Rotary Gripper
Series MRHQ
Size: 10, 16, 20, 25

How to Order

Lead wire length

Nil	0.5 m
L	3 m
Z	5 m

MRH Q 10 D — 90 S — M9NV L [ ] — M9N L [ ]

Rotary gripper

Gripper

Q	Parallel type: 2 fingers

Gripper bore

10	10 mm
16	16 mm
20	20 mm
25	25 mm

Action

D	Double acting
S	Single acting (Normally open)
C	Single acting (Normally closed)

Rotation angle

90	90°
180	180°

Single vane

Number of auto switches

Nil	2 pcs.
S	1 pc.

Type of auto switch for detecting rotation

Nil	Without auto switch

Applicable Auto Switch

Type	Electrical entry	Indicator light	Wiring (output)	Load voltage		Auto switch model	Lead wire length* (m)			Applicable load	
				DC		Electrical entry: In-line	0.5 (Nil)	3 (L)	5 (Z)		
Solid state switch	Grommet	Yes	3-wire (NPN)	24 V	5 V	M9N	●	●	○	IC circuit	Relay PLC
			3-wire (PNP)		12 V	M9P	●	●	○		
			2-wire		12 V	M9B	●	●	○	—	

* Lead wire length symbols: 0.5 m ..... Nil (Example) M9N
3 m ..... L M9NL
* Refer to page 12-13-1 for further information on auto switches.
* Auto switches marked with a "○" are made upon receipt of order.

Type of auto switch for gripper opening/closing

N	Without auto switch

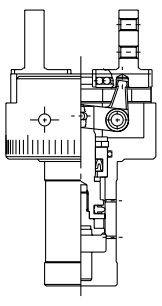
Applicable Auto Switch

Type	Electrical entry	Indicator light	Wiring (output)	Load voltage		Auto switch model	Lead wire length* (m)			Applicable load	
				DC		Electrical entry: Perpendicular	0.5 (Nil)	3 (L)	5 (Z)		
Solid state switch	Grommet	Yes	3-wire (NPN)	24 V	5 V	M9NV	●	●	○	IC circuit	Relay PLC
			3-wire (PNP)		12 V	M9PV	●	●	○		
			2-wire		12 V	M9BV	●	●	○	—	

* Lead wire length symbols: 0.5 m ..... Nil (Example) M9NV
3 m ..... L M9NVL
* Refer to page 12-13-1 for further information on auto switches.
* Auto switches marked with a "○" are made upon receipt of order.

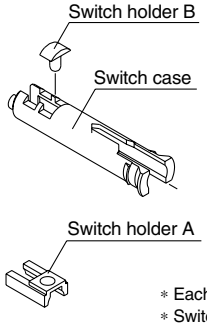
Unit list

Gripper unit



Model	Unit part no.
MRHQ10D	P407090-3D
MRHQ10S	P407090-3S
MRHQ10C	P407090-3C
MRHQ16D	P407060-3D
MRHQ16S	P407060-3S
MRHQ16C	P407060-3C
MRHQ20D	P407080-3D
MRHQ20S	P407080-3S
MRHQ20C	P407080-3C
MRHQ25D	P408080-3D
MRHQ25S	P408080-3S
MRHQ25C	P408080-3C

Switch mounting unit



Model	Unit part no.
MRHQ10□	P407090-1
MRHQ16□	P407060-1
MRHQ20□	
MRHQ25□	

* Each unit includes two of each of the parts indicated left.
* Switches are not included with a unit.

Specifications

Model			MRHQ10	MRHQ16	MRHQ20	MRHQ25
Fluid			Air			
Operating pressure	Rotary unit		0.25 to 0.7 MPa		0.25 to 1.0 MPa	
	Gripper unit	Double acting	0.25 to 0.7 MPa	0.1 to 0.7 MPa		
		Single acting	0.35 to 0.7 MPa	0.25 to 0.7 MPa		
Rotation angle			90° ±10°, 180° ±10°			
Gripper action			Double acting, Single acting			
Finger opening/closing repeatability			±0.01mm			
Gripper maximum operating frequency			180 c.p.m			
Ambient and fluid temperature			5 to 60°C			
Adjustable rotation time Note)			0.07 to 0.3 s/90° (at 0.5 MPa)			
Allowable kinetic energy			0.0046 J	0.014 J	0.034 J	0.074 J
Auto switch	Rotary unit		Solid state switch (2-wire, 3-wire)			
	Gripper unit		Solid state switch (2-wire, 3-wire)			

Note) Operate within the speed adjustment range, as speed control exceeding the limit value of the low speed may cause sticking or failure to operate.

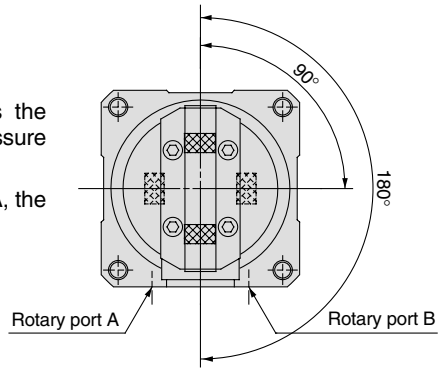
Model

Action	Model	Cylinder bore (mm)	Opening/Closing stroke (mm)	Rotating angle (°)	Note) Weight (g)
Double acting	**MRHQ10D**	10	4	90	306
				180	305
	MRHQ16D	16	6	90	593
				180	591
	MRHQ20D	20	10	90	1055
				180	1052
	MRHQ25D	25	14	90	1561
				180	1555
Single acting	**MRHQ10S MRHQ10C**	10	4	90	307
				180	306
	MRHQ16S MRHQ16C	16	6	90	594
				180	592
	MRHQ20S MRHQ20C	20	10	90	1060
				180	1057
	MRHQ25S MRHQ25C	25	14	90	1566
				180	1560

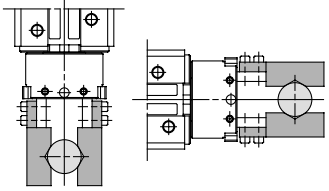
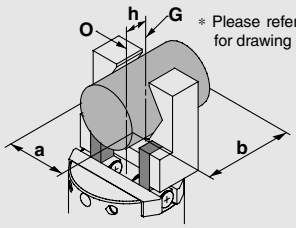
Note) Values do not include auto switch weight.

Gripper Rotation Range/View from Gripper Side

- The figure at the right indicates the position of the gripper when pressure is applied to port B.
- When pressure is applied to port A, the gripper rotates clockwise.

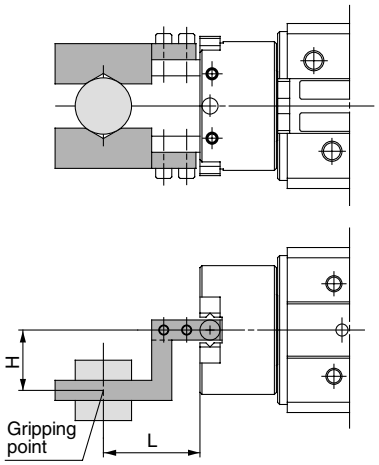


Series MRHQ
Model Selection

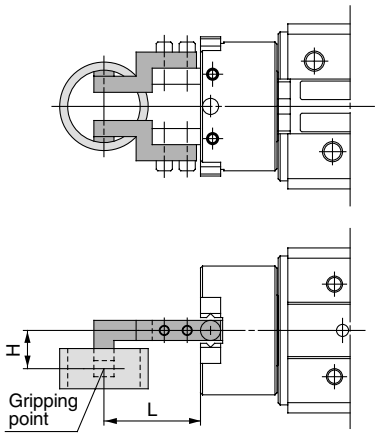
Procedure	Calculation	Example
1 Operating conditions **Enumerate the operating conditions according to the mounting position and workpiece configuration.**  Vertical mounting Horizontal mounting	• Model used • Operating pressure • Mounting position • Rotation time t (s) • Overhang H (mm) • Gripping point distance L (mm) • Distance between central axis and center of gravity h (mm) • Load weight m_1 (kg) • Weight of 2 attachments m_2 (kg)	 ∗ Please refer to page 12-11-12 for drawing dimensions. **Rotary gripper:** MRHQ16D-90S **Pressure:** 0.4 MPa **Mounting position:** Horizontal **Rotation time (t):** 0.2 s/90° **Overhang (H):** 10 mm **Gripping point distance (L):** 20 mm **Distance between central axis and center of gravity (h):** 10 mm **Load weight (m_1):** 0.07 kg **Weight of 2 attachments (m_2):** 0.05 kg
2 Rotation time **Confirm that it is within the adjustable rotation time range.**	0.07 to 0.3 s/90°	0.2 s/90° OK
3 Overhang and gripping point distance **Confirm that the overhang (H) and the gripping point distance (L) are within the operating pressure range limit.**	**Graph (1)** Gripping point range limit	Within the range limit OK
4 Load weight **Confirm that the load converted from the load weight is less than 1/20 of the effective gripping force. (A greater margin must be allowed if large impacts will be applied when work pieces are transported.)**	**Graph (2)** 20 x 9.8 x m_1 < Effective gripping force (N)	20 x 9.8 x 0.07 = 13.72 13.72 N < Effective gripping force OK
5 External force on finger **Make sure that the vertical load and each moment on finger are within allowable value.**	Less than allowable value (Refer to page 12-11-11 for the lateral load allowable value and each moment value	**Downward vertical load by load and attachment:** f = (0.07 + 2 x 0.05) x 9.8 = 1.67 (N) < Vertical allowable value OK
6 Rotational torque (horizontal mounting only) **Convert the weight of the load and attachments (2 pcs.) into a load value and multiply by the overhang (H). Confirm that this value is less than 1/20 of the effective torque.**	**Graph (3)** 20 x 9.8 x (m_1 + m_2) x H/1000 < Effective torque (N·m)	20 x 9.8 x (0.07 + 0.05) x 10/1000 = 0.24 0.24 N·m < Effective torque OK
7 Find the moment of inertia, "I_R" for the load + attachments (2 pcs.)	$I_R = K \times (a^2 + b^2 + 12h^2) \times (m_1 + m_2)/(12 \times 10^6)$ (K = 2: Safety factor)	$I_R = 2 \times (20^2 + 30^2 + 12 \times 10^2) \times (0.07 + 0.05)/(12 \times 10^6)$ = 0.00005 kg·m²
8 Kinetic energy **Confirm that the kinetic energy of the load + attachments (2 pcs.) is no more than the allowable value.** {Refer to "Moment of Inertia Calculation and Allowable Kinetic Energy" on page 12-11-12.}	1/2 x I_R x ω^2 < Allowable energy (J) $\omega = 2\theta/t$ (ω: Angular speed at the end) θ: Rotation angle (rad) t: Rotation time (s)	1/2 x 0.00005 x (2 x (3.14/2)/0.2)² = 0.0062 0.0062 J < Allowable energy OK

Gripping Point

External gripping



Internal gripping



L: Gripping point distance
H: Overhang

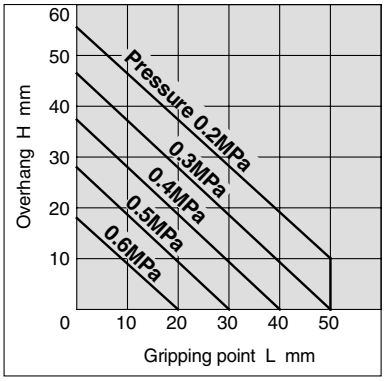
- Operate so that the workpiece gripping point distance "L" and the amount of overhang "H" stay within the range shown for each operating pressure given in the graphs to the right.
- If operated with the workpiece gripping point outside of the range limit, an excessive eccentric load will be applied to the fingers and guide section, causing play in the fingers and adversely affecting the gripper's life.

Gripping Point Range Limit

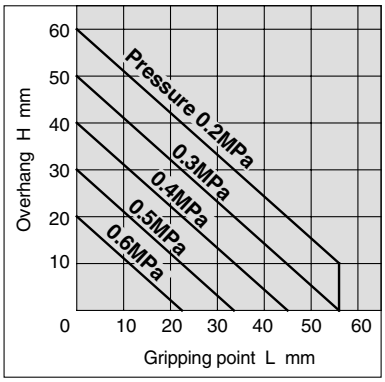
Graph (1)

External Gripping

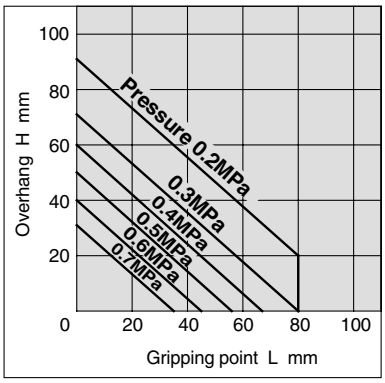
MRHQ10



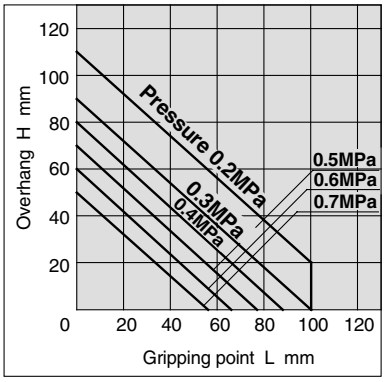
MRHQ16



MRHQ20

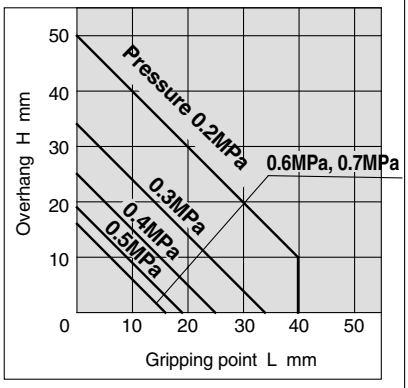


MRHQ25

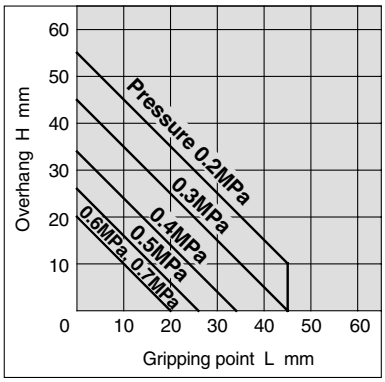


Internal Gripping

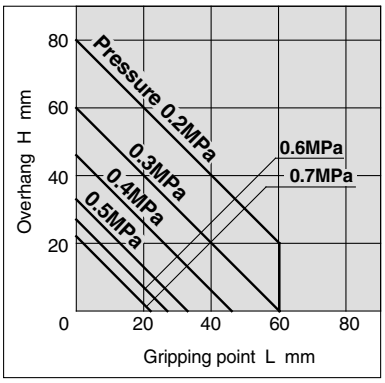
MRHQ10



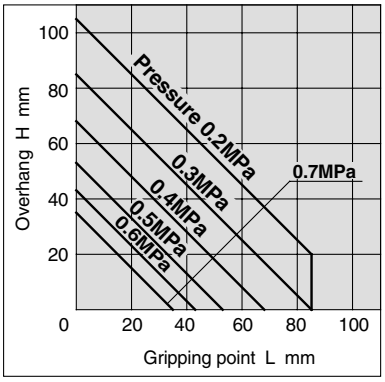
MRHQ16



MRHQ20



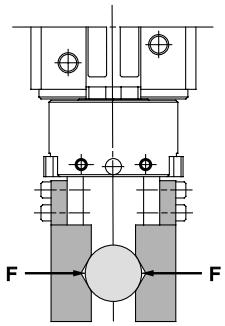
MRHQ25



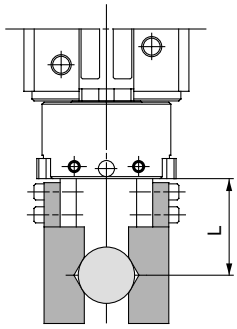
Effective Gripping Force

Expressing the effective gripping force

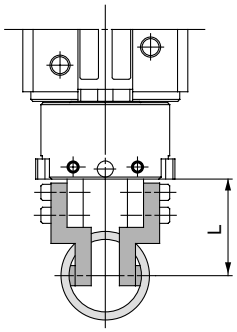
The effective gripping force shown in the graphs to the right is expressed as F, which is the impellent force of one finger, when both fingers and attachments are in full contact with the workpiece as shown in the figure below.



External gripping



Internal gripping



L: Gripping point distance

Model Selection Guidelines by Workpiece Weight

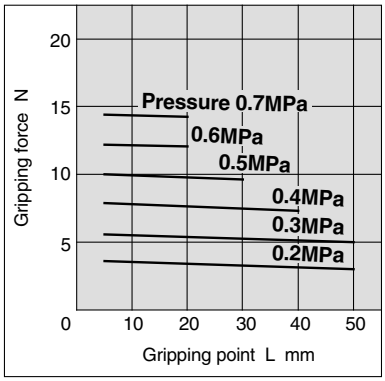
- Although conditions differ according to the workpiece shape and the coefficient of friction between the attachments and the workpiece, select a model that can provide a gripping force of 10 to 20 times the workpiece weight, or more.
- A greater margin of safety is required when high acceleration or impact occurs during workpiece transfer.

Effective Gripping Force

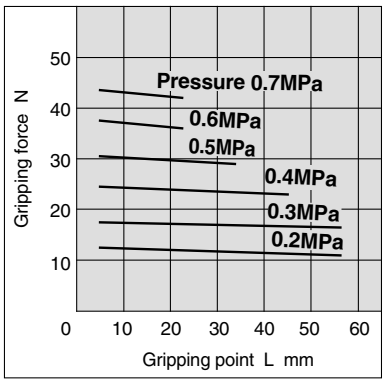
Graph (2)

External Gripping/Double Acting

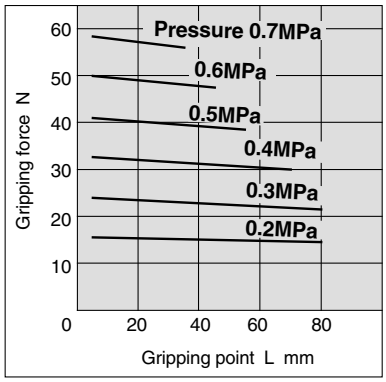
MRHQ10D



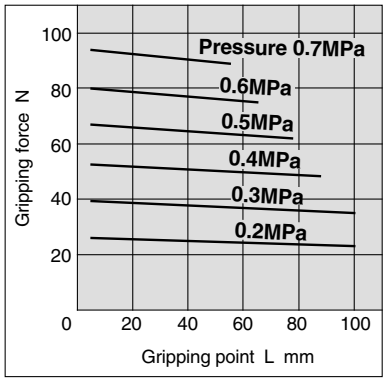
MRHQ16D



MRHQ20D

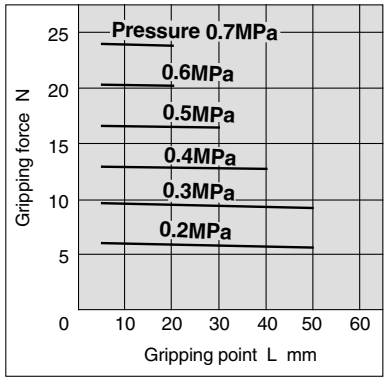


MRHQ25D

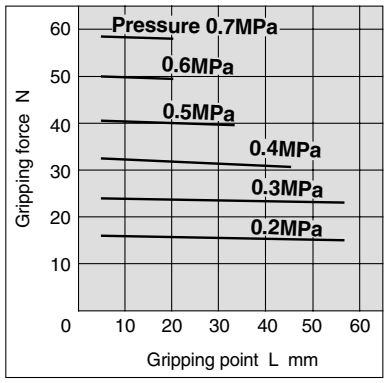


Internal Gripping/Double Acting

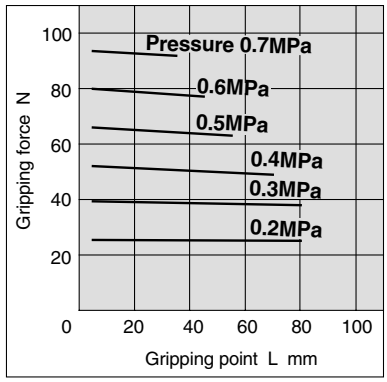
MRHQ10D



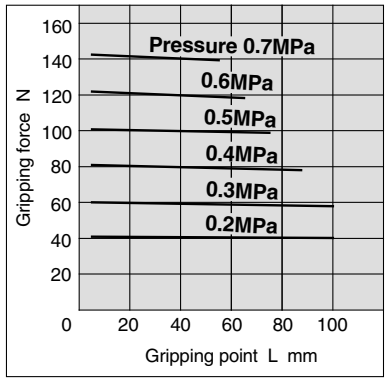
MRHQ16D



MRHQ20D

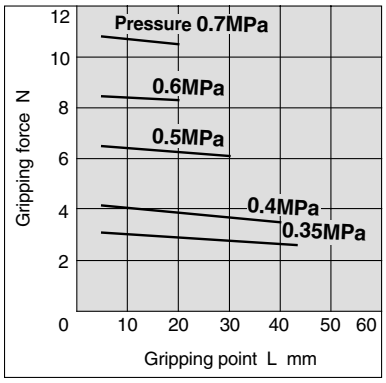


MRHQ25D

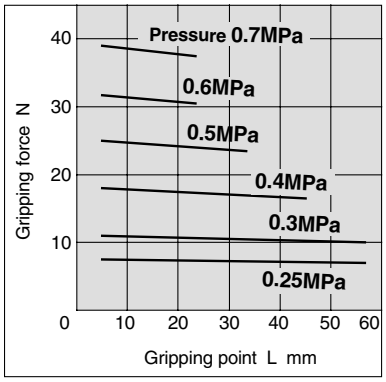


External Gripping Force/Single Acting

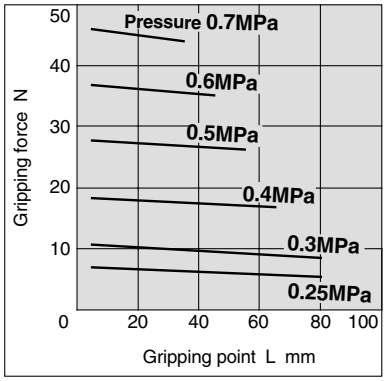
MRHQ10S



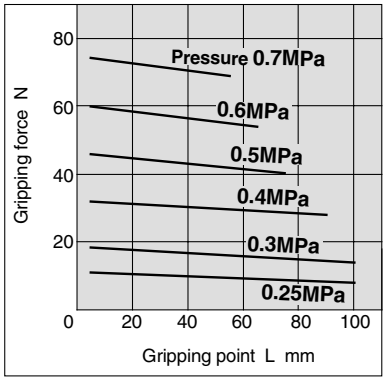
MRHQ16S



MRHQ20S

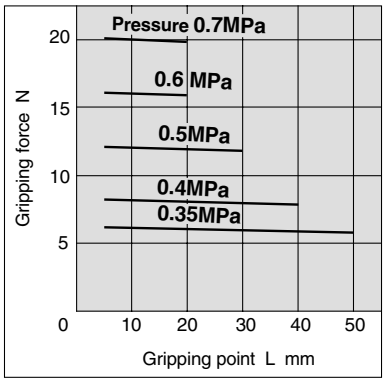


MRHQ25S

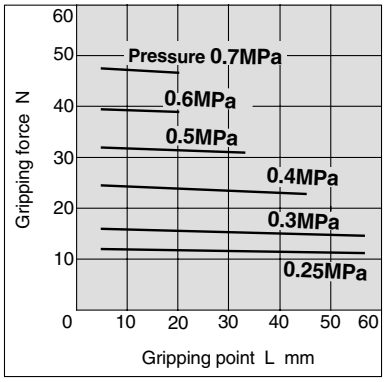


Internal Gripping Force/Single Acting

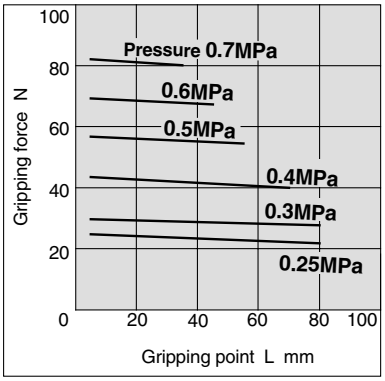
MRHQ10C



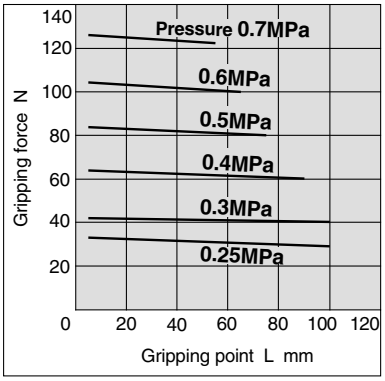
MRHQ16C



MRHQ20C



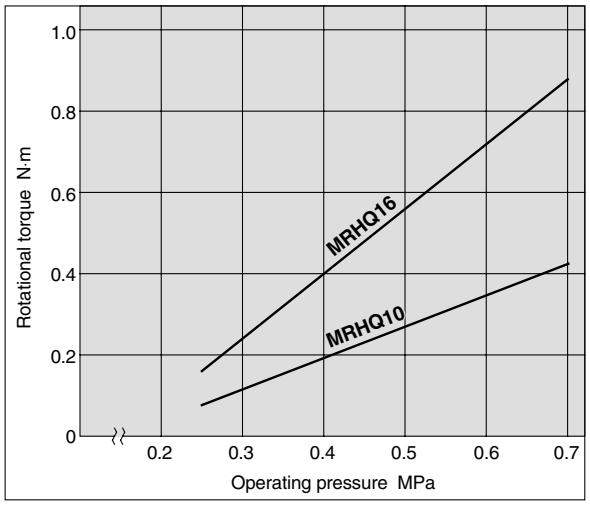
MRHQ25C

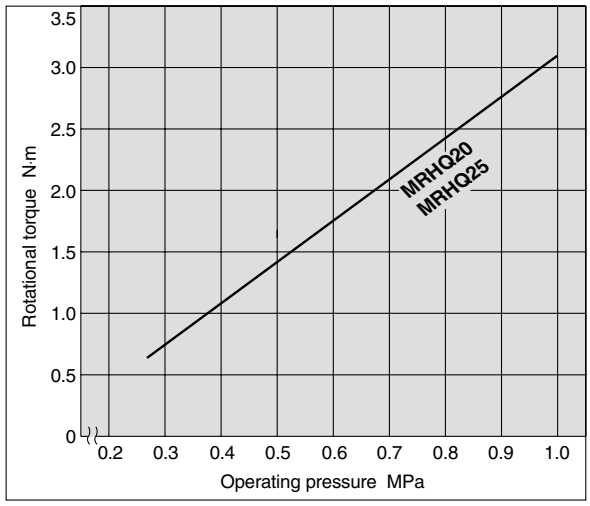


Rotational Torque and Gripping Point

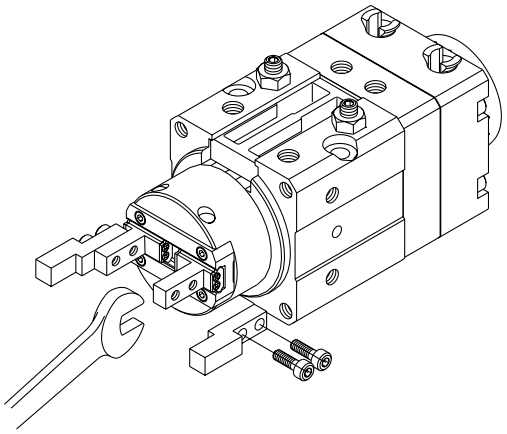
Rotational Torque

Graph (3)





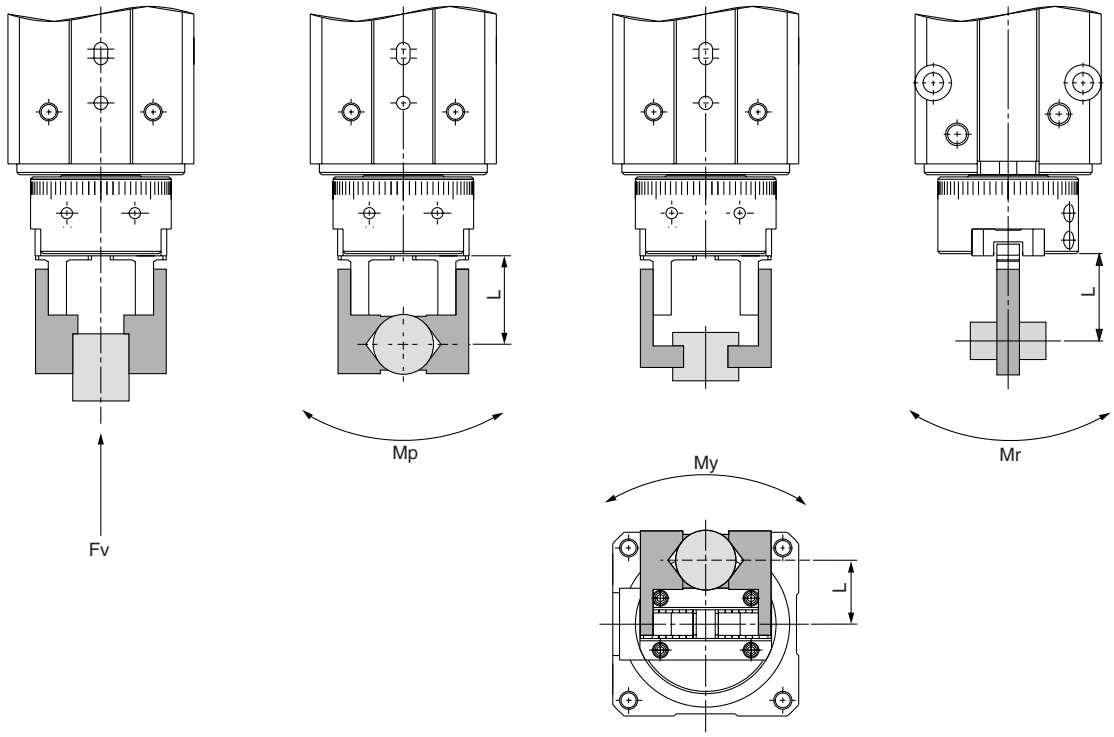
How to Mount Attachment on Fingers



When mounting attachments on fingers, support the fingers with a tool such as a spanner to prevent them from twisting. Refer to the table on the right for the tightening torques of finger mounting bolts.

Model	Bolt	Max. tightening torque N·m
MRHQ10	M2.5 x 0.45	0.31
MRHQ16	M3 x 0.5	0.59
MRHQ20	M4 x 0.7	1.4
MRHQ25	M5 x 0.8	2.8

Allowable Value of External Force on Fingers



L: Distance to the point at which a load is applied (mm)

Model	Allowable vertical load **Fv (N)**	Maximum allowable moment		
		Pitch moment **Mp (N·m)**	Yaw moment **My (N·m)**	Roll moment **Mr (N·m)**
MRHQ10□	58	0.26	0.26	0.53
MRHQ16□	98	0.68	0.68	1.36
MRHQ20□	147	1.32	1.32	2.65
MRHQ25□	255	1.94	1.94	3.88

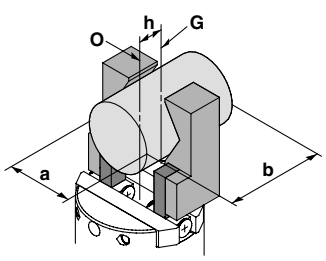
Note) Values of load and moment in the above table are static values.

Calculation for allowable external force (with moment load)	Calculation example
Allowable load F (N) $= \dfrac{\text{M (Maximum allowable moment) (N·m)}}{\text{L} \times 10^{-3}*}$ ∗ Unit conversion factor	When static load f = 10 N, which produces pitch moment to the point L = 30 mm from MRHQ16D guide, is applied. Operable condition requires that F be bigger than f. Example: Allowable load $F = \dfrac{0.68}{30 \times 10^{-3}}$ $= 22.7\ (N) > 10$ Since load F > f, it is operable.

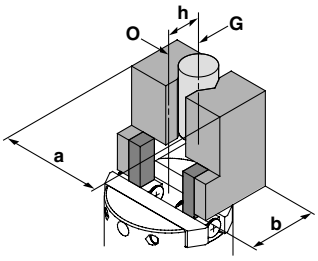
Moment of Inertia and Allowable Kinetic Energy

Moment of Inertia Calculation and Allowable Kinetic Energy

Calculate the moment of inertia as shown below, and confirm that the operating conditions are within the allowable kinetic energy shown in the graph "Moment of inertia and rotation time" on the right.



When load dimensions > attachment dimentions



When load dimensions < attachment dimentions

Description

O ····· Center of rotation
G ····· Center of gravity of attachment and load

····· Gripper fingers
····· Attachments
····· Load

Moment of inertia I: kg·m²

$$I = \frac{(a^2 + b^2 + 12h^2)(m_1 + m_2)}{12 \times 10^6}$$

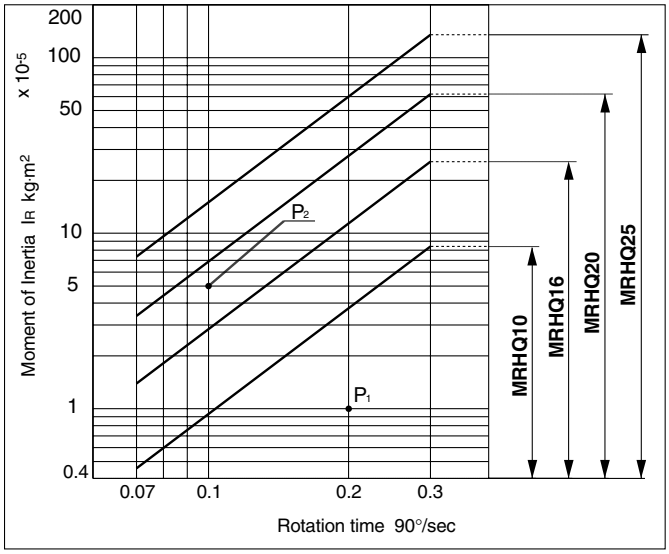
Practical moment of inertia I_R: kg·m²

$$I_R = K \times I$$

∗ Use I_R for this product.

m1: Mass of two attachments (kg)
m2: Mass of load (kg)
h: Distance between O and G (mm)
a, b: Dimensions of load or attachment (mm)
K = 2 (Coefficient)

Graph (Moment of inertia and rotation time)



How to Use the Graph

[Example 1]
- Moment of Inertia: 1 x 10⁻⁵ kg·m²
- Rotation time: 0.2 s/90°
- To select model **MRHQ10**

↓

It can be used because the point of intersection **P1** on the graph is within the limiting range.

[Example 2]
- Moment of Inertia: 5 x 10⁻⁵ kg·m²
- Rotation time: 0.1 s/90°
- To select model **MRHQ16**

↓

It cannot be used because the point of intersection **P2** on the graph is outside the range limit. (Review is necessary.)

To confirm by calculation, use formula (1) on the right and check that the kinetic energy of load E is within the allowable values below.

Kinetic energy of load E: J

$$E = 1/2 \times I_R \times \omega^2 \cdots\cdots (1)$$

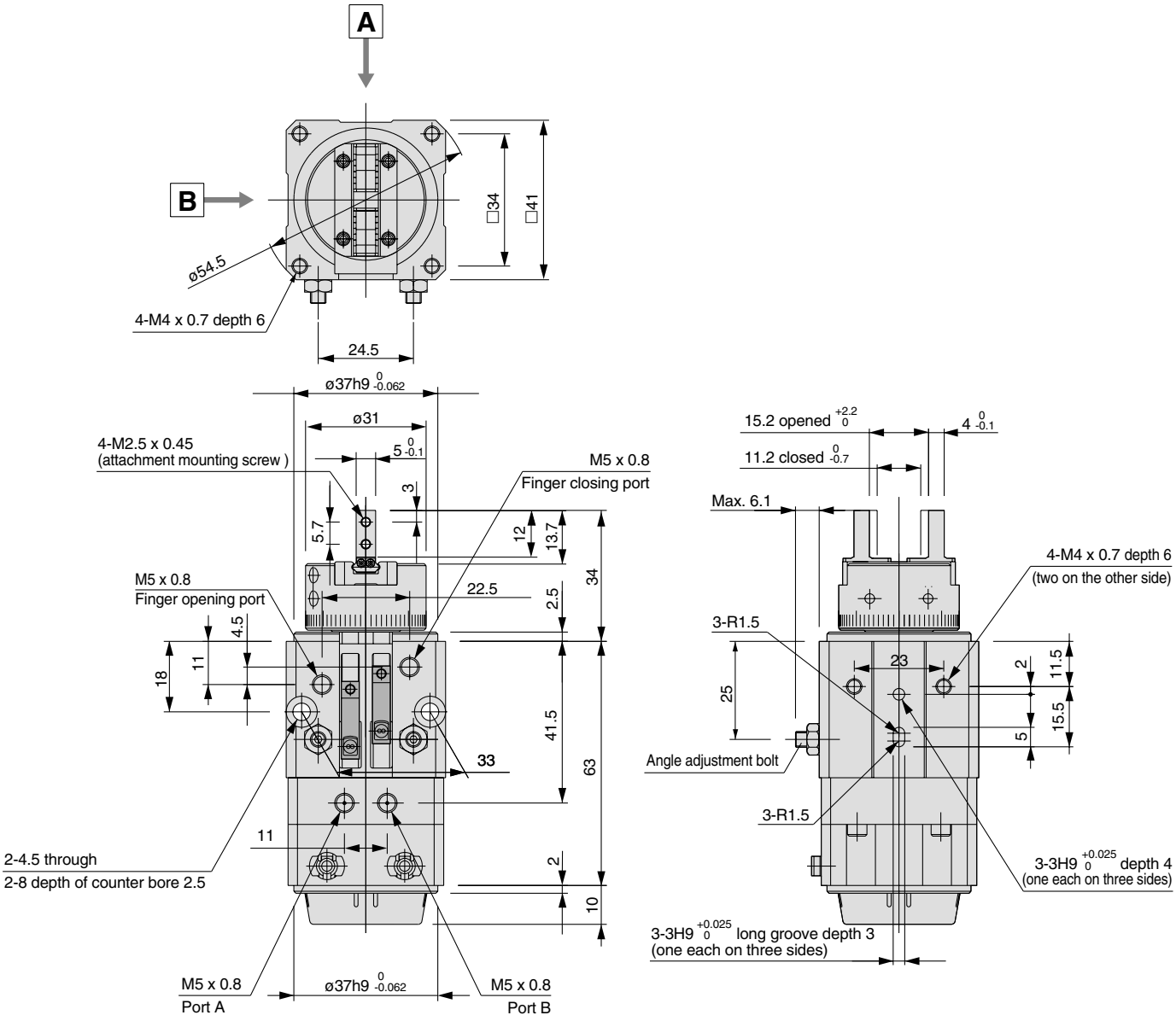
$\omega = 2\theta/t$
(ω: Angular speed at the end)
θ: Rotating angle (rad)
t: Rotation time (s)

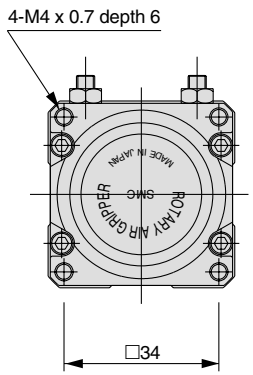
Allowable Kinetic Energy

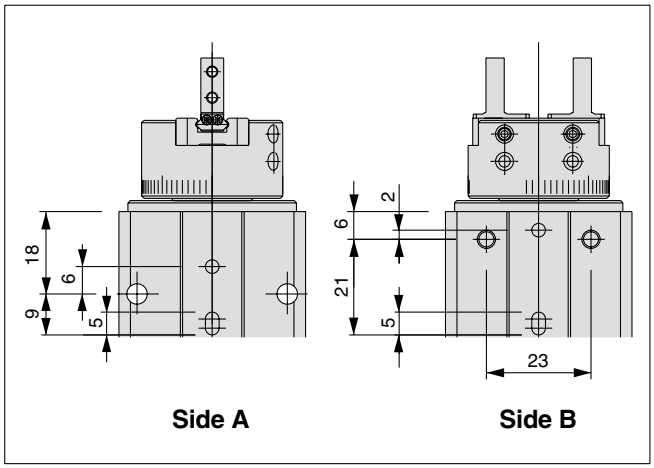
Model	Allowable value J
MRHQ10□	0.0046
MRHQ16□	0.014
MRHQ20□	0.034
MRHQ25□	0.074

Dimensions

MRHQ10

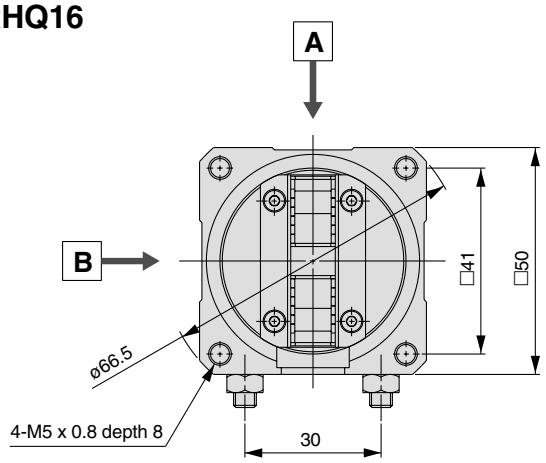


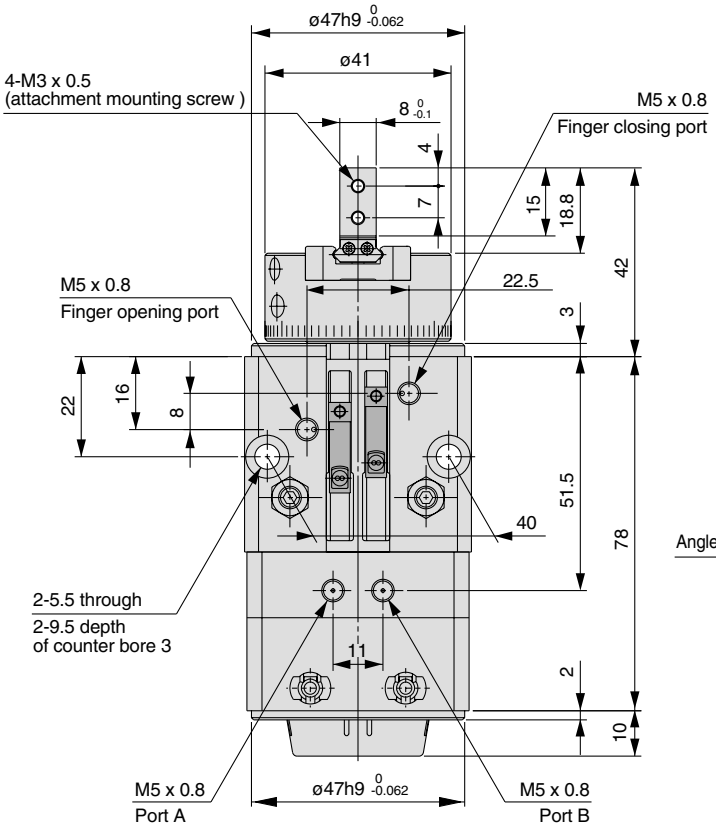


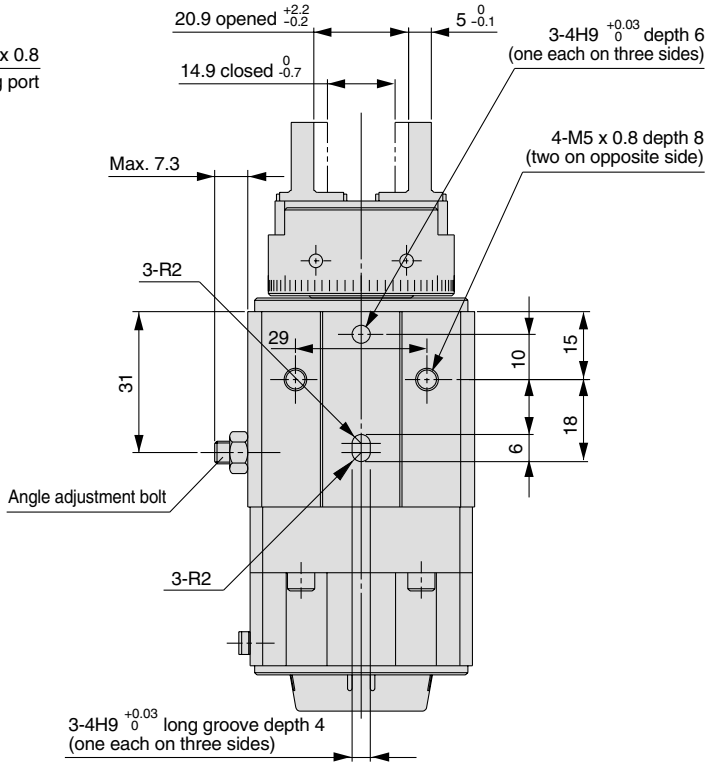


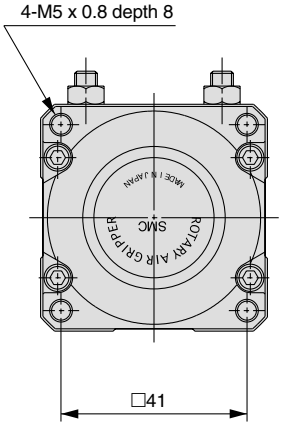
Dimensions

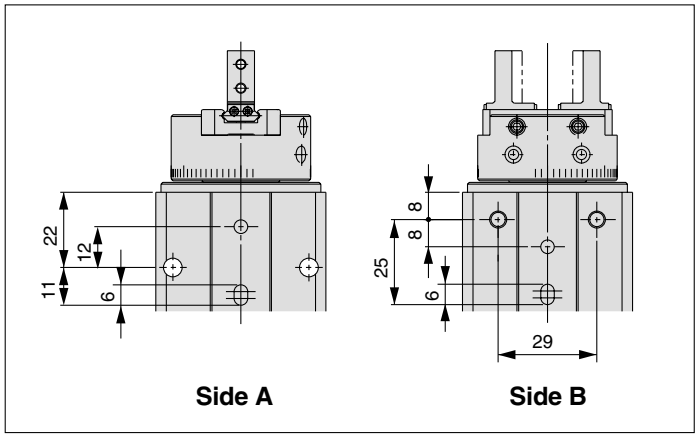
MRHQ16



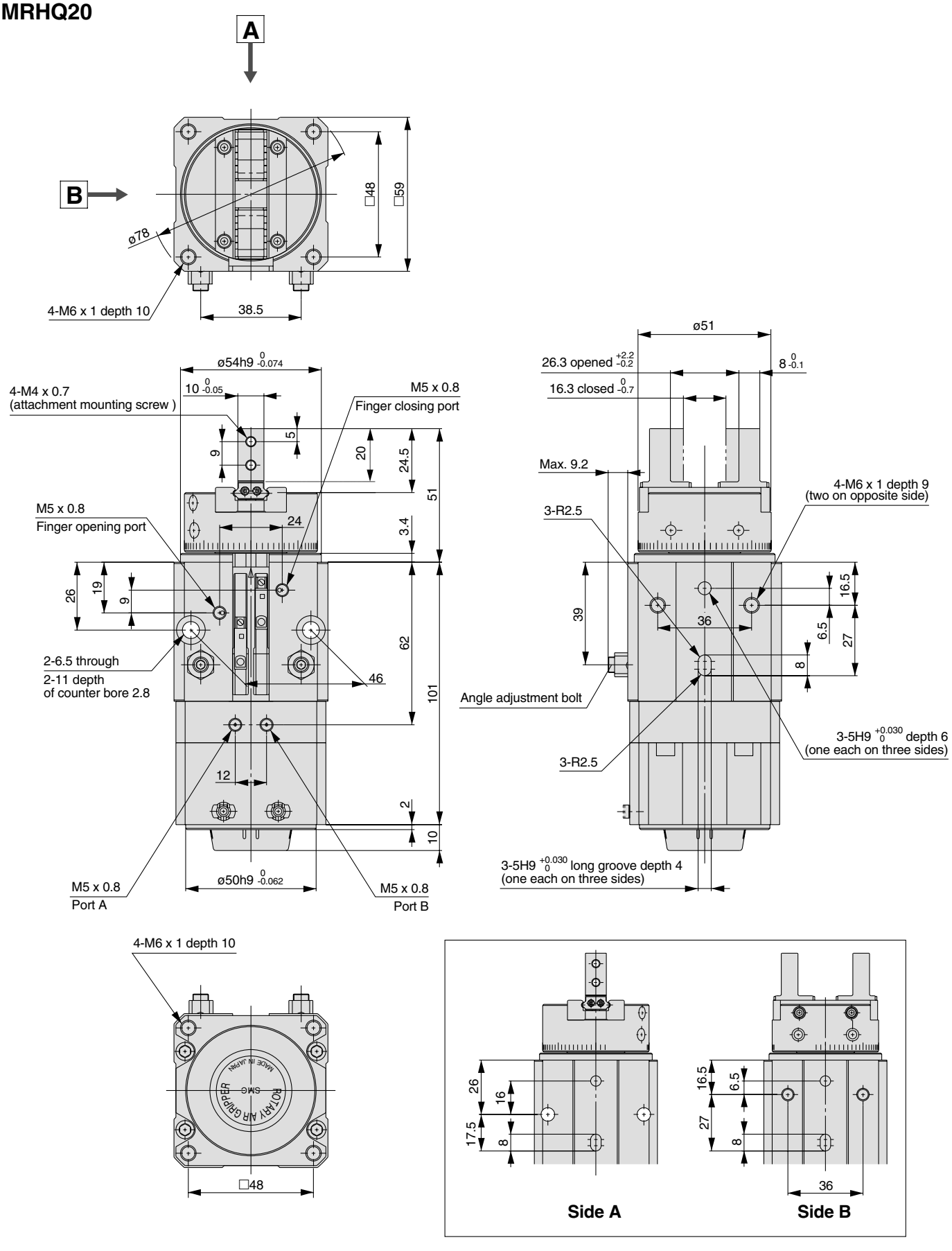






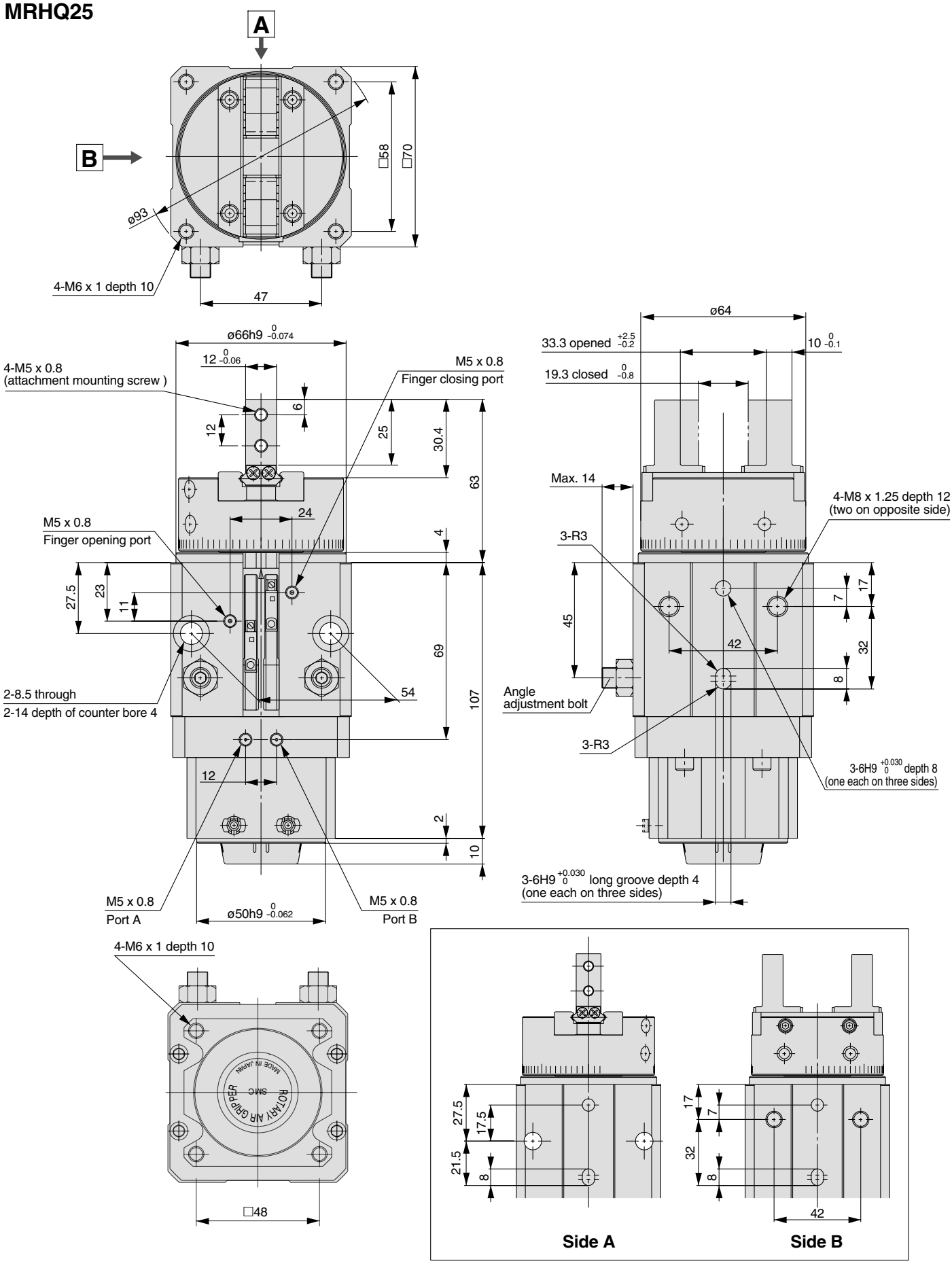


MRHQ20

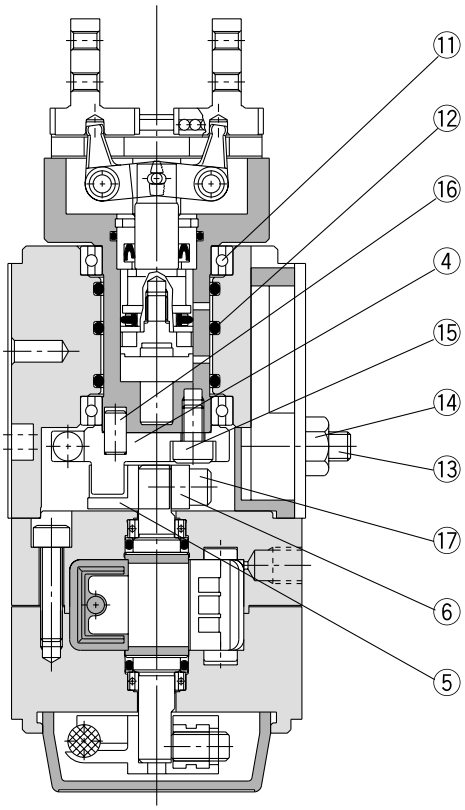

A
B
ø78
□48
□59
4-M6 x 1 depth 10
38.5
ø54h9 0 -0.074
10 0 -0.05
4-M4 x 0.7
(attachment mounting screw)
M5 x 0.8
Finger closing port
M5 x 0.8
Finger opening port
2-6.5 through
2-11 depth
of counter bore 2.8
24
46
12
ø50h9 0 -0.062
M5 x 0.8
Port A
M5 x 0.8
Port B
ø51
26.3 opened +2.2 -0.2
16.3 closed 0 -0.7
8 0 -0.1
Max. 9.2
4-M6 x 1 depth 9
(two on opposite side)
3-R2.5
36
39
Angle adjustment bolt
3-5H9 +0.030 0 depth 6
(one each on three sides)
3-5H9 +0.030 0 long groove depth 4
(one each on three sides)
4-M6 x 1 depth 10
□48
Side A
Side B

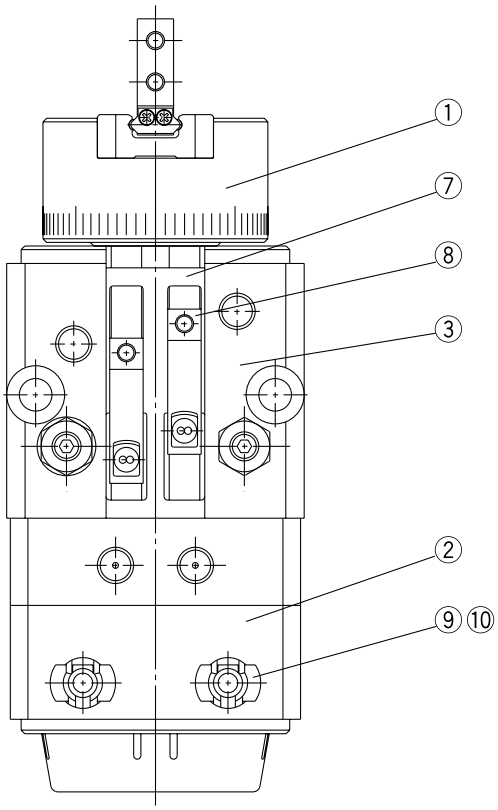
Dimensions

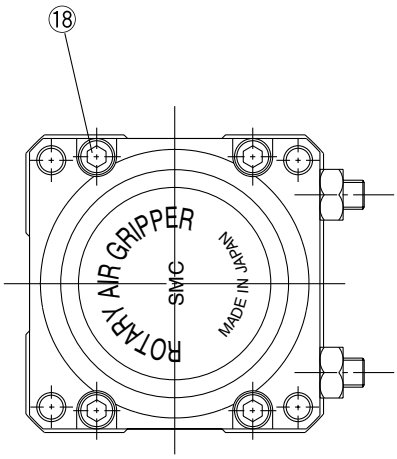
MRHQ25



Construction







Component Parts

No.	Description	Material	Note
①	Gripper unit	——	
②	Rotary unit	——	Two types for 90°and 180°
③	Body C	Aluminum alloy	Gray-White
④	Stopper lever	Carbon steel	Two types for 90°and 180°
⑤	Stopper guide	Stainless steel	
⑥	Retainer	Carbon steel	
⑦	Switch guide	Resin	
⑧	Switch holder A	Resin	
⑨	Switch case	Resin	
⑩	Switch holder B	Resin	
⑪	Bearing	High carbon bearing steel	
⑫	O-ring	NBR	
⑬	Adjustment bolt	Carbon steel	
⑭	Nut	Carbon steel	
⑮	Hexagon socket head cap screw	Carbon steel	
⑯	Parallel pin	Stainless steel	
⑰	Hexagon socket head cap screw	Stainless steel	
⑱	Hexagon socket head cap screw	Stainless steel	

Series MRHQ

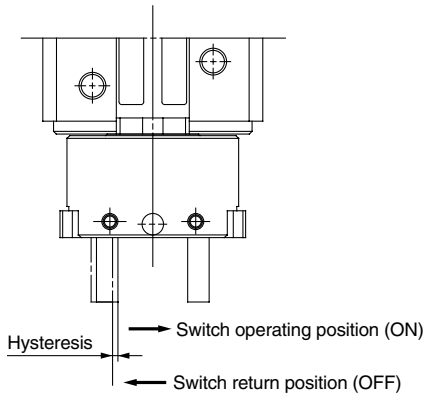
Auto Switch Specifications

Applicable Series

Series	Application	Auto switch model		Electrical entry
MRHQ10	Gripper opening/ closing verification	Solid state	**D-M9BV**	Grommet/2-wire
MRHQ16			**D-M9NV, M9PV**	Grommet/3-wire
MRHQ20	Rotation verification	Solid state	**D-M9B**	Grommet/2-wire
MRHQ25			**D-M9N, M9P**	Grommet/3-wire

Auto Switch Hysteresis

Auto switches have hysteresis similar to micro switches. Use the table below as a guide when adjusting auto switch positions, etc.

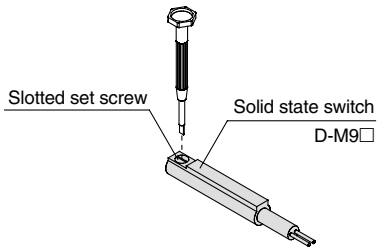


Model	Hysteresis (mm)
MRHQ10	0.5
MRHQ16	0.5
MRHQ20	1.0
MRHQ25	1.0

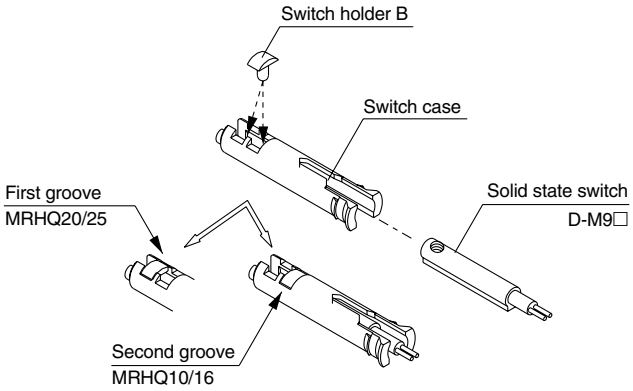
Mounting of Auto Switch

Mounting Switches to Verify Rotation

1. First, remove the slotted set screw installed in a standard switch.



2. Insert the switch into the switch case, and install switch holder B into the first groove (MRHQ20/25) or the second groove (MRHQ10/16) and secure the switch.



3. Install the switch case, with a switch attached securely in the hole, in the direction indicated in Figure (1).

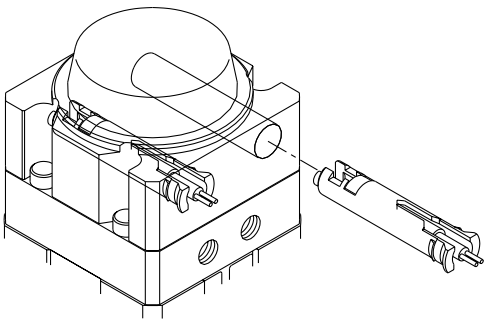


Figure (1)

Mounting Switches to Verify Opening/Closing of Gripper

1. Position switch holder A in the groove of the switch guide in the direction indicated in Figure (2).

2. Insert an auto switch into the switch guide and align the set screw with the hole of switch holder A.

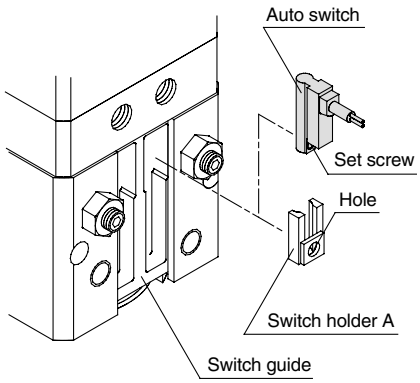


Figure (2)

3. Secure the switch at an appropriate position with a flat head watchmakers screwdriver as indicated in Figure (3).

Tightening torque: 0.05 to 0.1 N·m

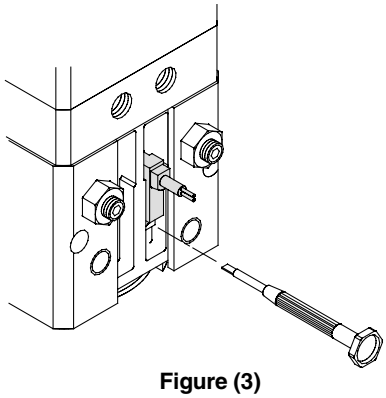
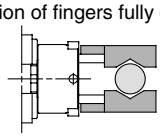
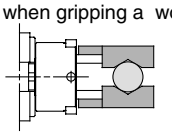
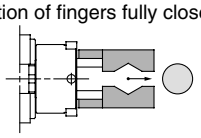
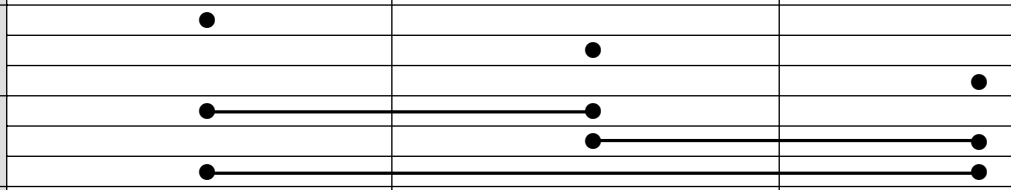
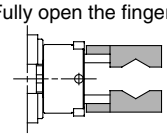
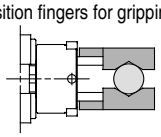
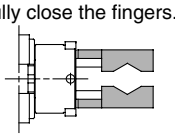
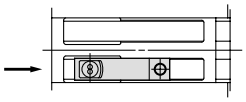
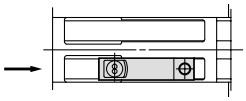
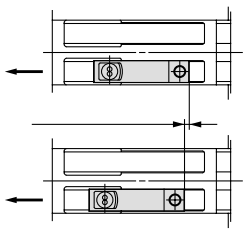
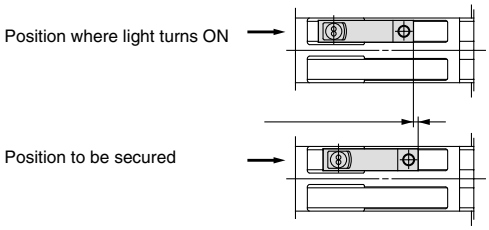


Figure (3)

Auto Switch Installation Example and Mounting Position

Various auto switch applications will be available with combinations of using different numbers of auto switches and varieties of detecting positions.

1) Detection when Gripping Exterior of Workpiece

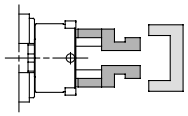
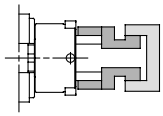
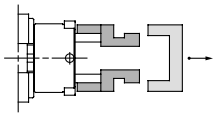
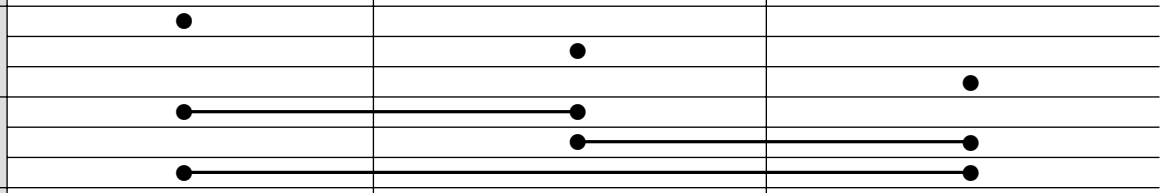
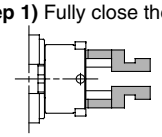
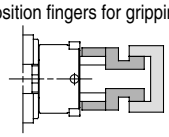
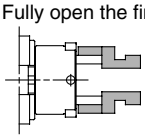
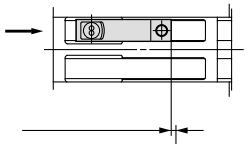
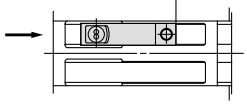
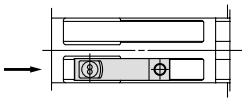
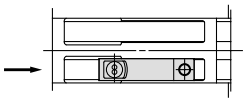
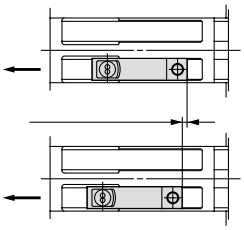
Detection example	1. Confirmation of fingers in reset position	2. Confirmation of workpiece held	3. Confirmation of workpiece released
Position to be detected	Position of fingers fully opened 	Position when gripping a workpiece 	Position of fingers fully closed 
Operation of auto switch	Switch turned ON when fingers return. (Light ON)	Switch turned ON when gripping a workpiece. (Light ON)	When a workpiece is held (Normal operation): Switch to turn OFF (Light not illuminating) When a workpiece is not held (Abnormal operation): Switch to turn ON (Light illuminating)
Detection combinations: One auto switch			
Detection combinations: Two auto switches			
How to determine auto switch installation position	**Step 1)** Fully open the fingers. 	**Step 1)** Position fingers for gripping a workpiece. 	**Step 1)** Fully close the fingers. 
At no pressure or low pressure, connect the switch to a power supply, and follow the directions.	**Step 2)** Refer to "Mounting Switches to Verify Opening/Closing of Gripper" on page 12-11-19 and position an auto switch in switch mounting groove.		
	Step 3) Slide the auto switch in the direction of the arrow until the indicator light illuminates.  **Step 4)** Slide the auto switch further in the direction of the arrow until the indicator light goes out.  **Step 5)** Move the auto switch in the opposite direction and fasten it at a position 0.3 to 0.5 mm beyond the position where the indicator light illuminates. 	**Step 3)** Slide the auto switch in the direction of the arrow until the light illuminates and fasten it at a position 0.3 to 0.5 mm in the direction of the arrow beyond the position where the indicator light illuminates. 

Note 1) It is recommended that gripping of a workpiece be performed close to the center of the finger stroke.
Note 2) When holding a workpiece close at the end of open/close stroke of fingers, detecting performance of the combinations listed in the above table may be limited, depending on the hysteresis of an auto switch, etc.

Auto Switch Installation Example and Mounting Position

Various auto switch applications will be available with combinations of using different numbers of auto switches and varieties of detecting positions.

2) Detection when Gripping Interior of Workpiece

Detection example	1. Confirmation of fingers in reset position	2. Confirmation of workpiece held	3. Confirmation of workpiece released
Position to be detected	Position of fingers fully closed 	Position when gripping workpiece 	Position of fingers fully opened 
Operation of auto switch	Switch turned ON when fingers return. (Light ON)	Switch turned ON when gripping a workpiece. (Light ON)	When a workpiece is held (Normal operation): Switch to turn OFF (Light not illuminating) When a workpiece is not held (Abnormal operation): Switch to turn ON (Light illuminating)
Detection combinations — **One auto switch**			
Detection combinations — **Two auto switches**			
How to determine auto switch installation position	**Step 1)** Fully close the fingers. 	**Step 1)** Position fingers for gripping a workpiece. 	**Step 1)** Fully open the fingers. 
At no pressure or low pressure, connect the switch to a power supply, and follow the directions.	**Step 2)** Refer to "Mounting Switches to Verify Opening/Closing of Gripper" on page 12-11-19 and position auto switch in switch mounting groove.		
	Step 3) Move the auto switch in the direction of the arrow and fasten it at a position 0.3 to 0.5 mm beyond the position where the indicator light illuminates. Position where light turns ON  Position to be secured 	**Step 3**) Slide the auto switch in the direction of the arrow until the indicator light illuminates.  **Step 4**) Slide the auto switch in the direction of the arrow until the indicator light goes out.  **Step 5**) Move the auto switch in the opposite direction, and fasten it at a position 0.3 to 0.5 mm in the direction of the arrow beyond the position where the indicator light illuminates. 

Note 1) It is recommended that gripping of a workpiece be performed close to the center of the finger stroke.
Note 2) When holding a workpiece close at the end of open/close stroke of fingers, detecting performance of the combinations listed in the above table may be limited, depending on the hysteresis of an auto switch, etc.