Doc. no. MRHQ-OM00002-D

Operation Manual

Model name

MRHQ Rotary Gripper

Part number / Series

MRHQ10,16,20,25

SMC Corporation

Contents

Safety Instructions

1. How to Order 1

2. Specifications 2

2-1. Specifications

2-2. Precautions on model selection 4

Gripping Point 5

Expressing the effective gripping force

Gripping Point Range Limit 6

Effective Gripping force（Double Acting） 7

Effective Gripping force（Single Acting） 8

Rotational Torque 9

2-3. Allowable Value of External Force on Fingers 10

2-4. Moment of Inertia and Allowable Kinetic Energy 11

Graph (Moment of inertia and rotation time) 12

3. Installation 13

3-1. Air supply

3-2. Piping

3-3. Operating environment

3-4. Mounting 14

3-5. Speed Adjustment 15

3-6. Adjustment of rotation angle

4. Mounting of Auto Switch 16

4-1. Mounting method

4-2. Switch position of the gripper side 17

1) Detection when Gripping Exterior of Workpiece

2) Detection when Gripping Interior of Workpiece 18

5. Maintenance 19

5-1. Construction

5-2. Part number of the unit and seals 20

5-3. Gripper Unit Replacement Procedure 21

5-4. Check 22

5-4-1. Check part

5-4-2. Inspection interval

6. Failure and measures 23

Safety Instructions

These safety instructions are intended to prevent hazardous situations and/or equipment damage. These instructions indicate the level of potential hazard with the labels of **"Caution," "Warning"** or **"Danger."** They are all important notes for safety and must be followed in addition to International Standards (ISO/IEC)*1), and other safety regulations.

*1) ISO 4414: Pneumatic fluid power - General rules and safety requirements for systems and their components
ISO 4413: Hydraulic fluid power - General rules and safety requirements for systems and their components
IEC 60204-1: Safety of machinery - Electrical equipment of machines - Part 1: General requirements
ISO 10218-1: Robots and robotic devices - Safety requirements for industrial robots - Part 1: Robots
etc.

Danger	**Danger** indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.
Warning	**Warning** indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
Caution	**Caution** indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.

Warning

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

Since the product specified here is used under various operating conditions, its compatibility with specific equipment must be decided by the person who designs the equipment or decides its specifications based on necessary analysis and test results. The expected performance and safety assurance of the equipment will be the responsibility of the person who has determined its compatibility with the product. This person should also continuously review all specifications of the product referring to its latest catalog information, with a view to giving due consideration to any possibility of equipment failure when configuring the equipment.

2. Only personnel with appropriate training should operate machinery and equipment.

The product specified here may become unsafe if handled incorrectly. The assembly, operation and maintenance of machines or equipment including our products must be performed by an operator who is appropriately trained and experienced.

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

1. The inspection and maintenance of machinery/equipment should only be performed after measures to prevent falling or runaway of the driven objects have been confirmed.
2. When the product is to be removed, confirm that the safety measures as mentioned above are implemented and the power from any appropriate source is cut, and read and understand the specific product precautions of all relevant products carefully.
3. Before machinery/equipment is restarted, take measures to prevent unexpected operation and malfunction.

4. Our products cannot be used beyond their specifications. Our products are not developed, designed, and manufactured to be used under the following conditions or environments. Use under such conditions or environments is not covered.

1. Conditions and environments outside of the given specifications, or use outdoors or in a place exposed to direct sunlight.
2. Use for nuclear power, railways, aviation, space equipment, ships, vehicles, military application, equipment affecting human life, body, and property, fuel equipment, entertainment equipment, emergency shut-off circuits, press clutches, brake circuits, safety equipment, etc., and use for applications that do not conform to standard specifications such as catalogs and operation manuals.
3. Use for interlock circuits, except for use with double interlock such as installing a mechanical protection function in case of failure. Please periodically inspect the product to confirm that the product is operating properly.

Safety Instructions

⚠ Caution

We develop, design, and manufacture our products to be used for automatic control equipment, and provide them for peaceful use in manufacturing industries.
Use in non-manufacturing industries is not covered.
Products we manufacture and sell cannot be used for the purpose of transactions or certification specified in the Measurement Act.
The new Measurement Act prohibits use of any unit other than SI units in Japan.

D

Limited warranty and Disclaimer/Compliance Requirements

The product used is subject to the following “Limited warranty and Disclaimer” and “Compliance Requirements”. Read and accept them before using the product.

Limited warranty and Disclaimer

1. The warranty period of the product is 1 year in service or 1.5 years after the product is delivered, whichever is first.*2)
   Also, the product may have specified durability, running distance or replacement parts. Please consult your nearest sales branch.
2. For any failure or damage reported within the warranty period which is clearly our responsibility, a replacement product or necessary parts will be provided.
   This limited warranty applies only to our product independently, and not to any other damage incurred due to the failure of the product.
3. Prior to using SMC products, please read and understand the warranty terms and disclaimers noted in the specified catalog for the particular products.

***2) Vacuum pads are excluded from this 1 year warranty.**
A vacuum pad is a consumable part, so it is warranted for a year after it is delivered.
Also, even within the warranty period, the wear of a product due to the use of the vacuum pad or failure due to the deterioration of rubber material are not covered by the limited warranty

Compliance Requirements

1. The use of SMC products with production equipment for the manufacture of weapons of mass destruction (WMD) or any other weapon is strictly prohibited.
2. The exports of SMC products or technology from one country to another are governed by the relevant security laws and regulations of the countries involved in the transaction. Prior to the shipment of a SMC product to another country, assure that all local rules governing that export are known and followed.

Design / Selection

⚠ Warning

1. **Confirm the specifications.**
   Products represented in this catalog are designed only for use in compressed air systems.
   Do not operate at pressures or temperatures, etc., beyond the range of specifications, as this can cause damage or malfunction. (Refer to the specifications.)
   We do not guarantee against any damage if the product is used outside of the specification range.
2. **If the operation involves load fluctuations, ascending/descending movements, or changes in friction resistance, make sure to provide safety measures.**
   Failure to provide such measures could accelerate the movement, which may be hazardous to humans, machinery, and other equipment.
3. **If there is a chance that the product will pose a hazard to humans, install a protective cover.**
   If the moving portion of the product will pose a hazard to humans or will damage machinery or equipment, provide a construction that prevents direct contact with those areas.
4. **Make sure that the secured portions will not loosen.**
   Be sure to adopt a reliable connecting method if the rotary gripper is used very frequently or if it is used in a location that is exposed to a large amount of vibrations.
5. **There may be cases in which a speed reduction circuit or a shock absorber is required.**
   If the driven object moves at high speeds or is heavy, it will be unfeasible for only the rotary gripper cushion to absorb the shock. Therefore, provide a speed-reduction circuit to reduce the rotary gripper speed before the thrust is applied to the cushion, or an external shock absorber to dampen the shock. If these countermeasures are taken, make sure to take the rigidity of the mechanical equipment into consideration.
6. **Consider the possibility of a reduction in the circuit air pressure caused by a power failure.**
   When a gripper is used as clamping mechanism, there is a danger of workpiece dropping if there is a decrease in clamping force, due to a drop in circuit pressure caused by a power failure. Therefore, safety equipment should be installed to prevent damage to machinery and bodily injury.
7. **Consider the possibility of power source related malfunctions that could occur.**
   For equipment that relies on power sources such as compressed air, electricity, or hydraulic pressure, adopt countermeasures to prevent the equipment from causing a hazard to humans or damage to the equipment in the event of malfunction.
8. **If a speed controller is provided in the exhaust restrictor, implement a safety design taking the residual pressure into consideration.**
   If air pressure is applied to the air supply side without residual pressure in the exhaust side, the rotary gripper will operate at abnormally high speeds, which could pose a hazard to humans and damage the machinery and equipment.
9. **Consider the behavior of the rotary gripper in the event of an emergency stop.**
   Devise a safe system so that if a person engages the emergency stop, or if a safety device is tripped during a system malfunction such as a power failure, the movement of the rotary gripper will not cause a hazard to humans or damage the equipment.
10. **Consider the action of the rotary gripper when restarting after an emergency stop.**
    Devise a safe design so that the restarting of the rotary gripper will not pose a hazard to humans or damage the equipment. Install manually controlled equipment for safety when the gripper has to be reset to the starting position.
11. **Do not use the product as a shock absorber.**
    If an abnormal pressure or air leakage occurs, the rotary gripper speed reduction capability could become severely affected, which could pose a hazard to humans and damage the machinery and equipment.
12. **Select a speed within the product's allowable energy value.**
    If the kinetic energy of the load exceeds the allowable value, it could damage the product, and cause a hazard to humans, or damage the machinery and equipment.

13. **Provide a shock absorber if the kinetic energy that is applied to the product exceeds the allowable value.**
    If the product's kinetic energy exceeds the allowable value, it could damage the product, and cause a hazard to humans, or damage the machinery or equipment.
14. **Do not stop or hold the product at midpoint by keeping air pressure in the product.**
    For a product without an external stopping mechanism, if the directional control valve is closed to keep the air pressure in the product, in an attempt to stop the product at midpoint, it might not be possible to maintain that stopped position due to an air leakage. As a result, it could pose a hazard to humans and cause damage to machinery and/or equipment.
15. **Give consideration to the decline in strength caused by changes in the shaft shape.**
    Some shaft types, such as simple specials, may have shapes and dimensions that result in decreased strength when compared with standard models. Consider this carefully when using
16. **Do not use two or more rotary grippers with the aim of synchronized movement.**
    One of the grippers may bear the load of operation, making synchronized movement impossible, and possibly leading to deformation of the equipment.
17. **Do not use in a location where external leakage of lubricant could have an adverse effect.**
    The lubricant coating the interior of the product may leak to the outside of the product from connecting parts of the rotary body, cover, etc.
18. **Do not disassemble the product or make any modifications, including additional machining.**
    This may cause human injury and/or an accident.
19. **Refer to the Auto Switches Precautions when using with an auto switch.**

⚠ Caution

1. **Do not use below the adjustment range specified for the product.**
   If the product is used below the specified speed adjustment range, it could cause the product to stick, slip, or the movement to stop.
2. **Do not apply external torque to the product that exceeds the rated output.**
   If an external force that exceeds the product's rated output is applied to the product, it could damage the product.
3. **If it is necessary to provide repeatability of the rotation angle, directly stop the load externally.**
   Even with a product that is equipped with an angle adjuster, there are times when the initial rotation angle could change.
4. **Do not use the product under hydraulic pressure.**
   The product will be damaged if it is used by applying hydraulic pressure.
5. **Do not use in a location where there are many temperature fluctuations.**
   When using in lower temperature applications, take care not to allow frost inside the cylinder.
   Operation may be unstable.
6. **Adjust the speed control in the environment in which the product is to be used.**
   The actuator may swing faster than expected when operated without pressurizing the gripper.
   Exercise caution when adjusting the equipment.

D

Design / Mounting

⚠ Warning

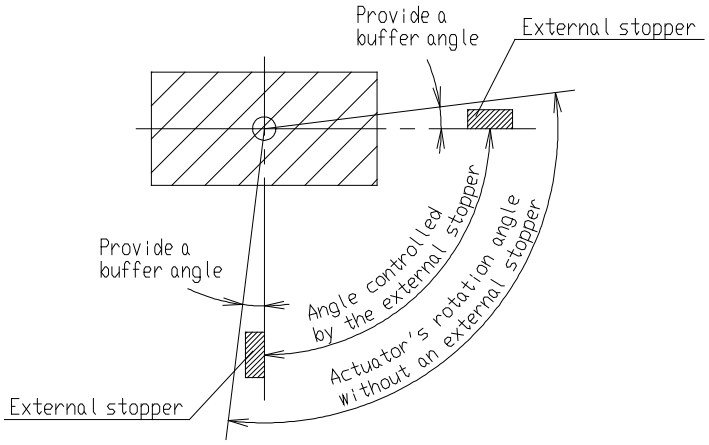
1. **Operation manual**
   Install the product and operate it only after reading the operation manual carefully and understanding its contents. Also, keep the manual in a location where it can be referred to as necessary.
2. **Ensure sufficient space for maintenance activities.**
   When installing the products, allow access for maintenance.
3. **Tighten threads with the proper tightening torque.**
   When installing the products, follow the listed torque specifications.
4. **Before adjusting the angle by supplying air pressure, take appropriate measures to prevent the equipment from rotating unnecessarily.**
   When an adjustment is performed under air pressure, the equipment could rotate and fall during the adjustment, depending on the mounted posture of the equipment. As a result, it could pose a hazard to humans and damage the machinery and equipment.
5. **Do not place a magnetic object near the product.**
   The auto switch is a magnetic sensing type. If a magnetic object is placed close to it, the rotary gripper could operate suddenly, which could pose a hazard to humans and damage the machinery and equipment.
6. **Do not perform additional machining to the product.**
   Additional machining to the product can result in insufficient strength and cause damage to the product. This can lead to possible human injury and damage to the surrounding equipment.
7. **Do not enlarge the fixed throttle by modifying the pipe connectors.**
   If the hole diameter is enlarged, the product's rotation speed will increase, causing the shock force to increase and damage to the product. As a result, it could pose a hazard to humans and damage the machinery and equipment.
8. **If shaft couplings are to be used, use those with angular freedom.**
   If shaft couplings that lack angular freedom are used, they could scrape due to eccentricity, leading to equipment malfunction and product damage. As a result, it could pose a hazard to humans and damage the machinery and equipment.
9. **Do not apply a load that exceeds the values given in the catalog.**
   If a load that exceeds the allowable values is applied to the product, it could lead to equipment malfunction, a hazard to humans, and damage to the machinery and equipment.
10. **Place an external stopper in a position away from the rotating shaft.**
    If the stopper is placed near the rotating shaft, the torque that is generated by the product itself will cause the reaction force which is directed to the stopper to be redirected and applied to the rotating shaft. This will lead to the breakage of the rotating shaft and bearing. As a result, it could pose a hazard to humans and damage the machinery and equipment.

Precautions when Using External Stoppers

- Be sure to install external stoppers in the proper places. Installation in the wrong place can result in equipment breakage, which could damage other equipment or cause human injury.

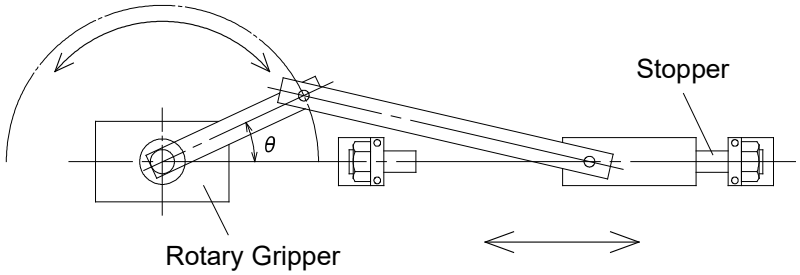
  *For details, please refer to BEST AUTOMATION (Rotary Actuators/General Precautions).

- Install external stoppers within the range of the rotating angle. Installing an external stopper at the maximum rotation angle may result in an inability to fully absorb the kinetic energy generated, and damage to equipment may occur.



Precautions when Converting Rotational Motion to Linear Motion

When using a link mechanism, etc., to convert rotational motion to linear motion, and determining the operation end using the stopper on the linear motion end (see below), a small value for θ at the operation end may result in the torque of the rotary gripper causing excessive radial load to act on the output axle, and equipment breakage may occur.
Install a stopper on the rotation motion side, or increase the value of θ at the operation end, to make sure the load generated does not exceed the allowable value for the product.



11. Do not use springs, etc., to add force in the rotational movement direction.

When rotational force from an external spring, etc., acts and generates negative pressure on the product's interior, breakage of the internal seal or acceleration of abrasion may occur.

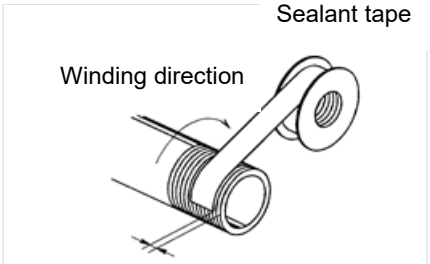
⚠ Caution

1. **Do not use organic solvent to wipe the area of the name plate that shows the model.**
   It will erase what is indicated on the name plate.
2. **Do not hit the output shaft by securing the body or hit the body by securing the output shaft.**
   These actions could cause the table to bend or damage the bearing. When a load must be coupled to the output shaft, secure the output shaft.
3. **Do not step directly onto the table or on the equipment that is coupled to the table.**
   Standing directly on the output shaft could cause the output shaft or the bearing to become damaged.
4. **If a product is equipped with an angle adjustment function, use it within the specified adjustment range.**
   If the product is used outside the specified adjustment range, it could lead to equipment malfunction or product damage. Refer to the product specifications for details on the adjustment range of the products.

Piping

⚠ Caution

1. **Refer to the Fittings and Tubing Precautions for handling one touch fittings.**
2. **Preparation before piping**
   Before piping is connected, it should be thoroughly blown out with air (flushing) or washed to remove chips, cutting oil and other debris from inside the pipe.
3. **Wrapping of pipe tape**
   When screwing piping or fittings into ports, ensure that chips from the pipe threads or sealing material do not enter the piping. Also, if pipe tape is used, leave 1.5 to 2 thread ridges exposed at the end of the threads.



Speed and Cushion Adjustment

⚠ Warning

1. **To make a speed adjustment, gradually adjust starting from the low speed end.**
   If the speed adjustment is performed from the high speed end, it could damage the product.
   As a result, it could pose a hazard to humans and damage the machinery and equipment.

Lubrication

⚠ Warning

1. **This product should be used without lubrication. Although it will operate even if it is lubricated, it could lead to sticking or slipping.**

Air Supply

⚠ Warning

1. **Type of fluids**
   Use compressed air.
2. **When there is a large amount of moisture**
   Compressed air containing a large amount of moisture can cause malfunction of pneumatic equipment. An air dryer or water separator should be installed upstream from filters.
3. **Drain flushing**
   If condensation in the drain bowl is not emptied on a regular basis, the bowl will overflow and allow the condensation to enter the compressed air lines. This may cause malfunction of pneumatic equipment. If the drain bowl is difficult to check and remove, installation of a drain bowl with an auto drain option is recommended.
4. **Use clean air.**
   Do not use compressed air that contains chemicals, synthetic oils that include organic solvents, salt, corrosive gases, etc., as it can cause damage or malfunction.

⚠ Caution

1. **When low dew point air air is used as the fluid, degradation of the lubrication properties inside the equipment may occur, resulting in reduced reliability (or reduced service life) of the equipment. Install an air filter.**
2. **Install an air filter.**
   Install an air filter upstream near the valve. Select an air filter with a filtration size of 5μm or smaller.
3. **Take measures to ensure air quality, such as by installing an aftercooler, air dryer, or water separator.**
   Compressed air that contains a large amount of moisture can cause malfunction of pneumatic equipment such as rotary gripper. Therefore, take appropriate measures to ensure air quality, such as by providing an aftercooler, air dryer, or water separator.
4. **Ensure that the fluid and ambient temperature are within the specified range.**
   If the fluid temperature is 5°C or less, the moisture in the circuit could freeze, causing damage to the seals and equipment malfunction. Therefore, take appropriate measures to prevent freezing.

Operating Environment

⚠ Warning

1. **Do not use in an atmosphere containing corrosive gases, chemicals, sea water, water, steam, or where there is direct contact with any of these.**
   Refer to the construction diagram for information on the materials used in the rotary gripper
2. **Do not expose the product to direct sunlight for an extended period of time.**
3. **Do not use in a place subject to heavy vibration and/or shock.**
4. **Do not mount the product in locations where it is exposed to radiant heat.**
5. **Do not use in dusty locations or where water oil, etc., splash on the equipment.**

Maintenance

⚠ Warning

1. **Perform maintenance inspection according to the procedures indicated in the operation manual.**
   If handled improperly, malfunction and damage of machinery or equipment may occur.
2. **Maintenance work**
   If handled improperly, compressed air can be dangerous. Assembly, handling, repair and element replacement of pneumatic systems should be performed by a knowledgeable and experienced person.
3. **Drain flushing**
   Remove drainage moisture from air filters regularly.
4. **Removal of equipment, and supply/exhaust of compressed air**
   When components are removed, first confirm that measures are in place to prevent workpieces from dropping, run-away equipment, etc. Then, cut off the supply pressure and electric power, and exhaust all compressed air from the system using the residual pressure release function.
   When machinery is restarted, proceed with caution after confirming that appropriate measures are in place to prevent cylinders from sudden movement.

⚠ Caution

1. **For lubrication, use the designated grease for each specific product.**
   The use of a non-designated lubricant could damage the seals.

Auto Switches Precautions

Design / Selection

⚠ Warning

1. **Confirm the specifications.**
   If the product is used with excess load applied or beyond the specification range, this may cause the product to break or malfunction. We do not guarantee against any damage if the product is used outside of the specification range.
2. **Cautions for use in an interlock circuit**
   When an auto switch is used for an interlock signal requiring high reliability, devise a double interlock system to avoid problems by providing a mechanical protection function, or by using another switch (sensor) together with the auto switch. Also, perform regular maintenance and confirm proper operation.
3. **Do not attempt to dissemble, modify (including exchanging the printed circuit boards), or repair the product.**
   This may cause human injuries and accidents.

⚠ Caution

1. **Pay attention to the length of time when a switch is ON at an intermediate stroke position.**
   When an auto switch is placed at an intermediate position of the stroke and a load is driven at the time the piston passes, the auto switch will operate, but if the operating time will be short if the speed is too fast. As a result, the load may not operate completely.
   The maximum detectable piston speed is:

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

2. **Keep wiring as short as possible.**
   <Solid state>
   Be sure to use a wire length of 100 m or less.
   When a long wire is required, we recommend attaching ferrite cores to both ends of the cable to prevent excess noise. A contact protection box is not necessary for solid state auto switches due to the nature of this product's construction.
3. **Do not use a load that generates surge voltage.**
   If a surge voltage is generated, discharge may be generated at the contact, possibly reducing the product life.
   If driving a load such as a relay that generates a surge voltage.
   <Solid state>
   Use a built-in surge absorbing element type device.

4. **Take precautions when multiple rotary gripper are used close together.**
   When multiple auto switch rotary gripper are used in close proximity, magnetic field interference may cause the auto switches to malfunction. Maintain a minimum separation of 40mm between rotary gripper.
   The auto switches may malfunction due to the interference from the magnetic fields.
   Use of a magnetic screen plate (MU-S025) or commercially available magnetic screening tape can reduce the interference of magnetic force.

5. **Pay attention to the internal voltage drop of the auto switch.**
   <Solid state>
   Generally, the internal voltage drop of the solid state auto switch is larger than that of the reed auto switch. When the auto switches (“n” pcs.) are connected in series, the voltage drop is multiplied by “n”. In this case, even if the auto switches operate correctly, the loads may not operate. Additionally, note that the 12 VDC relay does not apply to the auto switch.
6. **Pay attention to leakage current.**
   <Solid state / 2-wire type>
   Current (leakage current) flows to the load to operate the internal circuit even when in the OFF state.

   Operating current of load (OFF condition) > Leakage current

   If the criteria given in the above formula are not met, it will not reset correctly (stays ON).
   Use a 3-wire switch if this specification will not be satisfied.
   Moreover, leakage current flow to the load will be “n” times larger when “n” auto switches are connected in parallel.
7. **Ensure sufficient clearance for maintenance activities.**
   When designing an application, be certain to allow sufficient clearance for maintenance.
8. **Use the rotary gripper and auto switch in proper combination.**
   The auto switch is pre-adjusted to operate properly for an auto-switch-capable SMC rotary gripper.
   If the auto switch is mounted improperly, used for another brand of rotary gripper or used after changing the machine installation, the auto switch may not operate properly.

Mounting / Adjustment

⚠ Caution

1. **Do not drop or bump.**
   Do not drop, bump or apply excessive impacts (300m/s^2 or more for reed auto switches and 1000m/s^2 or more for solid state auto switches) while handling. Although the body of the auto switch may not be damaged, the inside of the auto switch could be damaged and cause malfunction.
2. **Observe the proper tightening torque for mounting an auto switch.**
   When an auto switch is tightened beyond the range of tightening torque, auto switch mounting screws, auto switch mounting brackets or auto switch may be damaged.
   On the other hand, tightening below the range of tightening torque may allow the auto switch to slip out of position.
3. **Do not carry a rotary gripper by the auto switch lead wires.**
   Never carry a rotary gripper by its lead wires. This may not only cause broken lead wires, but it may cause internal elements of the auto switch to be damaged by the stress.
4. **Fix the auto switch using the appropriate screws on the switch body. If other screws are used, the auto switch may be damaged.**

Wiring

⚠ Caution

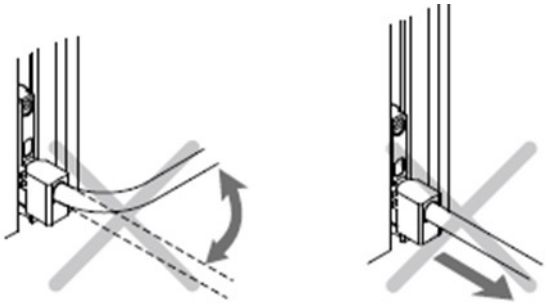
1. **Confirm proper insulation of wiring.**
   If there is any improper insulation (mixed contact with other circuits, grounding faults, improper insulation between terminals, etc.) in the wiring, an over-current may flow in, causing the auto switch to break.
2. **Wire separately from power lines or highvoltage lines, avoiding parallel wiring or wiring in the same conduit with these lines.**
   If an inrush current is generated, the noise may cause the auto switch to malfunction.

3. Avoid repeatedly bending or stretching lead wires.

Broken lead wires will result from repeatedly applying bending stress or stretching forces to the lead wires.

Stress and tensile force applied to the connection between the lead wire and auto switch increases the possibility of disconnection.

Keep the lead wire from moving, especially in the area where it connects with the auto switch.



4. Be certain to connect the load before power is applied.

<2-wire type>

If the power is turned ON when an auto switch is not connected to a load, the auto switch will be instantly damaged because of excess current (Short circuit).

In addition, when using a commercially available checker, etc., to perform an acceptance inspection or check the operation of a 2-wire auto switch, be sure to confirm the wiring method of the checker beforehand and make sure to connect the terminal with a built-in load (IN, etc.) to the 0 V terminal. (Do not connect the power supply terminal and the ground terminal directly when in a non-load state.)

5. Do not allow short-circuit of loads.

<Solid state>

PNP output type auto switches do not have built-in short circuit protection circuits.

Handle carefully as the auto switch may be damaged.

6. Avoid incorrect wiring.

<Solid state>

1) If connections are reversed on a 2-wire type auto switch, the auto switch will not be damaged if protected by a protection circuit, but the auto switch will remain in an ON state. However, it is still necessary to avoid reversed connections, since the auto switch could be damaged by a load short circuit in this condition.
2) If connections are reversed (power supply line + and power supply line-) on a 3-wire type auto switch, the auto switch will be protected by a protection circuit. However, if the power supply line (+) is connected to the blue wire and the power supply line (-) is connected to the black wire, the auto switch will be damaged.

Operation Environment

⚠ Warning

1. **Never use in an atmosphere with explosive gases.**
   Auto switches are not designed to prevent explosion. This may cause an explosion hazard.

⚠ Caution

1. **Do not use in an area where a magnetic field is generated.**
   Auto switches will malfunction or magnets inside rotary grippers will become demagnetized.
2. **Do not use in an environment where the auto switch will be continually exposed to water.**
   Although auto switches satisfy IEC standard IP67 construction, do not use auto switches in applications where they will be continually exposed to water splash or spray. This may cause improper insulation or malfunction.
3. **Do not use in an environment with oil or chemicals.**
   If auto switches are used in an environment with containing coolant, cleaning solvent, various oils or chemicals, even for a short period of time, this may adversely affect the auto switches, resulting improper insulation, malfunction due to the swelling of potting resin, or hardening of lead wires.
4. **Do not use in an environment with temperature cycles.**
   If temperature cycles other than normal temperature changes are applied, this may adversely affect the insides of the auto switches.
5. **Do not use in an environment where there is excessive impact shock.**
6. **Do not use in an area where surges are generated.**
   <Solid state>
   If there is an equipment unit (electromagnetic lifter, high-frequency induction furnace, motor, radio, etc.) that generates large surges or electromagnetic waves around cylinders or grippers with solid state auto switches, this may cause the circuit element inside the auto switch to break.
7. **Avoid the accumulation of iron waste or close contact with magnetic substances.**
   If too many iron particles, such as cutting chips or spatters, accumulate around a cylinder or gripper with auto switches, or if a magnetic substance (attracted by a magnet) is put close to a cylinder or gripper with auto switches, the magnetic force inside the cylinder or gripper may weaken, causing the auto switch to malfunction.
8. **Do not use in direct sunlight.**
9. **Do not mount the product in locations where it is exposed to radiant heat.**
10. **Take appropriate measures against the lightning surge on the equipment side as the auto switches do not have any lightning surge resistance specified in the CE marking.**

Maintenance

⚠ Warning

1. **Removal of equipment, and supply/exhaust of compressed air.**
   Before any machinery or equipment is removed, first ensure that the appropriate measures are in place to prevent workpieces from dropping, run-away equipment, etc. Then, cut off the electric power and reduce the pressure in the system to zero. Only then should you proceed with the removal of any machinery or equipment.
   When machinery is restarted, proceed with caution after confirming that appropriate measures are in place to prevent sudden movement.
2. **Do not touch a terminal during energizing.**
   Touching a terminal during energizing may cause electric shock, malfunction, or auto switch breakage.

⚠ Caution

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

1) Secure and tighten auto switch mounting screws.
   If screws become loose or the mounting position is dislocated, retighten them after readjusting the mounting position.
2) Confirm that there is no damage to lead wires.
   To prevent faulty insulation, replace auto switches or repair lead wires if damage is discovered.
3) Confirm the detection setting position.
   - Red light on 1-color indicator auto switch
     Confirm that the set position stops at the center of the operating range (red indication area).
   - Confirm the green light and position of the 2-color indicator auto switch.
     Confirm that the set position stops at the center of the appropriate operating range (green indication area). If stopped with the red LED lit, the operation may become unstable due to effects of the equipment environment or external disturbance. So, set the mounting position at the center of the appropriate operating range again.
     Some rotary grippers indicate a specific setting procedure for the auto switch. If so, set the mounting position according to the specific setting procedure.

2. Do not use solvents, such as benzene, thinner, etc., to clean the product.

They could damage the surface of the body and erase the markings on the body. For heavy stains, use a cloth lightly dampened with diluted neutral detergent, then wipe up any residue with a dry cloth.

1. How to Order

MRH Q 10 D - 90 S - M9NV □ □ - M9N □ □ - □

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)
S	Single acting (Normally closed)

Rotation angle

90	90°
180	180°

Single vane

Lead wire length

Nil	0. 5m
L	3m
Z	5m

Number of auto switches

Nil	2 pcs.
S	1 pcs.

Made to Order

Symbol	Specifications/Description
-X50	Flat finger type
-X51	Through hole in open/close direction
-X111	Air Gripper with Dust Cover Chloroprene rubber (CR)
-X112	Air Gripper with Dust Cover Fluororubber (FKM)
-X113	Air Gripper with Dust Cover Silicone rubber (Si)

Type of auto switch for detecting rotation

Nil	Without auto switch(Built-in magnet)

Applicable Auto switches

Type	Electrical entry	Indicator light	Wiring (output)	Load voltage		Auto switch symbol	Lead wire lenght (m)			Applicable load		Auto switch model
				DC		Electrical entry / In-line	0.5 (NIL)	3 (L)	5 (Z)			
Solid state auto switches	Grommet	Yes	3-wire (NPN)	24V	5V	M9N	●	●	O	IC circuit	Relay PLC	D-M9N□-746
			3-wire (PNP)		12V	M9P	●	●	O			D-M9P□-746
			2-wire		12V	M9B	●	●	O	–		D-M9B□-746

*Lead wire length symbols: 0.5 m .....Nil (Example) M9N PLC: Sequence controller
3 m .....L M9NL
5 m .....Z M9NZ

*Order with an auto switch part number when ordering a single auto switch unit.
*Auto switches marked with a "○" are made upon receipt of order.

Type of auto switch for detecting rotation

Nil	Without auto switch(Built-in magnet)

Applicable Auto switches

Type	Electrical entry	Indicator light	Wiring (output)	Load voltage		Auto switch symbol	Lead wire lenght (m)			Applicable load		Auto switch model
				DC		Electrical entry / In-line	0.5 (NIL)	3 (L)	5 (Z)			
Solid state auto switches	Grommet	Yes	3-wire (NPN)	24V	5V	M9NV	●	●	O	IC circuit	Relay PLC	D-M9NV□
			3-wire (PNP)		12V	M9PV	●	●	O			D-M9PV□
			2-wire		12V	M9BV	●	●	O	–		D-M9BV□

*Lead wire length symbols: 0.5 m .....Nil (Example) M9NV PLC: Sequence controller
3 m .....L M9NVZ
5 m .....Z M9NVZ

*Order with an auto switch part number when ordering a single auto switch unit.
*Auto switches marked with a "○" are made upon receipt of order.

2. Specifications

2-1. Specification

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°(Both ends of vibration ±5° adjustable)			
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℃			
Adjustable rotation time range(1)			0.07 to 0.3sec/90° (at 0.5 MPa)			
Allowable kinetic energy			0.0046J	0.014J	0.034J	0.074J
Auto switch		Rotary unit	Solid state auto switch (2-wire, 3-wire)			
		Gripper unit	Solid state auto switch (2-wire, 3-wire)			

Note 1: Operate within the speed adjustment range, as speed control exceeding the low speed limit value may cause sticking or failure to occur.
For a swing time of 0.07 s/90°, use a supply pressure of 0.5 MPa or higher.

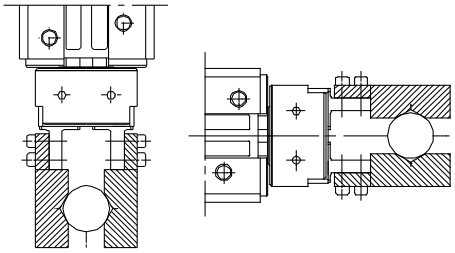
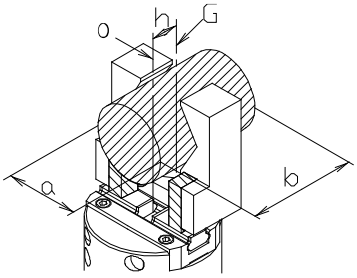
D

Action	Model	Cylinder bore (mm)	Opening/Closing stroke (mm)	Rotating Angle (°)	Weight (g) [1]
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 1: Values do not include auto switch weight.

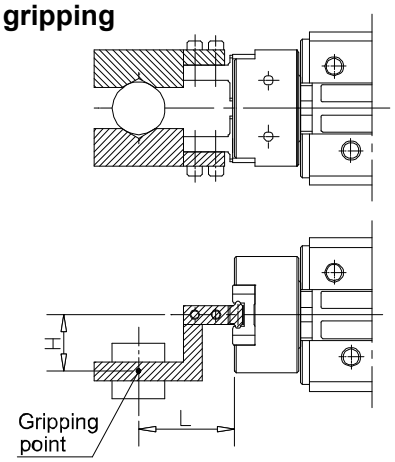
2-2. Precautions on model selection

⚠Caution

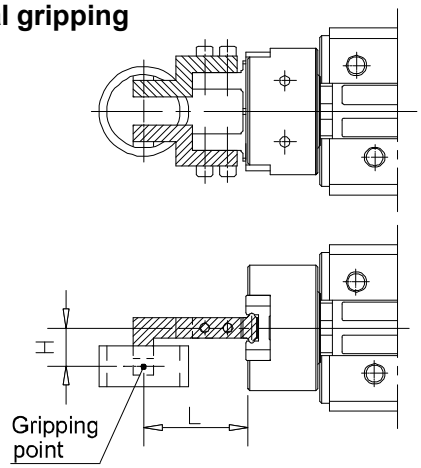
Step	Calculation	Example
(1) Operating conditions Enumerate the operating conditions according to the mounting position and workpiece configuration.  **Vertical mounting** **Horizontal mounting**	・Model used ・Operating pressure ・Mounting position ・Rotation time t(s) ・Overhang H(mm) ・Gripping point distance L(mm) ・Distance between central axis and center of gravity h(mm) ・Load mass m_1(kg) ・Mass of 2 attachments m_2(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 center of gravity (h):10m Load mass (m_1):0.07kg Mass of 2 attachments (m_2):0.05kg
(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 grange limit.	Gripping point range time Graph (1)	Within the range time OK
(4) Load mass Confirm that the load converted from the load mass is less than 1/20 of the effective gripping force. (A greater margin must be allowed if large impacts are applied when work pieces are transported.)	$20 \times 9.8 \times m_1$ < Effective gripping force (N)Graph (2)	20 x 9.8 x 0.07 =13.72 13.72N < Effective gripping force
(5) External force on finger Make sure that the vertical load and moment on each finger is within allowable limit.	Less than allowable value (Refer to page 9 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.	$20 \times 9.8 \times (m_1+m_2) \times H/1000$ < 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.) **(K=2: safety factor)**	$I_R = K \times (a^2+b^2+12h^2) \times (m_1+m_2)$ $/(12 \times 10^6)$	$I_R = 2 \times (20^2+30^2+12 \times 10^2) \times (0.07+0.05)$ $/(12 \times 10^6) = 0.00005 kg \cdot m_2$
(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".	$1/2 \times I_R \times \omega^2$ < allowable energy (J) $\omega = 2\Theta/t$ (ω: Angular speed at the end) Θ: Rotating angle (rad) t: Rotation time (s)	$1/2 \times 0.00005 \times (2 \times (3.14/2)/0.2)^2$ $=0.00005 kg \cdot m_2$ 0.0062J < allowable energy OK

Gripping point

External gripping



Internal gripping



L: Gripping point distance

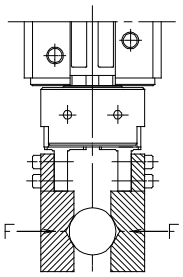
H: Overhang

-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 above.

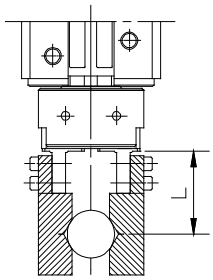
-If operated with the workpiece gripping point outside of the range, an excessive eccentric load will be applied to the fingers and guide section, causing play in the fingers and adversely affecting the gripper's life.

Expressing the effective gripping force

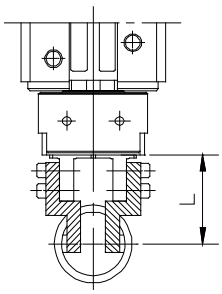
The effective gripping force shown in the graphs to the right is expressed as F, which is the impellent force of one finger, when both fingers and attachments are in full contact with the workpiece as shown in the figure below.



External gripping



Internal gripping



-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 mass, or more.

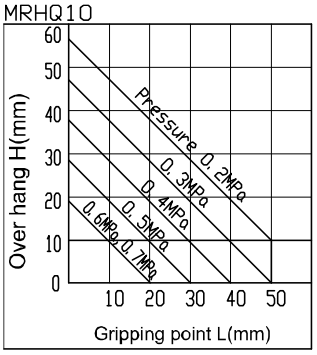
-A greater margin of safety is required when high acceleration or impact occurs during workpiece transfer.

Gripping Point Range Limit

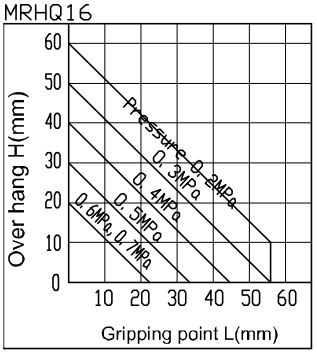
Graph (1)

External Gripping

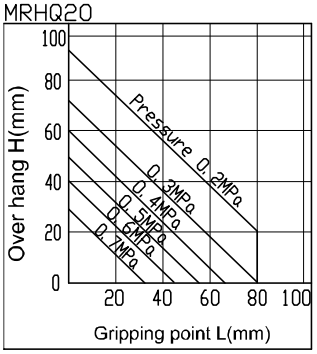
MRHQ10



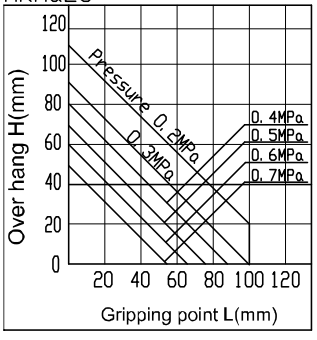
MRHQ16



MRHQ20

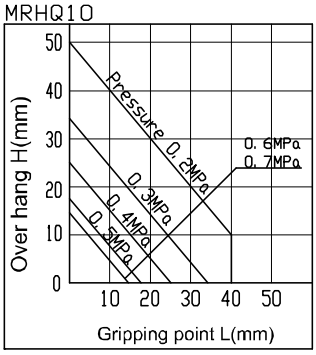


MRHQ25

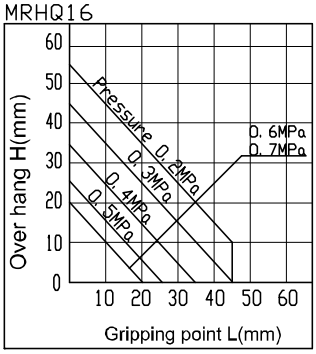


Internal Gripping

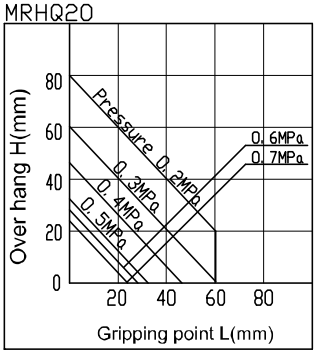
MRHQ10



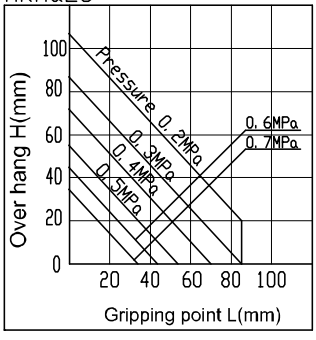
MRHQ16



MRHQ20



MRHQ25

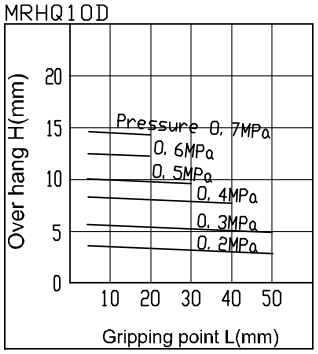


Effective Gripping force（Double Acting）

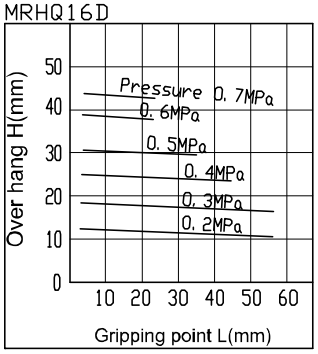
Graph (2)

External Gripping

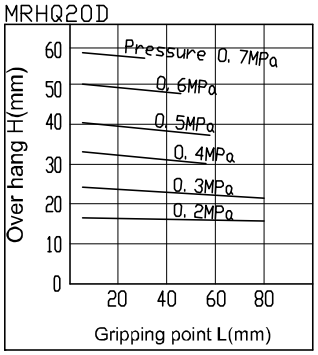
MRHQ10D



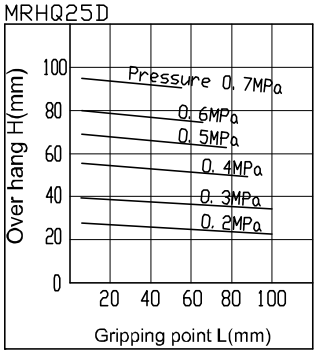
MRHQ16D



MRHQ20D

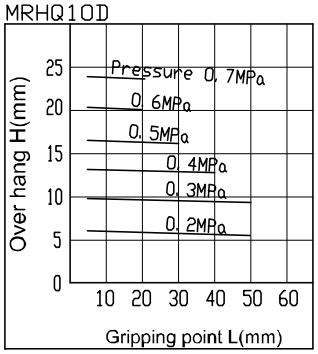


MRHQ25D

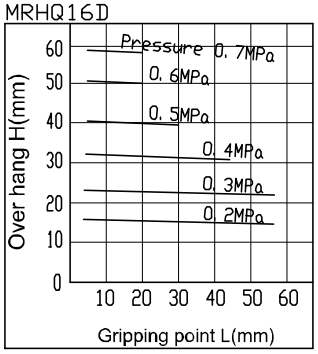


Internal Gripping

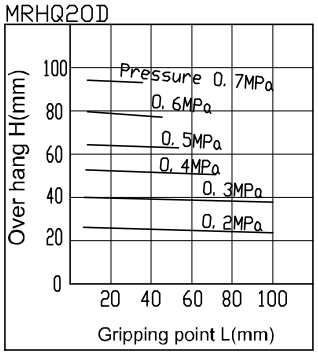
MRHQ10D



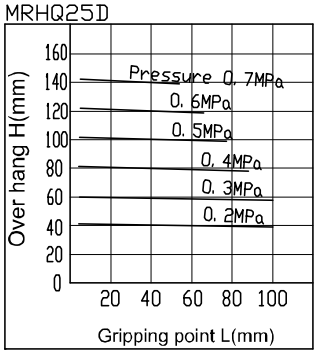
MRHQ16D



MRHQ20D



MRHQ25D

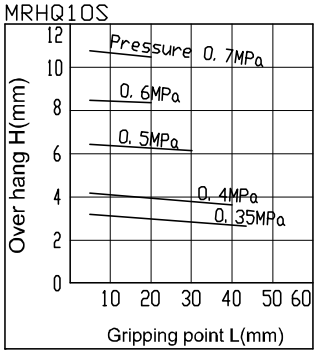


Effective Gripping force（Single Acting）

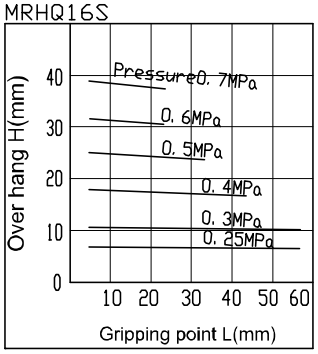
Graph (2)

External Gripping

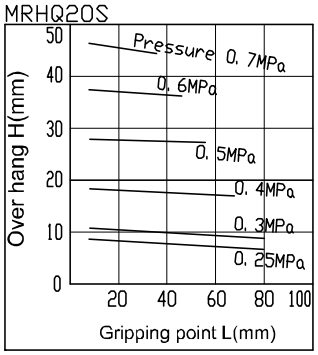
MRHQ10S



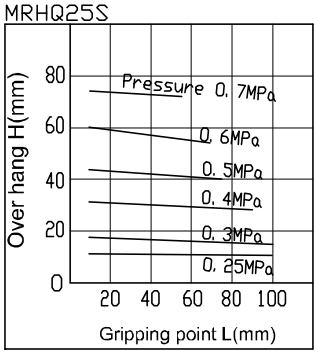
MRHQ16S



MRHQ20S

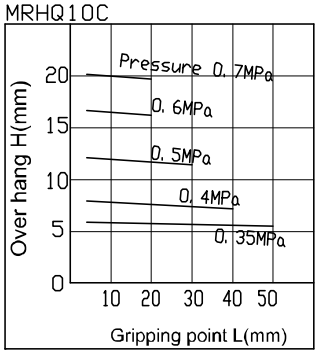


MRHQ25S

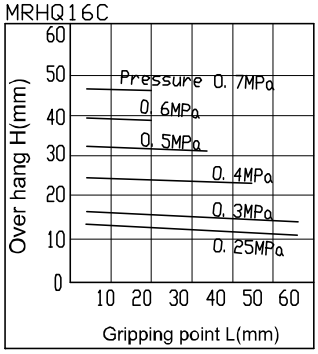


Internal Gripping

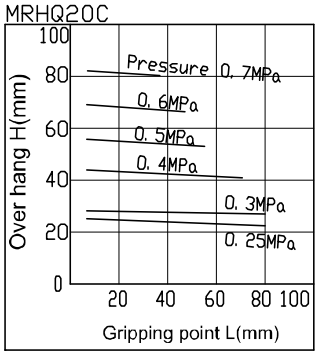
MRHQ10C



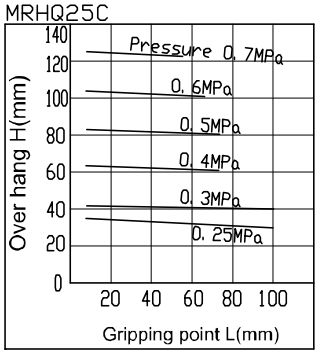
MRHQ16C



MRHQ20C

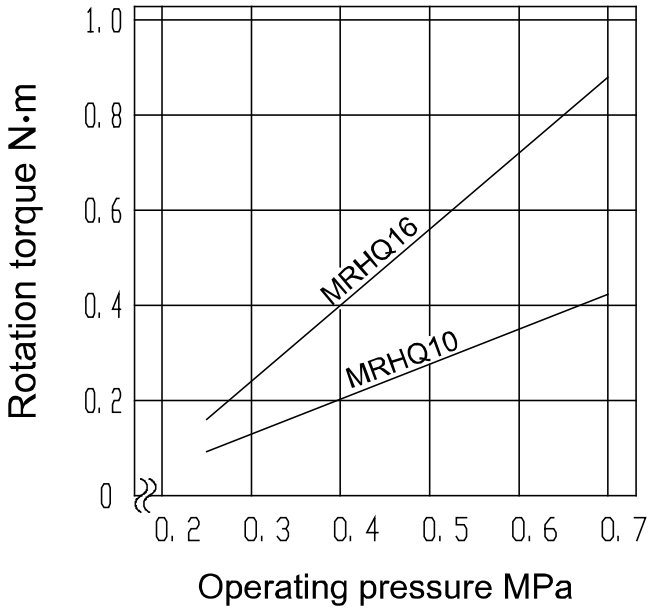


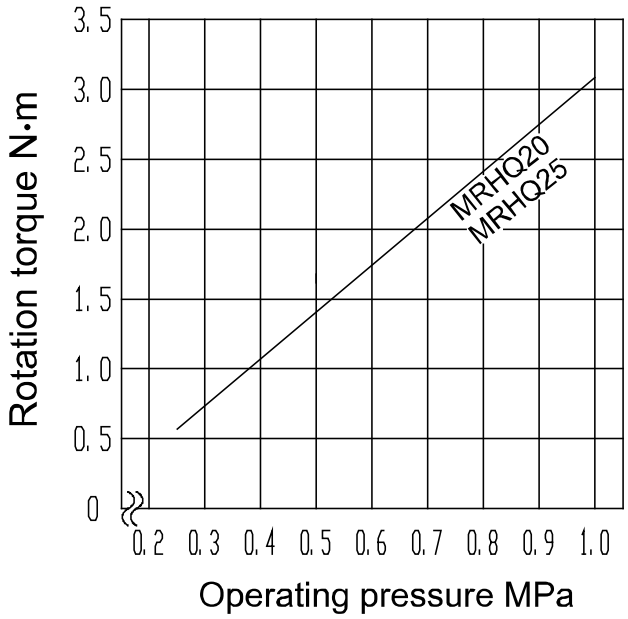
MRHQ25C



Rotational Torque

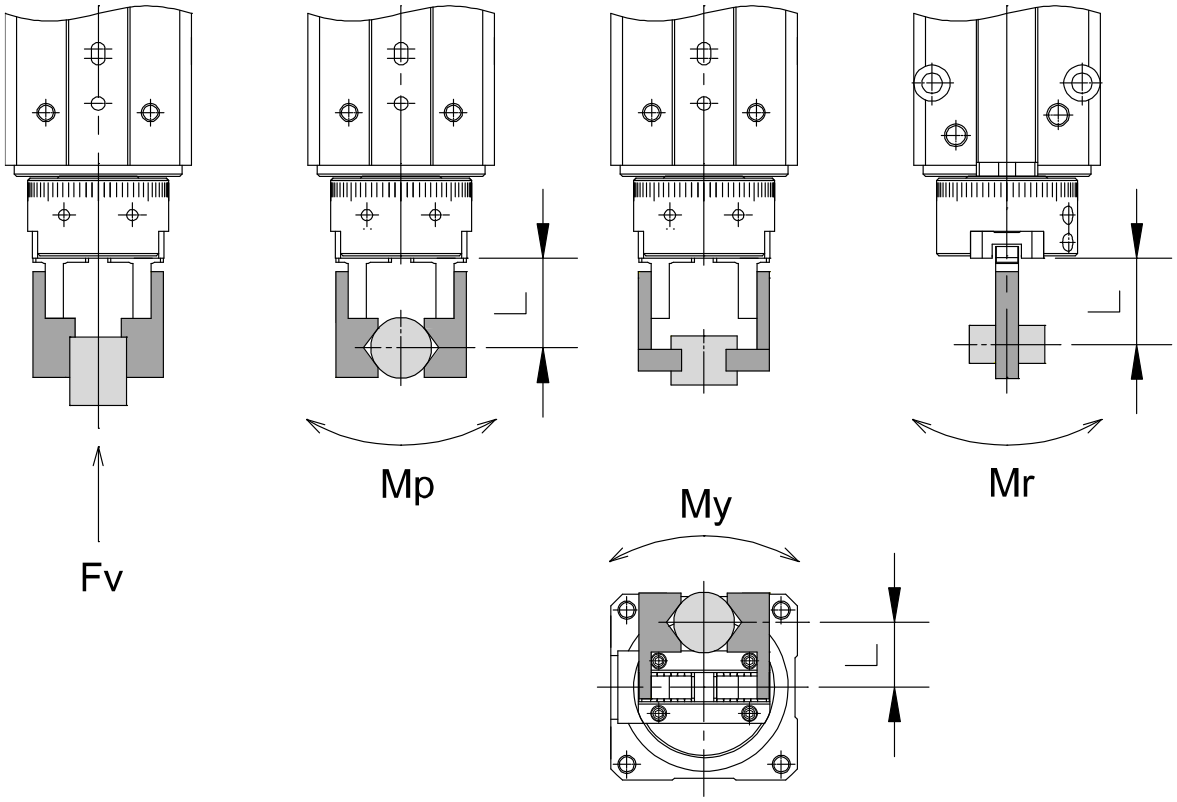
Graph (3)





2-3. Allowable Value of External Force on Fingers

-



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

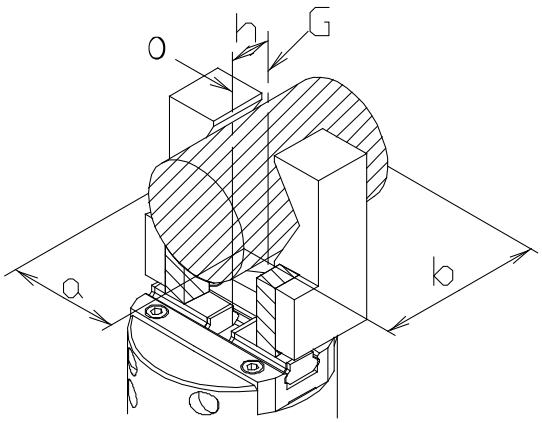
Model	Allowable vertical load Fv (N)	Maximum allowable moment		
		Pitch moment Mp (N·m)	Yaw moment My (N·m)	Roll moment Mr (N·m)
MRHQ10□	58	0.26	0.26	0.53
MRHQ16□	98	0.68	0.68	1.36
MRHQ20□	147	1.32	1.32	2.65
MRHQ25□	255	1.94	1.94	3.88

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

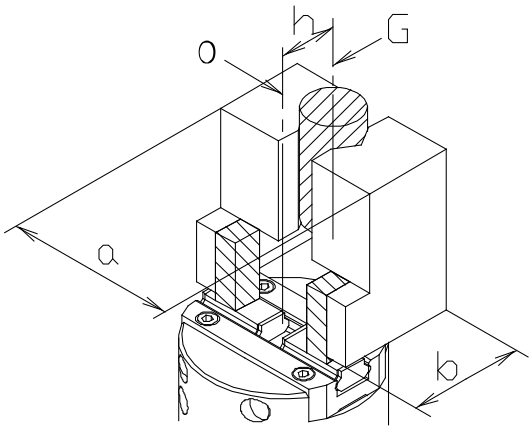
Calculation for allowable external force (with moment load)	Calculation example
$Allowable\ load\ F(N) = \frac{M(Maximum\ allowable\ moment)\ \ (N \cdot m)}{L \times^{*} 10^{-3}}$ * Unit conversion factor *= unit conversion factor	When static load f = 10 N, which produces pitch oment to the point L = 30 mm from MRHQ16 guide, is applied. Operable condition requires that F be bigger than f. $Allowable\ load\ F(N) = \frac{0.68}{30 \times 10^{-3}}$ = 22.7(N) > 10 Since load F >f, it is operable.

2-4. Moment of Inertia 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 following page.



When load dimensions > Attachment dimensions



When load dimensions < Attachment dimensions

Description

O…Center of rotation

G…Center of gravity of attachment and load

… Gripper fingers

… Attachments

… Load

Moment of inertia I: kg·m^2

$$I = \frac{(a^2 + b^2 + 12h^2)(m^1 + m^2)}{12x10^6}$$

m_1: Mass of two attachments (kg)

m_2: Mass of load (kg)

h: Distance between O and G (mm)

a, b: Distance of load or attachment (mm)

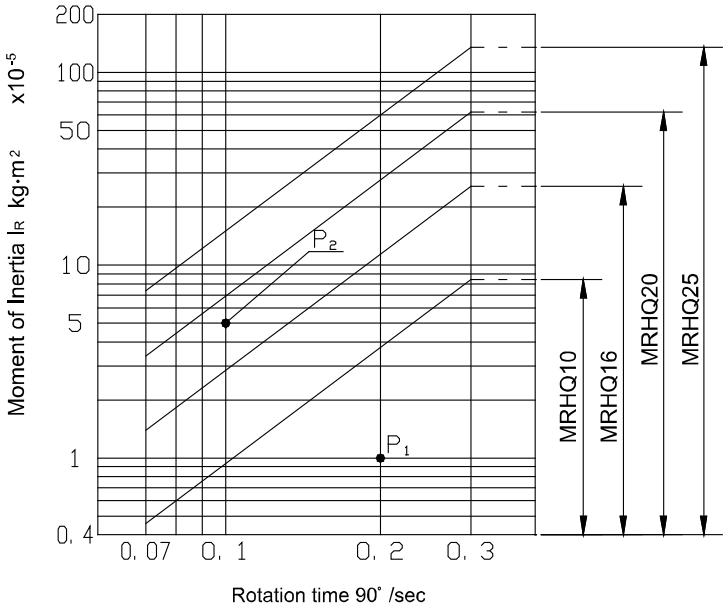
K= 2 (Coefficient)

Practical moment on inertia I_R: kg·m^2

I_R = K x I

*Use I_R for this product.

Graph (Moment of inertia and rotation time)



(How to Use the Graph)
[Example 1]
-Moment of Inertia: 1 x 10^{-5} kg·m^2
-Rotation time: 0.2 s/90°
-To select model **MRHQ10**

⬇

It can be used because the point of intersection **P_1** on the graph is within the limiting range.

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

⬇

It cannot be used because the point of intersection **P_2** 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

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

Allowable Kinetic Energy

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

$\omega = 2\Theta/t$
ω: Angular speed at the end
Θ: Rotating angle (rad) (θ=180°=3.14)
t: Rotation time (s)

3. Installation

3-1. Air supply

⚠Caution

(1) The air supplied to the rotary gripper should be filtered by SMC's AF series air filter and regulated to the specified set pressure by SMC's AR series regulator.

(2) This is a non-lube type actuator. Never supply lubricant oil.

If lubricant is supplied to the actuator, the grease inside the actuator will be washed away, and this may cause operation failure.

(3) Compressed air containing a large amount of condensate can cause the rotary table to malfunction. Therefore, take appropriate measures to ensure air quality, by providing an after-cooler, or water separator, if needed.

3-2. Piping

⚠Caution

(1) Before piping

Before piping, perform air blow (flushing) or cleaning inside of the piping to eliminate any cutting chips, cutting oil, dust, etc.

(2) Avoid repeatedly bending or stretching the lead wire of the switch.

Broken lead wires will result if bending stresses or tensile forces are applied to the lead wires.

(3) Make sure to connect a load to the switch before turning the power supply on.

If it is turned on with no load connected to the auto switch, over current will flow, causing the switch to break instantly.

3-3. Operating environment

(1) **Do not use this product in environments where there is a danger of corrosion.**

Refer to the construction drawings regarding the rotary gripper materials.

(2) Do not use this product in an area that is dusty, or in an environment in which water or oil splashes on the cylinder.

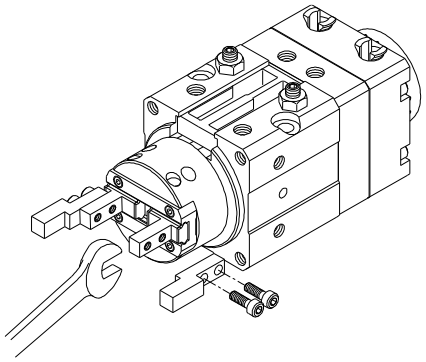
(3) Don't use the rotary gripper with switch in an atmosphere where explosive gases are used.

It can cause malfunction of the auto switch or decrease the magnetic force of the magnet mounted in the rotary gripper.

(4) Do not use the rotary gripper with switch in an area where a magnetic field is generated.

3-4. Mounting

(1) When mounting attachments on fingers, support the fingers with a tool such as a spanner to prevent them from twisting.

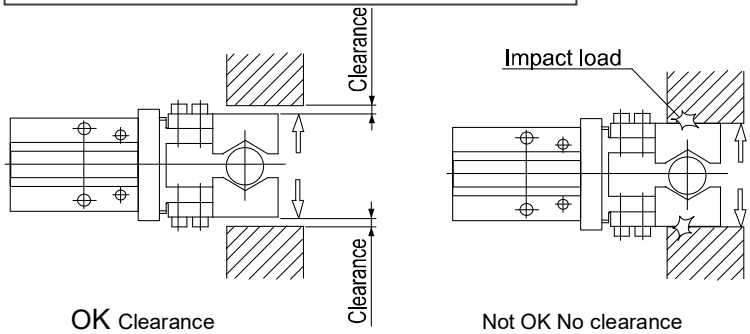


Refer to the table on the right for the tightening torque of finger mounting bolts.

Model	Bolt	Max. tightening torque N・m
MRHQ10	M2.5X0.45	0.31
MRHQ16	M3X0.5	0.59
MRHQ20	M4X0.7	1.4
MRHQ20	M5X0.8	2.8

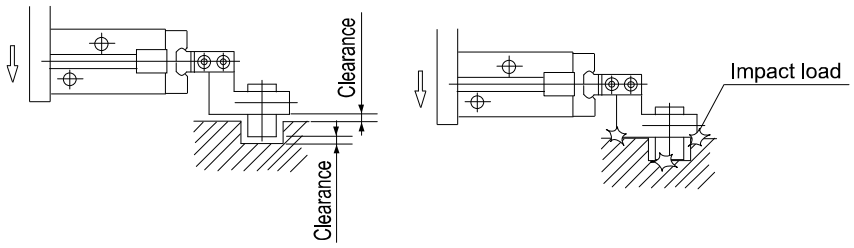
(2) Avoid external force on the finger. Fingers may be damaged by a continual lateral or impact load. Provide clearance to prevent the workpiece or the attachment from striking against any object at the stroke end of the rotary gripper.

1. Stroke end when fingers are opened



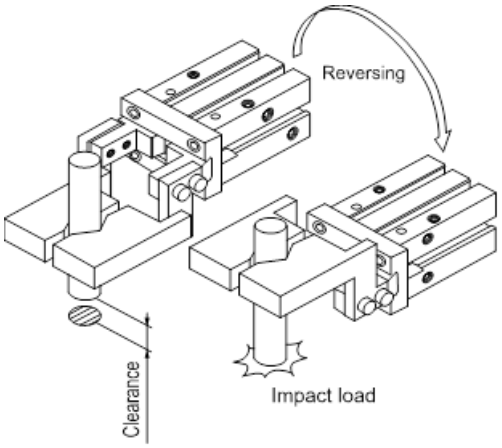
OK Clearance　　Not OK No clearance

2. Stroke end when gripper is moving



OK Clearance　　Not OK No clearance

3. When turning over



3-5. Speed Adjustment

⚠ Caution

(1) 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, the impact on the fingers and other components increases, causing poor repeatability while gripping workpieces, and increasing the risk of an adverse effect shortening 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

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

The product has a fixed orifice and is not designed to operate faster than 0.07s/90 degree. When the moment of inertia of the load is large, it is necessary to adjust the speed to within the allowable energy range to avoid damaging the product. If the product is used at speeds slower than 0.3s/90 degree, it can cause it to stick, slip or stop. Additionally, the actuator may swing faster than expected when operated without pressurizing the gripper. Exercise caution when adjusting the equipment.

D

3-6. Adjustment of rotation angle

⚠ Warning

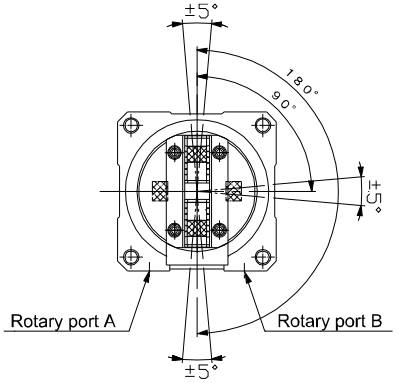
1) **Do not loosen the angle adjustment screw beyond the allowable adjustment range.**

The angle adjustment screw may fall out if it is loosened beyond its allowable adjustment range, which could pose a hazard to humans, the machinery and equipment.

⚠ Caution

2) **Adjust the rotation angle within the allowable range. (90º+/-10, 180º+/-10)**

Outside of the specified range, the product may malfunction or the switch may not operate.

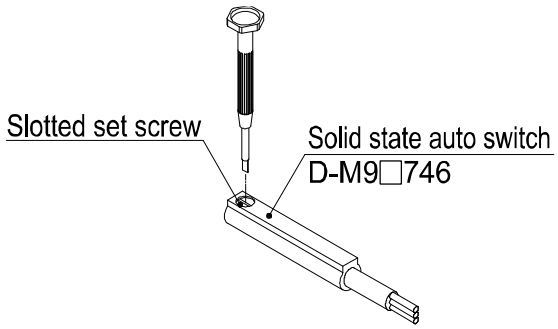


4. Mounting of Auto Switch

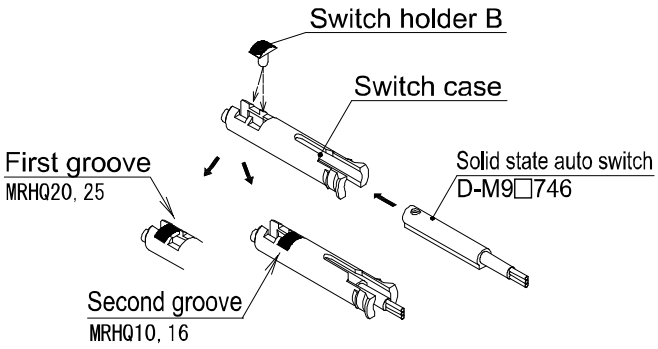
4-1. Mounting method

Mounting of Auto Switches to Verify Rotation

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



(2) Insert the auto switch into the switch case, and install switch holder B into the first groove (MRHQ20, 25) or the second groove (M RHQ10, 16) and secure the auto switch.



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

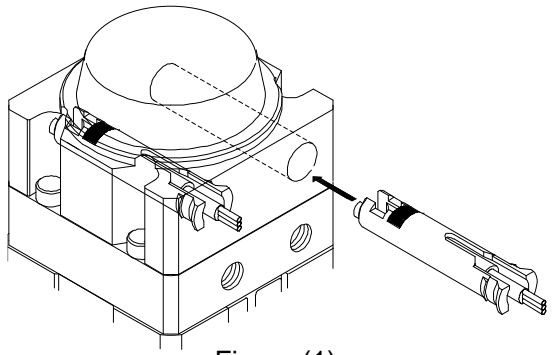


Figure (1)

Mounting Auto 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.

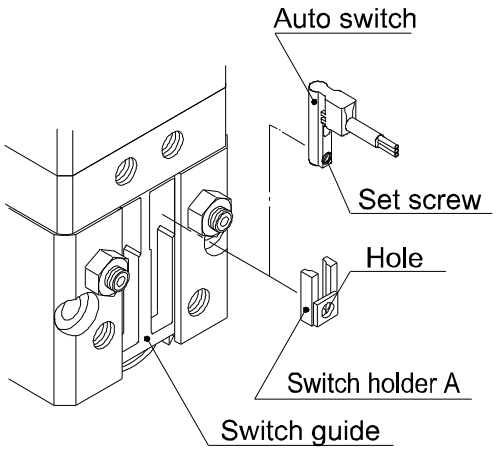


Figure (2)

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

Tightening torque: 0.05 to 0.1N·m

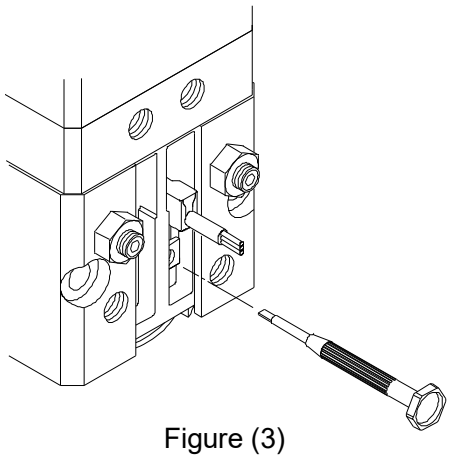
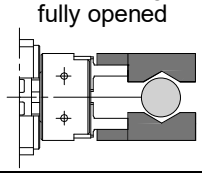
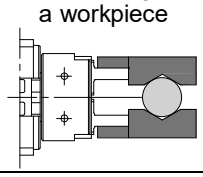
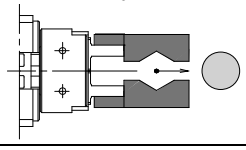
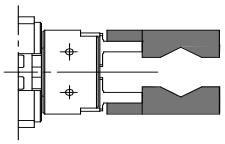
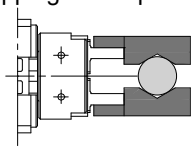
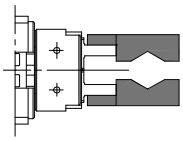
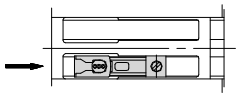
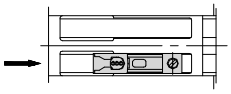
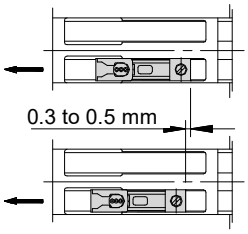


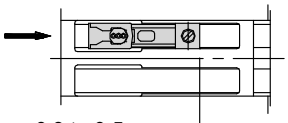
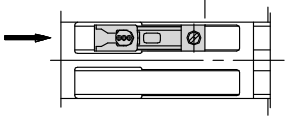
Figure (3)

4-2. Switch position of the gripper side

1) Detection when Gripping Exterior of Workpiece

<table>
<tr><td colspan="3">Detection example</td><td>1.Confirmation of fingers in reset position</td><td>2.Confirmation of workpiece held</td><td>3.Confirmation of workpiece released</td></tr>
<tr><td colspan="3">Position to be detected</td><td>Position of fingers fully opened
</td><td>Position when gripping a workpiece
</td><td>Position of fingers fully closed
</td></tr>
<tr><td colspan="3">Operation of auto switch</td><td>Auto switch turned ON when fingers return. (Light ON)</td><td>Auto switch turned ON when gripping a workpiece. (Light ON)</td><td>When a workpiece is not held (Abnormal operation): Auto switch to turn ON (Light ON)</td></tr>
<tr><td rowspan="4">Detection combinations</td><td colspan="2">One auto switch
*One position, any of (1), (2) and (3) can be detected.</td><td>●</td><td>●</td><td>●</td></tr>
<tr><td rowspan="3">Two auto switches
*Two positions of (1), (2) and (3) can be detected.</td><td>Pattern</td><td>A</td><td>●</td><td>●</td><td>—</td></tr>
<tr><td>B</td><td>—</td><td>●</td><td>●</td></tr>
<tr><td>C</td><td>●</td><td>—</td><td>●</td></tr>
<tr><td colspan="3" rowspan="3">How to determine Auto switch Installation position

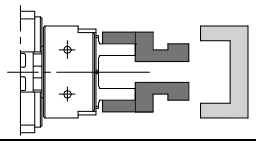
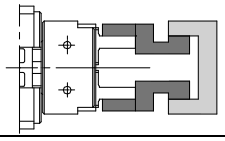
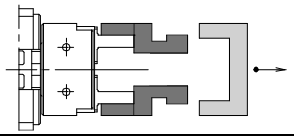
At no pressure or low pressure, connect the auto switch to a power supply, and follow the directions.</td><td>Step1) Fully open the fingers.
</td><td>Step1) Position fingers for gripping a workpiece.
</td><td>Step1) Fully close the fingers.
</td></tr>
<tr><td colspan="3">Step2) Refer to ”Mounting Switches to Verify Opening/Closing of Gripper” on page and position an auto switch in the auto switch mounting groove.</td></tr>
<tr><td>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 further it at a position 0.3 to 0.5 mm beyond the position where the indicator light illuminates.

0.3 to 0.5 mm</td><td colspan="2">Step 3) Slide the auto switch in the direction of the arrow until the right

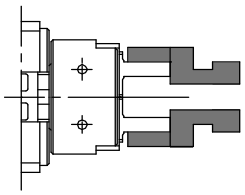
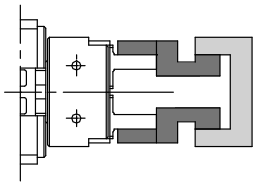
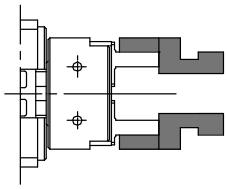
Position where light turns ON

0.3 to 0.5 mm
Position to be secured
</td></tr>
</table>

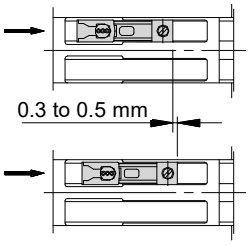
D

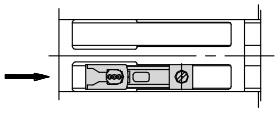
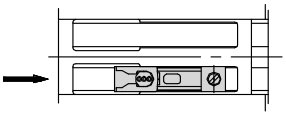
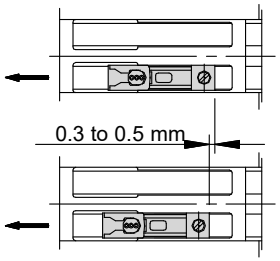
D

2) Detection when Gripping Interior of Workpiece

<table>
<tr><td colspan="3">Detection example</td><td>1.Confirmation of fingers in reset position</td><td>2.Confirmation of workpiece held</td><td>3.Confirmation of workpiece released</td></tr>
<tr><td colspan="3">Position to be detected</td><td>Position of fingers fully closed
</td><td>Position when gripping workpiece
</td><td>Position of fingers fully opened
</td></tr>
<tr><td colspan="3">Operation of auto switch</td><td>Auto switch turned ON when fingers return. (Light ON)</td><td>Auto switch turned ON when gripping a workpiece. (Light ON)</td><td>When a workpiece is not held (Abnormal operation): Auto switch to turn ON (Light ON)</td></tr>
<tr><td rowspan="4">Detection combinations</td><td colspan="2">One auto switch
*One position, any of (1), (2) and (3) can be detected.</td><td>●</td><td>●</td><td>●</td></tr>
<tr><td rowspan="3">Two auto switches
*Two positions of (1), (2) and (3) can be detected.</td><td>Pattern</td><td>A</td><td>●</td><td></td><td></td></tr>
<tr><td></td><td>B</td><td>—</td><td></td><td></td></tr>
<tr><td></td><td>C</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="3">How to determine Auto switch Installation position

At no pressure or low pressure, connect the auto switch to a power supply, and follow the directions.</td><td>Step1) Fully close the fingers.
</td><td>Step1) Position fingers for gripping a workpiece.
</td><td>Step1) Fully open the fingers.
</td></tr>
<tr><td colspan="3"></td><td colspan="3">Step2) Refer to ”Mounting Switches to Verify Opening/Closing of Gripper” on page and position an auto switch in the auto switch mounting groove.</td></tr>
<tr><td colspan="3"></td><td>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


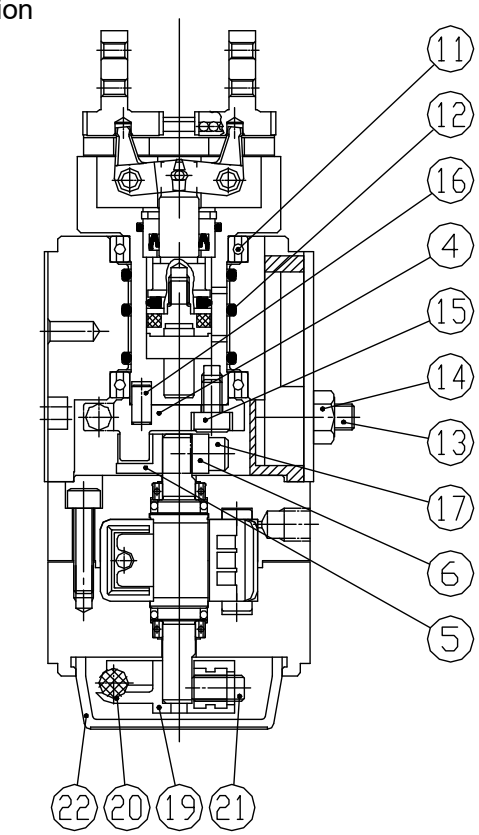
Position to be secured</td><td colspan="2">Step 3) Slide the auto switch in the direction of the arrow until the indicator right illuminates.

Step 4) Slide the auto switch in the direction of the arrow until the indicator right 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.

</td></tr>
</table>

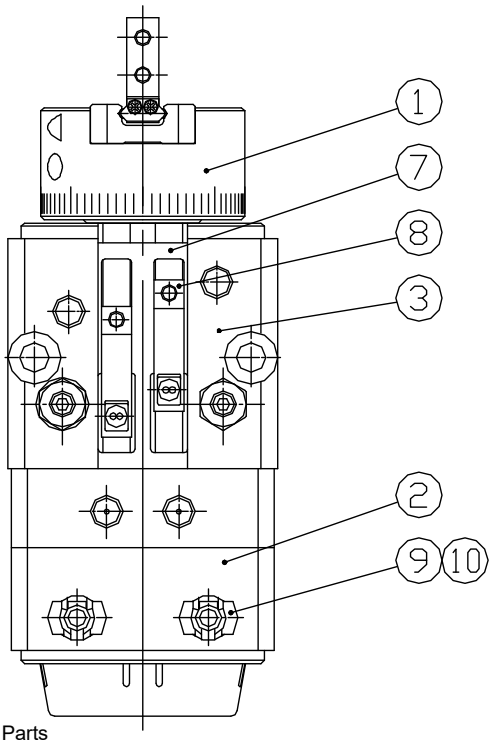
D

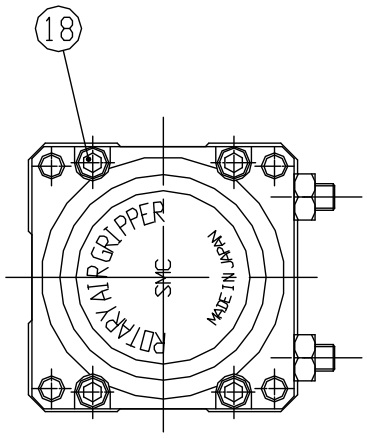
D

5. Maintenance

5-1. Construction





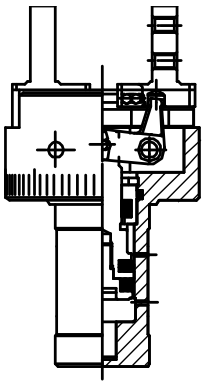


Component Parts

No.	Description	Material	Note
1	Air gripper	———	
2	Rotary unit	———	Two types for 90° and 180°
3	Body C	Aluminum alloy	Anodized
4	Stopper lever	Carbon steel	Heat treatment (90° and 180°)
5	Stopper guide	Stainless steel	Nitrilding
6	Lever retainer	Carbon steel	Zinc chromated
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	Heat treatment
14	Nut	Carbon steel	
15	Hexagon socket head cap screw		
16	Parallel pin	Stainless steel	
17	Hexagon socket head cap screw		
18	Hexagon socket head cap screw		
19	Magnet lever	Resin	
20	Magnet		Nickel plated
21	Hexagon socket head cap screw		
22	Resin case	Resin	

*Individual part cannot be shipped. Please purchase the whole unit.

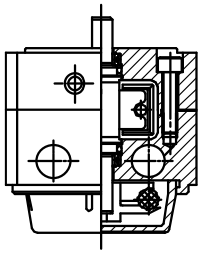
5-2. Part number of the unit and seals



Gripper unit

Model		Unit part no.
MRHQ10	D	P407090-3D
	S	P407090-3S
	C	P407090-3C
MRHQ16	D	P407060-3D
	S	P407060-3S
	C	P407060-3C
MRHQ20	D	P407080-3D
	S	P407080-3S
	C	P407080-3C
MRHQ25	D	P408080-3D
	S	P408080-3S
	C	P408080-3C

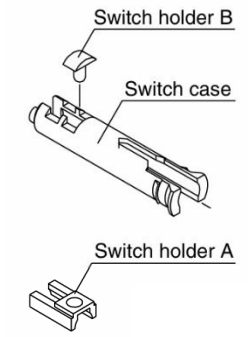
A gripper unit includes not only an air gripper, but also three O-ring (12) and three hexagon socket head cap screw (15) as shown in the construction on P18.



Rotary unit

Model	Unit part no.
MRHQ10*-90S	P406090-2A
MRHQ10*-18S	P406090-2B
MRHQ16*-90S	P406060-2A
MRHQ16*-18S	P406060-2B
MRHQ20*-90S	P407080-2A
MRHQ20*-18S	P407080-2B
MRHQ25*-90S	P408080-2A
MRHQ25*-18S	P408080-2B

Note that the rotation angle cannot be changed even through the rotary unit has been changed. For maintenance, order units with a part number suitable for the model being used.



Switch mounting unit

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

Each unit includes two of each of the parts indica

Auto switches are not included with a unit.

O-ring in the body C

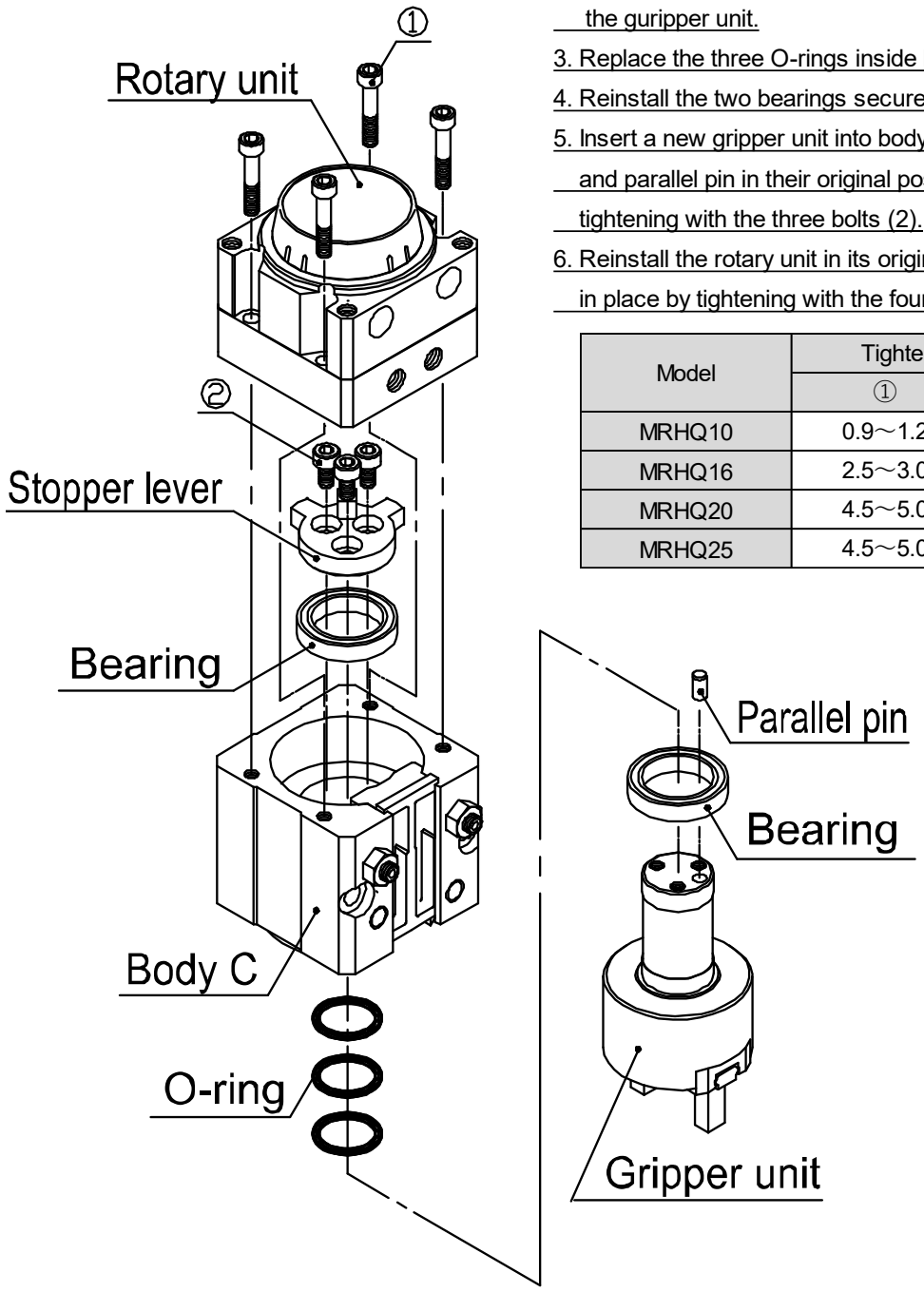
((12) O-ring in the construction on P18: 3 pcs.)

Model	Unit part no.
MRHQ10□	MRHQ10S-PS
MRHQ16□	MRHQ16S-PS
MRHQ20□	MRHQ20S-PS
MRHQ25□	MRHQ25S-PS

Special grease is applied.

This O-ring is included in the gripper init.

5-3. 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 guripper unit.
3. Replace the three O-rings inside body C.
4. Reinstall the two bearings securely in their original positions.
5. Insert a new gripper unit into body C. Then reinstall the stopper lever and parallel pin in their original positions and secure in place by tightening with the three bolts (2).
6. Reinstall the rotary unit in its original positions and secure in place by tightening with the four bolts (1).

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

5-4. Check
5-4-1. Check part

(1) Play of the gripper finger
(2) Tightening condition of the adjustment screw fixed by nut.
(3) Tightening condition of the slotted set screw that fixes the auto switch, for checking opening/ closing of the gripper.
(4) Tightening condition of the hexagon socket head cap screw fixing the body.
(5) Opening/ closing of chuck.
(6) Rotation.
(7) Rotation angle and position.
(8) External and internal leakage
(9) ON and OFF the switch

Check above points. If there are any problems with them, additionally tighten the screws, replace the maintenance parts or repair the parts.

5-4-2. Inspection interval
To use the Series MRHQ rotary gripper in the best condition, inspection needs to be performed once or twice a year.

⚠ Caution

Use the grease included in the accessory for the replacement of the rotary gripper.

6. Failure and measures

Countermeasures against	Possible causes	Countermeasure
Play or damage of the gripper finger	Excessive load for the holding force	Adjust the load to be within the specification range
	Excessive torque of the load	Adjust the torque of the load to be within the specification range
	Excessive energy of the load	Adjust the kinetic energy of the load to be within the specification range
	Exceed the gripping point	Adjust the gripping point to be within the specification range
	Exceed the allowable overhang	Adjust the overhang to be within the specification range
	External causes	If an obstacle is present in an open/close area or rotation area, remove the obstacle.
Unstable gripper operation	Circuit problem	Check the air and electric circuit again.
	Speed controller is restricted too much	Readjustment of the speed controller
	Air supply shortage	Make sure that the supply air flow of the port is adequate
	Air pressure shortage	Make sure that the supply pressure of the port is adjusted to the set pressure
Not rotate or rotation is unstable	(Circuit problem)	Check the air and electric circuit again.
	Speed controller is restricted too much	Readjustment of the speed controller
	Air supply shortage	Make sure that the supply air flow to the port is adequate
	Air pressure shortage	Make sure that the supply pressure to the port is adjusted to the set pressure
	Excessive torque of the load	Adjust the torque of the load to be within the specification range
The auto switch for opening/ closing the chuck does not operate or malfunctions.	Effect of an external magnetic field	Check that there is no strong magnetic field present.
	Trouble with the electrical circuit	Check that there is no trouble with the electrical circuit.
	Trouble with the electrical specification	Check that there is no trouble with the electrical specification.
The auto switch for detecting rotation does not operate or malfunctions.	Effect of an external magnetic field	Check that there is no strong magnetic field present.
	Trouble with the electrical circuit	Check that there is no trouble with the electrical circuit.
	Trouble with the electrical specification	Check that there is no trouble with the electrical specification.
	Setting problem of rotation start and stop.	Adjust the rotation angle to be within the specification range.
	Adjustment of rotation angle	

Notes for the Troubleshooting shown above

1. Causes of the operation failure due to product life are not shown in the troubleshooting table.

   For failures due to causes other than those shown in the troubleshooting table and product life, please contact SMC, as a disassembly investigation of the product may be required.

Doc. no. MRHQ-OM00002-D

Operation Manual

Model name

MRHQ Rotary Gripper

Part number / Series

MRHQ10,16,20,25

SMC Corporation

Contents

Safety Instructions

1. How to Order 1

2. Specifications 2

2-1. Specifications

2-2. Precautions on model selection 4

Gripping Point 5

Expressing the effective gripping force

Gripping Point Range Limit 6

Effective Gripping force（Double Acting） 7

Effective Gripping force（Single Acting） 8

Rotational Torque 9

2-3. Allowable Value of External Force on Fingers 10

2-4. Moment of Inertia and Allowable Kinetic Energy 11

Graph (Moment of inertia and rotation time) 12

3. Installation 13

3-1. Air supply

3-2. Piping

3-3. Operating environment

3-4. Mounting 14

3-5. Speed Adjustment 15

3-6. Adjustment of rotation angle

4. Mounting of Auto Switch 16

4-1. Mounting method

4-2. Switch position of the gripper side 17

1) Detection when Gripping Exterior of Workpiece

2) Detection when Gripping Interior of Workpiece 18

5. Maintenance 19

5-1. Construction

5-2. Part number of the unit and seals 20

5-3. Gripper Unit Replacement Procedure 21

5-4. Check 22

5-4-1. Check part

5-4-2. Inspection interval

6. Failure and measures 23

Safety Instructions

These safety instructions are intended to prevent hazardous situations and/or equipment damage. These instructions indicate the level of potential hazard with the labels of **"Caution," "Warning"** or **"Danger."** They are all important notes for safety and must be followed in addition to International Standards (ISO/IEC)*1), and other safety regulations.

*1) ISO 4414: Pneumatic fluid power - General rules and safety requirements for systems and their components
ISO 4413: Hydraulic fluid power - General rules and safety requirements for systems and their components
IEC 60204-1: Safety of machinery - Electrical equipment of machines - Part 1: General requirements
ISO 10218-1: Robots and robotic devices - Safety requirements for industrial robots - Part 1: Robots
etc.

Danger	**Danger** indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.
Warning	**Warning** indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
Caution	**Caution** indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.

Warning

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

Since the product specified here is used under various operating conditions, its compatibility with specific equipment must be decided by the person who designs the equipment or decides its specifications based on necessary analysis and test results. The expected performance and safety assurance of the equipment will be the responsibility of the person who has determined its compatibility with the product. This person should also continuously review all specifications of the product referring to its latest catalog information, with a view to giving due consideration to any possibility of equipment failure when configuring the equipment.

2. Only personnel with appropriate training should operate machinery and equipment.

The product specified here may become unsafe if handled incorrectly. The assembly, operation and maintenance of machines or equipment including our products must be performed by an operator who is appropriately trained and experienced.

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

1. The inspection and maintenance of machinery/equipment should only be performed after measures to prevent falling or runaway of the driven objects have been confirmed.
2. When the product is to be removed, confirm that the safety measures as mentioned above are implemented and the power from any appropriate source is cut, and read and understand the specific product precautions of all relevant products carefully.
3. Before machinery/equipment is restarted, take measures to prevent unexpected operation and malfunction.

4. Our products cannot be used beyond their specifications. Our products are not developed, designed, and manufactured to be used under the following conditions or environments. Use under such conditions or environments is not covered.

1. Conditions and environments outside of the given specifications, or use outdoors or in a place exposed to direct sunlight.
2. Use for nuclear power, railways, aviation, space equipment, ships, vehicles, military application, equipment affecting human life, body, and property, fuel equipment, entertainment equipment, emergency shut-off circuits, press clutches, brake circuits, safety equipment, etc., and use for applications that do not conform to standard specifications such as catalogs and operation manuals.
3. Use for interlock circuits, except for use with double interlock such as installing a mechanical protection function in case of failure. Please periodically inspect the product to confirm that the product is operating properly.

Safety Instructions

⚠ Caution

We develop, design, and manufacture our products to be used for automatic control equipment, and provide them for peaceful use in manufacturing industries.
Use in non-manufacturing industries is not covered.
Products we manufacture and sell cannot be used for the purpose of transactions or certification specified in the Measurement Act.
The new Measurement Act prohibits use of any unit other than SI units in Japan.

D

Limited warranty and Disclaimer/Compliance Requirements

The product used is subject to the following “Limited warranty and Disclaimer” and “Compliance Requirements”. Read and accept them before using the product.

Limited warranty and Disclaimer

1. The warranty period of the product is 1 year in service or 1.5 years after the product is delivered, whichever is first.*2)
   Also, the product may have specified durability, running distance or replacement parts. Please consult your nearest sales branch.
2. For any failure or damage reported within the warranty period which is clearly our responsibility, a replacement product or necessary parts will be provided.
   This limited warranty applies only to our product independently, and not to any other damage incurred due to the failure of the product.
3. Prior to using SMC products, please read and understand the warranty terms and disclaimers noted in the specified catalog for the particular products.

***2) Vacuum pads are excluded from this 1 year warranty.**
A vacuum pad is a consumable part, so it is warranted for a year after it is delivered.
Also, even within the warranty period, the wear of a product due to the use of the vacuum pad or failure due to the deterioration of rubber material are not covered by the limited warranty

Compliance Requirements

1. The use of SMC products with production equipment for the manufacture of weapons of mass destruction (WMD) or any other weapon is strictly prohibited.
2. The exports of SMC products or technology from one country to another are governed by the relevant security laws and regulations of the countries involved in the transaction. Prior to the shipment of a SMC product to another country, assure that all local rules governing that export are known and followed.

Design / Selection

⚠ Warning

1. **Confirm the specifications.**
   Products represented in this catalog are designed only for use in compressed air systems.
   Do not operate at pressures or temperatures, etc., beyond the range of specifications, as this can cause damage or malfunction. (Refer to the specifications.)
   We do not guarantee against any damage if the product is used outside of the specification range.
2. **If the operation involves load fluctuations, ascending/descending movements, or changes in friction resistance, make sure to provide safety measures.**
   Failure to provide such measures could accelerate the movement, which may be hazardous to humans, machinery, and other equipment.
3. **If there is a chance that the product will pose a hazard to humans, install a protective cover.**
   If the moving portion of the product will pose a hazard to humans or will damage machinery or equipment, provide a construction that prevents direct contact with those areas.
4. **Make sure that the secured portions will not loosen.**
   Be sure to adopt a reliable connecting method if the rotary gripper is used very frequently or if it is used in a location that is exposed to a large amount of vibrations.
5. **There may be cases in which a speed reduction circuit or a shock absorber is required.**
   If the driven object moves at high speeds or is heavy, it will be unfeasible for only the rotary gripper cushion to absorb the shock. Therefore, provide a speed-reduction circuit to reduce the rotary gripper speed before the thrust is applied to the cushion, or an external shock absorber to dampen the shock. If these countermeasures are taken, make sure to take the rigidity of the mechanical equipment into consideration.
6. **Consider the possibility of a reduction in the circuit air pressure caused by a power failure.**
   When a gripper is used as clamping mechanism, there is a danger of workpiece dropping if there is a decrease in clamping force, due to a drop in circuit pressure caused by a power failure. Therefore, safety equipment should be installed to prevent damage to machinery and bodily injury.
7. **Consider the possibility of power source related malfunctions that could occur.**
   For equipment that relies on power sources such as compressed air, electricity, or hydraulic pressure, adopt countermeasures to prevent the equipment from causing a hazard to humans or damage to the equipment in the event of malfunction.
8. **If a speed controller is provided in the exhaust restrictor, implement a safety design taking the residual pressure into consideration.**
   If air pressure is applied to the air supply side without residual pressure in the exhaust side, the rotary gripper will operate at abnormally high speeds, which could pose a hazard to humans and damage the machinery and equipment.
9. **Consider the behavior of the rotary gripper in the event of an emergency stop.**
   Devise a safe system so that if a person engages the emergency stop, or if a safety device is tripped during a system malfunction such as a power failure, the movement of the rotary gripper will not cause a hazard to humans or damage the equipment.
10. **Consider the action of the rotary gripper when restarting after an emergency stop.**
    Devise a safe design so that the restarting of the rotary gripper will not pose a hazard to humans or damage the equipment. Install manually controlled equipment for safety when the gripper has to be reset to the starting position.
11. **Do not use the product as a shock absorber.**
    If an abnormal pressure or air leakage occurs, the rotary gripper speed reduction capability could become severely affected, which could pose a hazard to humans and damage the machinery and equipment.
12. **Select a speed within the product's allowable energy value.**
    If the kinetic energy of the load exceeds the allowable value, it could damage the product, and cause a hazard to humans, or damage the machinery and equipment.

13. **Provide a shock absorber if the kinetic energy that is applied to the product exceeds the allowable value.**
    If the product's kinetic energy exceeds the allowable value, it could damage the product, and cause a hazard to humans, or damage the machinery or equipment.
14. **Do not stop or hold the product at midpoint by keeping air pressure in the product.**
    For a product without an external stopping mechanism, if the directional control valve is closed to keep the air pressure in the product, in an attempt to stop the product at midpoint, it might not be possible to maintain that stopped position due to an air leakage. As a result, it could pose a hazard to humans and cause damage to machinery and/or equipment.
15. **Give consideration to the decline in strength caused by changes in the shaft shape.**
    Some shaft types, such as simple specials, may have shapes and dimensions that result in decreased strength when compared with standard models. Consider this carefully when using
16. **Do not use two or more rotary grippers with the aim of synchronized movement.**
    One of the grippers may bear the load of operation, making synchronized movement impossible, and possibly leading to deformation of the equipment.
17. **Do not use in a location where external leakage of lubricant could have an adverse effect.**
    The lubricant coating the interior of the product may leak to the outside of the product from connecting parts of the rotary body, cover, etc.
18. **Do not disassemble the product or make any modifications, including additional machining.**
    This may cause human injury and/or an accident.
19. **Refer to the Auto Switches Precautions when using with an auto switch.**

⚠ Caution

1. **Do not use below the adjustment range specified for the product.**
   If the product is used below the specified speed adjustment range, it could cause the product to stick, slip, or the movement to stop.
2. **Do not apply external torque to the product that exceeds the rated output.**
   If an external force that exceeds the product's rated output is applied to the product, it could damage the product.
3. **If it is necessary to provide repeatability of the rotation angle, directly stop the load externally.**
   Even with a product that is equipped with an angle adjuster, there are times when the initial rotation angle could change.
4. **Do not use the product under hydraulic pressure.**
   The product will be damaged if it is used by applying hydraulic pressure.
5. **Do not use in a location where there are many temperature fluctuations.**
   When using in lower temperature applications, take care not to allow frost inside the cylinder.
   Operation may be unstable.
6. **Adjust the speed control in the environment in which the product is to be used.**
   The actuator may swing faster than expected when operated without pressurizing the gripper.
   Exercise caution when adjusting the equipment.

D

Design / Mounting

⚠ Warning

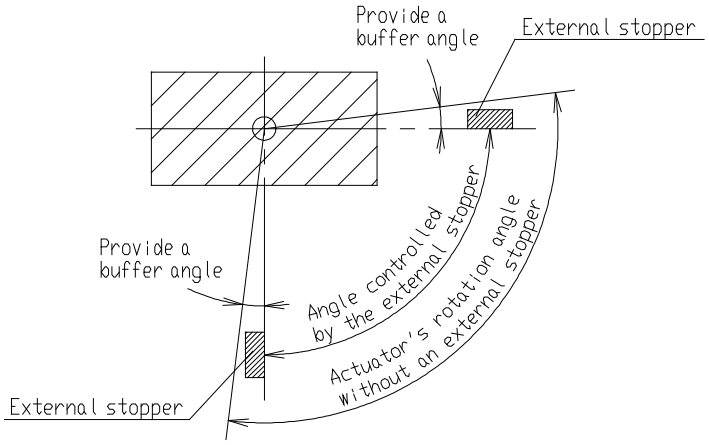
1. **Operation manual**
   Install the product and operate it only after reading the operation manual carefully and understanding its contents. Also, keep the manual in a location where it can be referred to as necessary.
2. **Ensure sufficient space for maintenance activities.**
   When installing the products, allow access for maintenance.
3. **Tighten threads with the proper tightening torque.**
   When installing the products, follow the listed torque specifications.
4. **Before adjusting the angle by supplying air pressure, take appropriate measures to prevent the equipment from rotating unnecessarily.**
   When an adjustment is performed under air pressure, the equipment could rotate and fall during the adjustment, depending on the mounted posture of the equipment. As a result, it could pose a hazard to humans and damage the machinery and equipment.
5. **Do not place a magnetic object near the product.**
   The auto switch is a magnetic sensing type. If a magnetic object is placed close to it, the rotary gripper could operate suddenly, which could pose a hazard to humans and damage the machinery and equipment.
6. **Do not perform additional machining to the product.**
   Additional machining to the product can result in insufficient strength and cause damage to the product. This can lead to possible human injury and damage to the surrounding equipment.
7. **Do not enlarge the fixed throttle by modifying the pipe connectors.**
   If the hole diameter is enlarged, the product's rotation speed will increase, causing the shock force to increase and damage to the product. As a result, it could pose a hazard to humans and damage the machinery and equipment.
8. **If shaft couplings are to be used, use those with angular freedom.**
   If shaft couplings that lack angular freedom are used, they could scrape due to eccentricity, leading to equipment malfunction and product damage. As a result, it could pose a hazard to humans and damage the machinery and equipment.
9. **Do not apply a load that exceeds the values given in the catalog.**
   If a load that exceeds the allowable values is applied to the product, it could lead to equipment malfunction, a hazard to humans, and damage to the machinery and equipment.
10. **Place an external stopper in a position away from the rotating shaft.**
    If the stopper is placed near the rotating shaft, the torque that is generated by the product itself will cause the reaction force which is directed to the stopper to be redirected and applied to the rotating shaft. This will lead to the breakage of the rotating shaft and bearing. As a result, it could pose a hazard to humans and damage the machinery and equipment.

Precautions when Using External Stoppers

- Be sure to install external stoppers in the proper places. Installation in the wrong place can result in equipment breakage, which could damage other equipment or cause human injury.

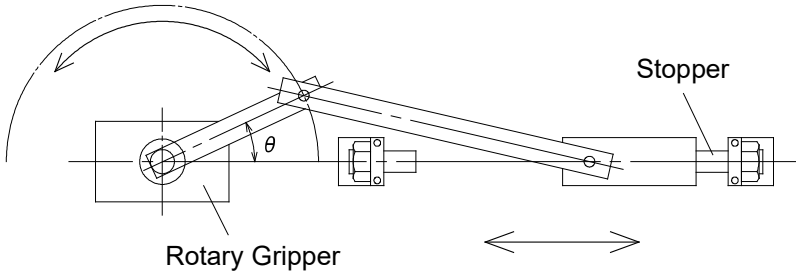
  *For details, please refer to BEST AUTOMATION (Rotary Actuators/General Precautions).

- Install external stoppers within the range of the rotating angle. Installing an external stopper at the maximum rotation angle may result in an inability to fully absorb the kinetic energy generated, and damage to equipment may occur.



Precautions when Converting Rotational Motion to Linear Motion

When using a link mechanism, etc., to convert rotational motion to linear motion, and determining the operation end using the stopper on the linear motion end (see below), a small value for θ at the operation end may result in the torque of the rotary gripper causing excessive radial load to act on the output axle, and equipment breakage may occur.
Install a stopper on the rotation motion side, or increase the value of θ at the operation end, to make sure the load generated does not exceed the allowable value for the product.



11. Do not use springs, etc., to add force in the rotational movement direction.

When rotational force from an external spring, etc., acts and generates negative pressure on the product's interior, breakage of the internal seal or acceleration of abrasion may occur.

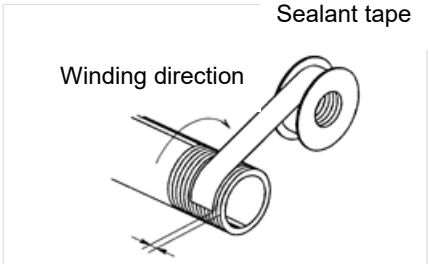
⚠ Caution

1. **Do not use organic solvent to wipe the area of the name plate that shows the model.**
   It will erase what is indicated on the name plate.
2. **Do not hit the output shaft by securing the body or hit the body by securing the output shaft.**
   These actions could cause the table to bend or damage the bearing. When a load must be coupled to the output shaft, secure the output shaft.
3. **Do not step directly onto the table or on the equipment that is coupled to the table.**
   Standing directly on the output shaft could cause the output shaft or the bearing to become damaged.
4. **If a product is equipped with an angle adjustment function, use it within the specified adjustment range.**
   If the product is used outside the specified adjustment range, it could lead to equipment malfunction or product damage. Refer to the product specifications for details on the adjustment range of the products.

Piping

⚠ Caution

1. **Refer to the Fittings and Tubing Precautions for handling one touch fittings.**
2. **Preparation before piping**
   Before piping is connected, it should be thoroughly blown out with air (flushing) or washed to remove chips, cutting oil and other debris from inside the pipe.
3. **Wrapping of pipe tape**
   When screwing piping or fittings into ports, ensure that chips from the pipe threads or sealing material do not enter the piping. Also, if pipe tape is used, leave 1.5 to 2 thread ridges exposed at the end of the threads.



Speed and Cushion Adjustment

⚠ Warning

1. **To make a speed adjustment, gradually adjust starting from the low speed end.**
   If the speed adjustment is performed from the high speed end, it could damage the product.
   As a result, it could pose a hazard to humans and damage the machinery and equipment.

Lubrication

⚠ Warning

1. **This product should be used without lubrication. Although it will operate even if it is lubricated, it could lead to sticking or slipping.**

Air Supply

⚠ Warning

1. **Type of fluids**
   Use compressed air.
2. **When there is a large amount of moisture**
   Compressed air containing a large amount of moisture can cause malfunction of pneumatic equipment. An air dryer or water separator should be installed upstream from filters.
3. **Drain flushing**
   If condensation in the drain bowl is not emptied on a regular basis, the bowl will overflow and allow the condensation to enter the compressed air lines. This may cause malfunction of pneumatic equipment. If the drain bowl is difficult to check and remove, installation of a drain bowl with an auto drain option is recommended.
4. **Use clean air.**
   Do not use compressed air that contains chemicals, synthetic oils that include organic solvents, salt, corrosive gases, etc., as it can cause damage or malfunction.

⚠ Caution

1. **When low dew point air air is used as the fluid, degradation of the lubrication properties inside the equipment may occur, resulting in reduced reliability (or reduced service life) of the equipment. Install an air filter.**
2. **Install an air filter.**
   Install an air filter upstream near the valve. Select an air filter with a filtration size of 5μm or smaller.
3. **Take measures to ensure air quality, such as by installing an aftercooler, air dryer, or water separator.**
   Compressed air that contains a large amount of moisture can cause malfunction of pneumatic equipment such as rotary gripper. Therefore, take appropriate measures to ensure air quality, such as by providing an aftercooler, air dryer, or water separator.
4. **Ensure that the fluid and ambient temperature are within the specified range.**
   If the fluid temperature is 5°C or less, the moisture in the circuit could freeze, causing damage to the seals and equipment malfunction. Therefore, take appropriate measures to prevent freezing.

Operating Environment

⚠ Warning

1. **Do not use in an atmosphere containing corrosive gases, chemicals, sea water, water, steam, or where there is direct contact with any of these.**
   Refer to the construction diagram for information on the materials used in the rotary gripper
2. **Do not expose the product to direct sunlight for an extended period of time.**
3. **Do not use in a place subject to heavy vibration and/or shock.**
4. **Do not mount the product in locations where it is exposed to radiant heat.**
5. **Do not use in dusty locations or where water oil, etc., splash on the equipment.**

Maintenance

⚠ Warning

1. **Perform maintenance inspection according to the procedures indicated in the operation manual.**
   If handled improperly, malfunction and damage of machinery or equipment may occur.
2. **Maintenance work**
   If handled improperly, compressed air can be dangerous. Assembly, handling, repair and element replacement of pneumatic systems should be performed by a knowledgeable and experienced person.
3. **Drain flushing**
   Remove drainage moisture from air filters regularly.
4. **Removal of equipment, and supply/exhaust of compressed air**
   When components are removed, first confirm that measures are in place to prevent workpieces from dropping, run-away equipment, etc. Then, cut off the supply pressure and electric power, and exhaust all compressed air from the system using the residual pressure release function.
   When machinery is restarted, proceed with caution after confirming that appropriate measures are in place to prevent cylinders from sudden movement.

⚠ Caution

1. **For lubrication, use the designated grease for each specific product.**
   The use of a non-designated lubricant could damage the seals.

Auto Switches Precautions

Design / Selection

⚠ Warning

1. **Confirm the specifications.**
   If the product is used with excess load applied or beyond the specification range, this may cause the product to break or malfunction. We do not guarantee against any damage if the product is used outside of the specification range.
2. **Cautions for use in an interlock circuit**
   When an auto switch is used for an interlock signal requiring high reliability, devise a double interlock system to avoid problems by providing a mechanical protection function, or by using another switch (sensor) together with the auto switch. Also, perform regular maintenance and confirm proper operation.
3. **Do not attempt to dissemble, modify (including exchanging the printed circuit boards), or repair the product.**
   This may cause human injuries and accidents.

⚠ Caution

1. **Pay attention to the length of time when a switch is ON at an intermediate stroke position.**
   When an auto switch is placed at an intermediate position of the stroke and a load is driven at the time the piston passes, the auto switch will operate, but if the operating time will be short if the speed is too fast. As a result, the load may not operate completely.
   The maximum detectable piston speed is:

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

2. **Keep wiring as short as possible.**
   <Solid state>
   Be sure to use a wire length of 100 m or less.
   When a long wire is required, we recommend attaching ferrite cores to both ends of the cable to prevent excess noise. A contact protection box is not necessary for solid state auto switches due to the nature of this product's construction.
3. **Do not use a load that generates surge voltage.**
   If a surge voltage is generated, discharge may be generated at the contact, possibly reducing the product life.
   If driving a load such as a relay that generates a surge voltage.
   <Solid state>
   Use a built-in surge absorbing element type device.

4. **Take precautions when multiple rotary gripper are used close together.**
   When multiple auto switch rotary gripper are used in close proximity, magnetic field interference may cause the auto switches to malfunction. Maintain a minimum separation of 40mm between rotary gripper.
   The auto switches may malfunction due to the interference from the magnetic fields.
   Use of a magnetic screen plate (MU-S025) or commercially available magnetic screening tape can reduce the interference of magnetic force.

5. **Pay attention to the internal voltage drop of the auto switch.**
   <Solid state>
   Generally, the internal voltage drop of the solid state auto switch is larger than that of the reed auto switch. When the auto switches (“n” pcs.) are connected in series, the voltage drop is multiplied by “n”. In this case, even if the auto switches operate correctly, the loads may not operate. Additionally, note that the 12 VDC relay does not apply to the auto switch.
6. **Pay attention to leakage current.**
   <Solid state / 2-wire type>
   Current (leakage current) flows to the load to operate the internal circuit even when in the OFF state.

   Operating current of load (OFF condition) > Leakage current

   If the criteria given in the above formula are not met, it will not reset correctly (stays ON).
   Use a 3-wire switch if this specification will not be satisfied.
   Moreover, leakage current flow to the load will be “n” times larger when “n” auto switches are connected in parallel.
7. **Ensure sufficient clearance for maintenance activities.**
   When designing an application, be certain to allow sufficient clearance for maintenance.
8. **Use the rotary gripper and auto switch in proper combination.**
   The auto switch is pre-adjusted to operate properly for an auto-switch-capable SMC rotary gripper.
   If the auto switch is mounted improperly, used for another brand of rotary gripper or used after changing the machine installation, the auto switch may not operate properly.

Mounting / Adjustment

⚠ Caution

1. **Do not drop or bump.**
   Do not drop, bump or apply excessive impacts (300m/s^2 or more for reed auto switches and 1000m/s^2 or more for solid state auto switches) while handling. Although the body of the auto switch may not be damaged, the inside of the auto switch could be damaged and cause malfunction.
2. **Observe the proper tightening torque for mounting an auto switch.**
   When an auto switch is tightened beyond the range of tightening torque, auto switch mounting screws, auto switch mounting brackets or auto switch may be damaged.
   On the other hand, tightening below the range of tightening torque may allow the auto switch to slip out of position.
3. **Do not carry a rotary gripper by the auto switch lead wires.**
   Never carry a rotary gripper by its lead wires. This may not only cause broken lead wires, but it may cause internal elements of the auto switch to be damaged by the stress.
4. **Fix the auto switch using the appropriate screws on the switch body. If other screws are used, the auto switch may be damaged.**

Wiring

⚠ Caution

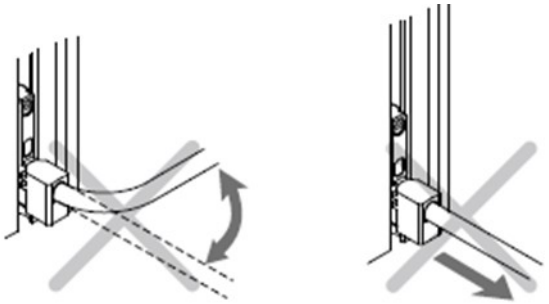
1. **Confirm proper insulation of wiring.**
   If there is any improper insulation (mixed contact with other circuits, grounding faults, improper insulation between terminals, etc.) in the wiring, an over-current may flow in, causing the auto switch to break.
2. **Wire separately from power lines or highvoltage lines, avoiding parallel wiring or wiring in the same conduit with these lines.**
   If an inrush current is generated, the noise may cause the auto switch to malfunction.

3. Avoid repeatedly bending or stretching lead wires.

Broken lead wires will result from repeatedly applying bending stress or stretching forces to the lead wires.

Stress and tensile force applied to the connection between the lead wire and auto switch increases the possibility of disconnection.

Keep the lead wire from moving, especially in the area where it connects with the auto switch.



4. Be certain to connect the load before power is applied.

<2-wire type>

If the power is turned ON when an auto switch is not connected to a load, the auto switch will be instantly damaged because of excess current (Short circuit).

In addition, when using a commercially available checker, etc., to perform an acceptance inspection or check the operation of a 2-wire auto switch, be sure to confirm the wiring method of the checker beforehand and make sure to connect the terminal with a built-in load (IN, etc.) to the 0 V terminal. (Do not connect the power supply terminal and the ground terminal directly when in a non-load state.)

5. Do not allow short-circuit of loads.

<Solid state>

PNP output type auto switches do not have built-in short circuit protection circuits.

Handle carefully as the auto switch may be damaged.

6. Avoid incorrect wiring.

<Solid state>

1) If connections are reversed on a 2-wire type auto switch, the auto switch will not be damaged if protected by a protection circuit, but the auto switch will remain in an ON state. However, it is still necessary to avoid reversed connections, since the auto switch could be damaged by a load short circuit in this condition.
2) If connections are reversed (power supply line + and power supply line-) on a 3-wire type auto switch, the auto switch will be protected by a protection circuit. However, if the power supply line (+) is connected to the blue wire and the power supply line (-) is connected to the black wire, the auto switch will be damaged.

Operation Environment

⚠ Warning

1. **Never use in an atmosphere with explosive gases.**
   Auto switches are not designed to prevent explosion. This may cause an explosion hazard.

⚠ Caution

1. **Do not use in an area where a magnetic field is generated.**
   Auto switches will malfunction or magnets inside rotary grippers will become demagnetized.
2. **Do not use in an environment where the auto switch will be continually exposed to water.**
   Although auto switches satisfy IEC standard IP67 construction, do not use auto switches in applications where they will be continually exposed to water splash or spray. This may cause improper insulation or malfunction.
3. **Do not use in an environment with oil or chemicals.**
   If auto switches are used in an environment with containing coolant, cleaning solvent, various oils or chemicals, even for a short period of time, this may adversely affect the auto switches, resulting improper insulation, malfunction due to the swelling of potting resin, or hardening of lead wires.
4. **Do not use in an environment with temperature cycles.**
   If temperature cycles other than normal temperature changes are applied, this may adversely affect the insides of the auto switches.
5. **Do not use in an environment where there is excessive impact shock.**
6. **Do not use in an area where surges are generated.**
   <Solid state>
   If there is an equipment unit (electromagnetic lifter, high-frequency induction furnace, motor, radio, etc.) that generates large surges or electromagnetic waves around cylinders or grippers with solid state auto switches, this may cause the circuit element inside the auto switch to break.
7. **Avoid the accumulation of iron waste or close contact with magnetic substances.**
   If too many iron particles, such as cutting chips or spatters, accumulate around a cylinder or gripper with auto switches, or if a magnetic substance (attracted by a magnet) is put close to a cylinder or gripper with auto switches, the magnetic force inside the cylinder or gripper may weaken, causing the auto switch to malfunction.
8. **Do not use in direct sunlight.**
9. **Do not mount the product in locations where it is exposed to radiant heat.**
10. **Take appropriate measures against the lightning surge on the equipment side as the auto switches do not have any lightning surge resistance specified in the CE marking.**

Maintenance

⚠ Warning

1. **Removal of equipment, and supply/exhaust of compressed air.**
   Before any machinery or equipment is removed, first ensure that the appropriate measures are in place to prevent workpieces from dropping, run-away equipment, etc. Then, cut off the electric power and reduce the pressure in the system to zero. Only then should you proceed with the removal of any machinery or equipment.
   When machinery is restarted, proceed with caution after confirming that appropriate measures are in place to prevent sudden movement.
2. **Do not touch a terminal during energizing.**
   Touching a terminal during energizing may cause electric shock, malfunction, or auto switch breakage.

⚠ Caution

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

1) Secure and tighten auto switch mounting screws.
   If screws become loose or the mounting position is dislocated, retighten them after readjusting the mounting position.
2) Confirm that there is no damage to lead wires.
   To prevent faulty insulation, replace auto switches or repair lead wires if damage is discovered.
3) Confirm the detection setting position.
   - Red light on 1-color indicator auto switch
     Confirm that the set position stops at the center of the operating range (red indication area).
   - Confirm the green light and position of the 2-color indicator auto switch.
     Confirm that the set position stops at the center of the appropriate operating range (green indication area). If stopped with the red LED lit, the operation may become unstable due to effects of the equipment environment or external disturbance. So, set the mounting position at the center of the appropriate operating range again.
     Some rotary grippers indicate a specific setting procedure for the auto switch. If so, set the mounting position according to the specific setting procedure.

2. Do not use solvents, such as benzene, thinner, etc., to clean the product.

They could damage the surface of the body and erase the markings on the body. For heavy stains, use a cloth lightly dampened with diluted neutral detergent, then wipe up any residue with a dry cloth.

1. How to Order

MRH Q 10 D - 90 S - M9NV □ □ - M9N □ □ - □

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)
S	Single acting (Normally closed)

Rotation angle

90	90°
180	180°

Single vane

Lead wire length

Nil	0. 5m
L	3m
Z	5m

Number of auto switches

Nil	2 pcs.
S	1 pcs.

Made to Order

Symbol	Specifications/Description
-X50	Flat finger type
-X51	Through hole in open/close direction
-X111	Air Gripper with Dust Cover Chloroprene rubber (CR)
-X112	Air Gripper with Dust Cover Fluororubber (FKM)
-X113	Air Gripper with Dust Cover Silicone rubber (Si)

Type of auto switch for detecting rotation

Nil	Without auto switch(Built-in magnet)

Applicable Auto switches

Type	Electrical entry	Indicator light	Wiring (output)	Load voltage		Auto switch symbol	Lead wire lenght (m)			Applicable load		Auto switch model
				DC		Electrical entry / In-line	0.5 (NIL)	3 (L)	5 (Z)			
Solid state auto switches	Grommet	Yes	3-wire (NPN)	24V	5V	M9N	●	●	O	IC circuit	Relay PLC	D-M9N□-746
			3-wire (PNP)		12V	M9P	●	●	O			D-M9P□-746
			2-wire		12V	M9B	●	●	O	–		D-M9B□-746

*Lead wire length symbols: 0.5 m .....Nil (Example) M9N PLC: Sequence controller
3 m .....L M9NL
5 m .....Z M9NZ

*Order with an auto switch part number when ordering a single auto switch unit.
*Auto switches marked with a "○" are made upon receipt of order.

Type of auto switch for detecting rotation

Nil	Without auto switch(Built-in magnet)

Applicable Auto switches

Type	Electrical entry	Indicator light	Wiring (output)	Load voltage		Auto switch symbol	Lead wire lenght (m)			Applicable load		Auto switch model
				DC		Electrical entry / In-line	0.5 (NIL)	3 (L)	5 (Z)			
Solid state auto switches	Grommet	Yes	3-wire (NPN)	24V	5V	M9NV	●	●	O	IC circuit	Relay PLC	D-M9NV□
			3-wire (PNP)		12V	M9PV	●	●	O			D-M9PV□
			2-wire		12V	M9BV	●	●	O	–		D-M9BV□

*Lead wire length symbols: 0.5 m .....Nil (Example) M9NV PLC: Sequence controller
3 m .....L M9NVZ
5 m .....Z M9NVZ

*Order with an auto switch part number when ordering a single auto switch unit.
*Auto switches marked with a "○" are made upon receipt of order.

2. Specifications

2-1. Specification

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°(Both ends of vibration ±5° adjustable)			
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℃			
Adjustable rotation time range(1)			0.07 to 0.3sec/90° (at 0.5 MPa)			
Allowable kinetic energy			0.0046J	0.014J	0.034J	0.074J
Auto switch		Rotary unit	Solid state auto switch (2-wire, 3-wire)			
		Gripper unit	Solid state auto switch (2-wire, 3-wire)			

Note 1: Operate within the speed adjustment range, as speed control exceeding the low speed limit value may cause sticking or failure to occur.
For a swing time of 0.07 s/90°, use a supply pressure of 0.5 MPa or higher.

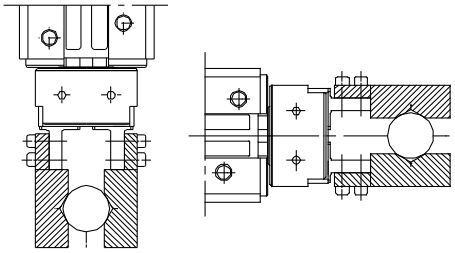
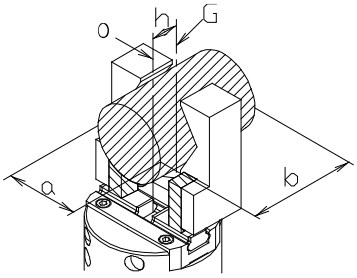
D

Action	Model	Cylinder bore (mm)	Opening/Closing stroke (mm)	Rotating Angle (°)	Weight (g) [1]
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 1: Values do not include auto switch weight.

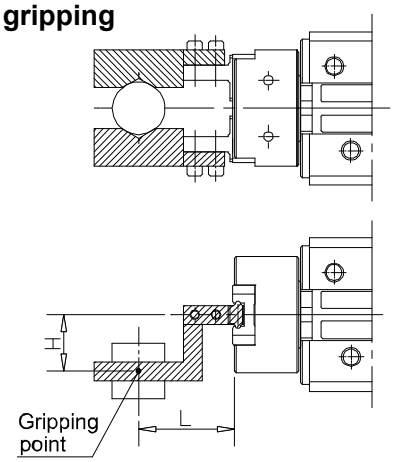
2-2. Precautions on model selection

⚠Caution

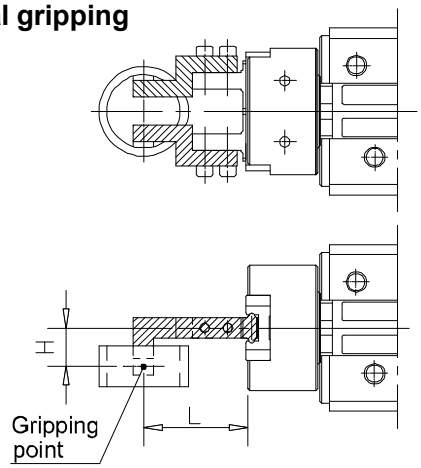
Step	Calculation	Example
(1) Operating conditions Enumerate the operating conditions according to the mounting position and workpiece configuration.  **Vertical mounting** **Horizontal mounting**	・Model used ・Operating pressure ・Mounting position ・Rotation time t(s) ・Overhang H(mm) ・Gripping point distance L(mm) ・Distance between central axis and center of gravity h(mm) ・Load mass m_1(kg) ・Mass of 2 attachments m_2(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 center of gravity (h):10m Load mass (m_1):0.07kg Mass of 2 attachments (m_2):0.05kg
(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 grange limit.	Gripping point range time Graph (1)	Within the range time OK
(4) Load mass Confirm that the load converted from the load mass is less than 1/20 of the effective gripping force. (A greater margin must be allowed if large impacts are applied when work pieces are transported.)	$20 \times 9.8 \times m_1$ < Effective gripping force (N)Graph (2)	20 x 9.8 x 0.07 =13.72 13.72N < Effective gripping force
(5) External force on finger Make sure that the vertical load and moment on each finger is within allowable limit.	Less than allowable value (Refer to page 9 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.	$20 \times 9.8 \times (m_1+m_2) \times H/1000$ < 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.) **(K=2: safety factor)**	$I_R = K \times (a^2+b^2+12h^2) \times (m_1+m_2)$ $/(12 \times 10^6)$	$I_R = 2 \times (20^2+30^2+12 \times 10^2) \times (0.07+0.05)$ $/(12 \times 10^6) = 0.00005 kg \cdot m_2$
(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".	$1/2 \times I_R \times \omega^2$ < allowable energy (J) $\omega = 2\Theta/t$ (ω: Angular speed at the end) Θ: Rotating angle (rad) t: Rotation time (s)	$1/2 \times 0.00005 \times (2 \times (3.14/2)/0.2)^2$ $=0.00005 kg \cdot m_2$ 0.0062J < allowable energy OK

Gripping point

External gripping



Internal gripping



L: Gripping point distance

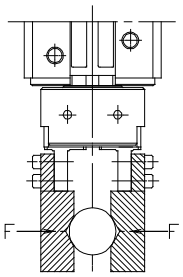
H: Overhang

-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 above.

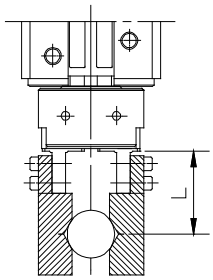
-If operated with the workpiece gripping point outside of the range, an excessive eccentric load will be applied to the fingers and guide section, causing play in the fingers and adversely affecting the gripper's life.

Expressing the effective gripping force

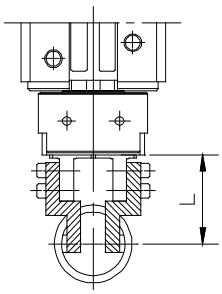
The effective gripping force shown in the graphs to the right is expressed as F, which is the impellent force of one finger, when both fingers and attachments are in full contact with the workpiece as shown in the figure below.



External gripping



Internal gripping



-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 mass, or more.

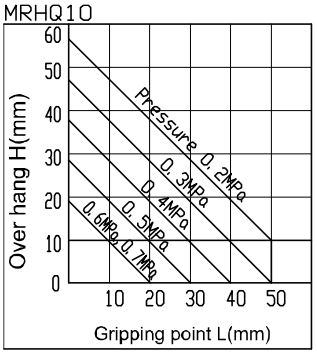
-A greater margin of safety is required when high acceleration or impact occurs during workpiece transfer.

Gripping Point Range Limit

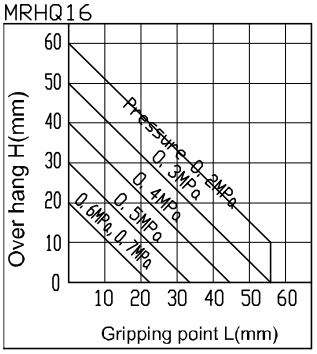
Graph (1)

External Gripping

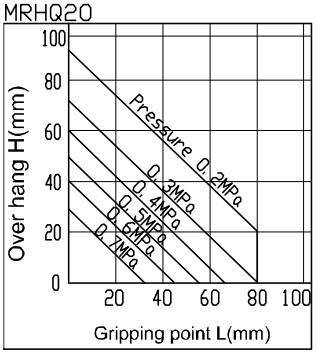
MRHQ10



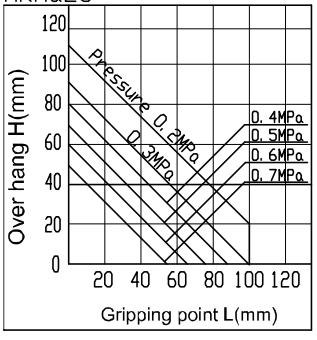
MRHQ16



MRHQ20

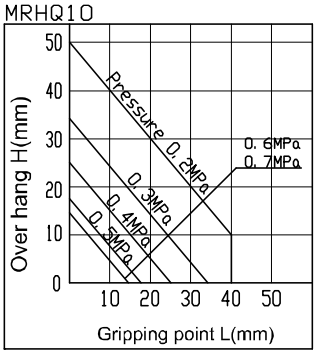


MRHQ25

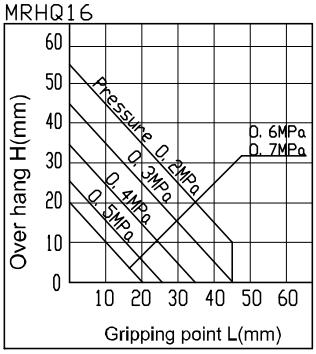


Internal Gripping

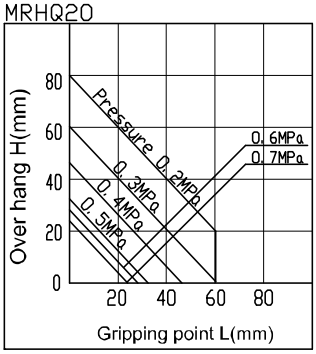
MRHQ10



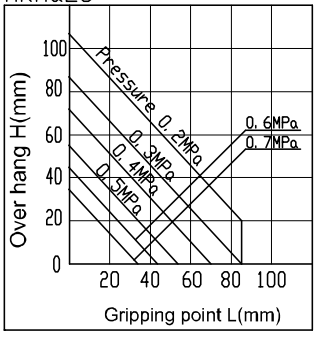
MRHQ16



MRHQ20



MRHQ25

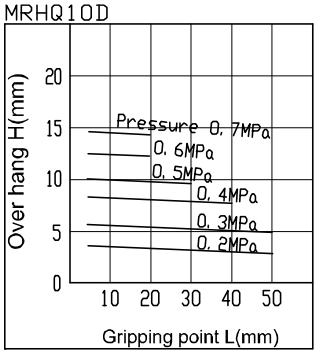


Effective Gripping force（Double Acting）

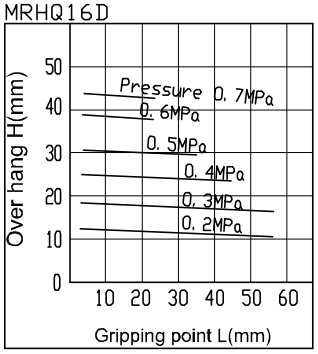
Graph (2)

External Gripping

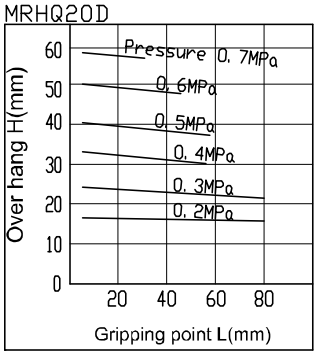
MRHQ10D



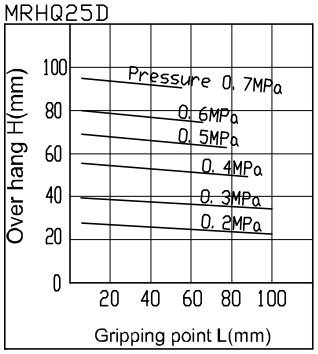
MRHQ16D



MRHQ20D

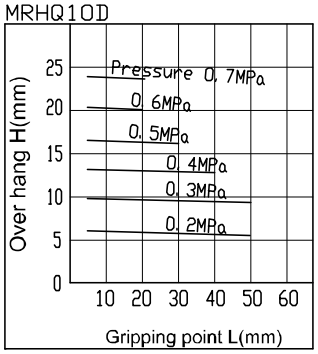


MRHQ25D

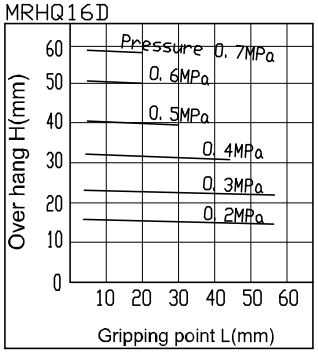


Internal Gripping

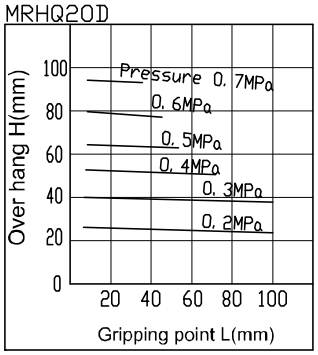
MRHQ10D



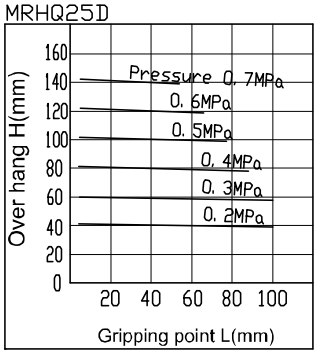
MRHQ16D



MRHQ20D



MRHQ25D

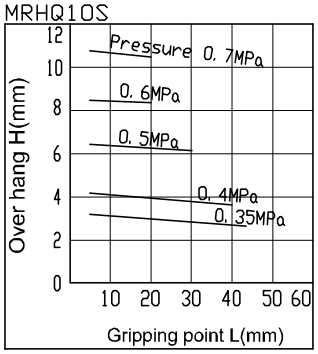


Effective Gripping force（Single Acting）

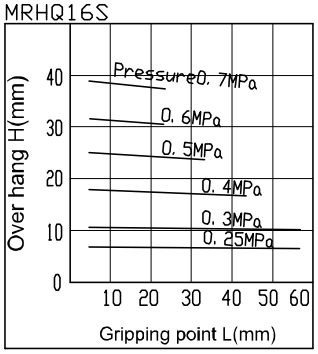
Graph (2)

External Gripping

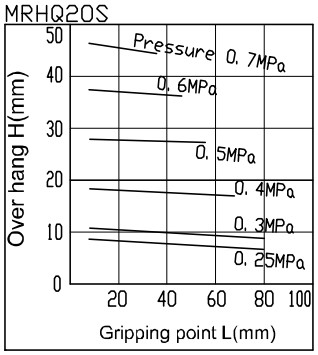
MRHQ10S



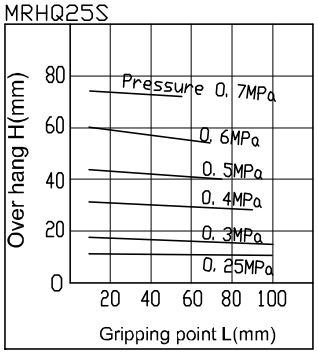
MRHQ16S



MRHQ20S

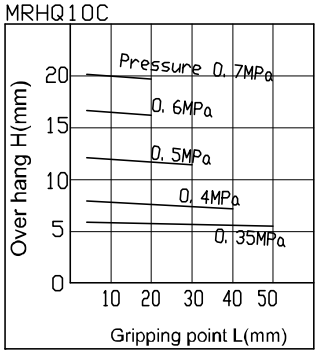


MRHQ25S

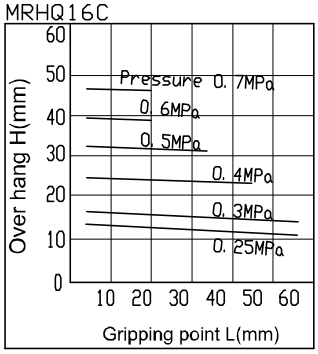


Internal Gripping

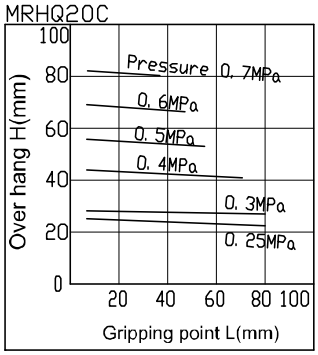
MRHQ10C



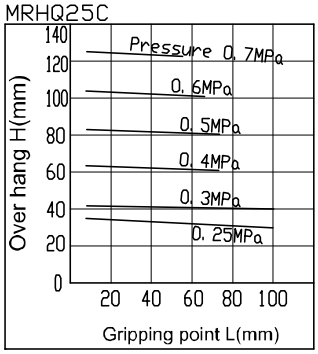
MRHQ16C



MRHQ20C

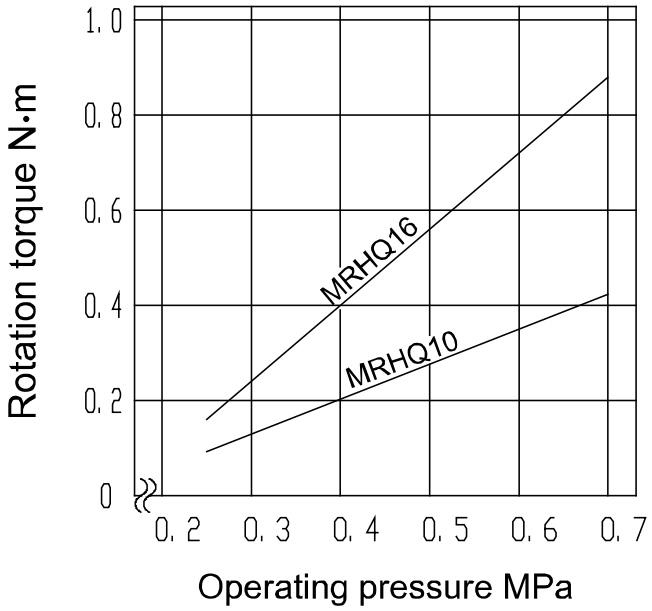


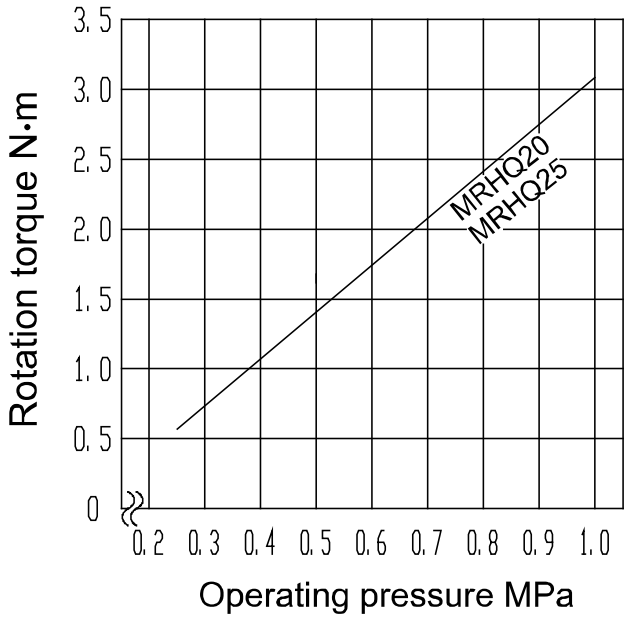
MRHQ25C



Rotational Torque

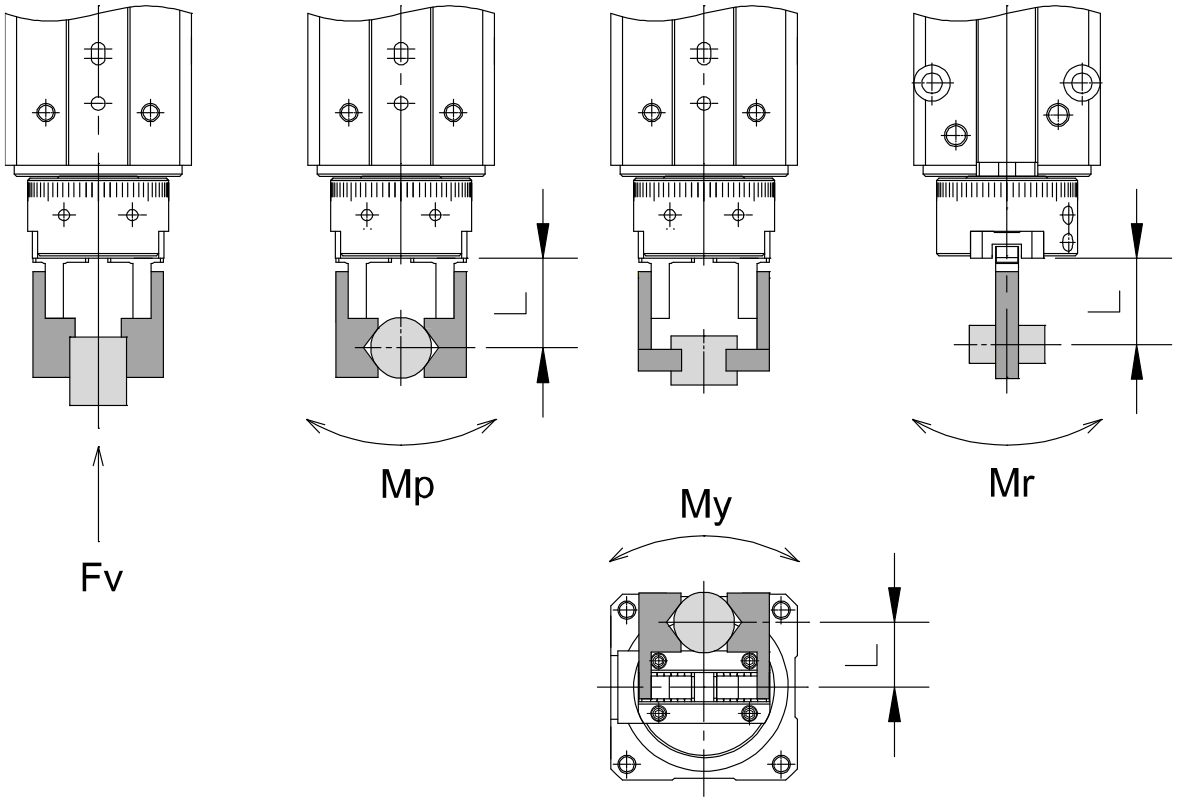
Graph (3)





2-3. Allowable Value of External Force on Fingers

-



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

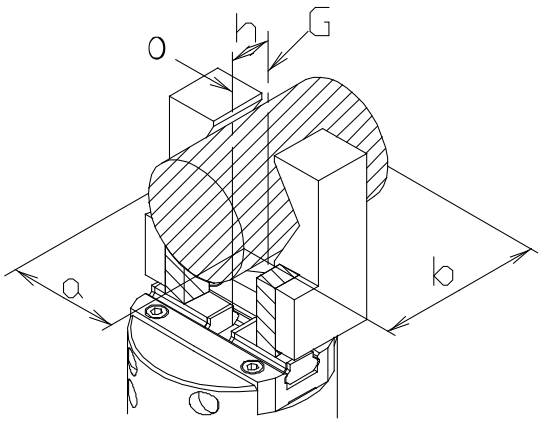
Model	Allowable vertical load Fv (N)	Maximum allowable moment		
		Pitch moment Mp (N·m)	Yaw moment My (N·m)	Roll moment Mr (N·m)
MRHQ10□	58	0.26	0.26	0.53
MRHQ16□	98	0.68	0.68	1.36
MRHQ20□	147	1.32	1.32	2.65
MRHQ25□	255	1.94	1.94	3.88

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

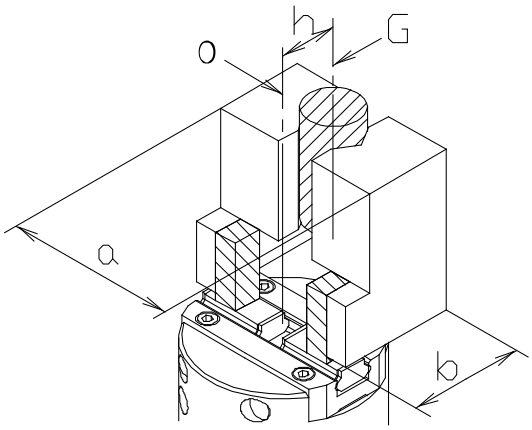
Calculation for allowable external force (with moment load)	Calculation example
$Allowable\ load\ F(N) = \frac{M(Maximum\ allowable\ moment)\ \ (N \cdot m)}{L \times^{*} 10^{-3}}$ * Unit conversion factor *= unit conversion factor	When static load f = 10 N, which produces pitch oment to the point L = 30 mm from MRHQ16 guide, is applied. Operable condition requires that F be bigger than f. $Allowable\ load\ F(N) = \frac{0.68}{30 \times 10^{-3}}$ = 22.7(N) > 10 Since load F >f, it is operable.

2-4. Moment of Inertia 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 following page.



When load dimensions > Attachment dimensions



When load dimensions < Attachment dimensions

Description

O…Center of rotation

G…Center of gravity of attachment and load

… Gripper fingers

… Attachments

… Load

Moment of inertia I: kg·m^2

$$I = \frac{(a^2 + b^2 + 12h^2)(m^1 + m^2)}{12x10^6}$$

m_1: Mass of two attachments (kg)

m_2: Mass of load (kg)

h: Distance between O and G (mm)

a, b: Distance of load or attachment (mm)

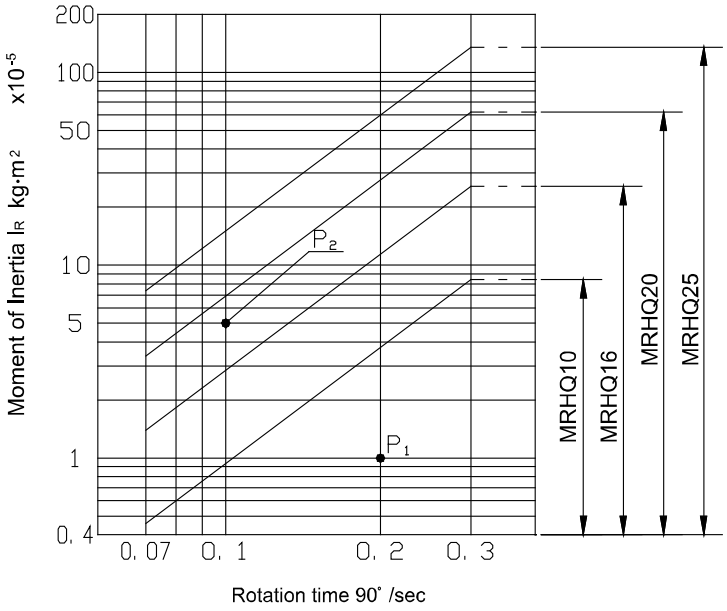
K= 2 (Coefficient)

Practical moment on inertia I_R: kg·m^2

I_R = K x I

*Use I_R for this product.

Graph (Moment of inertia and rotation time)



(How to Use the Graph)
[Example 1]
-Moment of Inertia: 1 x 10^{-5} kg·m^2
-Rotation time: 0.2 s/90°
-To select model **MRHQ10**

⬇

It can be used because the point of intersection **P_1** on the graph is within the limiting range.

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

⬇

It cannot be used because the point of intersection **P_2** 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

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

Allowable Kinetic Energy

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

$\omega = 2\Theta/t$
ω: Angular speed at the end
Θ: Rotating angle (rad) (θ=180°=3.14)
t: Rotation time (s)

3. Installation

3-1. Air supply

⚠Caution

(1) The air supplied to the rotary gripper should be filtered by SMC's AF series air filter and regulated to the specified set pressure by SMC's AR series regulator.

(2) This is a non-lube type actuator. Never supply lubricant oil.

If lubricant is supplied to the actuator, the grease inside the actuator will be washed away, and this may cause operation failure.

(3) Compressed air containing a large amount of condensate can cause the rotary table to malfunction. Therefore, take appropriate measures to ensure air quality, by providing an after-cooler, or water separator, if needed.

3-2. Piping

⚠Caution

(1) Before piping

Before piping, perform air blow (flushing) or cleaning inside of the piping to eliminate any cutting chips, cutting oil, dust, etc.

(2) Avoid repeatedly bending or stretching the lead wire of the switch.

Broken lead wires will result if bending stresses or tensile forces are applied to the lead wires.

(3) Make sure to connect a load to the switch before turning the power supply on.

If it is turned on with no load connected to the auto switch, over current will flow, causing the switch to break instantly.

3-3. Operating environment

(1) **Do not use this product in environments where there is a danger of corrosion.**

Refer to the construction drawings regarding the rotary gripper materials.

(2) Do not use this product in an area that is dusty, or in an environment in which water or oil splashes on the cylinder.

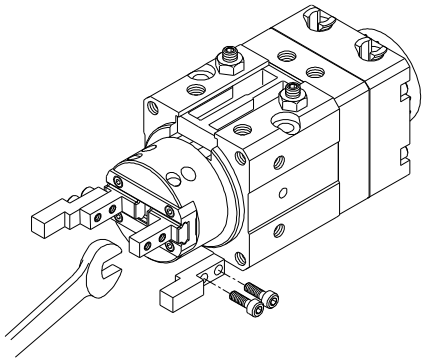
(3) Don't use the rotary gripper with switch in an atmosphere where explosive gases are used.

It can cause malfunction of the auto switch or decrease the magnetic force of the magnet mounted in the rotary gripper.

(4) Do not use the rotary gripper with switch in an area where a magnetic field is generated.

3-4. Mounting

(1) When mounting attachments on fingers, support the fingers with a tool such as a spanner to prevent them from twisting.

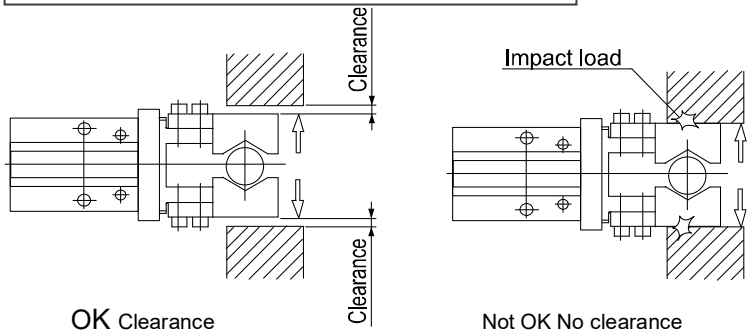


Refer to the table on the right for the tightening torque of finger mounting bolts.

Model	Bolt	Max. tightening torque N・m
MRHQ10	M2.5X0.45	0.31
MRHQ16	M3X0.5	0.59
MRHQ20	M4X0.7	1.4
MRHQ20	M5X0.8	2.8

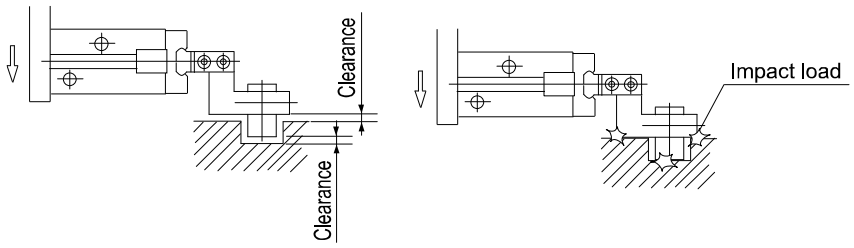
(2) Avoid external force on the finger. Fingers may be damaged by a continual lateral or impact load. Provide clearance to prevent the workpiece or the attachment from striking against any object at the stroke end of the rotary gripper.

1. Stroke end when fingers are opened



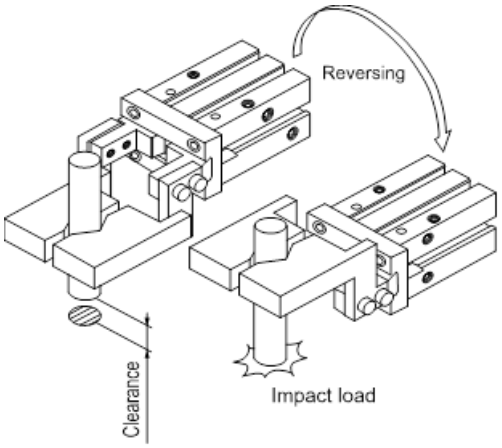
OK Clearance　　Not OK No clearance

2. Stroke end when gripper is moving



OK Clearance　　Not OK No clearance

3. When turning over



3-5. Speed Adjustment

⚠ Caution

(1) 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, the impact on the fingers and other components increases, causing poor repeatability while gripping workpieces, and increasing the risk of an adverse effect shortening 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

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

The product has a fixed orifice and is not designed to operate faster than 0.07s/90 degree. When the moment of inertia of the load is large, it is necessary to adjust the speed to within the allowable energy range to avoid damaging the product. If the product is used at speeds slower than 0.3s/90 degree, it can cause it to stick, slip or stop. Additionally, the actuator may swing faster than expected when operated without pressurizing the gripper. Exercise caution when adjusting the equipment.

D

3-6. Adjustment of rotation angle

⚠ Warning

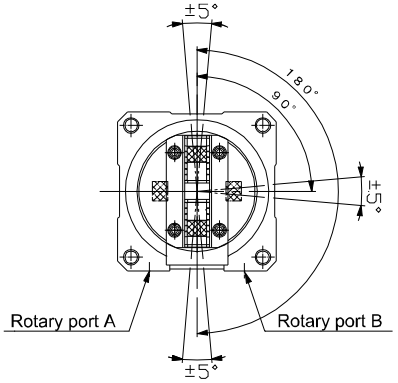
1) **Do not loosen the angle adjustment screw beyond the allowable adjustment range.**

The angle adjustment screw may fall out if it is loosened beyond its allowable adjustment range, which could pose a hazard to humans, the machinery and equipment.

⚠ Caution

2) **Adjust the rotation angle within the allowable range. (90º+/-10, 180º+/-10)**

Outside of the specified range, the product may malfunction or the switch may not operate.

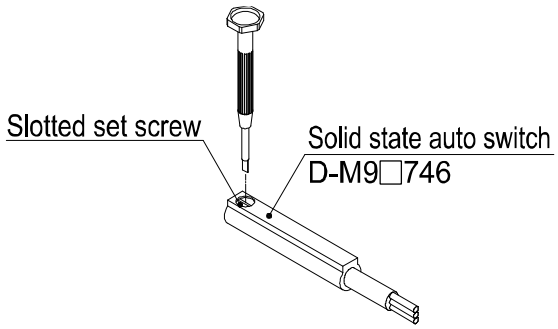


4. Mounting of Auto Switch

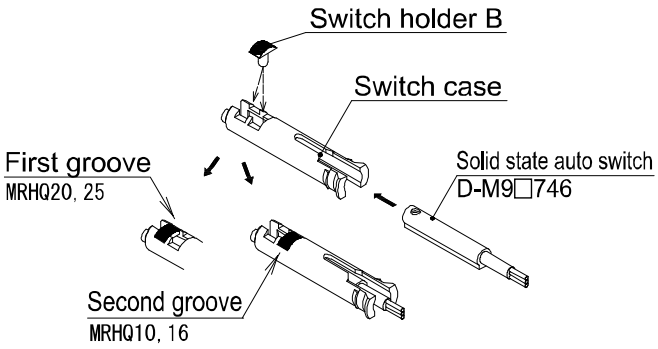
4-1. Mounting method

Mounting of Auto Switches to Verify Rotation

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



(2) Insert the auto switch into the switch case, and install switch holder B into the first groove (MRHQ20, 25) or the second groove (M RHQ10, 16) and secure the auto switch.



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

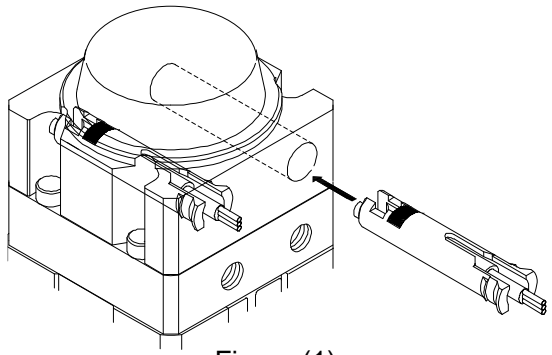


Figure (1)

Mounting Auto 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.

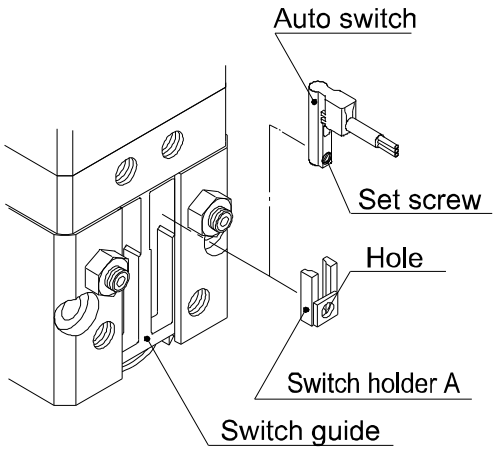


Figure (2)

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

Tightening torque: 0.05 to 0.1N·m

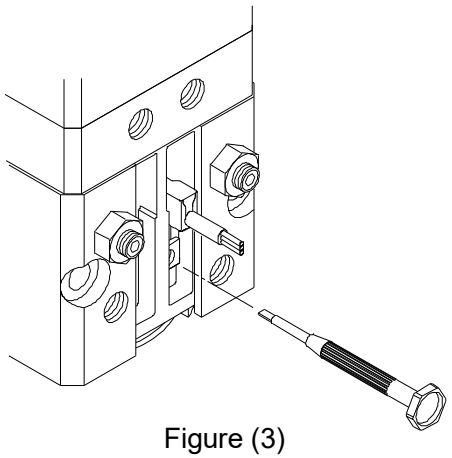
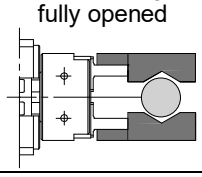
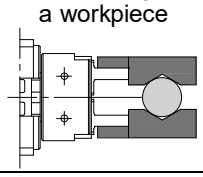
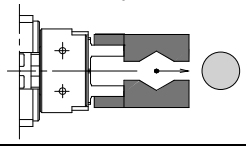
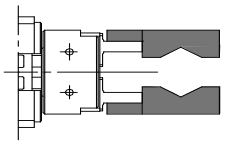
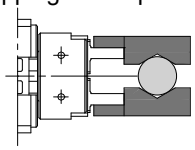
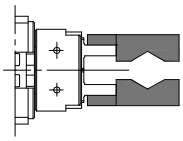
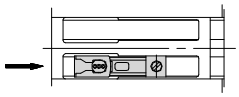
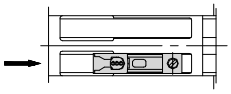
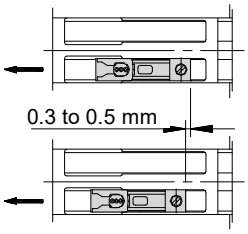


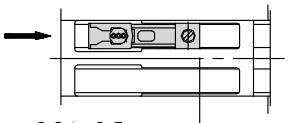
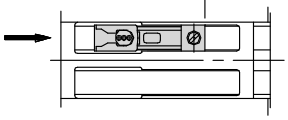
Figure (3)

4-2. Switch position of the gripper side

1) Detection when Gripping Exterior of Workpiece

<table>
<tr><td colspan="3">Detection example</td><td>1.Confirmation of fingers in reset position</td><td>2.Confirmation of workpiece held</td><td>3.Confirmation of workpiece released</td></tr>
<tr><td colspan="3">Position to be detected</td><td>Position of fingers fully opened
</td><td>Position when gripping a workpiece
</td><td>Position of fingers fully closed
</td></tr>
<tr><td colspan="3">Operation of auto switch</td><td>Auto switch turned ON when fingers return. (Light ON)</td><td>Auto switch turned ON when gripping a workpiece. (Light ON)</td><td>When a workpiece is not held (Abnormal operation): Auto switch to turn ON (Light ON)</td></tr>
<tr><td rowspan="4">Detection combinations</td><td colspan="2">One auto switch
*One position, any of (1), (2) and (3) can be detected.</td><td>●</td><td>●</td><td>●</td></tr>
<tr><td rowspan="3">Two auto switches
*Two positions of (1), (2) and (3) can be detected.</td><td>Pattern</td><td>A</td><td>●</td><td>●</td><td>—</td></tr>
<tr><td>B</td><td>—</td><td>●</td><td>●</td></tr>
<tr><td>C</td><td>●</td><td>—</td><td>●</td></tr>
<tr><td colspan="3" rowspan="3">How to determine Auto switch Installation position

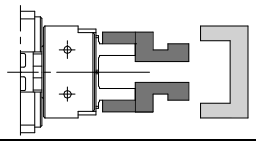
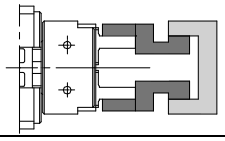
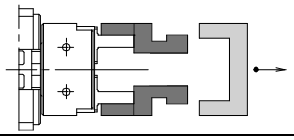
At no pressure or low pressure, connect the auto switch to a power supply, and follow the directions.</td><td>Step1) Fully open the fingers.
</td><td>Step1) Position fingers for gripping a workpiece.
</td><td>Step1) Fully close the fingers.
</td></tr>
<tr><td colspan="3">Step2) Refer to ”Mounting Switches to Verify Opening/Closing of Gripper” on page and position an auto switch in the auto switch mounting groove.</td></tr>
<tr><td>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 further it at a position 0.3 to 0.5 mm beyond the position where the indicator light illuminates.

0.3 to 0.5 mm</td><td colspan="2">Step 3) Slide the auto switch in the direction of the arrow until the right

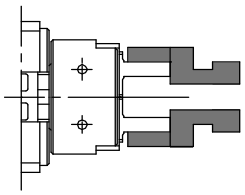
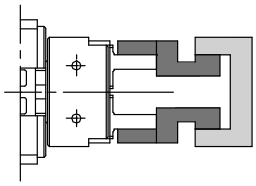
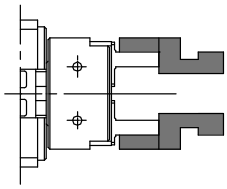
Position where light turns ON

0.3 to 0.5 mm
Position to be secured
</td></tr>
</table>

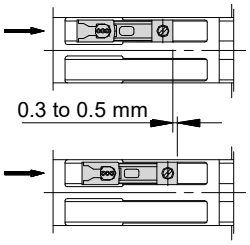
D

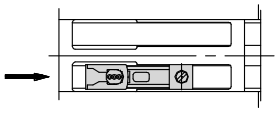
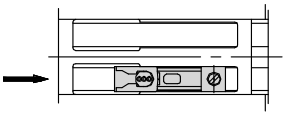
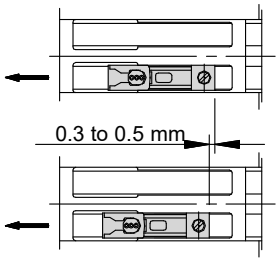
D

2) Detection when Gripping Interior of Workpiece

<table>
<tr><td colspan="3">Detection example</td><td>1.Confirmation of fingers in reset position</td><td>2.Confirmation of workpiece held</td><td>3.Confirmation of workpiece released</td></tr>
<tr><td colspan="3">Position to be detected</td><td>Position of fingers fully closed
</td><td>Position when gripping workpiece
</td><td>Position of fingers fully opened
</td></tr>
<tr><td colspan="3">Operation of auto switch</td><td>Auto switch turned ON when fingers return. (Light ON)</td><td>Auto switch turned ON when gripping a workpiece. (Light ON)</td><td>When a workpiece is not held (Abnormal operation): Auto switch to turn ON (Light ON)</td></tr>
<tr><td rowspan="4">Detection combinations</td><td colspan="2">One auto switch
*One position, any of (1), (2) and (3) can be detected.</td><td>●</td><td>●</td><td>●</td></tr>
<tr><td rowspan="3">Two auto switches
*Two positions of (1), (2) and (3) can be detected.</td><td>Pattern</td><td>A</td><td>●</td><td></td><td></td></tr>
<tr><td></td><td>B</td><td>—</td><td></td><td></td></tr>
<tr><td></td><td>C</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="3">How to determine Auto switch Installation position

At no pressure or low pressure, connect the auto switch to a power supply, and follow the directions.</td><td>Step1) Fully close the fingers.
</td><td>Step1) Position fingers for gripping a workpiece.
</td><td>Step1) Fully open the fingers.
</td></tr>
<tr><td colspan="3"></td><td colspan="3">Step2) Refer to ”Mounting Switches to Verify Opening/Closing of Gripper” on page and position an auto switch in the auto switch mounting groove.</td></tr>
<tr><td colspan="3"></td><td>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


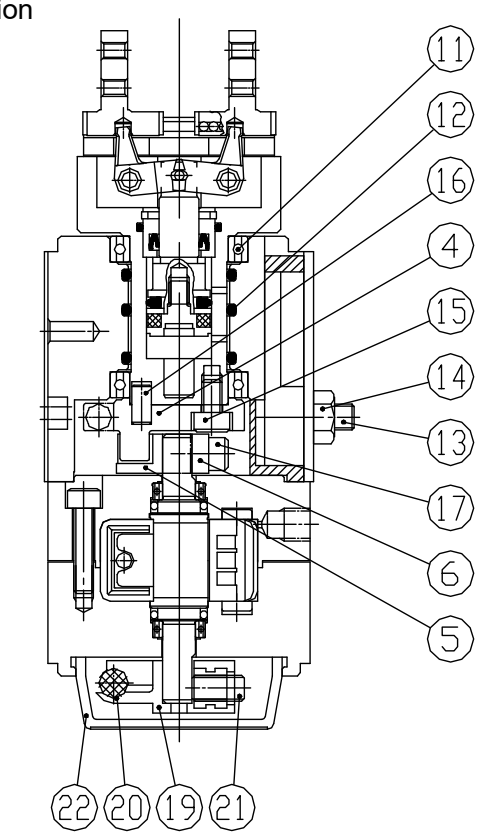
Position to be secured</td><td colspan="2">Step 3) Slide the auto switch in the direction of the arrow until the indicator right illuminates.

Step 4) Slide the auto switch in the direction of the arrow until the indicator right 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.

</td></tr>
</table>

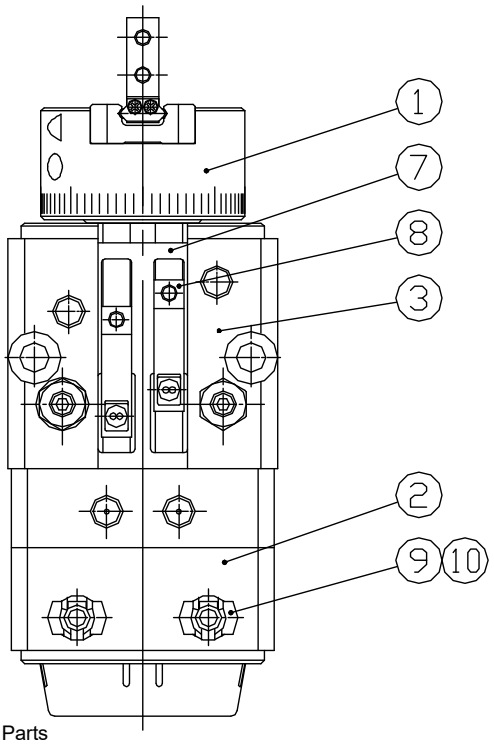
D

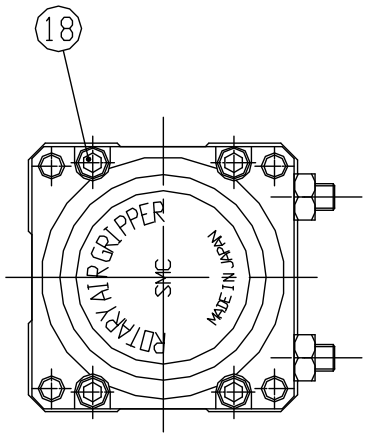
D

5. Maintenance

5-1. Construction





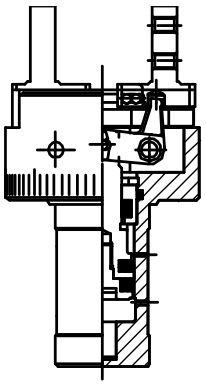


Component Parts

No.	Description	Material	Note
1	Air gripper	———	
2	Rotary unit	———	Two types for 90° and 180°
3	Body C	Aluminum alloy	Anodized
4	Stopper lever	Carbon steel	Heat treatment (90° and 180°)
5	Stopper guide	Stainless steel	Nitrilding
6	Lever retainer	Carbon steel	Zinc chromated
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	Heat treatment
14	Nut	Carbon steel	
15	Hexagon socket head cap screw		
16	Parallel pin	Stainless steel	
17	Hexagon socket head cap screw		
18	Hexagon socket head cap screw		
19	Magnet lever	Resin	
20	Magnet		Nickel plated
21	Hexagon socket head cap screw		
22	Resin case	Resin	

*Individual part cannot be shipped. Please purchase the whole unit.

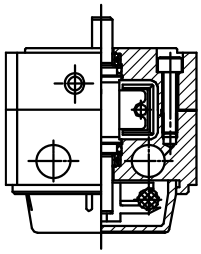
5-2. Part number of the unit and seals



Gripper unit

Model		Unit part no.
MRHQ10	D	P407090-3D
	S	P407090-3S
	C	P407090-3C
MRHQ16	D	P407060-3D
	S	P407060-3S
	C	P407060-3C
MRHQ20	D	P407080-3D
	S	P407080-3S
	C	P407080-3C
MRHQ25	D	P408080-3D
	S	P408080-3S
	C	P408080-3C

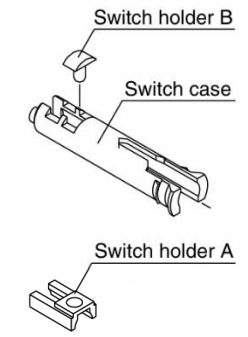
A gripper unit includes not only an air gripper, but also three O-ring (12) and three hexagon socket head cap screw (15) as shown in the construction on P18.



Rotary unit

Model	Unit part no.
MRHQ10*-90S	P406090-2A
MRHQ10*-18S	P406090-2B
MRHQ16*-90S	P406060-2A
MRHQ16*-18S	P406060-2B
MRHQ20*-90S	P407080-2A
MRHQ20*-18S	P407080-2B
MRHQ25*-90S	P408080-2A
MRHQ25*-18S	P408080-2B

Note that the rotation angle cannot be changed even through the rotary unit has been changed. For maintenance, order units with a part number suitable for the model being used.



Switch mounting unit

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

Each unit includes two of each of the parts indica

Auto switches are not included with a unit.

O-ring in the body C

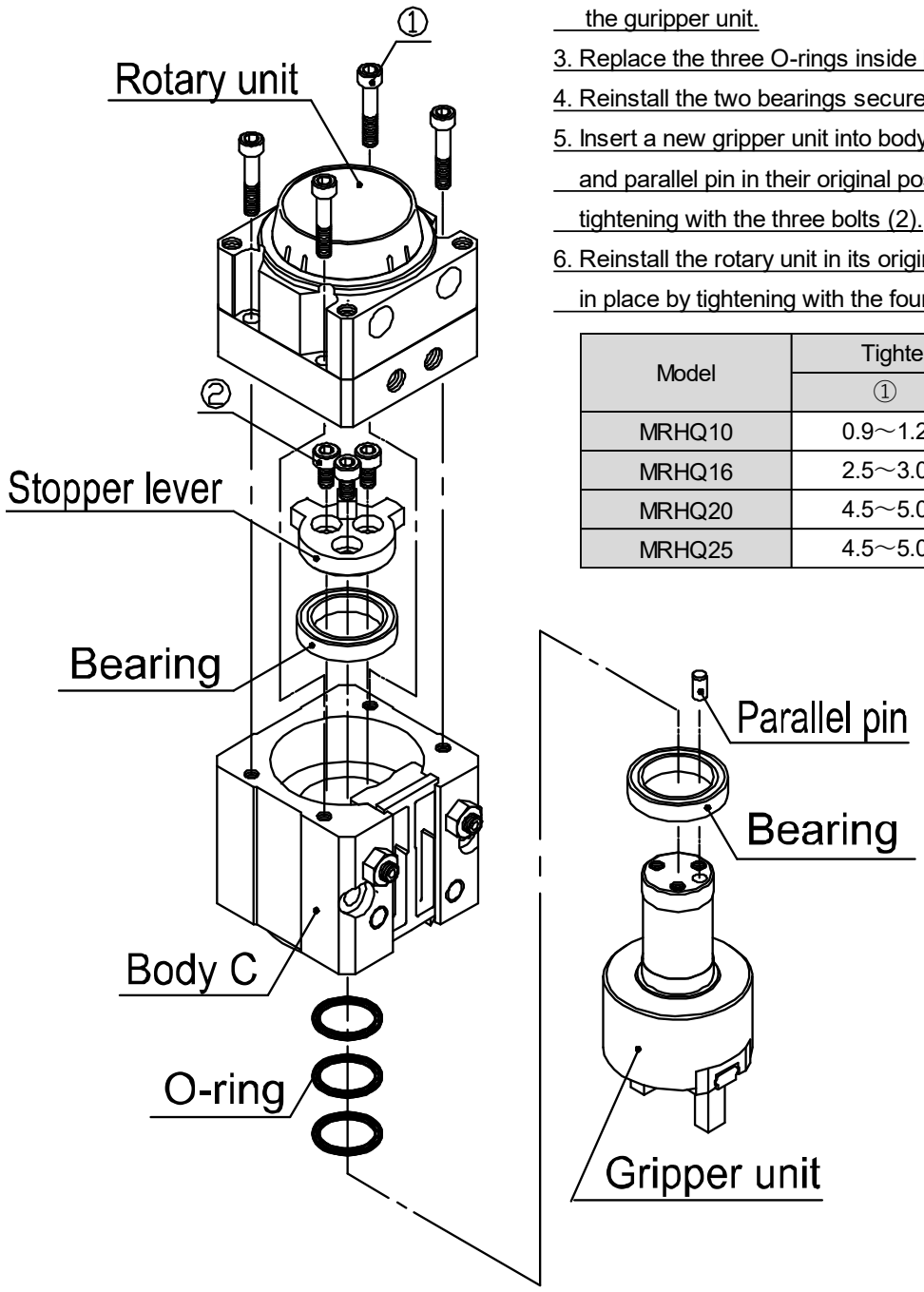
((12) O-ring in the construction on P18: 3 pcs.)

Model	Unit part no.
MRHQ10□	MRHQ10S-PS
MRHQ16□	MRHQ16S-PS
MRHQ20□	MRHQ20S-PS
MRHQ25□	MRHQ25S-PS

Special grease is applied.

This O-ring is included in the gripper init.

5-3. 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 guripper unit.
3. Replace the three O-rings inside body C.
4. Reinstall the two bearings securely in their original positions.
5. Insert a new gripper unit into body C. Then reinstall the stopper lever and parallel pin in their original positions and secure in place by tightening with the three bolts (2).
6. Reinstall the rotary unit in its original positions and secure in place by tightening with the four bolts (1).

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

5-4. Check
5-4-1. Check part

(1) Play of the gripper finger
(2) Tightening condition of the adjustment screw fixed by nut.
(3) Tightening condition of the slotted set screw that fixes the auto switch, for checking opening/ closing of the gripper.
(4) Tightening condition of the hexagon socket head cap screw fixing the body.
(5) Opening/ closing of chuck.
(6) Rotation.
(7) Rotation angle and position.
(8) External and internal leakage
(9) ON and OFF the switch

Check above points. If there are any problems with them, additionally tighten the screws, replace the maintenance parts or repair the parts.

5-4-2. Inspection interval
To use the Series MRHQ rotary gripper in the best condition, inspection needs to be performed once or twice a year.

⚠ Caution

Use the grease included in the accessory for the replacement of the rotary gripper.

6. Failure and measures

Countermeasures against	Possible causes	Countermeasure
Play or damage of the gripper finger	Excessive load for the holding force	Adjust the load to be within the specification range
	Excessive torque of the load	Adjust the torque of the load to be within the specification range
	Excessive energy of the load	Adjust the kinetic energy of the load to be within the specification range
	Exceed the gripping point	Adjust the gripping point to be within the specification range
	Exceed the allowable overhang	Adjust the overhang to be within the specification range
	External causes	If an obstacle is present in an open/close area or rotation area, remove the obstacle.
Unstable gripper operation	Circuit problem	Check the air and electric circuit again.
	Speed controller is restricted too much	Readjustment of the speed controller
	Air supply shortage	Make sure that the supply air flow of the port is adequate
	Air pressure shortage	Make sure that the supply pressure of the port is adjusted to the set pressure
Not rotate or rotation is unstable	(Circuit problem)	Check the air and electric circuit again.
	Speed controller is restricted too much	Readjustment of the speed controller
	Air supply shortage	Make sure that the supply air flow to the port is adequate
	Air pressure shortage	Make sure that the supply pressure to the port is adjusted to the set pressure
	Excessive torque of the load	Adjust the torque of the load to be within the specification range
The auto switch for opening/ closing the chuck does not operate or malfunctions.	Effect of an external magnetic field	Check that there is no strong magnetic field present.
	Trouble with the electrical circuit	Check that there is no trouble with the electrical circuit.
	Trouble with the electrical specification	Check that there is no trouble with the electrical specification.
The auto switch for detecting rotation does not operate or malfunctions.	Effect of an external magnetic field	Check that there is no strong magnetic field present.
	Trouble with the electrical circuit	Check that there is no trouble with the electrical circuit.
	Trouble with the electrical specification	Check that there is no trouble with the electrical specification.
	Setting problem of rotation start and stop.	Adjust the rotation angle to be within the specification range.
	Adjustment of rotation angle	

Notes for the Troubleshooting shown above

1. Causes of the operation failure due to product life are not shown in the troubleshooting table.

   For failures due to causes other than those shown in the troubleshooting table and product life, please contact SMC, as a disassembly investigation of the product may be required.

Revision history
C: Full text revision. D: Revised the "Safety Instructions" section and unified terminology with other catalogs. Added text to the "Design Considerations / Selection" section. Corrected the switch travel distance in the "Auto Switch Mounting Position / Setting Procedure" section.

SMC Corporation

Tel: + 81 3 5207 8249 Fax: +81 3 5298 5362
URL https://www.smcworld.com

Note: Specifications are subject to change without prior notice and any obligation on the part of the manufacturer.
© SMC Corporation All Rights Reserved