can cause damage or malfunction.

⚠ Caution

1. Install air filters.

Install air filters at the upstream side of valves. The rated filtration should be 5μm or finer.

2. Install an after cooler, air dryer or water separator, etc.

Air that includes excessive drainage may cause malfunction of rotary actuators and other pneumatic equipment. To prevent this, install an after cooler air dryer or water separator, etc.

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

Take measures to prevent freezing, since moisture in circuits may be frozen under 5°C, and this can cause damage to seals and lead to malfunction.

Refer to SMC's "Best Pneumatic vol.3" catalog for further details on compressed air quality.

Series MSQ
Rotary Table Precations 3

Be sure to read before handling.

Operating Environment

⚠Warning

1. Do not use in environments where there is a danger of corrosion.
Refer to the construction drawings regarding rotary actuator materials.

2. Do not use in dusty locations or where water and oil, etc., splash on the equipment.

Speed Adjustment

⚠Warning

1. Perform speed adjustment gradually from the low speed side.
Speed adjustment from the high speed side can cause product damage leading to human injury and damage to equipment an machinery.

⚠Caution

1. When operating at high speed with a large load weight, a large amount of energy is applied to the actuator and can cause damage.
Refer to the model selection on page 1 to find the proper operating time.

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 and cause damage.

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.

Maintenance

⚠Warning

1. Maintenance should be performed according to the procedure indicated in the instruction manual. Improper handling can cause damage and malfunction of equipment and machinery.

2. During maintenance, do not disassemble while the electric power and supply air are turned ON.

3. Conduct suitable function tests after the product has been disassembled for maintenance.
Failure to test functions can result in inability to satisfy the product specifications.

Maintenance

⚠Caution

1. For lubrication use the grease specified for each product.
Use of a lubricant other than that specified can cause damage to seals, etc.

Rotation Adjustment

⚠Caution

1. As a standard feature, the rotary table is equipped with a rotation adjustment screw (adjustment bolt or shock absorber) that can be used to adjust the rotation. The table below shows the rotation adjustment per single rotation of the rotation adjustment screw.
Please refer to following pages for the rotation direction, rotation angle and rotation angle range.
MSQ size1 to 7 → page 9
MSQ size10 to 200 → page 15
MSQ with external shock absorber → page 23

With adjustment bolt, With external shock absorber

Size	Rotation adjustment per single rotation of rotation adjustment screw
1	8.2°
2	10.0°
3	10.9°
7	10.2°
10	10.2°
20	7.2°
30	6.5°
50	8.2°
70	7.0°
100	6.1°
200	4.9°

With external shock absorber

Size	Rotation adjustment per single rotation of rotation adjustment screw
10	1.4°
20	1.2°
30	1.1°
50	1.3°

The rotation adjustment range for the external shock absorber is ±3° at each rotation end. When adjusted beyond this range, note that the shock absorber's durability may decrease.

2. Series MSQ is equipped with a rubber bumper or shock absorber. Therefore, perform rotation adjustment in the pressurized condition (minimum operation pressure: 0.1MPa or more for adjustment bolt and internal shock absorber types, and 0.2MPa or more for external shock absorber type.)

Series MSQ
Rotary Table Precations 4

Be sure to read before handling.

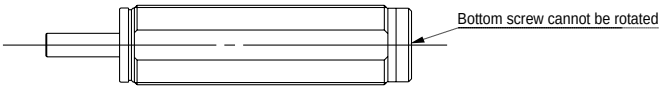
Shock Absorber

⚠Caution

1. Refer to the table below for tightening torques of the shock absorber setting nut.

Size	10	20	30	50	70	100	200
Tightening torque N · m	1.67	3.14		10.8	23.5		62.8

2. Never rotate the bottom screw of the shock absorber. (It is not an adjustment screw.) This may cause oil leakage.



3. When rotation of the rotary table with internal shock absorber is set at a value smaller than the table below, the piston stroke becomes smaller than the shock absorber's effective stroke and energy absorption capacity decreases.

Size	10	20	30	50	70	100	200
Minimum rotation without energy absorption capacity decrease	52°	43°	40°	60°	71°	62°	82°

4. Products with shock absorber are not designed to smooth movement after collision into the shock absorber but to absorb the kinetic energy of the load. If the load has to be stopped smoothly, a shock absorber of the optimum size meeting the operating conditions must be installed external to the equipment.

5. Shock absorbers are consumable parts. When a decrease in energy absorption capacity is noticed, it must be replaced.

With internal shock absorber

Size	Shock absorber model
10	RBA0805-X692
20	RBA1006-X692
30	
50	RBA1411-X692
70	RBA2015-X821
100	
200	RBA2725-X821

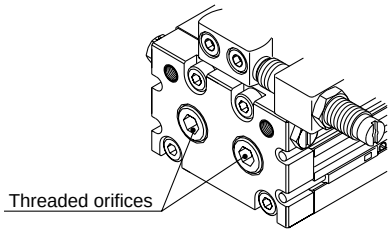
With external shock absorber

Size	Type	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

External Shock Absorber

⚠Caution

The threaded orifices shown below are not connecting ports. Never remove the plugs as this will cause malfunction.



Speed Controller and Fittings

⚠Caution

Size 1, 2, and 3 use M3 x 0.5 piping ports. When connecting a speed controller or fittings directly, use the following series.

- Speed controller
  AS12□1F/Elbow type
  AS13□1F/Universal type
- One-touch fitting
  One-touch miniature fittings Series KJ
- Miniature fittings Series M3

Auto switch

⚠Caution

In case of sizes 1, 2, 3 and 7, when 2 pieces of auto switches are installed in one switch groove, the minimum detectable rotation angles are as follows.

Size	Minimum detectable rotation
1	25°
2	25°
3	20°
7	20°

Maintenance and Inspection

⚠Caution

Because sizes 1, 2, 3 and 7 require special tools, they cannot be disassembled.
Because sizes 10, 20, 30 and 50 have the table press fit into an angular type bearing, they cannot be disassembled.

Series MSQ
Auto Switch Precations 1

Be sure to read before handling.

Design and Selection

⚠Warning

1. Confirm the specifications.

Read the specifications carefully and use this product appropriately. The product may be damaged or malfunction if it is used outside the range of specifications for current load, voltage, temperature or impact.

2. Take precautions when multiple cylinders are used close together.

When multiple auto switch cylinders are used in close proximity, magnetic field interference may cause the switches to malfunction. Maintain a minimum cylinder separation of 40mm. (When the allowable separation is indicated for each cylinder series, use the specified value.)

3. Pay attention to the length of time that a switch is ON at an intermediate stroke position.

When an auto switch is placed at an intermediate position of the stroke and a load is driven at the time the piston passes, the auto switch will operate, but if the speed is too great the operating time will be shortened and the load may not operate properly. The maximum detectable piston speed is:

$$V\ (mm/s) = \frac{\text{Auto switch operating range (mm)}}{\text{Load operating time (ms)}} \times 1000$$

4. Keep wiring as short as possible.

<Reed switch>

As the length of the wiring to a load gets longer, the rush current at switching ON becomes greater, and this may shorten the product's life. (The switch will stay ON all the time.)

1) For an auto switch without a contact protection circuit, use a contact protection box when the wire length is 5m or longer.
2) Even if an auto switch has a built-in contact protection circuit, when the wiring is more than 30m long, it is not able to adequately absorb the rush current and its life may be reduced. It is again necessary to connect a contact protection box in order to extend its life. Please contact SMC in this case.

<Solid state switch>

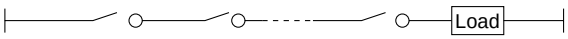
3) Although wire length does not affect switch function, use wiring 100 m or shorter.

5. Take precautions for the internal voltage drop of the switch.

<Reed switch>

1) Switches with an indicator light (Except D-A96, A96V)

- If auto switches are connected in series as shown below, take note that there will be a large voltage drop because of internal resistance in the light emitting diodes. (Refer to internal voltage drop in the auto switch specifications.)
  [The voltage drop will be "n" times larger when n auto switches are connected.]
  Even though an auto switch operates normally, the load may not operate.



- In the same way, when operating under a specified voltage, although an auto switch may operate normally, the load may not operate. Therefore, the formula below should be satisfied after confirming the minimum operating voltage of the load.

$$\text{Supply voltage} - \text{Internal voltage drop of switch} > \text{Minimum operating voltage of load}$$

2) If the internal resistance of a light emitting diode causes a problem, select a switch without an indicator light (Model A90, A90V).

<Solid state switch>

3) Generally, the internal voltage drop will be greater with a 2-wire solid state auto switch than with a reed switch. Take the same precautions as in 1).
   Also, note that a 12VDC relay is not applicable.

6. Pay attention to leakage current.

<Solid state switch>

With a 2-wire solid state auto switch, current (leakage current) flows to the load to operate the internal circuit even when in the OFF state.

Operating current of load (OFF condition) > Leakage current

If the criteria given by the above formula are not met, it will not reset correctly (stays ON). Use a 3-wire switch if this specification will not be satisfied.
Moreover, leakage current flow to the load will be "n" times larger when "n" auto switches are connected in parallel.

7. Do not use a load that generates surge voltage.

<Reed switch>

If driving a load such as a relay that generates a surge voltage, use a switch with a built-in contact protection circuit or use a contact protection box.

<Solid state switch>

Although a zener diode for surge protection is connected at the output side of a solid state auto switch, damage may still occur if the surge is applied repeatedly. When a load, such as a relay or solenoid valve, which generates surge is directly driven, use a type of switch with a built-in surge absorbing element.

8. Cautions for use in an interlock circuit

When an auto switch is used for an interlock signal requiring high reliability, devise a double interlock system to avoid trouble by providing a mechanical protection function, or by also using another switch (sensor) together with the auto switch. Also perform periodic maintenance and confirm proper operation.

9. Ensure sufficient clearance for maintenance activities.

When designing an application, be sure to allow sufficient clearance for maintenance and inspections.

Series MSQ
Auto Switch Precautions 2
Be sure to read before handling.

Mounting and Adjustment

⚠Warning

1. Do not drop or bump.
Do not drop, bump or apply excessive impacts (300m/s^2 or more for reed switches and 1000m/s^2 or more for solid state switches) while handling.
Although the body of the switch may not be damaged, the inside of the switch could be damaged and cause a malfunction.

2. Do not carry a cylinder by the auto switch lead wires.
Never carry a cylinder by its lead wires. This may not only cause broken lead wires, but it may cause internal elements of the switch to be damaged by the stress.

3. Mount switches using the proper tightening torque.
When a switch is tightened beyond the range of tightening torque, the mounting screws mounting bracket or switch may be damaged. On the other hand, tightening below the range of tightening torque may allow the switch to slip out of position.

4. Mount a switch at the center of the operating range.
Adjust the mounting position of an auto switch so that the piston stops at the center of the operating range (the range in which a switch is ON). (The mounting positions shown in the catalog indicate the optimum positions at stroke end.) If mounted at the end of the operating range (around the borderline of ON and OFF), operation may be unstable.

Wiring

⚠Warning

1. Avoid repeatedly bending or stretching lead wires.
Broken lead wires will result from repeatedly applying bending stress or stretching force to the lead wires.

2. Be sure to connect the load before power is applied.
<2-wire type>
If the power is turned ON when an auto switch is not connected to a load, the switch will be instantly damaged because of excess current.

3. Confirm proper insulation of wiring.
Be certain that there is no faulty wiring insulation (contact with other circuits, ground fault, improper insulation between terminals, etc.). Damage may occur due to excess current flow into a switch.

4. Do not wire with power lines or high voltage lines.
Wire separately from power lines or high voltage lines, avoiding parallel wiring or wiring in the same conduit with these lines. Control circuits containing auto switches may malfunction due to noise from these other lines.

Wiring

⚠Warning

5. Do not allow short circuit of loads.
<Reed switch>
If the power is turned ON with a load in a short circuit condition, the switch will be instantly damaged because of excess current flow into the switch.
<Solid state switch>
Model D-F9□(V), F9□W(V) and all models of PNP output type switches do not have built-in short circuit protection circuits. If loads are short circuited, the switches will be instantly damaged, as in the case of reed switches.
Take special care to avoid reverse wiring with the brown [red] power supply line and the black [white] output line on 3-wire type switches.

6. Avoid incorrect wiring.
<Reed switch>
A 24VDC switch with indicator light has polarity. The brown [red] lead wire or terminal no. 1 is (+), and the blue [black] lead wire or terminal no. 2 is (−).
1) If connections are reversed, a switch will operate, however, the light emitting diode will not light up.
   Also note that a current greater than that specified will damage a light emitting diode and it will no longer operate.
   Applicable models: D-A93, A93V

<Solid state switch>
1) If connections are reversed on a 2-wire type switch, the switch will not be damaged if protected by a protection circuit, but the switch will be in a normally ON state.
   However, note that the switch will be damaged if reversed connections are made while the load is in a short circuited condition.
2) If connections are reversed (power supply line + and power supply line −) on a 3-wire type switch, the switch will be protected by a protection circuit. However, if the power supply line (+) is connected to the blue [black] wire and the power supply line (−) is connected to the black [white] wire, the switch will be damaged.

∗ Lead wire color changes
Lead wire colors of SMC switches have been changed in order to meet NECA Standard 0402 for production beginning September, 1996 and thereafter. Please refer to the tables provided.
Special care should be taken regarding wire polarity during the time that the old colors still coexist with the new colors.

2-wire

	Old	New
Output (+)	Red	Brown
Output (−)	Black	Blue

3-wire

	Old	New
Power supply	Red	Brown
GND	Black	Blue
Output	White	Black

Solid state with diagnostic output

	Old	New
Power supply	Red	Brown
GND	Black	Blue
Output	White	Black
Diagnostic output	Yellow	Orange

Solid state with latch type diagnostic output

	Old	New
Power supply	Red	Brown
GND	Black	Blue
Output	White	Black
Latch type diagnostic output	Yellow	Orange

Series MSQ
Auto Switch Precautions 3
Be sure to read before handling.

Operating Environment

⚠Warning

1. Never use in an atmosphere of explosive gases.

The structure of auto switches is not intended to prevent explosion. Never use in an atmosphere with an explosive gas since this may cause a serious explosion.

2. Do not use in an area where a magnetic field is generated.

Auto switches will malfunction or magnets inside cylinders will become demagnetized. (Consult SMC regarding the availability of a magnetic field resistant auto switch.)

3. Do not use in an environment where the auto switch will be continually exposed to water.

Although switches, except for some models, satisfy IEC standard IP67 construction (JIS C 0920: watertight construction), do not use switches in applications where continually exposed to water splash or spray. Poor insulation or swelling of the potting resin inside switches may cause malfunction.

4. Do not use in an environment with oil or chemicals.

Consult SMC if auto switches will be used in an environment with coolant, cleaning solvent, various oils or chemicals. If auto switches are used under these conditions for even a short time, they may be adversely affected by improper insulation, malfunction due to swelling of the potting resin, or hardening of the lead wires.

5. Do not use in an environment with temperature cycles.

Consult SMC if switches are used where there are temperature cycles other than normal temperature changes, as they may be adversely affected internally.

6. Do not use in environment where there is excessive impact shock.

<Reed switch>

When excessive impact (300m/s^2 or more) is applied to a reed switch during operation, the contact will malfunction and generate or cut off a signal momentarily (1ms or less). Consult SMC regarding the need to use a solid state switch depending upon the environment.

7. Do not use in an area where surges are generated.

<Solid state switch>

When there are units (solenoid type lifter, high frequency induction furnace, motor, etc.) which generate a large amount of surge in the area around cylinders with solid state auto switches, this may cause deterioration or damage to internal circuit elements of the switch. Avoid sources of surge generation and crossed lines.

8. Avoid accumulation of iron debris or close contact with magnetic substances.

When a large amount of ferrous debris such as machining chips or welding spatter is accumulated, or a magnetic substance (something attracted by a magnet) is brought into close proximity with an auto switch cylinder, it may cause auto switches to malfunction due to a loss of the magnetic force inside the cylinder.

Maintenance

⚠Warning

1.Perform the following maintenance periodically in order to prevent possible danger due to unexpected auto switch malfunction.

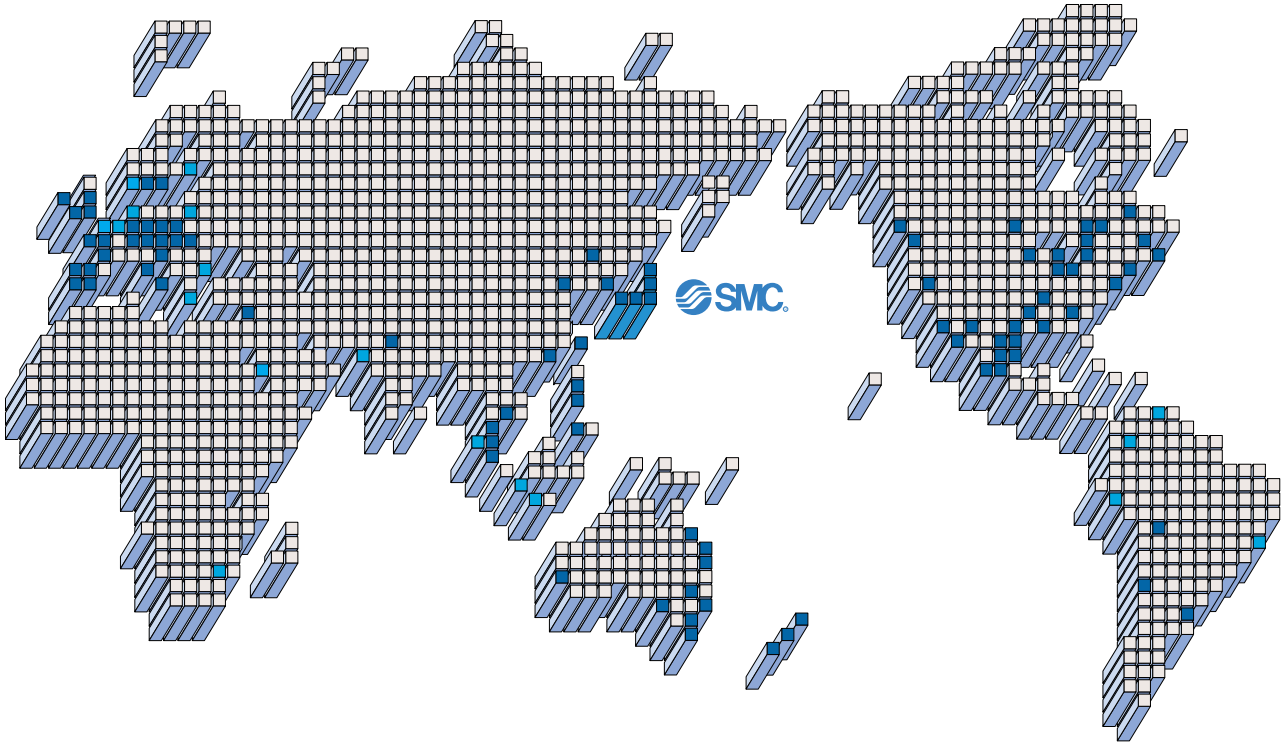
1) Securely tighten switch mounting screws.
   If screws become loose or the mounting position is dislocated, retighten them after readjusting the mounting position.
2) Confirm that there is no damage to lead wires.
   To prevent faulty insulation, replace switches or repair lead wires, etc., if damage is discovered.
3) Confirm the lighting of the green light on a 2-color display type switch.
   Confirm that the green LED is on when stopped at the established position. If the red LED is on, the mounting position is not appropriate. Readjust the mounting position until the green LED lights up.

Other

⚠Warning

1. Consult SMC concerning water resistance, elasticity of lead wires and usage at welding sites, etc.

SMC'S GLOBAL MANUFACTURING, DISTRIBUTION AND SERVICE NETWORK



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