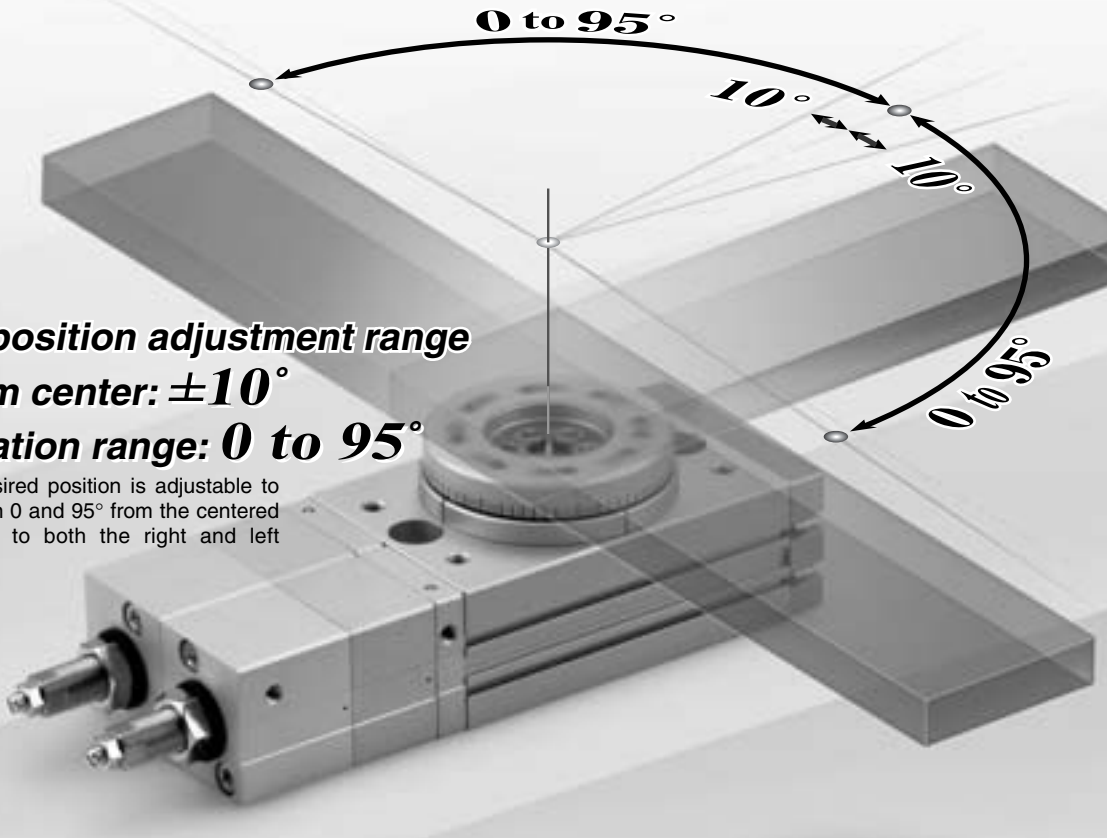
3-Position Rotary Table

Series MSZ



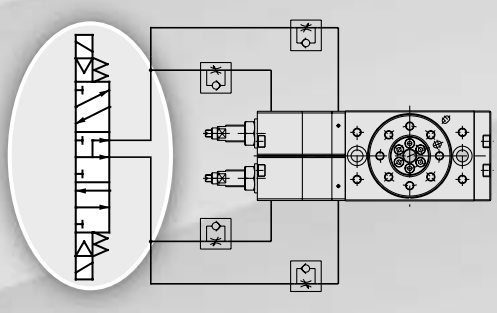
Stop position adjustment range

- **From center: ±10°**
- **Rotation range: 0 to 95°**

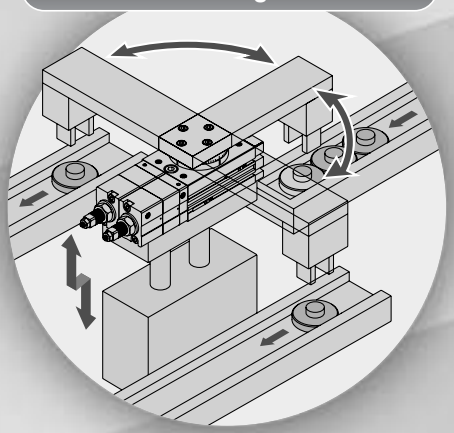
The desired position is adjustable to between 0 and 95° from the centered position to both the right and left sides.

Can be operated by a single valve.

Controllable with one 3-position solenoid valve.

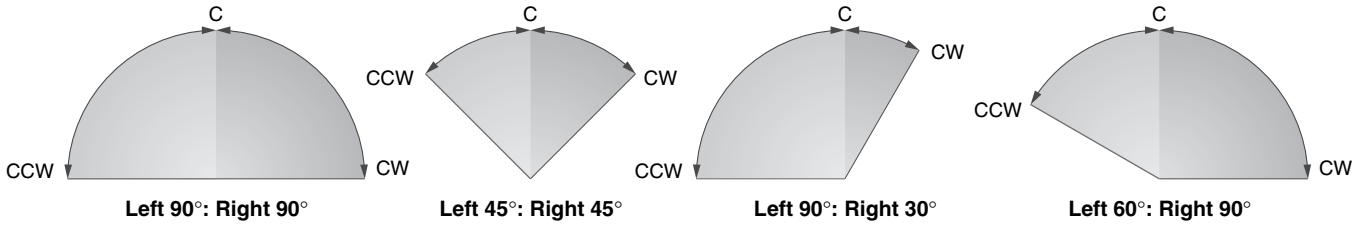


Sorts work to the right or left side



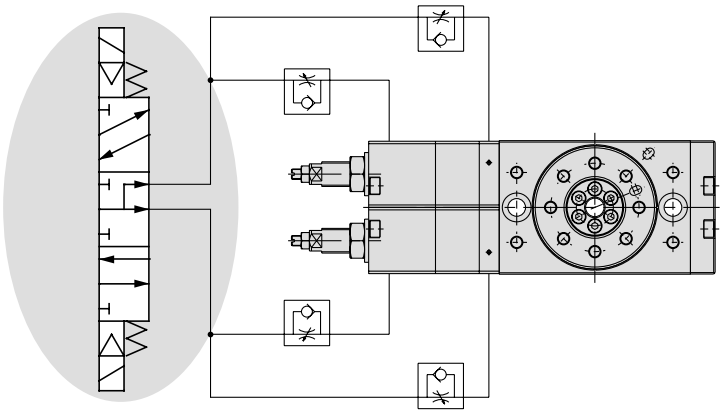
■Example of Stop Position Settings

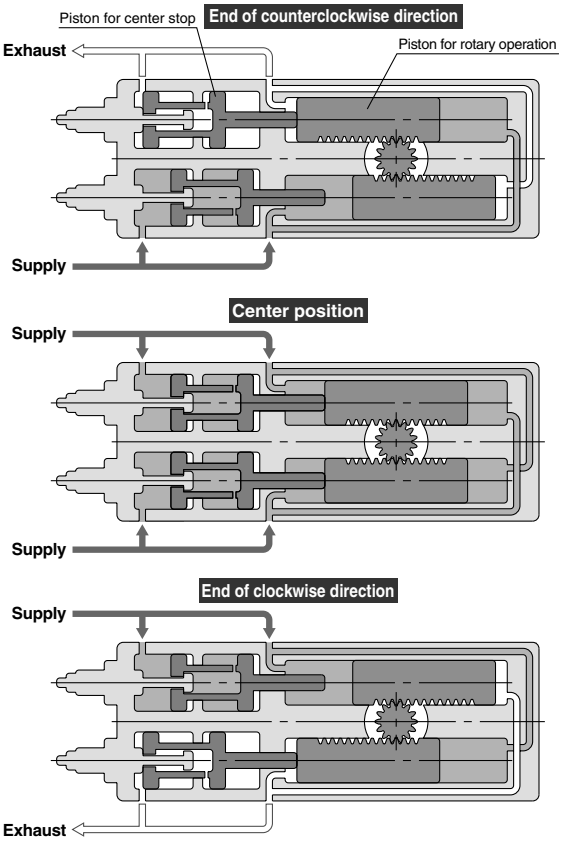
Angle adjustable as shown below. (CCW: Counterclockwise, C: Center, CW: Clockwise)



■Working Principle

This model uses a 3-position 5-port solenoid valve (pressure center). When air is supplied to all ports after the solenoid valve is pressure-center positioned, the pistons for rotary operation do not have any thrust, as the pressure in both sides is equal, and the pistons for rotary operation move to the center position due to the thrust of the pistons for center stop. When all of the pistons (center stop and rotary operation) are in contact with each other, the piston system stops.

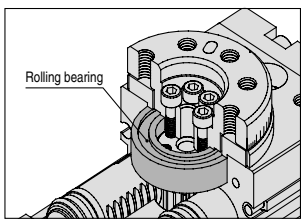




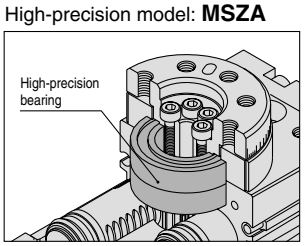
■A load can be mounted directly on the table.

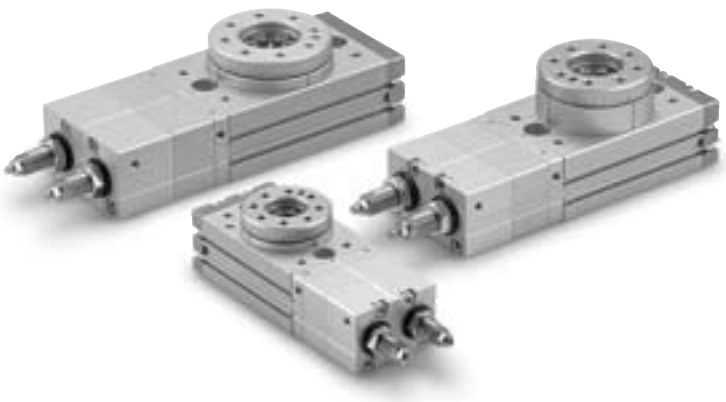
■A High-precision model is also available in addition to the basic model.

Basic model: **MSZB**



High-precision model: **MSZA**





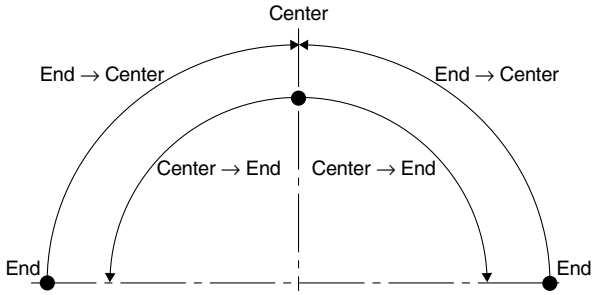
Model	Size	Torque (N·m) (at 0.5 MPa)	Port size
Basic **MSZB** High-precision **MSZA**	10	1	M5 x 0.8
	20	2	
	30	3	
	50	5	

Effective Torque

Unit: N·m

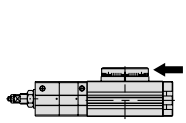
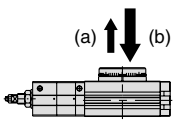
Size	Operating direction	Operating pressure (MPa)								
		0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
10	End→Center	0.38	0.60	0.83	1.06	1.28	1.51	1.73	1.96	2.18
	Center→End	0.29	0.50	0.70	0.90	1.10	1.30	1.51	1.71	1.91
20	End→Center	0.72	1.14	1.55	1.97	2.39	2.81	3.22	3.64	4.06
	Center→End	0.62	1.01	1.40	1.78	2.17	2.56	2.95	3.34	3.73
30	End→Center	1.09	1.72	2.36	3.00	3.63	4.27	4.90	5.54	6.18
	Center→End	0.91	1.49	2.07	2.65	3.23	3.81	4.39	4.97	5.55
50	End→Center	1.83	2.83	3.84	4.84	5.84	6.85	7.85	8.85	9.85
	Center→End				4.75	5.74	6.74	7.73	8.72	9.72

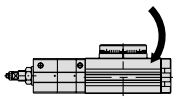
Note) Effective torque values are representative values and not to be considered as guaranteed values.
Torque changes depending on the rotating direction. Please refer to the figure below for the rotating directions.



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.)

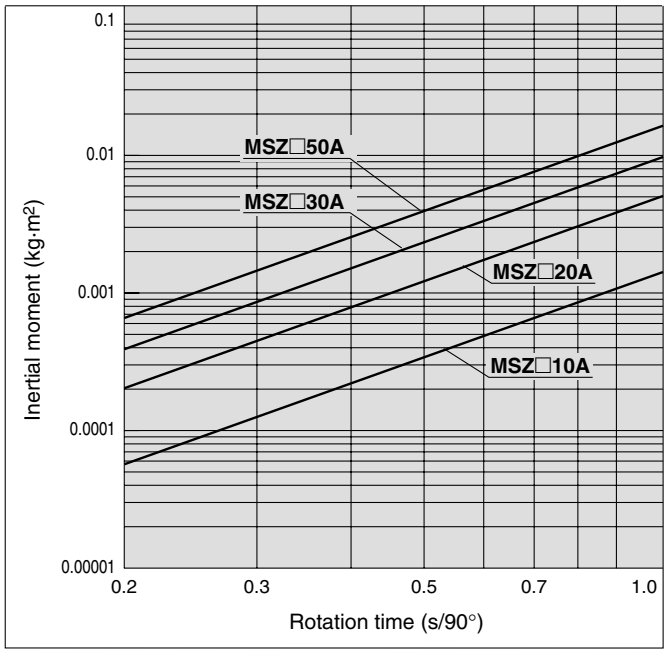





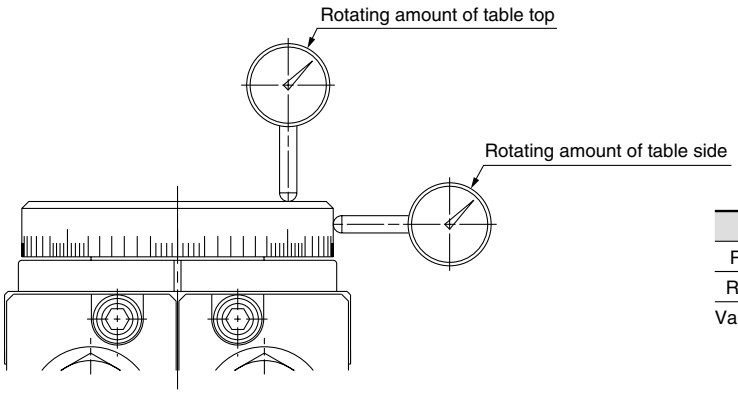
Size	Allowable radial load (N)		Allowable thrust load (N)				Allowable moment (N·m)	
			(a)		(b)			
	Basic type	High precision type	Basic type	High precision type	Basic type	High precision type	Basic type	High precision type
10	78	86	74	74	78	107	2.4	2.9
20	147	166	137	137	137	197	4.0	4.8
30	196	233	197	197	363	398	5.3	6.4
50	314	378	296	296	451	517	9.7	12.0

Kinetic Energy/Rotation Time

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



Rotation Accuracy: Displacement Values at 180° (Reference values)



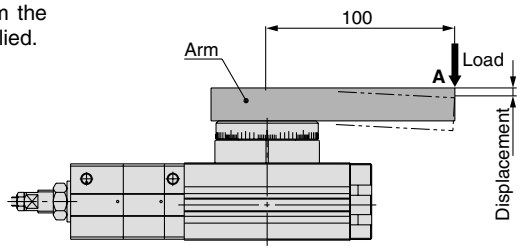
mm

Measuring plate	MSZA	MSZB
Rotating amount of table top	0.03	0.1
Rotating amount of table side	0.03	0.1

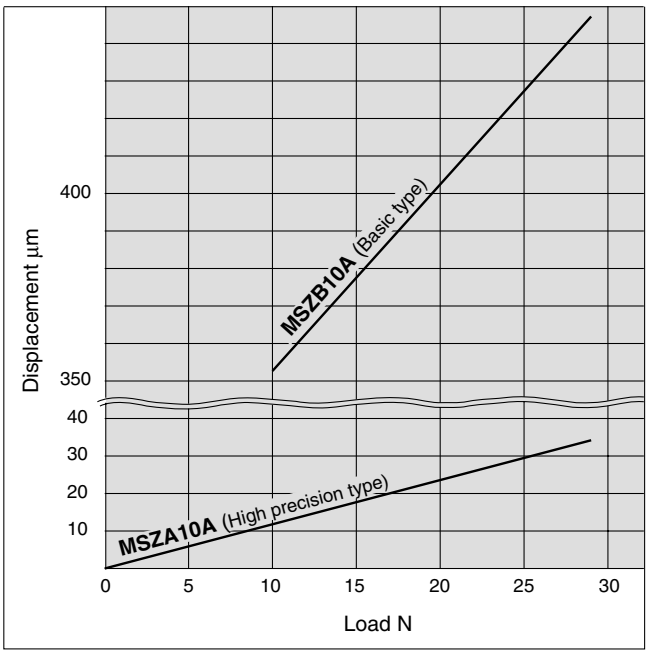
Values in the table are actual values and not guaranteed values.

Table Displacement (Reference values)

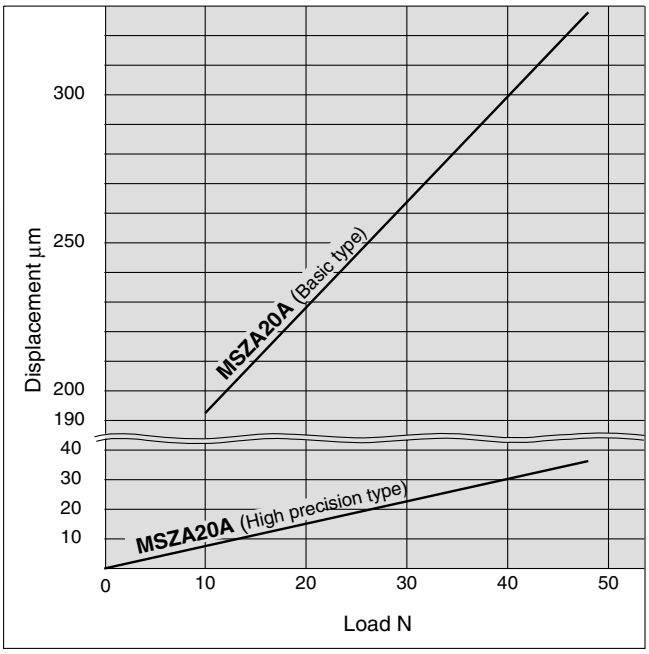
• The following graphs show the displacement at point A, which is 100 mm apart from the center of rotation, where the load is applied.



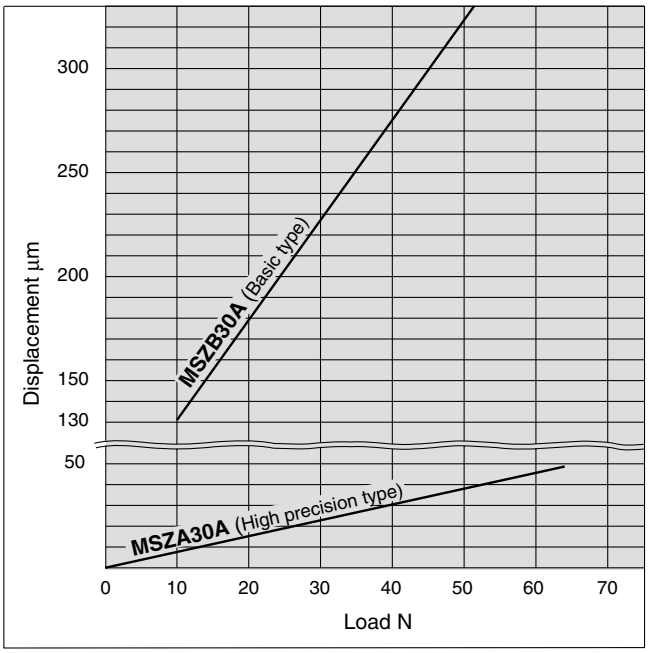
MSZ□10A



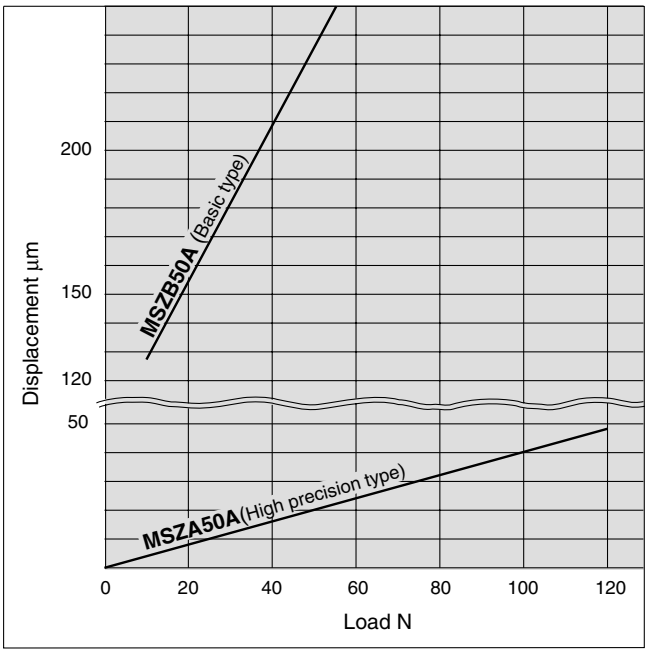
MSZ□20A



MSZ□30A



MSZ□50A



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.

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

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

Q_{CR} = Amount of air consumption of rotary table	[ℓ (ANR)]
Q_{CP} = Amount of air consumption of tube or piping	[ℓ (ANR)]
V = Inner volume of the rotary table	[cm^3]
P = Operating pressure	[MPa]
L = Length of piping	[mm]
a = Inner sectional area of piping	[mm^2]

Internal volume changes depending on the rotating direction (refer to the figure shown in the lower right). Because of this, to obtain the total air consumption, first calculate the air consumption of each stroke respectively by using formula (1), then add up each result.
Air in the tubing is consumed only when the table rotates from end to center. The air consumption in the tubing can be obtained by using formula (2).
The internal volume for each rotating direction and air consumption at each operating pressure calculated using formula (1) are shown in the table below.

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

Formula

$$Q_{c2} = Q_c \times n \times \text{No. of actuators} \times \text{Margin rate}$$

Q_{c2} = Amount of exhaust air from a compressor [ℓ/min (ANR)]
n = Actuator oscillations per minute

Internal Cross Section of Tubing and Steel Piping

Nominal	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

[Calculation example]
Size: 10 Operating pressure: 0.5 MPa Inner sectional area of piping: 12.6 mm^2
Lengh of piping: 1000 mm Stroke: Center → Counterclockwise → Center → Clockwise → Center
Total air consumption, Q1, is obtained by adding up the air consumption of each stroke, which is shown in the table below.

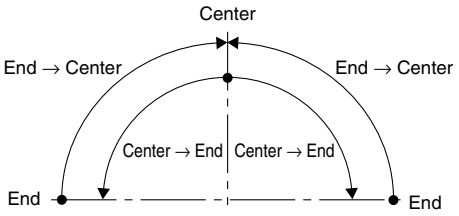
$Q_1 = 0.019 + 0.040 + 0.019 + 0.040 = 0.118\ell$ (ANR)

Air consumed in the tubing is calculated using formula (2), as shown below.

$$Q_2 = 12.6 \times 1000 \times \frac{0.5}{0.1} \times 10^{-6} = 0.063\ell \text{ (ANR)}$$

An entire stroke includes two rotations from end to center where the air is consumed. Thus, the total air consumption Q of the rotary table and tubing is obtained as shown below.

$Q = Q_1 + Q_2 + 2 = 0.244\ell$ (ANR)



Air Consumption

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

Size	Operating direction	Rotation	Inner volume (cm^3)	Operating pressure (MPa)								
				0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
10	End → Center	90°	6.69	0.020	0.027	0.033	0.040	0.047	0.054	0.060	0.067	0.074
	Center → End		3.11	0.009	0.012	0.016	0.019	0.022	0.025	0.028	0.031	0.034
20	End → Center		13.2	0.040	0.053	0.066	0.079	0.093	0.106	0.119	0.132	0.145
	Center → End		6.40	0.019	0.026	0.032	0.038	0.045	0.051	0.058	0.064	0.070
30	End → Center		20.0	0.060	0.080	0.100	0.120	0.140	0.160	0.180	0.200	0.220
	Center → End		9.52	0.029	0.038	0.048	0.057	0.067	0.076	0.086	0.095	0.105
50	End → Center		32.6	0.098	0.130	0.163	0.195	0.228	0.261	0.293	0.326	0.358
	Center → End		16.2	0.049	0.065	0.081	0.097	0.113	0.130	0.146	0.162	0.178

3-Position Rotary Table

Series MSZ

Size: 10, 20, 30, 50

How to Order

High precision type MSZA 10 A – M9BW

Basic type MSZB 10 A – M9BW

Size

10
20
30
50

A	With adjustment bolt

Auto switch

Nil	Without auto switch (Built-in magnet)

Number of auto switches

Nil	2 pcs.
n	"n" pcs.

Applicable Auto Switch/Refer to pages 761 to 809 for detailed auto switch specification.

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

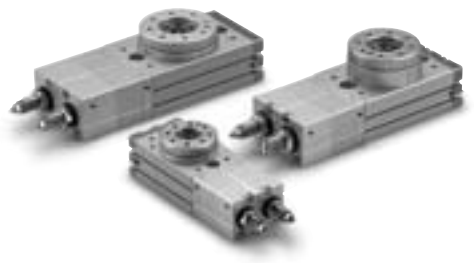
** Although it is possible to mount water resistant type auto switches, note that the rotary actuator itself is not of water resistant construction.

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

* Auto switches are shipped together, (but not assembled).

* Auto switches marked with a "○" are produced upon receipt of orders.

Refer to pages 796 and 797 for the details of solid state auto switch with pre-wired connector.



Specifications

Size	10	20	30	50
Fluid	Air (non-lube)			
Maximum operating pressure	1 MPa			
Minimum operating pressure	0.2 MPa			
Ambient and fluid temperature	0 to 60°C (with no freezing)			
Cushion	None			
Rotation angle adjustment range	0 to 190°			
Center position adjustment range	±10°			
Port size	M5 x 0.8			

Allowable Kinetic Energy and Rotation Time Adjustment Range

Size	Allowable kinetic energy (J)	Rotation time adjustment range for stable operation (s/90°)
10	0.007	0.2 to 1.0
20	0.025	
30	0.048	
50	0.081	

Note) If operated where the kinetic energy exceeds the allowable value, this may cause damage to the internal parts and result in product failure. Please pay special attention to the kinetic energy levels when designing, adjusting and during operation to avoid exceeding the allowable limit.

Mass

Unit: g

Size	10	20	30	50
Basic type	730	1350	1730	2660
High precision type	760	1450	1850	2820

Note) Excluding the mass of auto switches.

Piping and speed conrol

1) A single 3-position pressure center solenoid valve or two 3-port solenoid valves are used. (Refer to Figure 1 or Figure 2.)
2) A meter-out-type speed controller is used for ports **A** and **B** and a meter-in speed controller is used for ports **C** and **D**. (Figures 1 and 2 show the state at which pressure is applied to ports **B** and **D**.)

Figure 1 3-position pressure center solenoid valve: 1 pc.

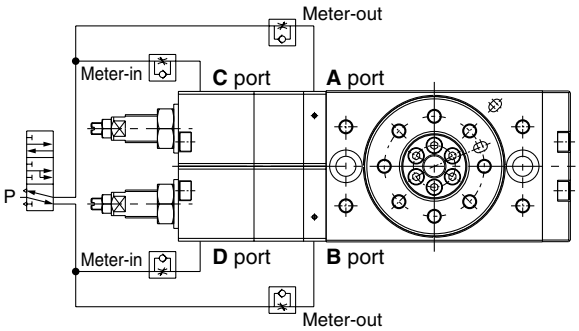
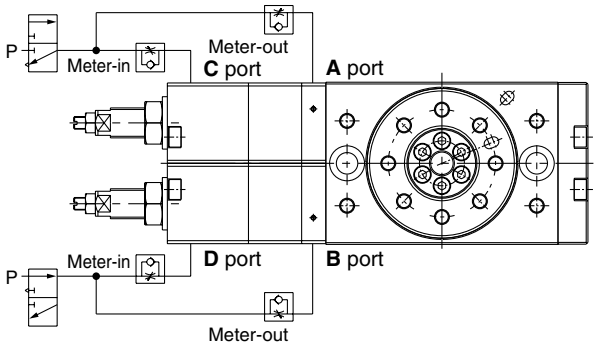


Figure 2 3-position solenoid valve: 2 pcs.



∗ The table return position under the power-off state changes depending on the solenoid valve type. Please refer to page 309 for details.

3) Figure 3 shows the rotation range and Table 1 shows the active speed controller.

Figure 3 Each operational contents

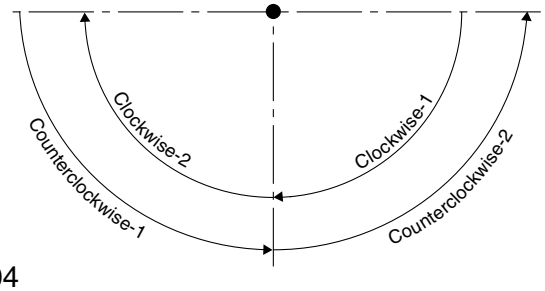


Table 1 Pressure port and active speed controller

Operating	Pressure port		Speed controller
	A, C	**B, D**	
Clockwise-1	●	●	**C** port
Clockwise-2	●	—	**B** port
Counterclockwise-1	●	●	**D** port
Counterclockwise-2	—	●	**A** port

Angle Adjustment

1) Stop positions are adjusted with the adjusting bolts shown in Figure 4.
   ① Adjusting bolts “a” and “b” are used for adjusting the rotation ends. Adjusting bolts “c” and “d” are used for adjusting the center position.
   ② Figure 5 shows angle ranges adjusted with each adjusting bolt.

2) Angle adjustment
   Supply air when adjusting the angle (a low pressure of approx. 0.2 MPa is recommended).
   ① First adjust both rotation end positions.
   - Apply pressure to ports A and C to adjust adjusting bolt “b”.
   - Apply pressure to ports B and D to adjust adjusting bolt “a”.
   - Lock the bolts with fixing nuts after adjustment.

   ② Next, apply pressure to ports A to D to adjust the center position.
   - Loosen the fixing nuts for adjusting bolts “c” and “d”.
   - Tighten adjusting bolts “c” and “d” almost completely (allowing manual table rotation).
   - Follow the appropriate procedure (R or L) shown in Table 2.

Figure 4 Adjusting bolt position

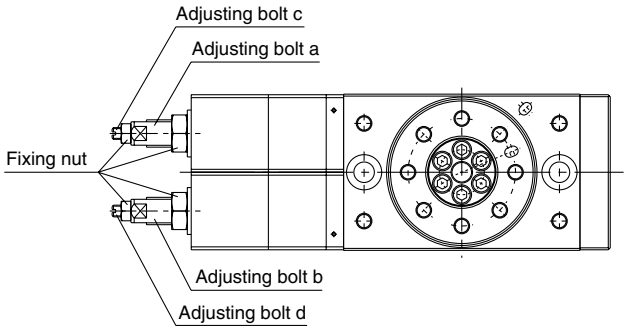


Figure 5 Angle adjustment Range

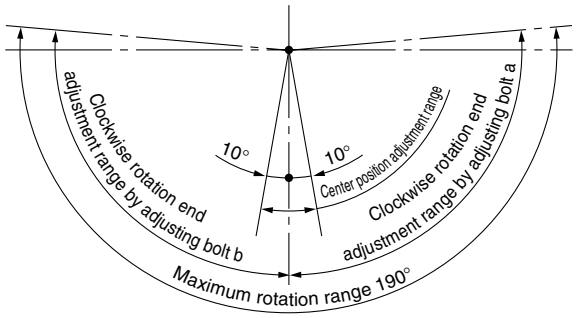


Table 2 Center position adjustment

	R: Clockwise adjustment	L: Counterclockwise adjustment
1	Manually rotate the table counterclockwise until resistance is felt.	Manually rotate the table clockwise until resistance is felt.
2	Rotate the table clockwise when adjusting bolt “d” is loosened. Set it to the desired position.	Rotate the table counterclockwise when adjusting bolt “c” is loosened. Set it to the desired position.
3	Loosen adjusting bolt “c” until resistance is felt. (Make sure that there is no rotation backlash in the table.)	Loosen adjusting bolt “d” until resistance is felt. (Make sure that there is no rotation backlash in the table.)
4	Tighten both adjusting bolts “c” and “d” to approx. 45°. Note 1)	Tighten both adjusting bolts “c” and “d” to approx. 45°. Note 1)
5	Lock adjusting bolts “c” and “d” with fixing nuts. Note 2)	Lock adjusting bolts “c” and “d” with fixing nuts. Note 2)

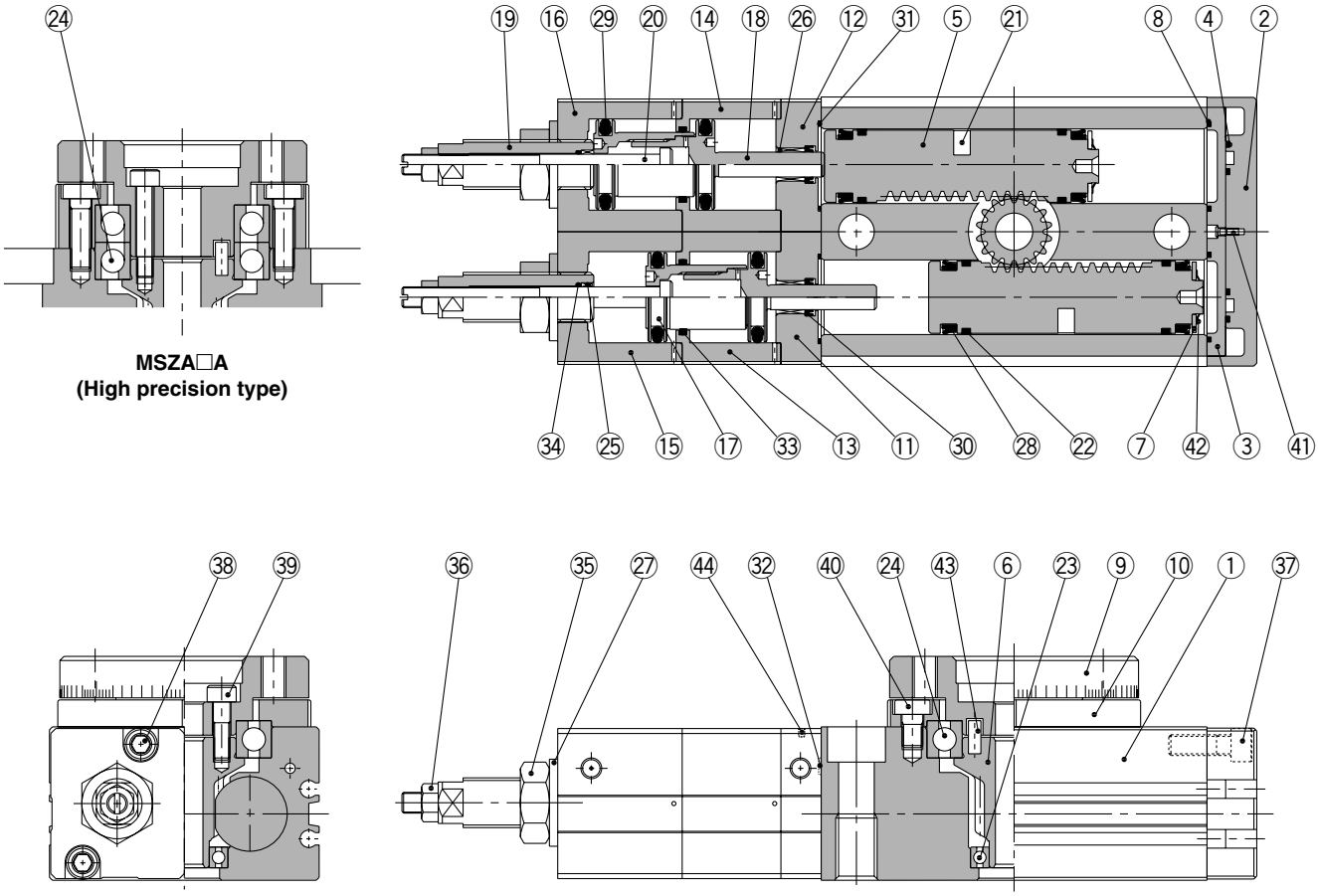
Note 1) Since the position of the adjusting bolt shifts with changing the screw clearance, pre-tighten the fixing nuts.
Note 2) If the table has a rotation backlash after tightening the nut, readjust it.

Adjusting angle per rotation of angle adjusting screw

size	Adjusting bolt a, b (End position adjustment)	Adjusting bolt c, d (Center position adjustment)
10	10.2°	5.1°
20	9.0°	3.6°
30	8.2°	3.3°
50	8.2°	4.1°

A piping, speed control, and angle adjustment manual is attached to the product.

Construction



MSZA□A
(High precision type)

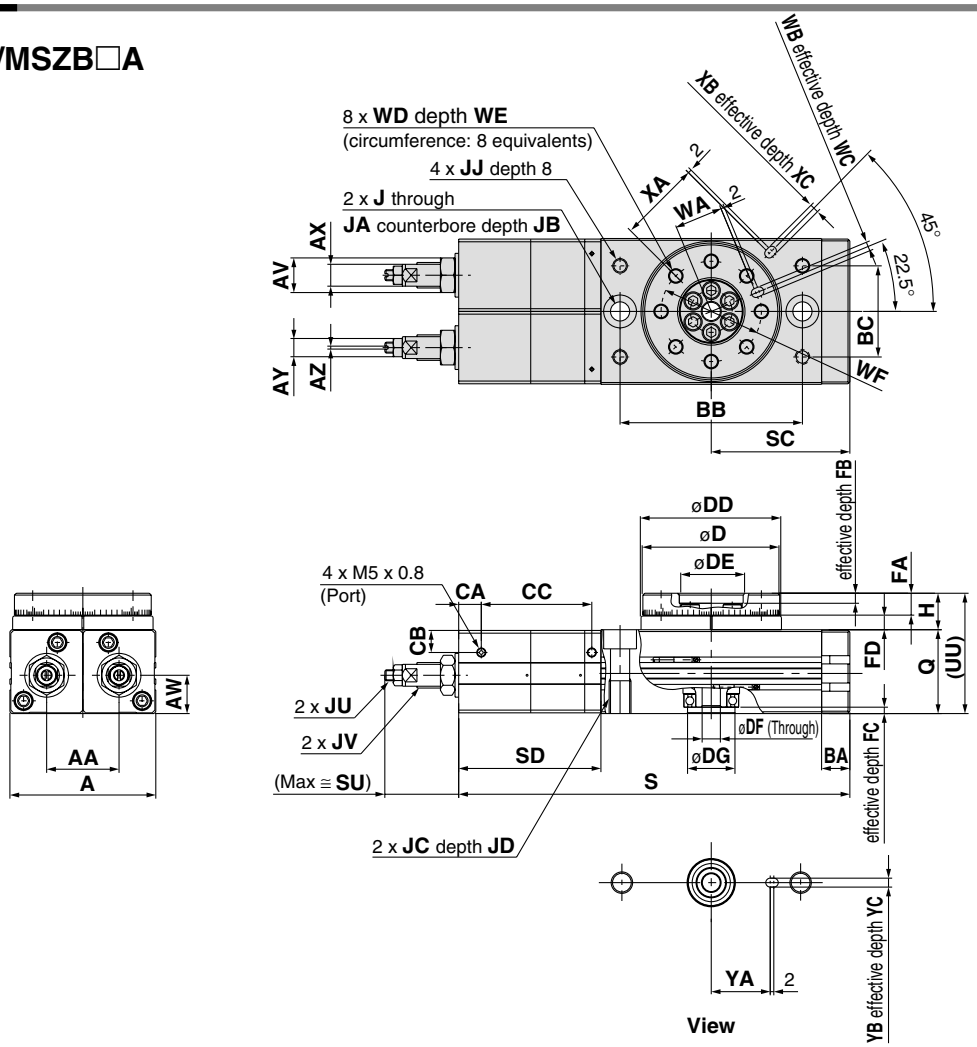
Component Parts

No.	Description	Material	Note
1	**Body**	Aluminium alloy	Anodized
2	**Cover**	Aluminium alloy	Nickel plated
3	**Plate**	Aluminium alloy	Chromated
4	**Seal**	NBR	
5	**Piston**	Stainless steel	Nitrided
6	**Pinion**	Chrome molybdenum steel	Nitrided
7	**Seal retainer**	Aluminium alloy	Chromated
8	**Gasket (for cover)**	NBR	
9	**Table**	Aluminium alloy	Anodized
10	**Bearing retainer**	Aluminium alloy	Anodized
11	**End cover (A)**	Aluminium alloy	Anodized
12	**End cover (B)**	Aluminium alloy	Anodized
13	**Cylinder tube (A)**	Aluminium alloy	Anodized
14	**Cylinder tube (B)**	Aluminium alloy	Anodized
15	**Tube cover (A)**	Aluminium alloy	Anodized
16	**Tube cover (B)**	Aluminium alloy	Anodized
17	**Sub piston (R)**	Carbon steel	Nickel plated
18	**Sub piston (F)**	Carbon steel	Nickel plated
19	**Adjustment bolt (R)**	Carbon steel	Nickel plated
20	**Adjustment bolt (F)**	Carbon steel	Nickel plated
21	**Magnet**	—	Chromated
22	**Wear ring**	Resin	
23	**Deep groove ball bearing**	Bearing steel	

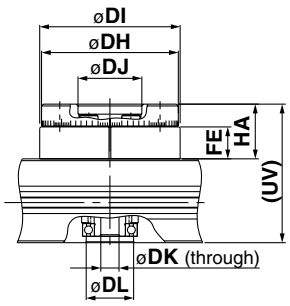
No.	Description		Material	Note
24	**Basic type**	Deep groove ball bearing	Bearing steel	
	High precision type	Angular contact ball bearing		
25	**Bushing**		SPCC	
26	**Bushing**		SPCC	
27	**Seal washer**		NBR	
28	**Piston seal**		NBR	
29	**Piston seal**		NBR	
30	**Rod seal**		NBR	
31	**Gasket**		NBR	
32	**O-ring**		NBR	
33	**O-ring**		NBR	
34	**O-ring**		NBR	
35	**Compact hexagon nut**		Steel wire	Nickel plated
36	**Hexagon nut**		Steel wire	Nickel plated
37	**Hexagon socket head set bolt**		Stainless steel	
38	**Hexagon socket head set bolt**		Stainless steel	
39	**Hexagon socket head set bolt**		Stainless steel	
40	Round head phillips screw	**Size: 10**	Stainless steel	
	Low head cap screw	**Size: 20, 30, 50**	Chrome molybdenum steel	Nickel plated
41	**Round head phillips screw No.0**		Steel wire	Chromated
42	**Type CS retaining ring**		Spring steel	
43	**Parallel pin**		Carbon steel	
44	**Steel ball**		Stainless steel	

Dimensions

Basic type/MSZB□A



High precision type/MSZA□A



(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

The position table shows the counterclockwise end when adjusted the rotation angle to 180°.

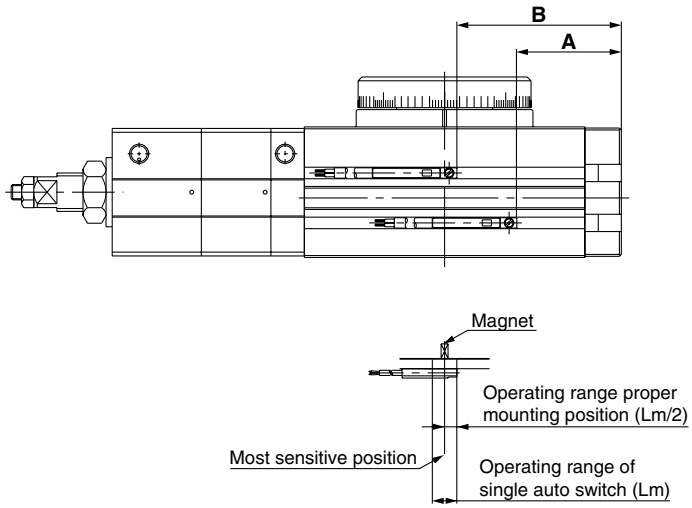
(mm)

Size	AA	A	AV	AW	AX	AY	AZ	BA	BB	BC	CA	CB	CC	D	DD	DE	DF	DG	FA	FB	FC	FD	H	J	JA	JB
10	24.7	50	14	17	8	7	1	9.5	60	27	7	7	38	45h9	46h9	20H9	5	15H9	8	4	3	4.5	13	6.8	11	6.5
20	32.4	65	17	18.5	10	8	1.2	12	76	34	8.1	10	50.4	60h9	61h9	28H9	9	17H9	10	6	2.5	6.5	17	8.6	14	8.5
30	34.7	70	17	18.5	10	8	1.2	12	84	37	10.5	10.5	53.5	65h9	67h9	32H9	9	22H9	10	4.5	3	6.5	17	8.6	14	8.5
50	39.7	80	19	21	12	10	1.6	15.5	100	50	12.4	12.5	60.6	75h9	77h9	35H9	10	26H9	12	5	3	7.5	20	10.5	18	10.5

(mm)

Size	JC	JD	JJ	JU	JV	Q	S	SC	SD	SU	UU	WA	WB	WC	WD	WE	WF	XA	XB	XC	YA	YB	YC
10	M8 x 1.25	12	M5 x 0.8	M4 x 0.5	M10 x 1	34	132.5	46	50	27.3	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	M5 x 0.5	M12 x 1.25	37	168.5	58.5	63.5	39	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	M5 x 0.5	M12 x 1.25	40	184	63.5	69	36.4	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	M6 x 0.75	M14 x 1.5	46	214.5	76	78	42.4	66	26.5	5H9	5.5	M8 x 1.25	12	55	45	5H9	5.5	33	5H9	5.5

Proper Auto Switch Mounting Position



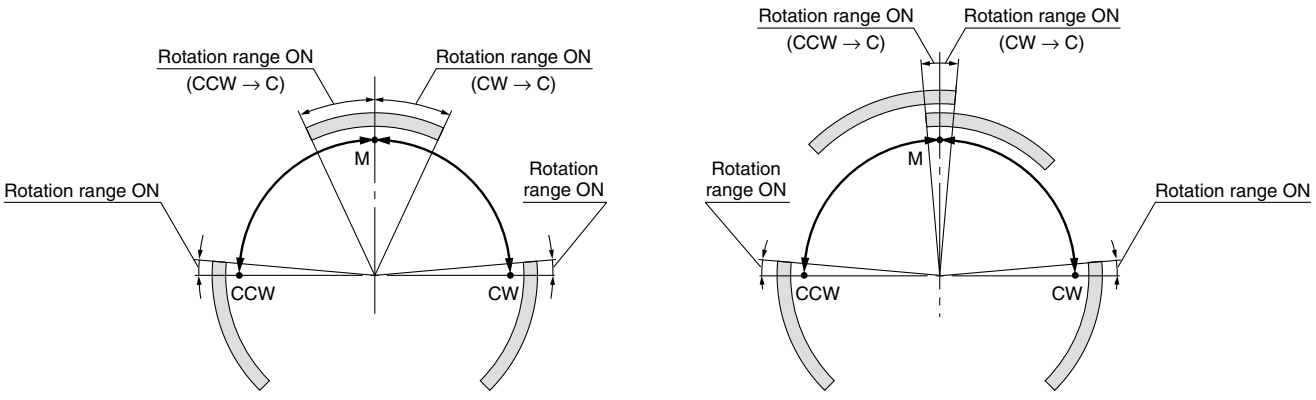
Size	Rotation	Reed auto switch				Solid state auto switch			
		D-A9□, D-A9□V				D-M9□ (V), D-M9□W (V)			
		A	B	Operating angle θ m	Hysterisis angle	A	B	Operating angle θ m	Hysterisis angle
10	190°	27	45	90°	10°	31	49	55°	10°
20	190°	35	62	80°	10°	39	66	45°	10°
30	190°	39	68	65°	10°	43	72	35°	10°
50	190°	49	83	50°	10°	53	87	30°	10°

Operating angle θ m: Value of the operating range Lm of a single auto switch converted to an axial rotation angle.
Hysteresis angle: Value of auto switch hysteresis converted to an angle.
Note) Since the above values are only provided as a guideline, they are not guaranteed.
In the actual setting, adjust them after confirming the auto switch operating condition.

Detection of the Center Position

The appropriate mounting position of the center position detection switch is between dimensions A and B, as shown above. However, since the auto switch turns on in the range of the operating angle (θ m), when one auto switch is used for detecting the center position, the auto switch turns on long before reaching the center position, as shown in the left figure below.
To avoid this, use two auto switches (as shown in the right figure below) so that the rotation may be detected from both the clockwise rotation end to the center position and from the counterclockwise rotation end to the center position.

Center position detecting auto switch: 1 pc. **Center position detecting auto switch: 2 pcs.**



: Operating range of auto switch CCW: Counterclockwise C: Center CW: Clockwise

Series MSZ
Specific Product Precautions

Be sure to read before handling.
Refer to front matters 38 and 39 for Safety Instructions and pages 4 to 13 for Rotary Actuator and Auto Switch Precautions.

Operation which requires no stop at the center position

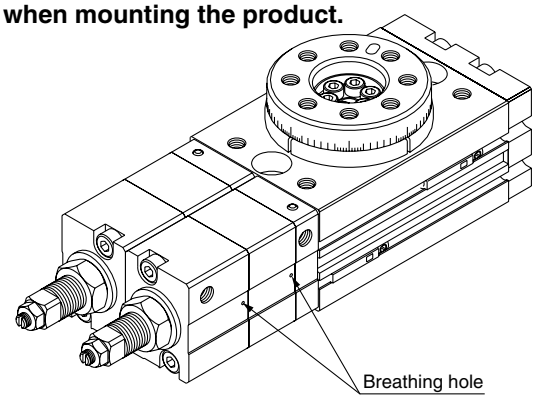
⚠ Caution

1. End-to-end operation without stopping at the center position includes situations such as decelerating or pausing around the center position. Avoid use for applications in which speed change is a problem during end-to-end operation since the product may stop for max. 0.1s during high-speed rotation (0.2s/90°) and for max. 0.5s during low-speed rotation (1s/90°).

Breathing hole

⚠ Caution

1. The breathing holes located at the intermediate stopping position repeatedly absorb and release air. Care should be taken not to block the holes when mounting the product.



Mounting

⚠ Caution

1. Although any mounting direction is available with this product, when the gravity acting on the load acts in the direction of table rotation (e.g. the center of load gravity and the rotation center are not aligned when the rotation shaft is horizontal), stable rotation speed cannot be obtained.
In particular, since a meter-in speed controller controls the operation of rotating from the end to center position, when this operating direction is the same as the direction the gravity acts on, then gravitational acceleration cannot be controlled, which may cause bouncing when it stops.

Backlash in the table at the center position

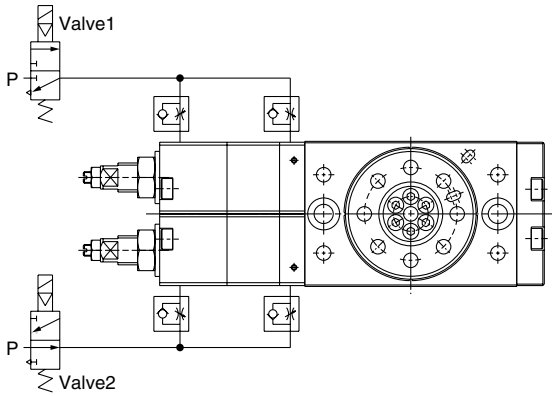
⚠ Caution

1. Backlash in the table in the rotating direction can be controlled by adjusting the center position properly. However, backlash (about 0.1°) may occur as the rotation speed increases. If this causes any problems during operation, readjust the center position.

Behavior in the power-off condition

⚠ Caution

1. When a pressure-center (PAB) type 3-position solenoid valve is used, the table as well as the solenoid valve return to the center position when the power is cut due to blackouts, etc.
If the return position must be at a particular rotation end either counterclockwise or clockwise when a blackout occurs, use two 3-port solenoid valves as shown below. Please refer to the table below for the solenoid valve type to be used.



Reset potion	Valve1	Valve2
Counterclockwise rotation end	Normally closed	Normally open
Clockwise rotation end	Normally open	Normally closed

When the stop position must be held when the power is cut, use two 5-port double solenoid valves as shown below. (Plug the port A or B, that is not being used.)