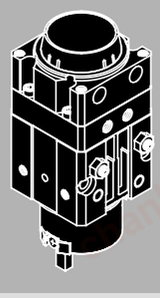
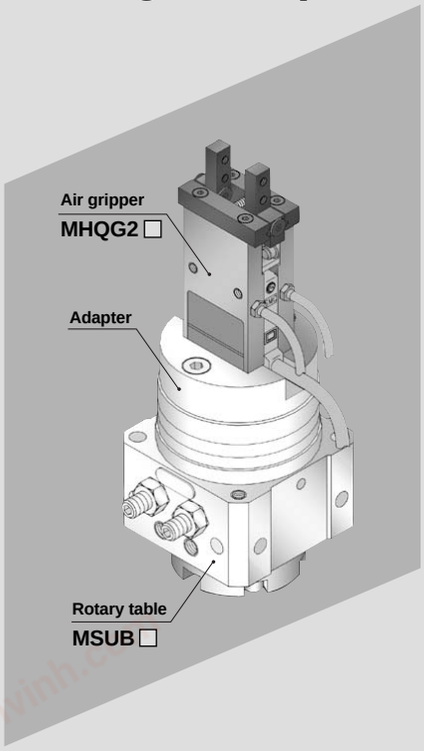
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Rotary Gripper
Series MRHQ

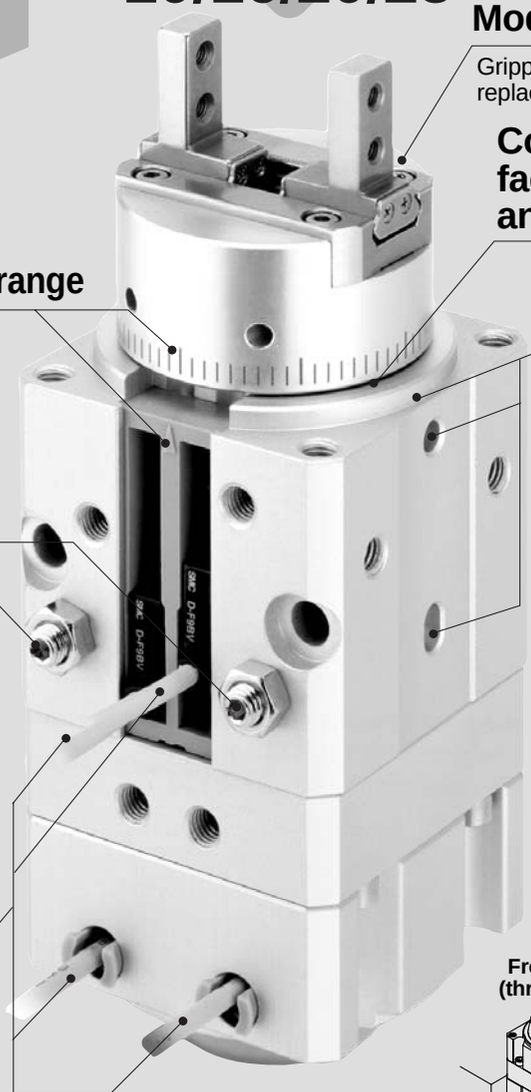
Size: 10, 16, 20, 25

Rotary gripper suitable for holding and reversing work pieces on transfer lines



- Compact integration of gripping and rotating functions
- Eliminates the peripheral piping and wiring of the previous product (rotary table + adapter + air gripper)
- Length reduced by approx. 20% compared with the previous product
- 2 standard rotation angles of 90° and 180°
- Equipped with standard magnet for auto switch installation

Rotary Gripper
MRHQ
10/16/20/25



Modular construction

Gripper section is unitised for simple replacement.

Compact bearings facilitate a light weight and compact design

Easy adjustment of rotating range

A scale indicator on the side of the gripper unit allows easy angle adjustments and is useful for verification of rotating positions.

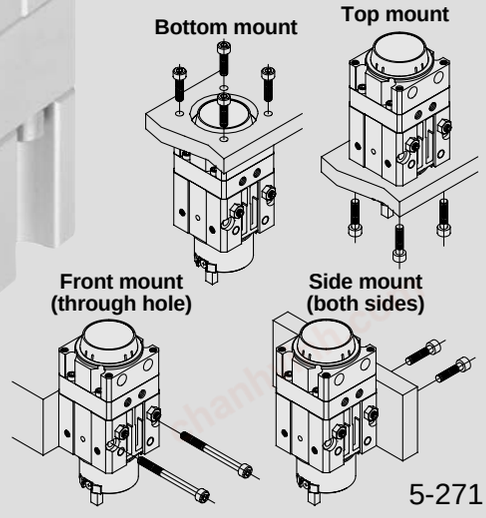
Easy alignment when mounting body

Provided with reference diameters at the top and bottom of the body, and mounting guide pin holes on three sides of the body along its centre axis. (aligned with centre of body)

Angle adjustment bolts are standard

Angle adjustment bolts allow the rotation range of the gripper unit to be adjusted by ±10° for both 90° and 180° rotation angles.
(±5° at end of rotation)

Can be mounted from five directions: two ends and three sides of the body



All piping and wiring centralised on one side for easy work operations

Auto switch capable

Switches can be installed to verify positions for opening and closing of the gripper and the end of rotation.

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⚠ Actuator Precautions

Be sure to read before handling.

Selection

⚠ Warning

1. Keep the load energy within the product's allowable energy value.

Operation with a load kinetic energy exceeding the allowable value can cause human injury and/or damage to equipment or machinery. (Refer to model section procedures in this catalog.)

⚠ Caution

1. When there are load fluctuations, allow a sufficient margin in the actuator torque.

In case of horizontal mounting (operation with product facing sideways), malfunction may occur due to load fluctuations.

Mounting

⚠ Caution

1. Adjust the rotation angle within the prescribed ranges. (90°±10°, 180°±10°) (±5° at end of rotation)

Adjustment outside the prescribed ranges may cause malfunction of the product or failure of switches to operate.

2. Adjust the opening/closing speed of the fingers with a speed controller so that they do not operate any faster than necessary.

When fingers open and close faster than necessary, impact on the fingers and other parts increases, causing poor repeatability when gripping work pieces and danger of an adverse effect on the product's life.

Adjustment of finger opening/closing speed

Double acting	Install two speed controllers and adjust with meter-out throttling.
Single acting	Install one speed controller and adjust with meter-in throttling. For external gripping – connect to closing port For internal gripping – connect to opening port

3. Adjust the rotation time within the prescribed values using a speed controller, etc. (0.07 to 0.3s/90°)

The product is provided with a fixed throttle and is designed not to operate faster than 0.07s/90°. However, in cases such as a large load inertia, it can exceed the allowable energy causing damage to equipment. (Refer to the model selection procedures in this catalog.)

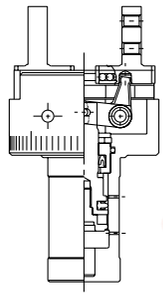
Furthermore, adjustment to a speed slower than 0.3s/90° can cause sticking and slipping or stopping of operation.

Maintenance

⚠ Caution

1. When replacing a gripper unit, follow the gripper unit replacement procedures on the next page. Confirm the correct unit part number.

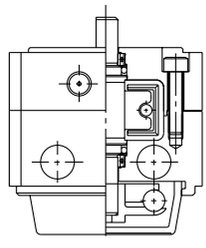
Gripper unit



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

2. In case a rotary unit is required for maintenance, order with the unit part numbers shown below.

Rotary unit



Model	Unit part no.
MRHQ10□- 90S	P406090-2A
MRHQ10□-180S	P406090-2B
MRHQ16□- 90S	P406060-2A
MRHQ16□-180S	P406060-2B
MRHQ20□- 90S	P407080-2A
MRHQ20□-180S	P407080-2B
MRHQ25□- 90S	P408080-2A
MRHQ25□-180S	P408080-2B

∗ Note that the rotation angle should not be changed even though the rotary unit has been changed.

For maintenance, order units with a part number suitable for the model being used.

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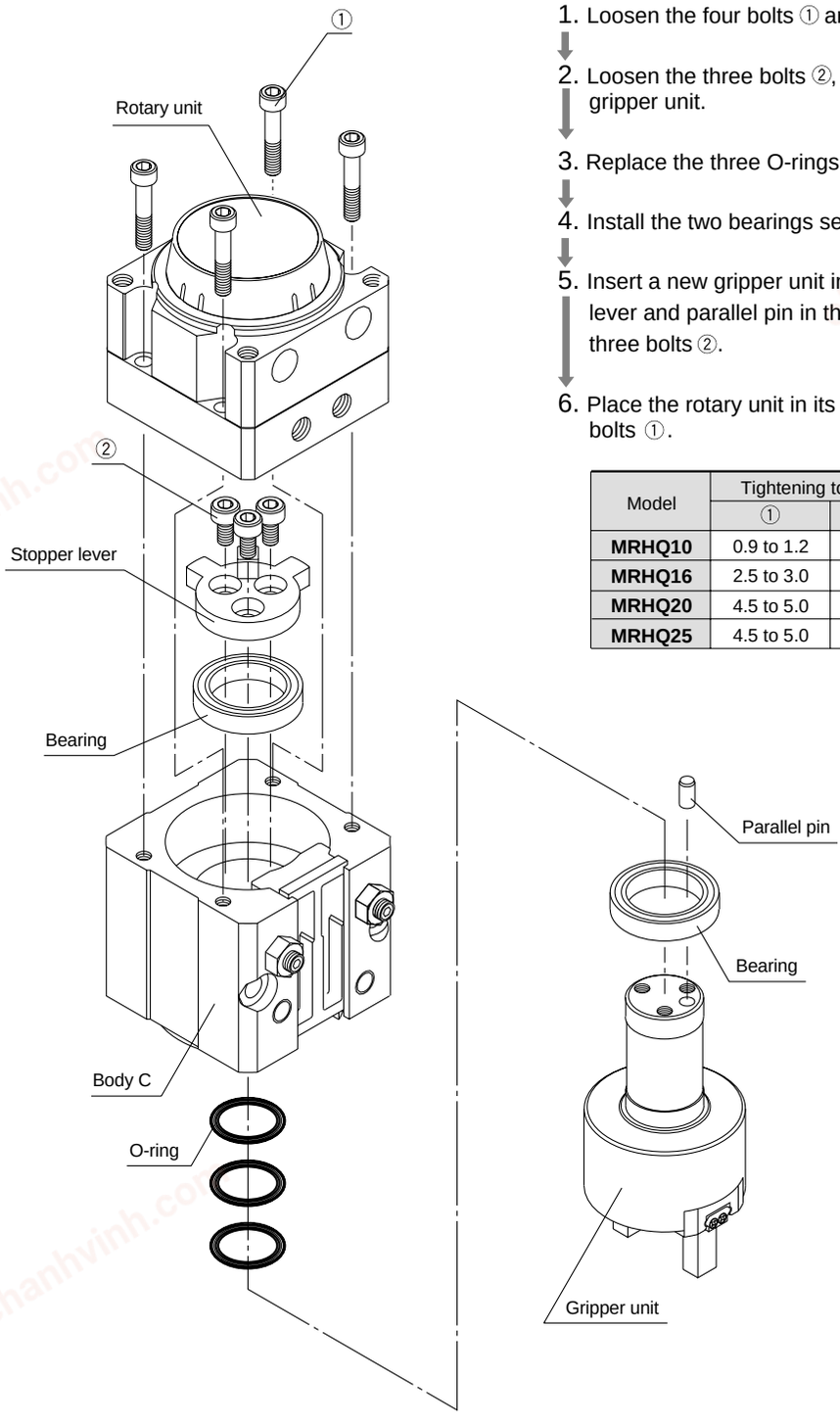
⚠ Actuator Precautions

Be sure to read before handling.

Maintenance

⚠ Caution

Gripper Unit Replacement Procedure



1. Loosen the four bolts ① and remove the rotary unit.
2. Loosen the three bolts ②, remove the stopper lever and pull out the gripper unit.
3. Replace the three O-rings inside body C.
4. Install the two bearings securely in their original positions.
5. Insert a new gripper unit into the body C. Then place the stopper lever and parallel pin in their original positions and tighten with the three bolts ②.
6. Place the rotary unit in its original position and tighten with the four bolts ①.

Model	Tightening torque N·m	
	①	②
MRHQ10	0.9 to 1.2	1.4 to 1.7
MRHQ16	2.5 to 3.0	3.2 to 3.7
MRHQ20	4.5 to 5.0	6.5 to 7.0
MRHQ25	4.5 to 5.0	10.0 to 10.5

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Rotary Gripper

Series MRHQ

How to Order

Length of lead wire

–	0.5m
L	3m
Z	5m

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

Rotary gripper

Gripper

Q	Parallel type: 2 fingers

Gripper bore

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

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 switchs

–	2
S	1

Auto switch for detecting rotation

–	Without auto switch

Applicable auto switch

Type	Electrical entry	Indicator light	Wiring (output)	Load voltage DC		Auto switch part No. Electrical entry In-line	Length of lead wire (m)* 0.5 (–)	Length of lead wire (m)* 3 (L)	Applicable load	Auto switch model
Solid state switch	Grommet	With	3 wire (NPN)	24V	5V 12V	M9N	●	●	Relay, PLC	D-M9N□-746
			3 wire (PNP)			M9P	●	●		D-M9P□-746
			2 wire		12V	M9B	●	●		D-M9B□-746

∗Lead wire length 0.5m·····– (Example) M9N
3m·····L M9NL

∗Refer to p.6-15 for specifications on auto switches.

Type of auto switch for gripper opening and closing

N	Without auto switch

Applicable auto switch

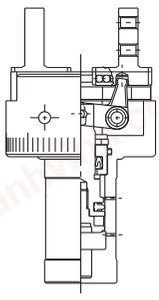
Type	Electrical entry	Indicator light	Wiring (output)	Load voltage DC		Auto switch part No. Electrical entry Perpendicular	Length of lead wire (m)* 0.5 (–)	Length of lead wire (m)* 3 (L)	Applicable load	Auto switch model
Solid state switch	Grommet	With	3 wire (NPN)	24V	5V 12V	M9NV	●	●	Relay, PLC	D-M9NV□
			3 wire (PNP)			M9PV	●	●		D-M9PV□
			2 wire		12V	M9BV	●	●		D-M9BV□

∗Lead wire length 0.5m·····– (Example) M9N
3m·····L M9NL

∗Refer to p.6-15 for detail specifications of auto switches.

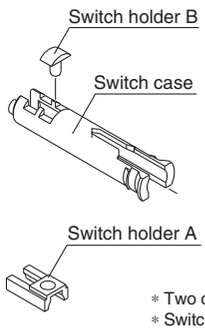
Unit lists

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□	

∗ Two of each part indicated at the left are included in a unit.
∗ Switches are not included with a unit.

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Specifications

Model			MRHQ10	MRHQ16	MRHQ20	MRHQ25
Fluid			Air			
Operating pressure	**Rotary unit**		0.25 to 0.7MPa		0.25 to 1.0MPa	
	Gripper unit	**Double acting**	0.25 to 0.7MPa	0.1 to 0.7MPa		
		Single acting	0.35 to 0.7MPa	0.25 to 0.7MPa		
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 0.3s/90° (at 0.5MPa)			
Allowable kinetic energy			0.0046J	0.014J	0.034J	0.074J
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.

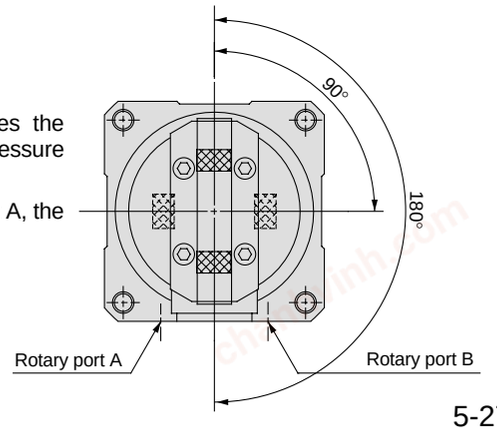
Models

Action	Model	Cylinder bore (mm)	Opening/closing stroke (mm)	Rotation angle (°)	Note 1) 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°	600
				180°	594
	MRHQ20S MRHQ20C	20	10	90°	592
				180°	1057
	MRHQ25S MRHQ25C	25	14	90°	1566
				180°	1560

Note 1) Values without auto switch weight.

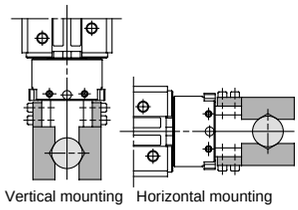
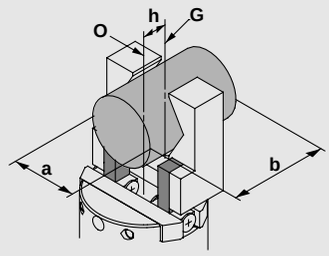
Gripper Rotation Range/View from Gripper Side

- 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.



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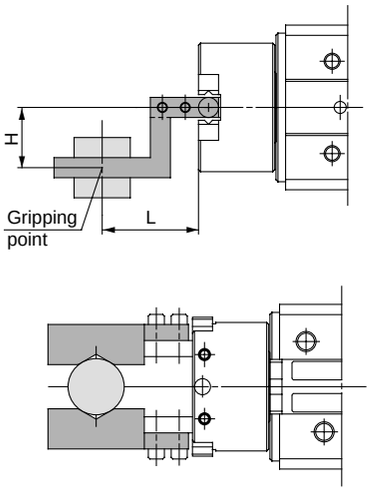
Series MRHQ

Selection Procedure	Formula	Selection Example
1 Operating conditions Enumerate the operating conditions according to the mounting position and work piece configuration.  Vertical mounting Horizontal mounting	• Model used • Operating pressure • Mounting position • Rotation time t (s) • Amount of overhang H (mm) • Gripping point distance L (mm) • Distance between central axis and centre of gravity h (mm) • Weight of load m1 (kg) • Weight of 2 attachments m2 (kg)	 Rotary gripper: MRHQ16D-90S Pressure: 0.4MPa Mounting position: Horizontal Rotation time (t): 0.2s/90° Overhang (H): 10mm Gripping point distance (L): 20mm Distance between central axis and centre of gravity (h): 10mm Load weight (m1): 0.07kg Weight of 2 attachments (m2): 0.05kg
2 Rotation time Confirm that it is within the adjustable range of rotation time .	0.07 to 0.3s/90°	0.2s/90° OK
3 Overhang and gripping point distance Confirm that the overhang (H) and the gripping point distance (L) are within the limiting ranges for the operating pressure.	Gripping point limiting range **Graph 1**	Within the limiting range OK
4 Weight of load 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.)	20 x 9.8 x m1<Effective gripping force (N) **Graph 2**	20 x 9.8 x 0.07 = 13.72 13.72N<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 5-281 for the lateral load allowable value and each moment value formulas.)	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.	20 x 9.8 x (m1 + m2) x H/1000 <Effective torque (N·m) **Graph 3**	20 x 9.8 x (0.07 + 0.05) x 10/1000 = 0.24 0.24N·m<Effective torque OK
7 Find the moment of inertia: I_R for the load + attachments (2 pcs.)	$I_R = K \times (a^2 + b^2 + 12h^2) \times (m1 + m2)/(12 \times 10^6)$ (K = 2: Safety factor)	$I_R = 2 \times (20^2 + 30^2 + 12 \times 10^2) \times (0.07 + 0.05)/(12 \times 10^6)$ $= 0.00005 kg \cdot m^2$
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 5-281}	$1/2 \times I_R \times \omega^2$<Allowable energy (J) $\omega = 2\theta/t$ (ω: Angular speed at the end) θ: Rotation angle (rad) t : Rotation time (s)	$1/2 \times 0.00005 \times (2 \times (3.14/2)/0.2)^2 = 0.0062$ 0.0062J<Allowable energy OK

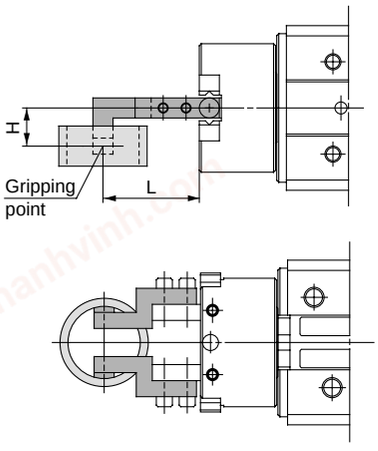
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Gripping Point

External gripping



Internal gripping



L: Gripping point distance
H: Overhang

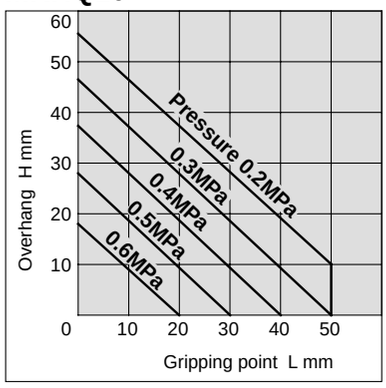
- Operate so that the work piece gripping point distance "L" and the amount of overhang "H" stay within the range shown for each operating pressure given in the graphs to the right.
- If operated with the work piece gripping point outside of the limiting range, an excessive eccentric load will be applied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

Limitation range of gripping point

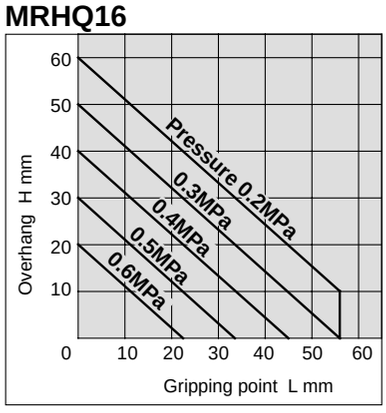
Graph 1

External gripping

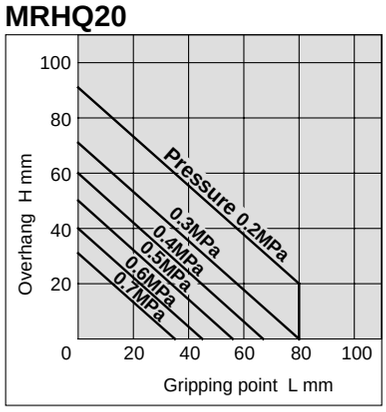
MRHQ10



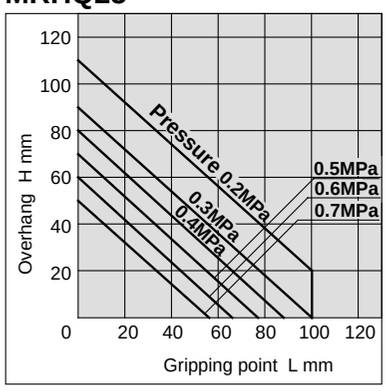
MRHQ16



MRHQ20

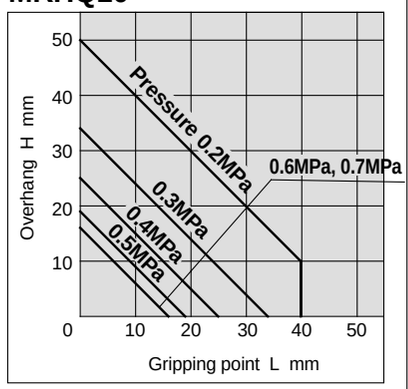


MRHQ25

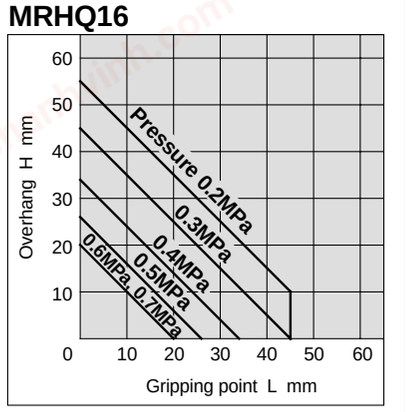


Internal gripping

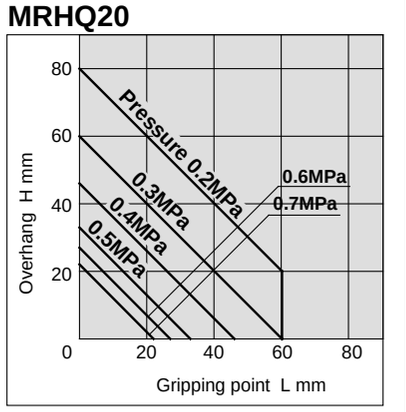
MRHQ10



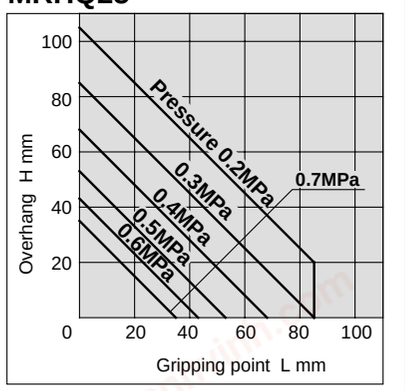
MRHQ16



MRHQ20



MRHQ25



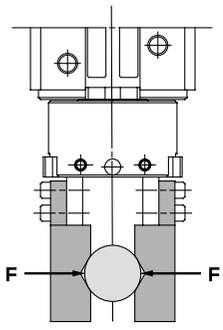
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Series MRHQ

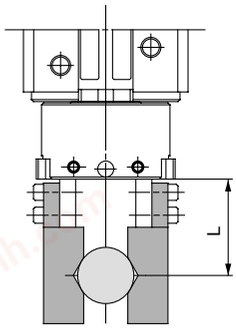
Effective Gripping Force

Expressing the effective gripping force

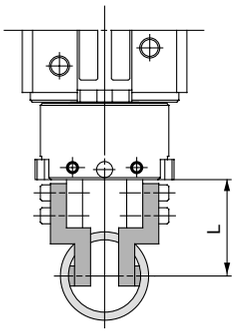
The effective gripping force shown in the graphs to the right is expressed as F, which is the impellant force of one finger, when both fingers and attachments are in full contact with the work piece as shown in the figure below.



External gripping



Internal gripping



L: Gripping point distance

Model selection guidelines by work piece weight

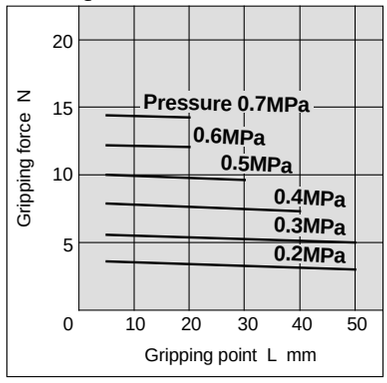
- Although conditions differ according to the work piece shape and the coefficient of friction between the attachments and the work piece, select a model which can provide a gripping force 10 to 20 times the work piece weight.
- A greater margin of safety is required when high acceleration or impact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

Effective gripping force

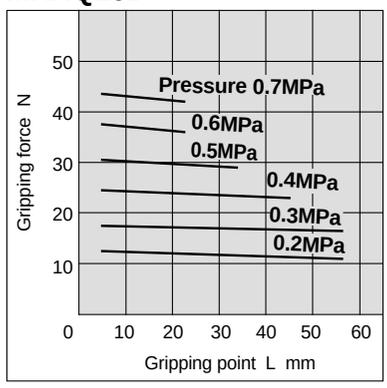
Graph 2

External gripping/Double acting

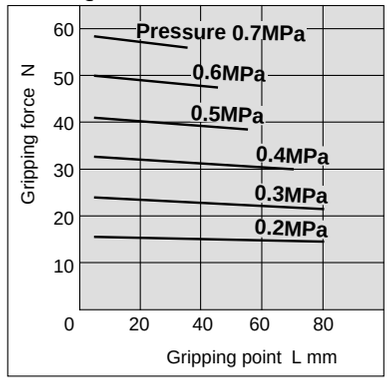
MRHQ10D



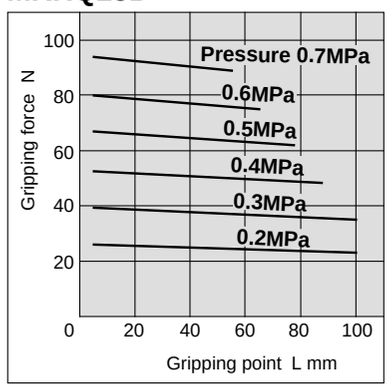
MRHQ16D



MRHQ20D

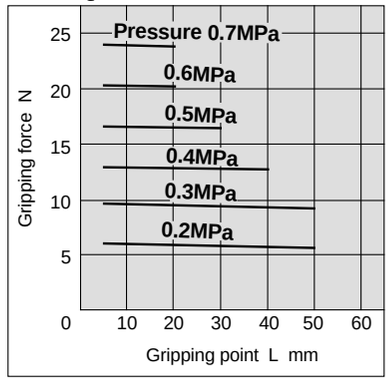


MRHQ25D

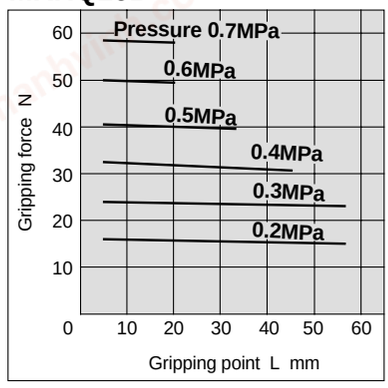


Internal gripping/Double acting

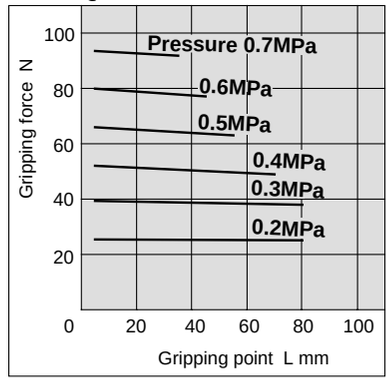
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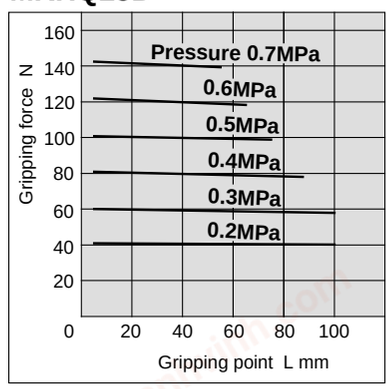
MRHQ16D



MRHQ20D



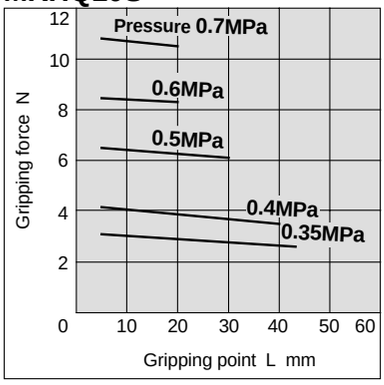
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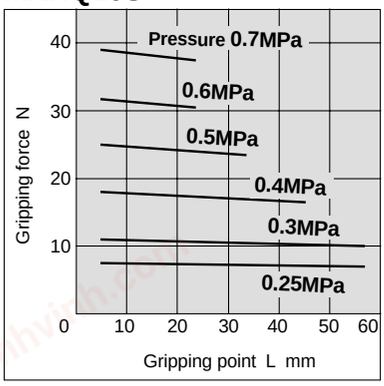
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External gripping force/Single acting

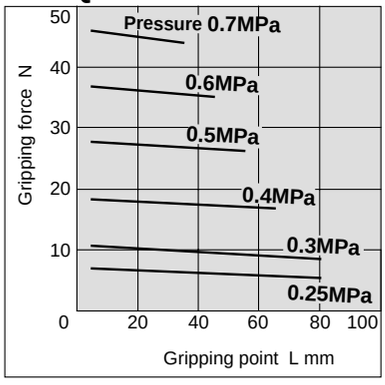
MRHQ10S



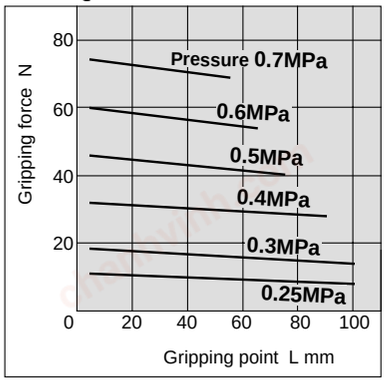
MRHQ16S



MRHQ20S

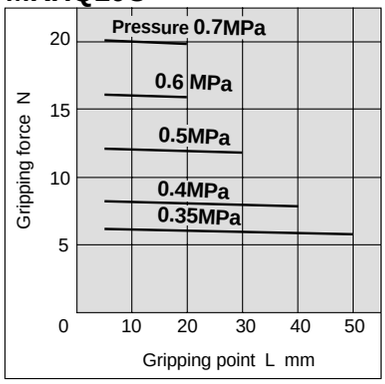


MRHQ25S

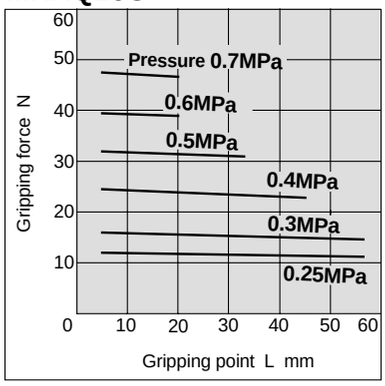


Internal gripping force/Single acting

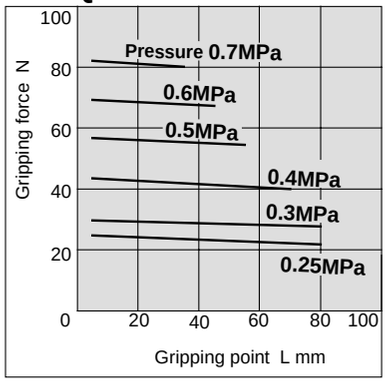
MRHQ10C



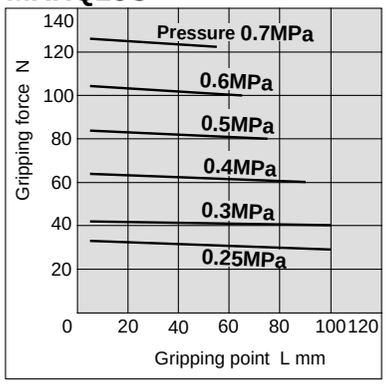
MRHQ16C



MRHQ20C



MRHQ25C



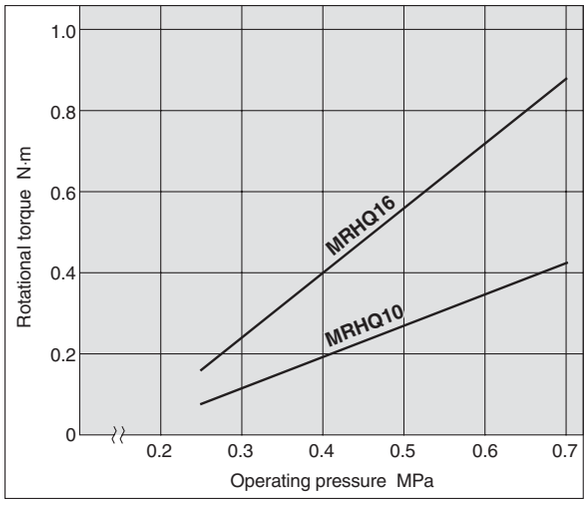
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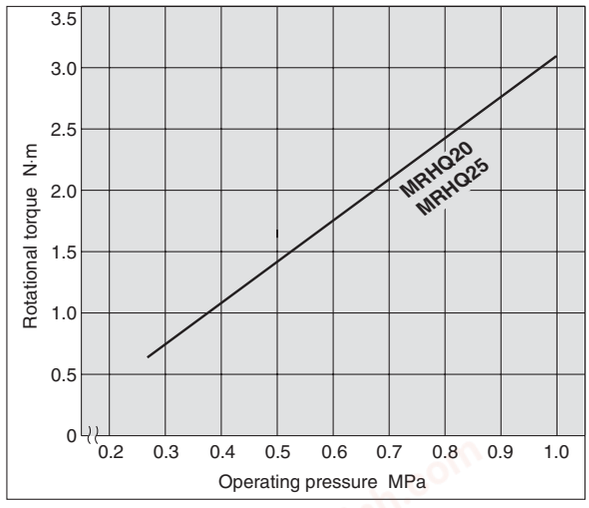
Series MRHQ

Rotational Torque and Gripping Point

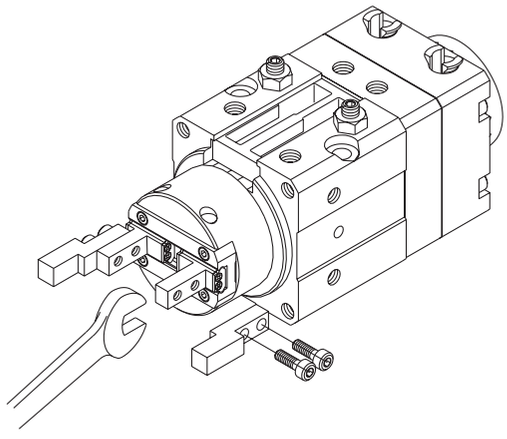
Rotational torque

Graph 3





How to mount attachments on fingers

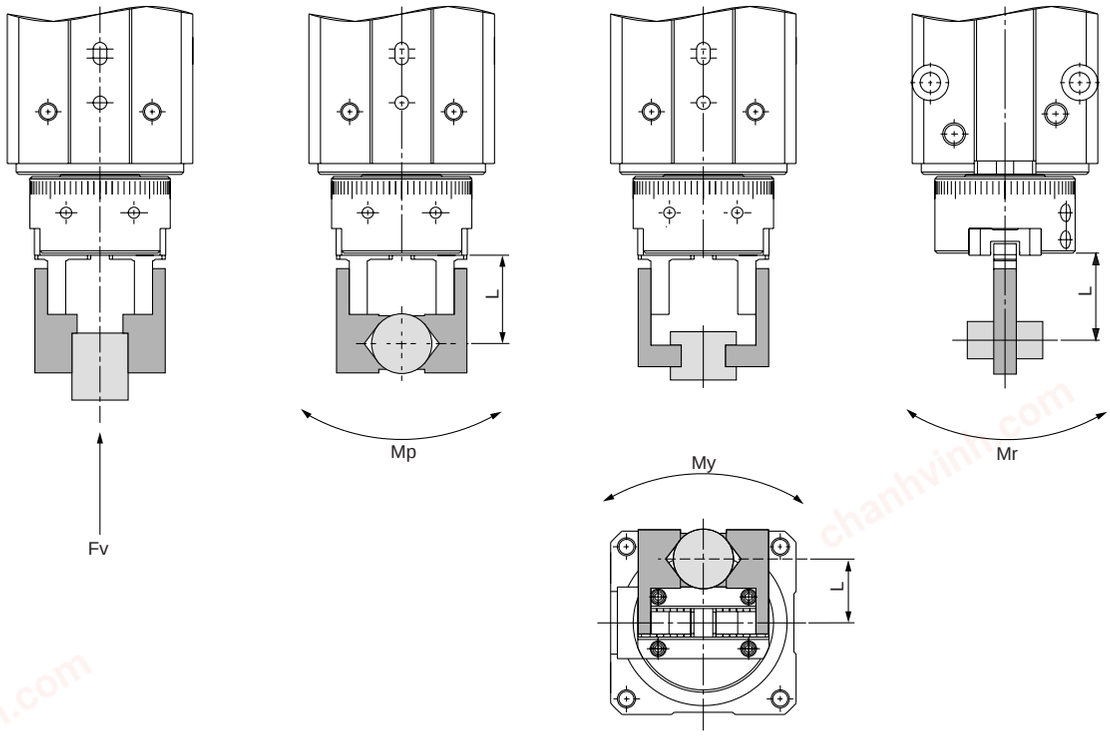


When mounting attachments on fingers, support the fingers with a tool such as a spanner to prevent them from twisting. Refer to the table on the right for the tightening torques of finger mounting bolts.

Model	Bolts	Max. tightening torque N·m
MRHQ10	M2.5	0.31
MRHQ16	M3	0.59
MRHQ20	M4	1.4
MRHQ25	M5	2.8

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Allowable Value of External Force on Fingers



L: Distance to the point 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 $F\ (N) = \dfrac{M\ (\text{Maximum allowable moment})\ (N\cdot m)}{L \times 10^{-3*}}$ ∗ Unit conversion factor	When static load f = 10N, which produces pitch moment to the point L = 30mm 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.

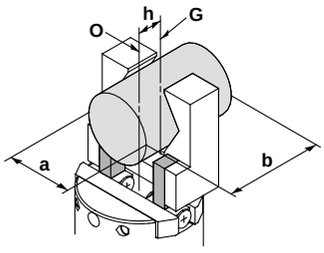
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Series MRHQ

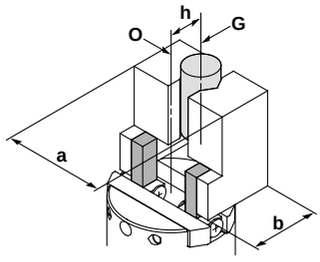
Moment of Inertia and Allowable Kinetic Energy

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.



Dimension of load>attachment



Dimension of load<attachment

Description

O ····· Center of rotation
G ····· Attachment and load center of gravity

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

Moment of inertia **I: kg·m²**

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

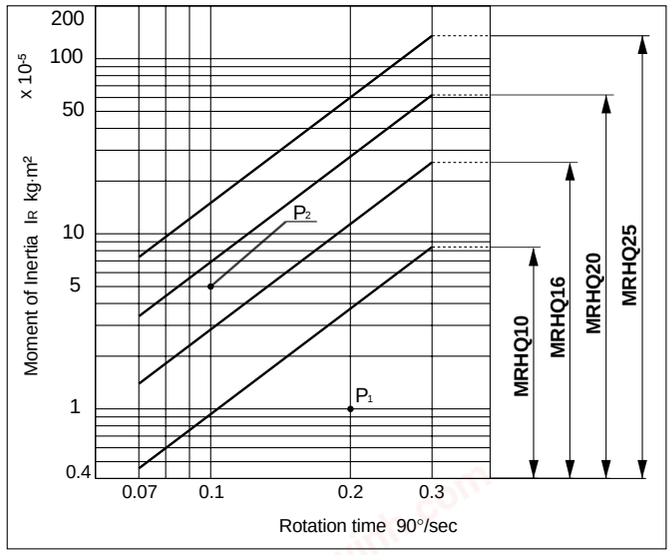
Practical moment of inertia **I_R: kg·m²**

$$I_R = K \times I$$

∗ 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: Dimension 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: 0.3s/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: 0.1s/90°
• To select model **MRHQ16**
↓
It cannot be used because the point of intersection **P2** on the graph is outside the limiting range. (Review is necessary.)

To confirm by calculation, use formula (1) on the right and check kinetic energy of load: E will be within the allowable value below.

Allowable kinetic energy

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

Kinetic energy of load **E: J**

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

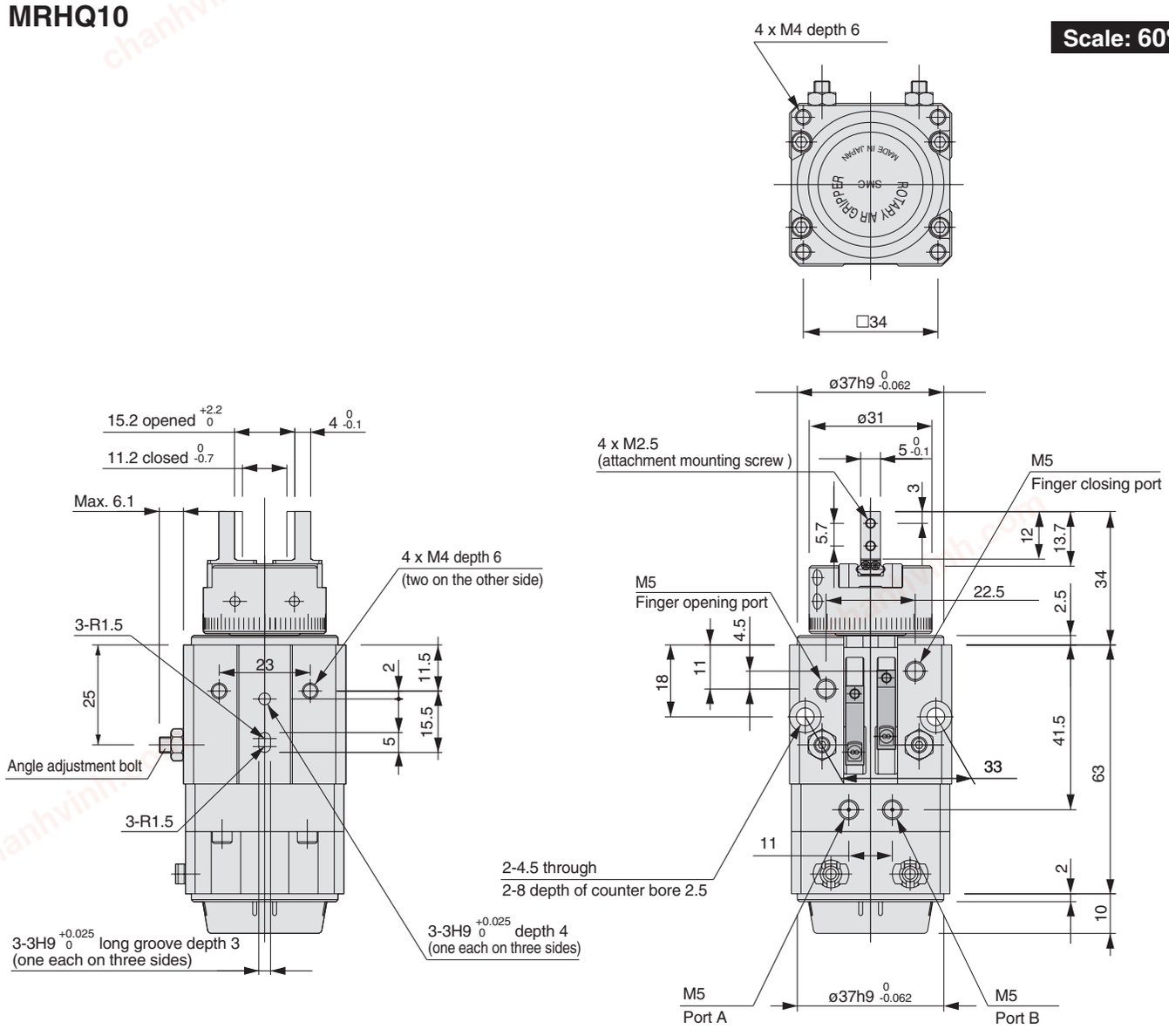
$\omega = 2\theta/t$
(ω: Angular speed at the end)
θ: Rotation angle (rad)
t: Rotation time (s)

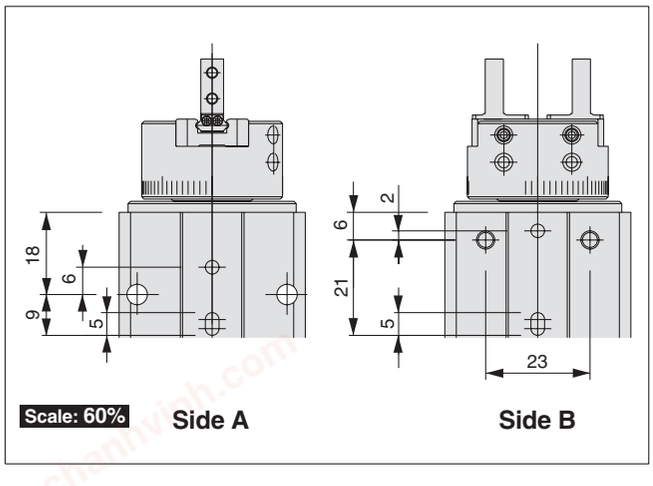
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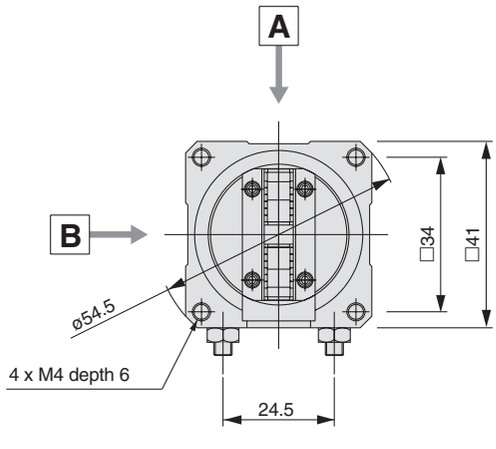
Dimensions

MRHQ10

Scale: 60%





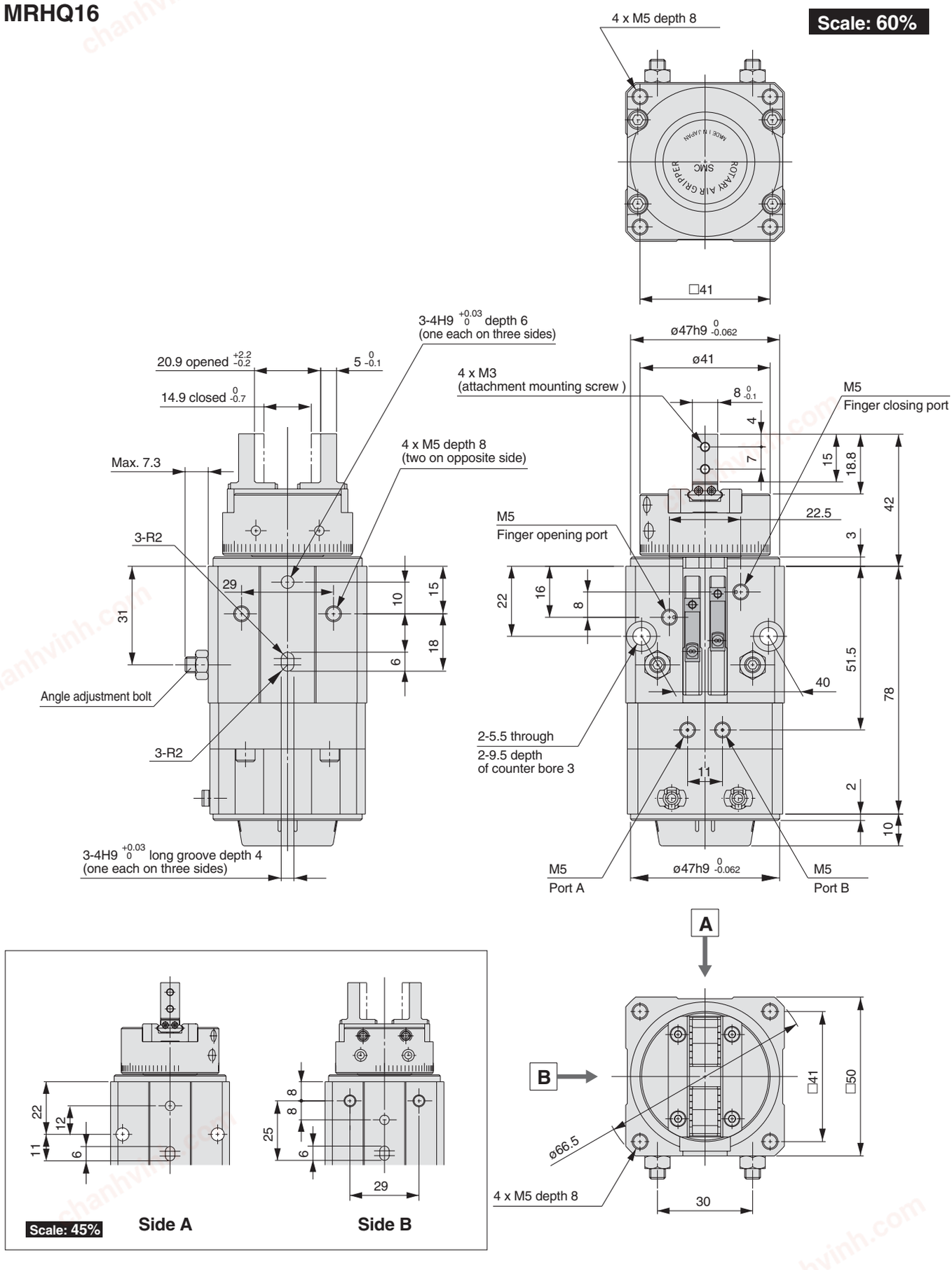


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Series MRHQ

MRHQ16

Scale: 60%

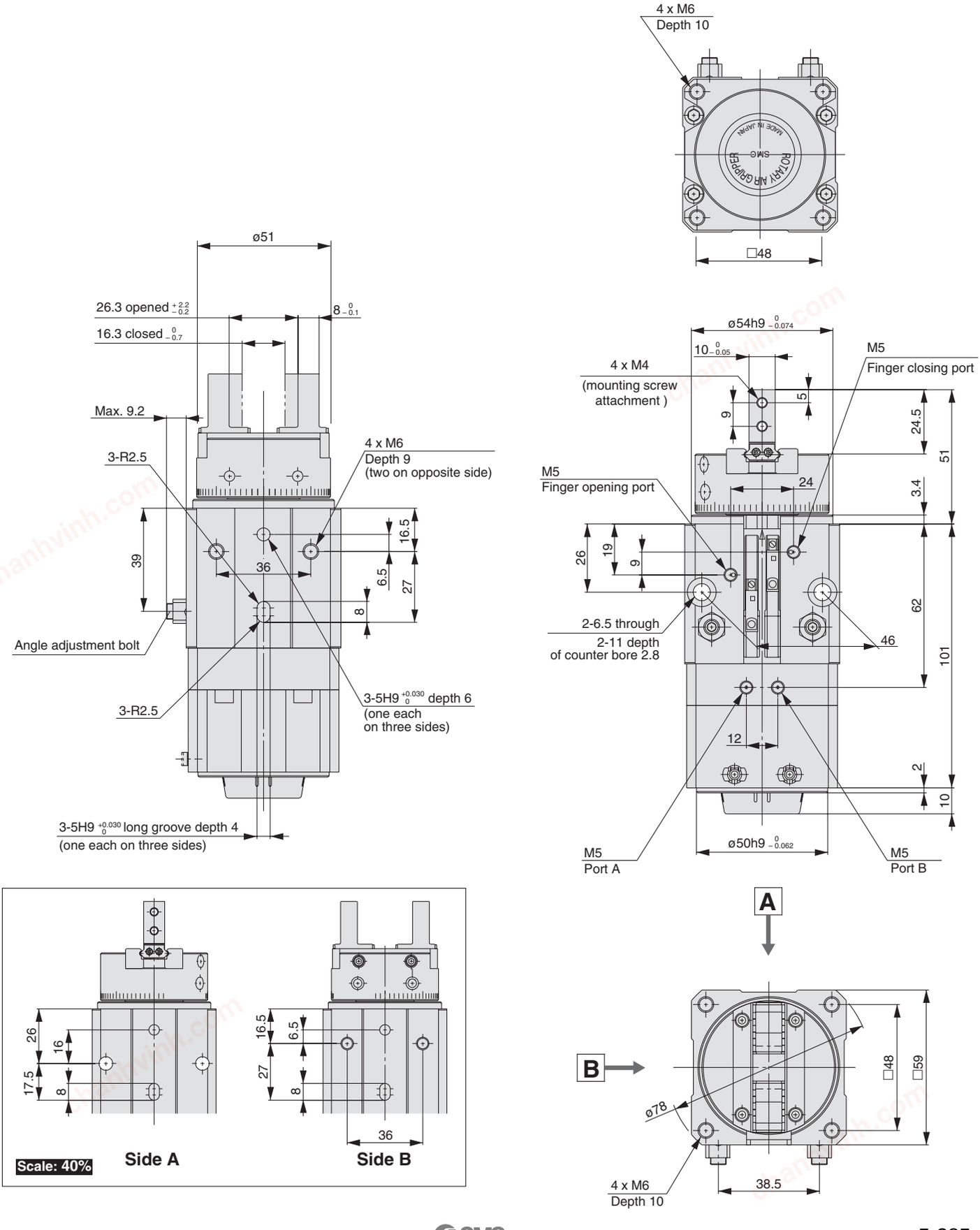


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Dimensions

MRHQ20

Scale: 50%

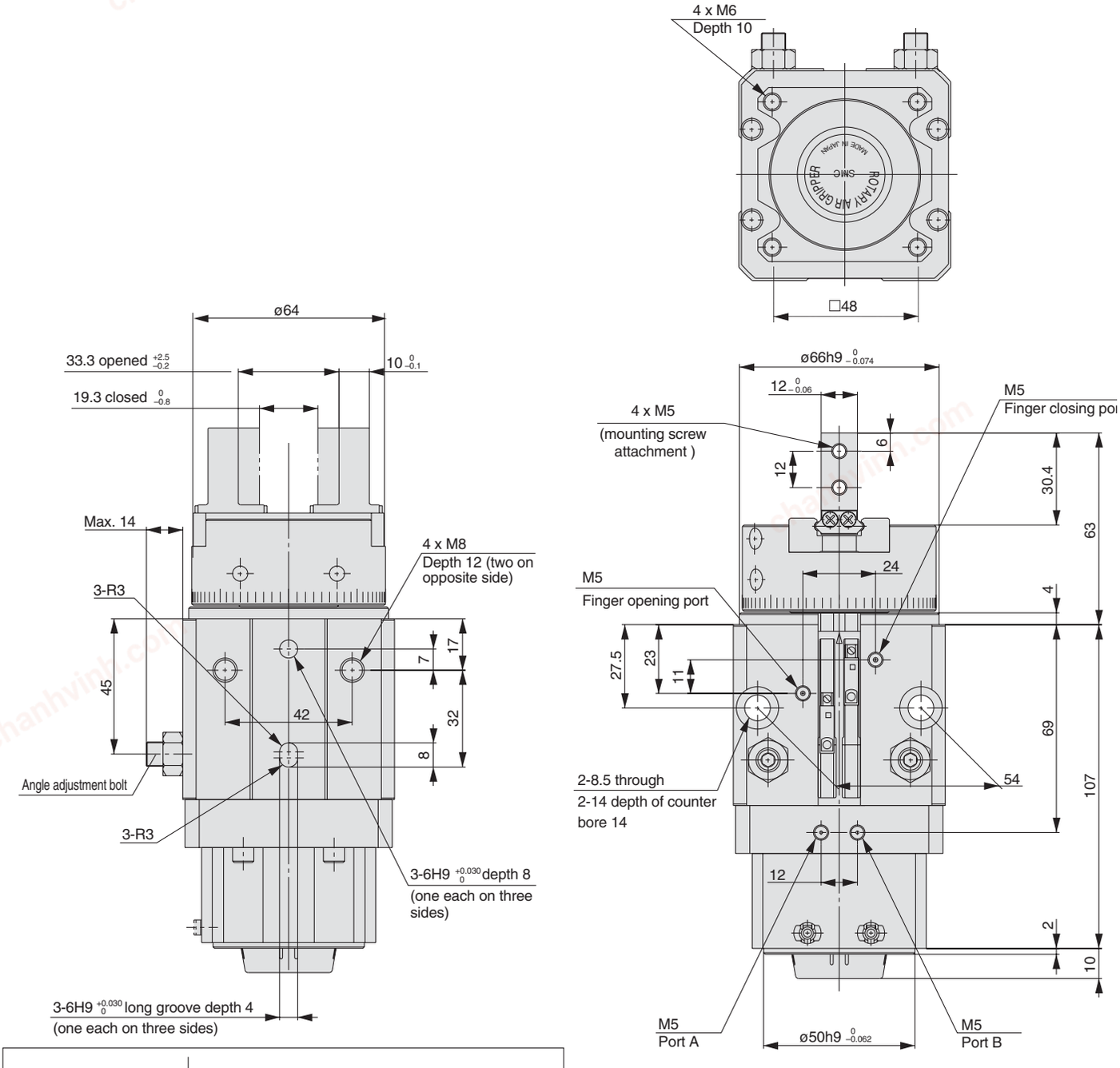


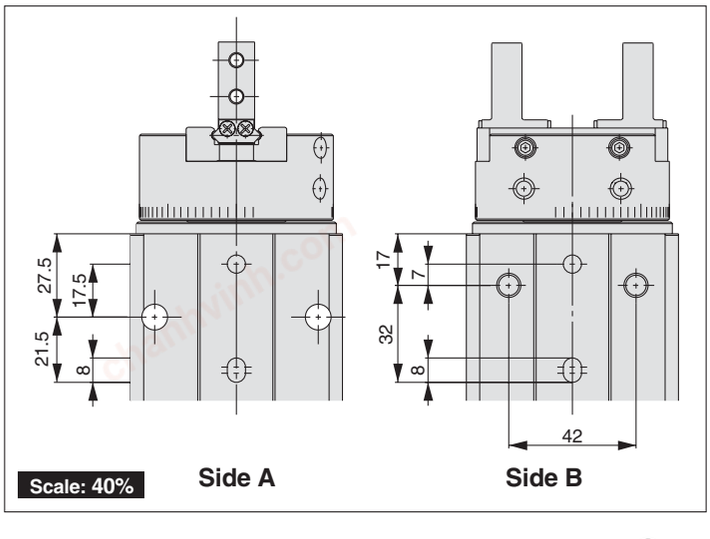
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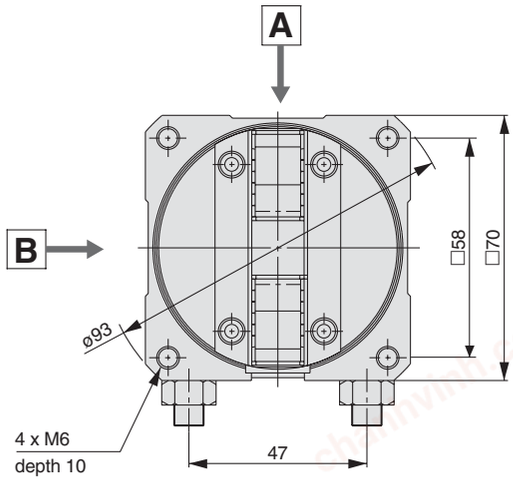
Series MRHQ

MRHQ25

Scale: 50%





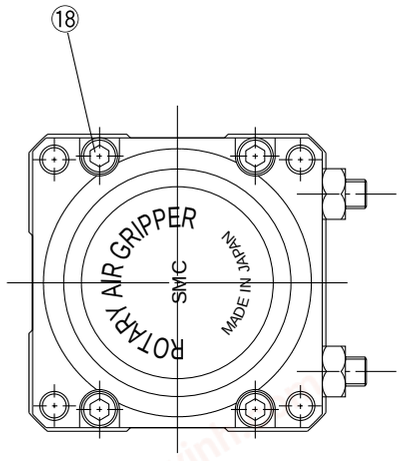


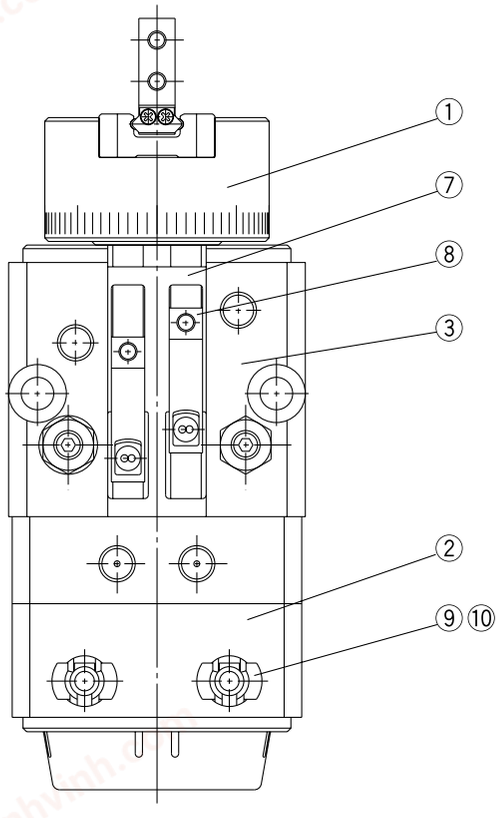
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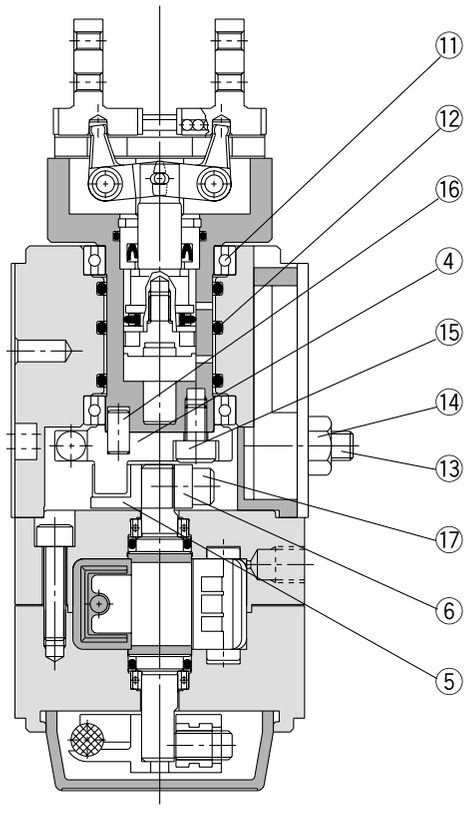
Construction

Parts list

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	







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Series MRHQ

Auto Switch Specifications



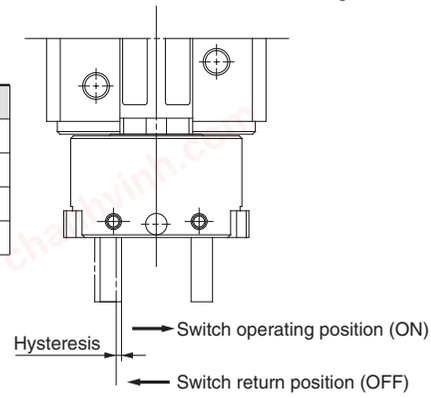
Applicable Series

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-746**	Grommet/2 wire
MRHQ25			**D-M9N, M9P-746**	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.

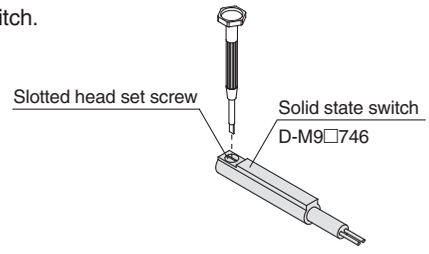
Model	Hysteresis (mm)
MRHQ10	0.5
MRHQ16	0.5
MRHQ20	1.0
MRHQ25	1.0



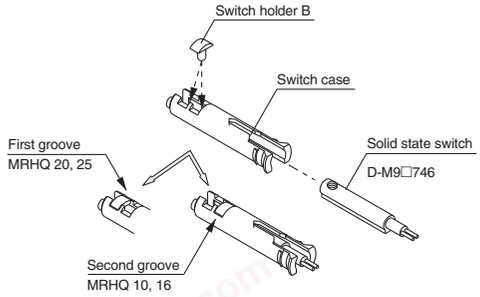
Auto Switch Mounting

Mounting switches to verify rotation

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



2. Insert the switch into the switch case, and install switch holder B into the first groove (MRHQ 20, 25) or the second groove (MRHQ 10, 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.

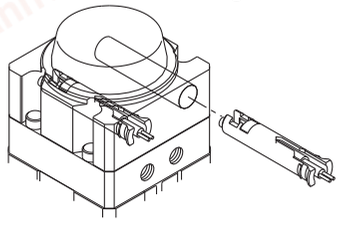


Figure 1

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.

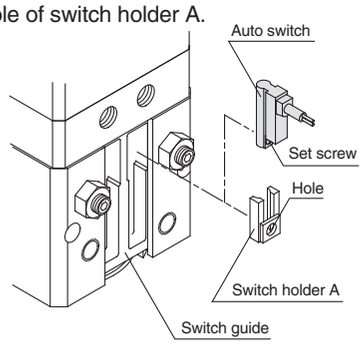


Figure 2

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

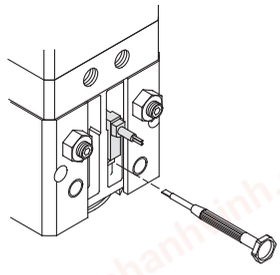


Figure 3