



Operation Manual

Model name

ROTARY ACTUATOR

Part number / Series

Vane Type
CRB2BW40

- Thoroughly read and understand this operation manual to install and operate this product.
- Pay particular attention to the safety statements.
- Retain this operation manual to read whenever needed.

SMC Corporation

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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) Japan Industrial Standards (JIS) ^{*1)} and other safety regulations.

- *1) ISO 4414: Pneumatic fluid power -- General rules relating to systems
ISO 4413: Hydraulic fluid power -- General rules relating to systems
IEC 60204-1: Safety of machinery -- Electrical equipment of machines (Part 1: General requirements)
ISO 10218-1992: Manipulating industrial robots -- Safety

etc.



Caution

Operator error could result in injury or equipment damage.



Warning

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



Danger

In extreme conditions, there is a possibility of serious injury or loss of life.

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. Contact SMC beforehand and take special consideration of safety measures if the product is to be used in any of the following conditions.

1) Conditions and environments outside of the given specifications, or use outdoors or in a place exposed to direct sunlight.

2) Installation on equipment in conjunction with atomic energy, railways, air navigation, space, shipping, vehicles, military, medical treatment, combustion and recreation, or equipment in contact with food and beverages, emergency stop circuits, clutch and brake circuits in press applications, safety equipment or other applications unsuitable for the standard specifications described in the product catalog.

3) An application which could have negative effects on people, property, or animals requiring special safety analysis.

4) Use in an interlock circuit, which requires the provision of double interlock for possible failure by using a mechanical protective function, and periodical checks to confirm proper operation.

Caution

The product is provided for use in manufacturing industries.

The product herein described is basically provided for peaceful use in manufacturing industries.

If considering using the product in other industries, consult SMC beforehand and exchange specifications or a contract if necessary.

If anything is unclear, contact your nearest sales branch.

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

When the product is exported, strictly follow the laws required by the Ministry of Economy, Trade and Industry (Foreign Exchange and Foreign Trade Control Law).

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.)

Please contact SMC when using a fluid other than compressed air.

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 table 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 actuator cushion to absorb the shock. Therefore, provide a speed-reduction circuit to reduce the rotary actuator 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 an actuator 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 actuator 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 actuator 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 actuator will not cause a hazard to humans or damage the equipment.

(10) Consider the action of the rotary actuator when restarting after an emergency stop.

Devise a safe design so that the restarting of the rotary actuator will not pose a hazard to humans or damage the equipment. Install manually controlled equipment for safety when the actuator 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 actuator 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 and 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 and 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 a 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) Do not use two or more rotary actuator with the aim of synchronized movement.

One of the actuators may bear the load of operation, making synchronized movement impossible, and possibly leading to deformation of the equipment.

(16) 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.

(17) Do not disassemble the product or make any modifications, including additional machining.

This may cause human injury and/or an accident.

(18) Refer to the Auto Switches Precautions when using with an auto switch.

Selection

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) Perform speed adjustment in the environment in which the product is to be used.

Speed adjustments may be necessary if the environmental conditions vary.

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 actuator 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.

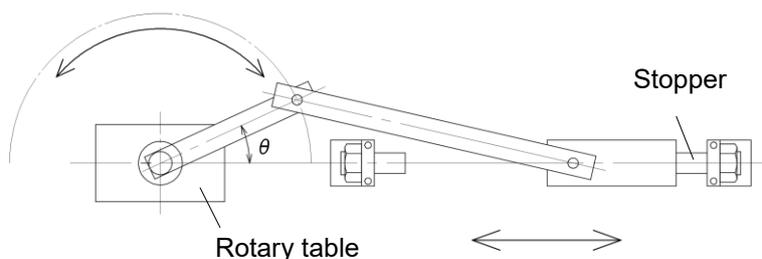
Precautions when using external stoppers

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.

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 actuator 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

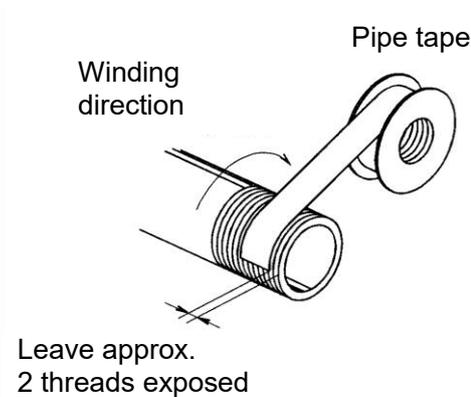
(1) Refer to the Fittings and Tubing Precautions (Best Pneumatics No.6) for handling one touch fittings.

(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.

For products with shock absorbers, when the shock absorber stops moving before reaching the stroke end by using a stopper mechanism with the objective of shortening tact time, be sure the shock absorber is stopped in a position where it has adequately absorbed the kinetic energy.

Failure to do so can result in damage to 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

Please consult with SMC when using the product in applications other than 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.

Caution

(1) When extremely dry 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. Please consult with SMC.

(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 actuator. 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 actuator.

(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.

Read the specifications carefully and use this product appropriately. The product may be damaged or malfunction if it is used outside the range of specifications of current load, voltage, temperature or impact. 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 trouble by providing a mechanical protection function, or by also using another switch (sensor) together with the auto switch.

Also, perform regular maintenance and confirm proper operation.

(3) Do not make any modifications (including exchanging the printed circuit boards) to 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 speed is too great the operating time will be shortened and the load may not operate properly.

The maximum piston speed is:

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

(2) Keep wiring as short as possible.

<Reed>

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

1) Use a contact protection box when the wire length is 5m or longer.

2) Even if an auto switch has a built-in contact protection circuit, when the wiring is more than 30m long, it is not able to adequately absorb the rush current and its life may be reduced.

It is again necessary to connect a contact protection box in order to extend its life. Please consult SMC in this case.

<Solid state>

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

Even if the length is less than 100m, longer wiring makes it more likely to be affected by noise.

When the wire length is long, we recommended a ferrite core should be attached to both ends of the cable to prevent excess noise.

A contact protection box is not necessary for solid state switches due to the nature of the product 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.

<Reed>

Use an auto switch with built-in contact protection circuit or use a contact protection box.

<Solid state>

Use a built-in surge absorbing element type device.

(4) Take precautions when multiple rotary actuator are used close together.

When multiple auto switch rotary actuator are used in close proximity, magnetic field interference may cause the auto switches to malfunction. Maintain a minimum separation of 40mm between rotary actuator.

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.

<Reed>

1) Auto switch with an indicator light

- If auto switches are connected in series as shown below, note that there will be a large voltage drop because of internal resistance in the LED. (Refer to the internal voltage drop in the auto switch specifications.)

[The voltage drop will be “n” times larger when “n” auto switches are connected.]

Even though an auto switch operates normally, the load may not operate.



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

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

2) If the internal resistance of an LED causes a problem, select an auto switch without an indicator light.

<Solid state / 2-wire type>

3) Generally, the internal voltage drop will be greater with a 2-wire solid state auto switch than with a reed auto switch. Take the same precautions as in 1).

Also, take note that a 12VDC relay is not applicable.

(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.

$$\text{Operating current of load (OFF condition)} > \text{Leakage current}$$

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 actuator and auto switch in proper combination.

The auto switch is pre-adjusted to operate properly for an auto-switch-capable SMC rotary actuator.

If the auto switch is mounted improperly, used for another brand of rotary actuator 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/s² or more for reed auto switches and 1000m/s² 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 actuator by the auto switch lead wires.

Never carry a rotary actuator 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.

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

(2) Do not wire with power lines or high voltage lines.

Wire separately from power lines or high voltage lines, avoiding parallel wiring or wiring in the same conduit with these lines. Control circuits containing auto switches may malfunction due to noise from these other lines.

(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 cable and auto switch increases the possibility of disconnection.

Fix the cable in the middle so that it is not movable 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).

It is the same as when the 2-wire brown lead wire (+, output) is directly connected to the (+) power supply terminal.

(5) Do not allow short-circuit of loads.

<Reed>

If the power is turned ON with a load in a short circuit condition, the switch will be instantly damaged because of excess current flow into the switch.

<Solid state>

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

If a load is short circuited, the auto switch will be instantly damaged as in the case of reed auto switches.

Take special care to avoid reverse wiring with the brown power supply line and the black output line on 3-wire type auto switches.

(6) Avoid incorrect wiring.

<Reed>

A 24 VDC auto switch with indicator light has polarity. The brown lead wire or terminal No.1 is (+), and the blue lead wire or terminal No.2 is (-).

- 1) If connections are reversed, the auto switch will operate, however, the LED will not light up.
Also, take note that a current greater than that specified will damage the LED and it will no longer operate.
Applicable models: D-93, A93V

<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 always stay 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.

When the cable sheath is stripped, confirm the stripping direction. The insulator may be split or damaged depending on the direction. (D-M9□ only)



Recommended Tool

Description	Model
Wire stripper	D-M9N-SWY

* Stripper for a round cable ($\phi 2.0$) can be used for a 2-wire type cable.



Operation Environment

Warning

(1) Never use in an atmosphere with explosive gases.

Auto switches are not designed with explosion-proof construction. Never use in an atmosphere containing explosive gas since this may cause a serious explosion.

Please contact SMC concerning ATEX compliant products.

Caution

(1) Do not use in an area where a magnetic field is generated.

Auto switches will malfunction or magnets inside rotary actuator will become demagnetized. (Please consult with SMC if a magnetic field resistant auto switch can be used.)

(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 (JIS C 0920: watertight construction), do not use auto switches in applications where continually exposed to water splash or spray. Poor insulation or swelling of the potting resin inside auto switches may cause malfunction.

(3) Do not use in an environment with oil or chemicals.

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

(4) Do not use in an environment with temperature cycles.

Please consult with SMC if switches are used where there are temperature cycles other than normal temperature changes, as there may be adverse effects inside the auto switches.

(5) Do not use in an environment where there is excessive impact shock.

<Reed>

When excessive impact (300m/s^2 or more) is applied to a reed auto switch during operation, the contacts may malfunction and generate or cut off a signal momentarily (1ms or less). Please consult with SMC if a solid state auto switch can be used according to the environment.

(6) Do not use in an area where surges are generated.

<Solid state>

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

(7) Avoid accumulation of iron debris or close contact with magnetic substances.

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

(8) Please contact SMC concerning water resistance, elasticity of lead wires, usage at welding sites, etc.

(9) Do not use in direct sunlight.

(10) Do not mount the product in locations where it is exposed to radiant heat.

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 the fall or erratic movement of driven objects and equipment, 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 and equipment.

When machinery is restarted, proceed with caution after confirming that appropriate measures are in place to prevent actuators from moving suddenly.

Caution

(1) Perform the following maintenance 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, etc., if damage is discovered.

3) Confirm the lighting of the green light on the 2-color indicator type auto switch.

Confirm that the green LED is on when stopped at the established position. If the red LED is on, the mounting position is not appropriate. Readjust the mounting position until the green LED lights up.

1. Product Description

This operation manual describes Vane Type of Rotary Actuator.

Confirm the specifications of this product including load (moment of inertia), rotation time and other Operating conditions before the use.

1-1. Model

Model	Internal Volume (cm ²)	Weight (g)	Port Size
CRB2BW40-90S(E)	25	386.8	M5×0.8
CRB2BW40-180S(E)	31.5	376.2	
CRB2BW40-270S(E)	41	365.3	
CRB2BW40-90S(E)	33	399.7	
CRB2BW40-100S(E)	33	446.2	

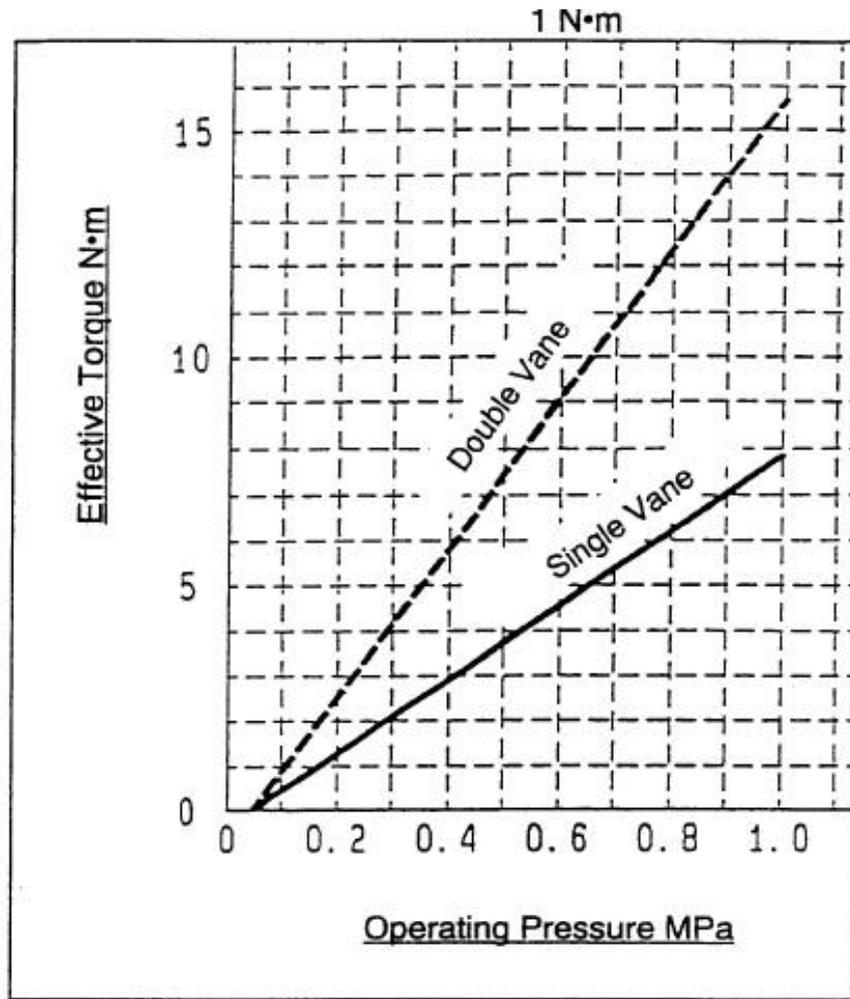
1-2. Specifications

Size	CRB2BW40-※S	CRB2BW40-※D
Vane	Single Vane	Double Vane
Rotating Angle Range	90°+4° 0	180°+4° 0
	270°+4° 0	90°+4° 0
		100° -5°
Fluid	Air (Non-lube)	
Proof Pressure	1.5 MPa	
Max. Operating Pressure	1.0 MPa	
Min. Operating Pressure	0.15 MPa	
Kinetic Energy Note2)	0.04 J	
	0.03 J	
Speed Adjustable Range Note1)	0.07 to 0.5 sec/90°	
Fluid and Ambient Temperature	5 to 60 °C	
Shaft Type	Both shafts (Long shaft side: w/ Key, Short shaft side: single spanner flat)	

Note 1) Since sticking and/ or malfunction may occur with slower speed than 0.5 sec/90° , use the product within the speed adjusting range.

Note 2) Value in the upper column shows energy when rubber cushion is used (at rotation end) and that in the lower column shows energy when rubber cushion is not used.

1-3. Effective Torque



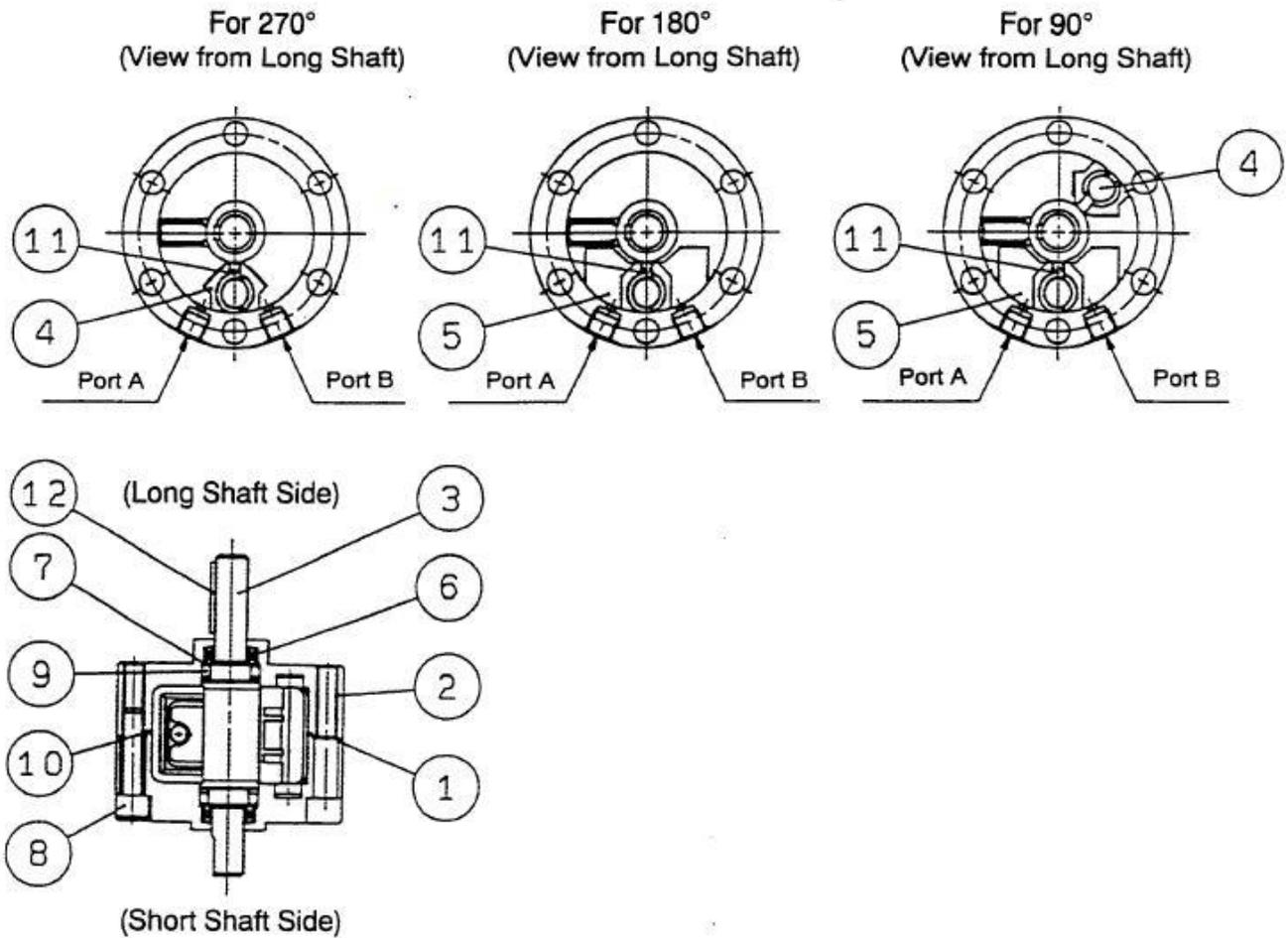
1-4. Key (Keyway) Position and Rotation Range

Rotation Range/ View from Long Shaft (Parallel key position in each figure below is when Port B is pressurized).

Series CRB2/ Size:40			
Single Vane Type			Double Vane Type
90°	180°	270°	90°, 100°

2. Internal Construction and Description of Individual Parts

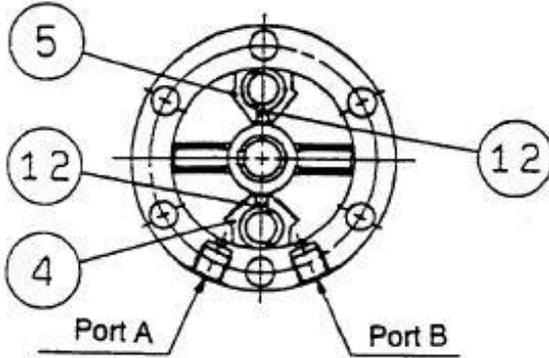
2-1. Single Vane Type



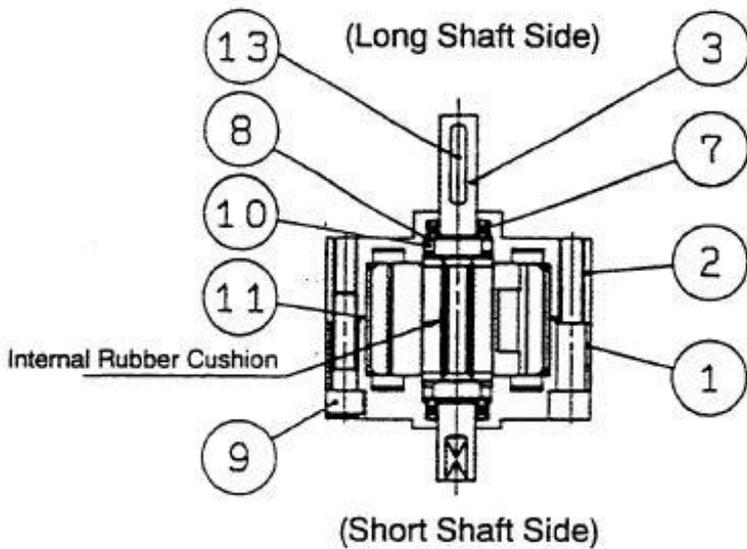
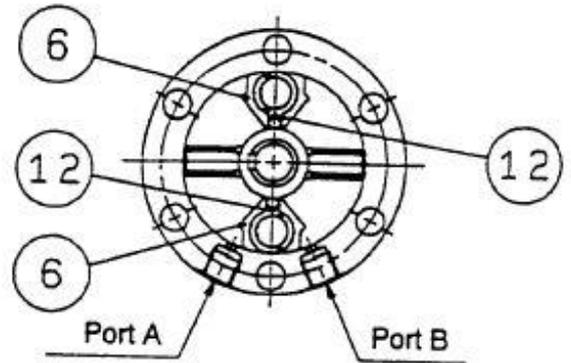
No.	Part	Material	Note
1	Body (A)	Aluminum Alloy	White
2	Body (B)	Aluminum Alloy	White
3	Vane Shaft	Carbon Steel (NBR)	
4	Stopper	Resin	For 270°
5	Stopper	Resin	For 180°
6	Bearing	Bearing Steel	
7	Back-up Ring	Stainless Steel	
8	Hexagon Socket Head Cap Screw	Stainless Steel	Special bolt
9	O-ring	NBR	
10	O-ring	NBR	
11	Stopper Packing	NBR	
12	Parallel Key	Carbon Steel	

2-2. Double Vane Type

For 90°
(View from Long Shaft)



For 100°
(View from Long Shaft)



No.	Part	Material	Note
1	Body (A)	Aluminum Alloy	White
2	Body (B)	Aluminum Alloy	White
3	Vane Shaft	Carbon Steel (NBR)	
4	Stopper	Aluminum Die Casting	For 90°
5	Stopper	Resin	For 90°
6	Stopper	Aluminum Die Casting	For 100°
7	Bearing	Bearing Steel	
8	Back-up Ring	Stainless Steel	
9	Hexagon Socket Head Cap Screw	Stainless Steel	Special bolt
10	O-ring	NBR	
11	O-ring	NBR	
12	Stopper Packing	NBR	
13	Parallel Key	Carbon Steel	

3. Basic Circuit

3-1. Circuit Configuration

Figure 1 shows a basic circuit to activate Rotary Actuator by using Air Filter, Regulator, Solenoid Valve and Speed Controllers.

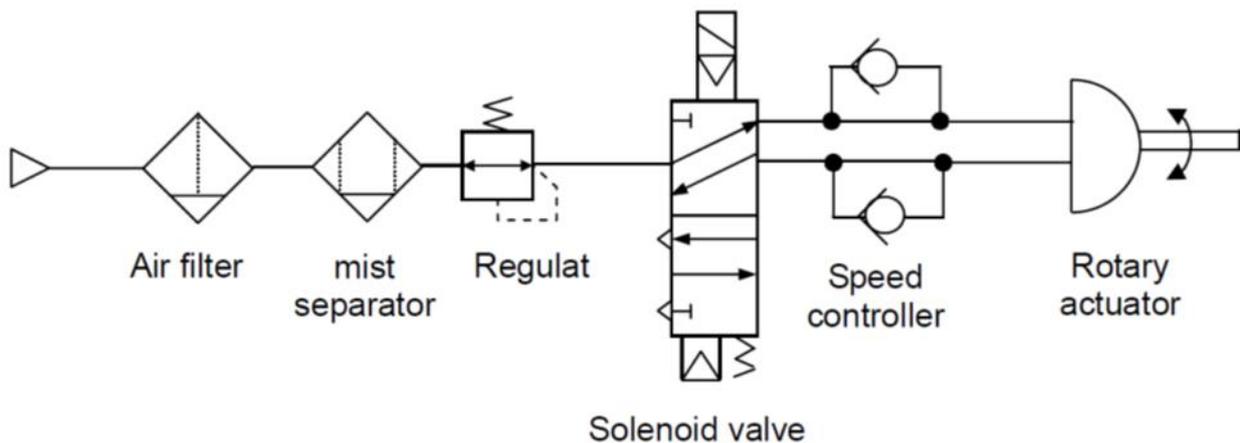


Figure 1

3-2. Preferred Components

Table 1 shows preferred components of solenoid valve, speed controller and tubing used in the basic circuit as Figure 1.

Table 1

Model	Solenoid Valve (CV)	Speed Controller	Tubing
CRB2BW40	0.1 to 0.2	AS1*-M5 Note) Make sure to use speed controller In meter-out control.	Φ4 / Φ2.5

4. Installation

4-1. Air Supply

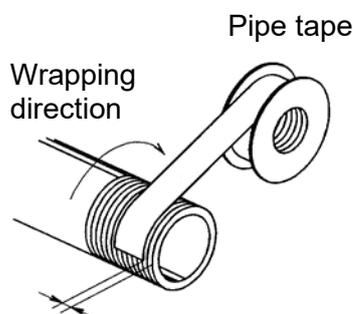
⚠ Caution

- ① Filter and regulate air supplied to Rotary Actuator by using SMC Air Filter and Regulator (Series AR).
- ② **Do not apply lubricant since this is non-lube type.**
Internal grease will be flowed out by lubrication so that normal operation will not be obtained.
- ③ Compressed air containing a large quantity of drain may cause malfunction of Rotary Actuator.
Install After Cooler, Air Dryer or Drain Catch as a measure.

4-2. Piping

⚠ Caution

- ① Preparation before piping.
Flush or wash piping thoroughly to remove chips, cutting oil and dust from inside the pipe.
- ② When screwing together pipes and fittings, be certain that chips from the pipe threads and sealing material do not get inside the piping. Also, when pipe tape is used, **leave 1.5 to 2 thread ridges exposed** at the end of the pipe.



Leave approx.
2 threads exposed.

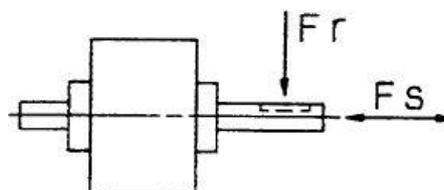
4-3. Shaft Load Limit

- ① Although static loads shown in Table 2 are allowable, avoid the use applying direct load to the shaft.

Table 2: Allowable Shaft Load

Model	Fr	Fs
CRB2BW40	60	40

Note) Point of application of force Fr is the center to longitudinal dimension of key.



② It is recommended to use the method in Figure 2 to avoid applying direct load to the shaft for better operating conditions.

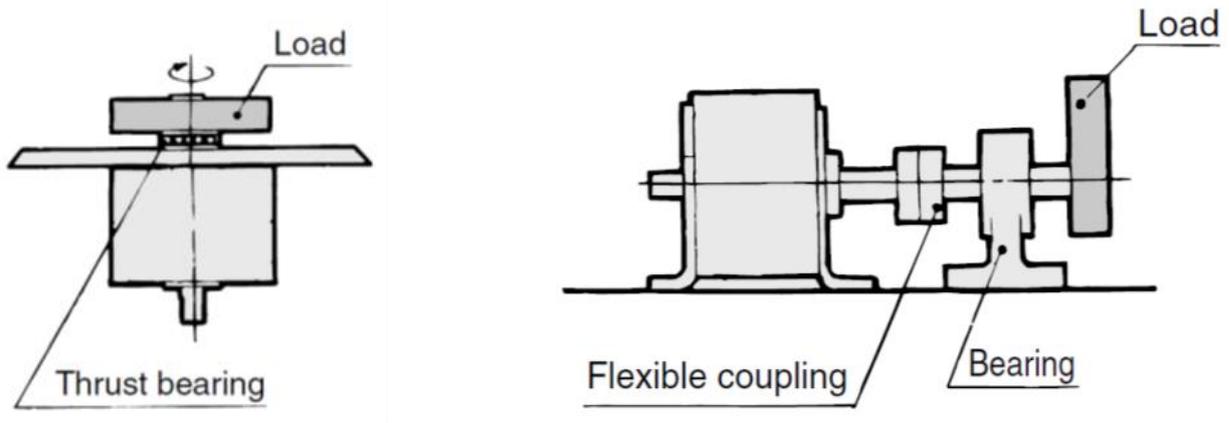


Figure 2

■ 4-4. Piping

⚠ Warning

As Figure 3 shows, when actuator is used with extended shaft, center the shaft of Rotary Actuator and the counterpart. If they were decentered, load factor partially becomes large and excessive bending moment is applied to the shaft. In such a condition, stable operation cannot be obtained and the shaft may be damaged. In this case, use **Flexible Fitting** (Flexible Joint in JIS).

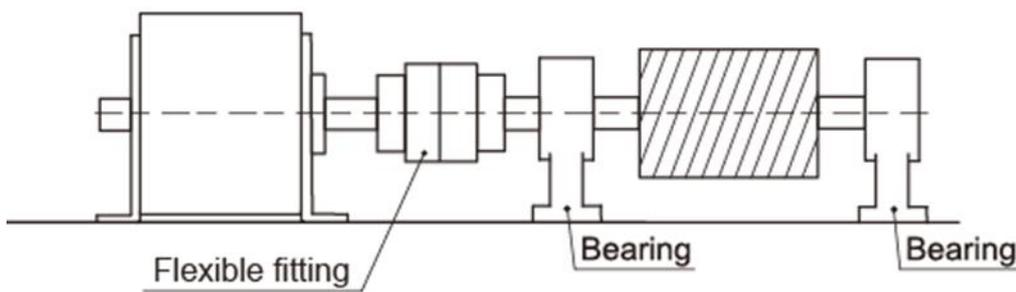


Figure 3

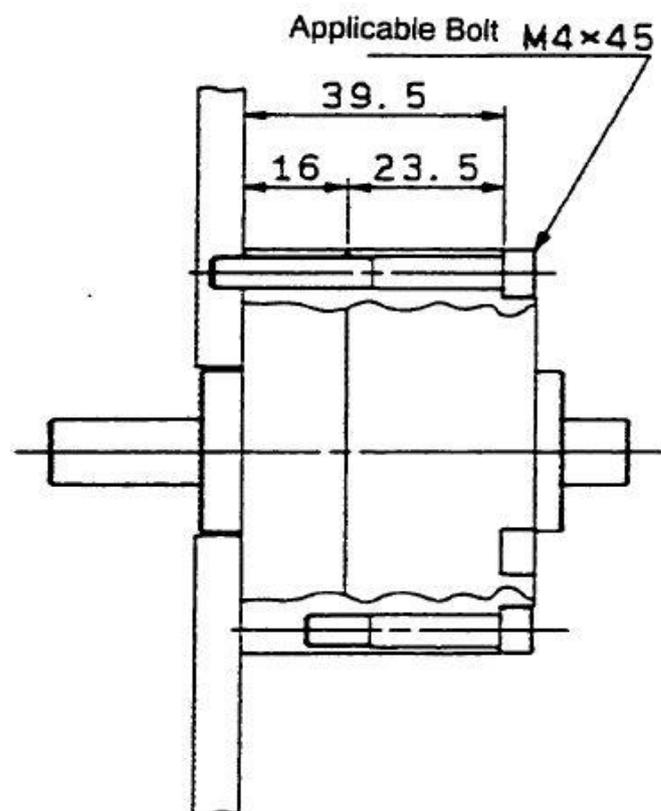
■ 4-5. Operating Environment

⚠ Caution

- ① **Do not use the product in atmospheres or places where there is a danger of corrosion.**
Refer to “internal” Construction and Description of Individual Parts” (pages 3 and 4) for materials used for Rotary Actuator.
- ② **Do not use the product in dusty places or where water and oil drops splash on.**
- ③ **Do not use the product in atmospheres containing ozone.**
- ④ **Do not use the product in atmospheres containing gases which damage metals, resins and rubbers.**

■ 4-6. Using Body As Flange

Use JIS hexagon socket head cap screw M4x45L since it fits in the groove of Rotary Actuator.



5. How To Set Rotation Time

Due to inertia of the load, even a small torque generated by Rotary Actuator may cause damage to the shaft and internal parts. Therefore, consider the inertia of the load and kinetic energy to set rotation time.

5-1. Moment of Inertia

① Moment of inertia is effort required to turn an object, in other words, effort required to stop it.

When an object is moved by Rotary Actuator, the object has inertia force. Large impact (kinetic energy) is applied to Rotary Actuator when Actuator stops at the stroke end. Kinetic energy can be calculated by using the formula below.

$$E = 1/2 \times I \times \omega^2$$

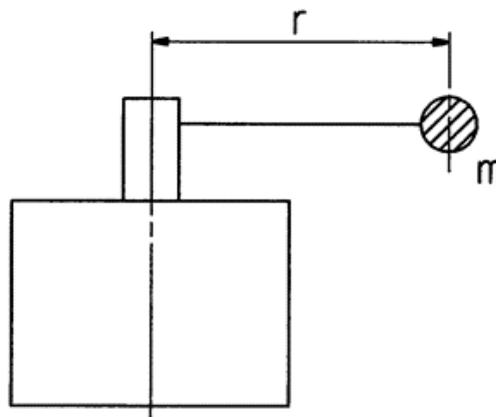
E : Kinetic energy (J)
I : Moment of inertia (kg. m²)
 ω : Angular speed (rad/s)

② Since allowable kinetic energy Rotary Actuator is limited, of rotation time can be obtained by finding moment of inertia. How to find moment of inertia is described below.

Moment of inertia can be indicated by the formula below.

$$I = m \times r^2 \quad m: \text{ Mass (kg)}$$

This is moment of inertia to rotation axis of an object with mass m in the distance from the rotation axis.



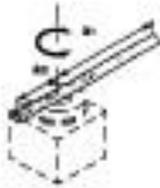
③ How To Calculate Moment of Inertia

Calculation of Moment of Inertia

I: Moment of inertia (kg·m²)

m: Load mass (kg)

① Thin rod



Position of pivot :
Passes through one end
perpendicular to the rod.

$$I_{cm} = \frac{ma^2}{3} + m \cdot \frac{a^2}{3}$$

② Column (inclusive of thin disk)



Position of pivot :
Axis

$$I_{cm} = \frac{\pi d^4}{32}$$

③ Thin rod



Position of pivot :
Passes through the center
of gravity perpendicular
to the rod.

$$I_{cm} = \frac{ma^2}{12}$$

④ Solid globe



Position of pivot :
Diameter

$$I_{cm} = \frac{2d^2}{5}$$

⑤ Thin rectangular plate (rectangular parallel piped)



Position of pivot :
Passes through the center
of gravity, parallel to side b.

$$I_{cm} = \frac{ab^3}{12}$$

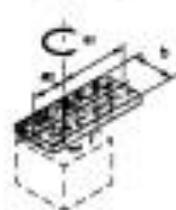
⑥ Thin disk



Position of pivot :
Diameter

$$I_{cm} = \frac{\pi d^4}{64}$$

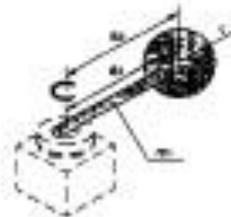
⑦ Thin rectangular plate (rectangular parallel piped)



Position of pivot :
Passes through one end
perpendicular to the plate.

$$I_{cm} = \frac{4a^3b^3}{12} + m \cdot \frac{4a^2b^2}{12}$$

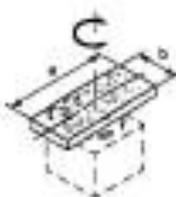
⑧ If load is in the end of lever



$$I_{cm} = \frac{8a^3}{3} + m \cdot a^2 = K$$

(Example)
When m is spherical,
 $K = m \cdot \frac{2a^2}{5}$ according to ④

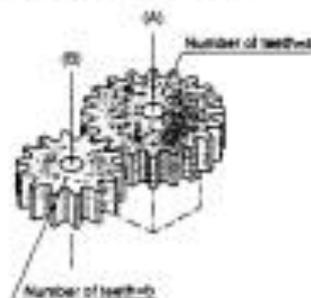
⑨ Thin rectangular plate (rectangular parallel piped)



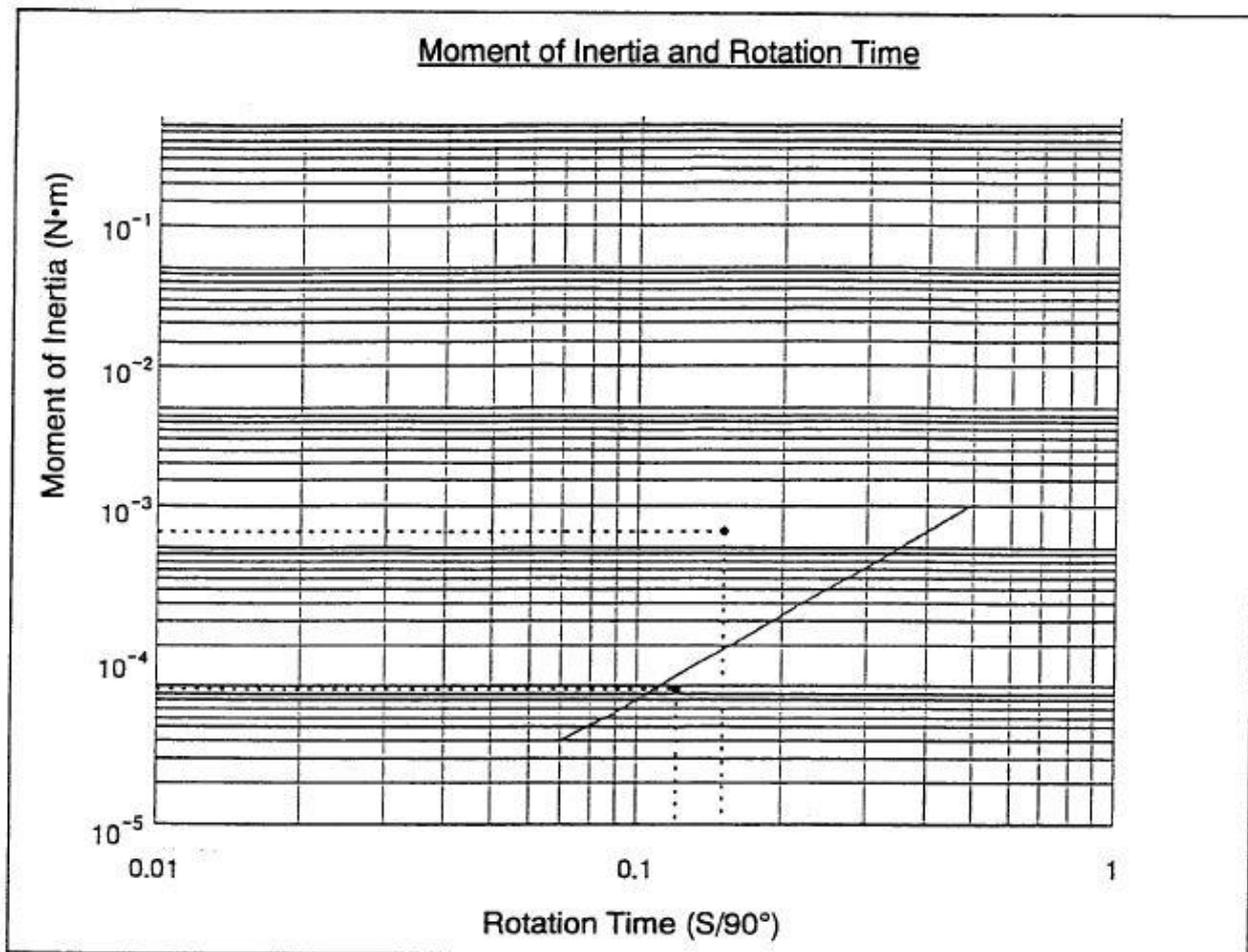
Position of pivot :
Passes through the center of
gravity perpendicular to the plate.
(Similar to thick rectangular plate)

$$I_{cm} = \frac{a^2 + b^2}{12}$$

⑩ Propagation of gear



1. Find the moment of inertia I_B around the shaft (B).
2. Then replace the moment of inertia I_B around the shaft (A) by I_A
 $I_A = \left(\frac{a}{b}\right)^2 \cdot I_B$



Graph 1

How To Read Graph 1.

Example 1) When CRB2BW40 is used in conditions of moment of inertia of load inertia of load: $9.5 \times 10^{-5} \text{ kg} \cdot \text{m}^2$ and rotation time: $0.12 \text{ sec}/90^\circ$.

Since the intersection of $9.5 \times 10^{-5} \text{ kg} \cdot \text{m}^2$ on the vertical axis and 0.12 seconds on the horizontal axis is below the energy curve, CRB2BW40 is applicable.

Example 2) When CRB2BW40 is used in conditions of moment of inertia of load: $1.3 \times 10^{-4} \text{ kg} \cdot \text{m}^2$ and rotation time: $0.15 \text{ sec}/90^\circ$.

Since the intersection of $1.3 \times 10^{-4} \text{ kg} \cdot \text{m}^2$ on the vertical axis and 0.15 seconds on the horizontal axis is above the energy curve, CRB2BW40 is not applicable.

In this case, consider using larger size or external stopper (buffer mechanism) to stop the load itself.

5-2. Kinetic Energy

Allowable kinetic energy of CRB2BW40 is 0.04 (J) when rubber cushion is used, and it is 0.03 (J) when rubber cushion is not used.

Since Rotary Actuator reaches the rotation end during acceleration, terminal acceleration " ω " can be found by :

$$\omega = 2\theta / t$$

θ : Rotation angle (rad)
 t : Rotation time (s)

Since Kinetic energy E is :

$$E = 1 / 2 \cdot I \cdot \omega^2$$

Rotation time "t" of Rotary Actuator is :

$$t = \sqrt{\frac{2 \cdot I \cdot \theta^2}{E}}$$

E : Allowable kinetic energy (J)
 I : Moment of inertia ($\text{kg} \cdot \text{m}^2$)
 θ : Rotating angle (rad) $180^\circ = 3.14 \text{ rad}$

In uniformly angular accelerated motion, angular speed ω and seconds of arc θ are found as follows.

$$\omega = \dot{\omega} \times t \tag{1}$$

$$\theta = \int \dot{\omega} t dt = 1/2 \dot{\omega} t^2 + C \tag{2}$$

C is integration constant.

Since seconds of arc θ is $\theta = 0$ at $t = 0$, integration constant C is $C = 0$.

$$\theta = 1/2 \dot{\omega} t^2 = 1/2 \omega t$$

Therefore,

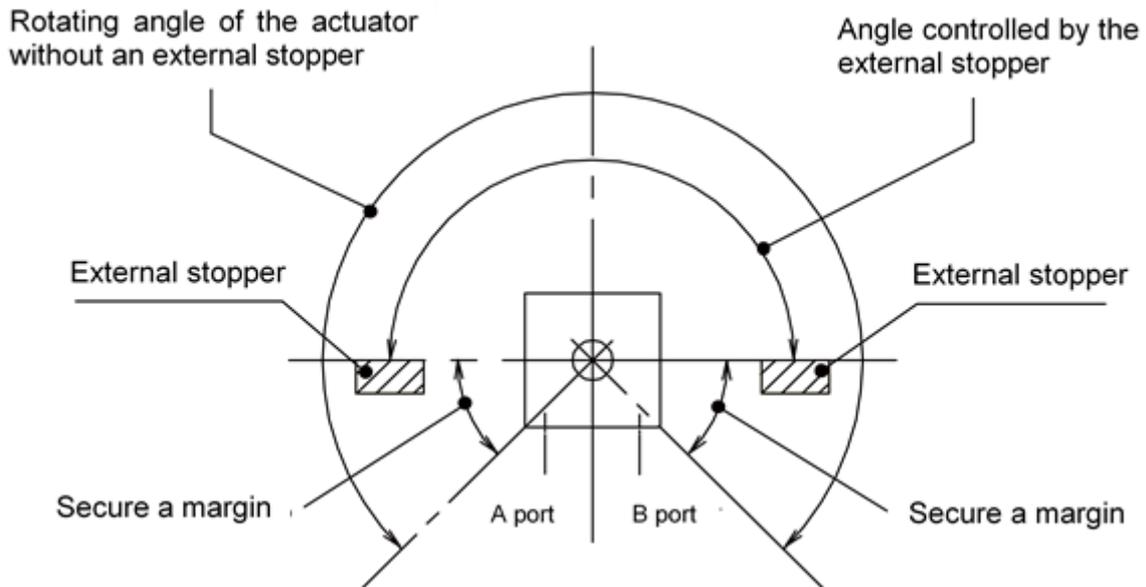
$$\omega = 2 \theta / t$$

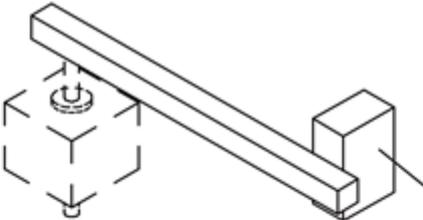
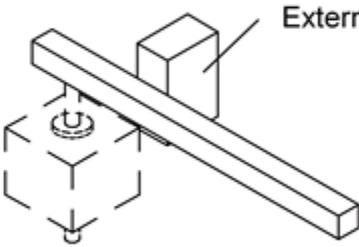
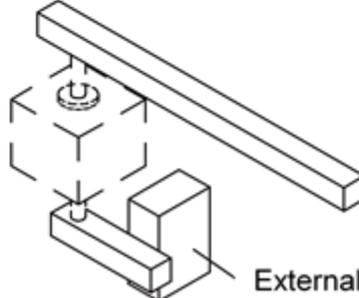
5-3. External Stopper

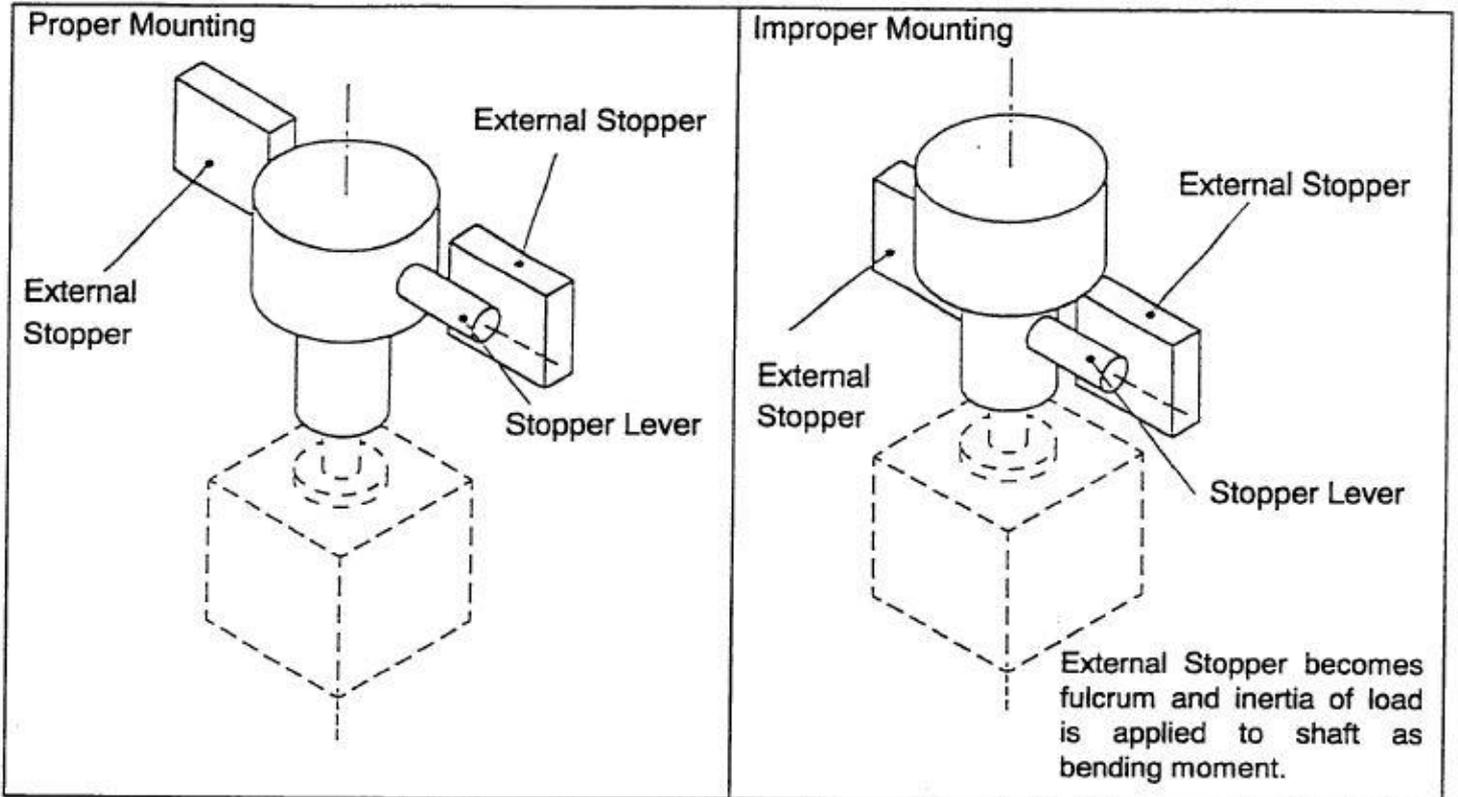
When kinetic energy generated by load exceeds allowable energy of Actuator, use external buffer mechanism to absorb inertia force.

The figure below shows correct installation of external stopper.

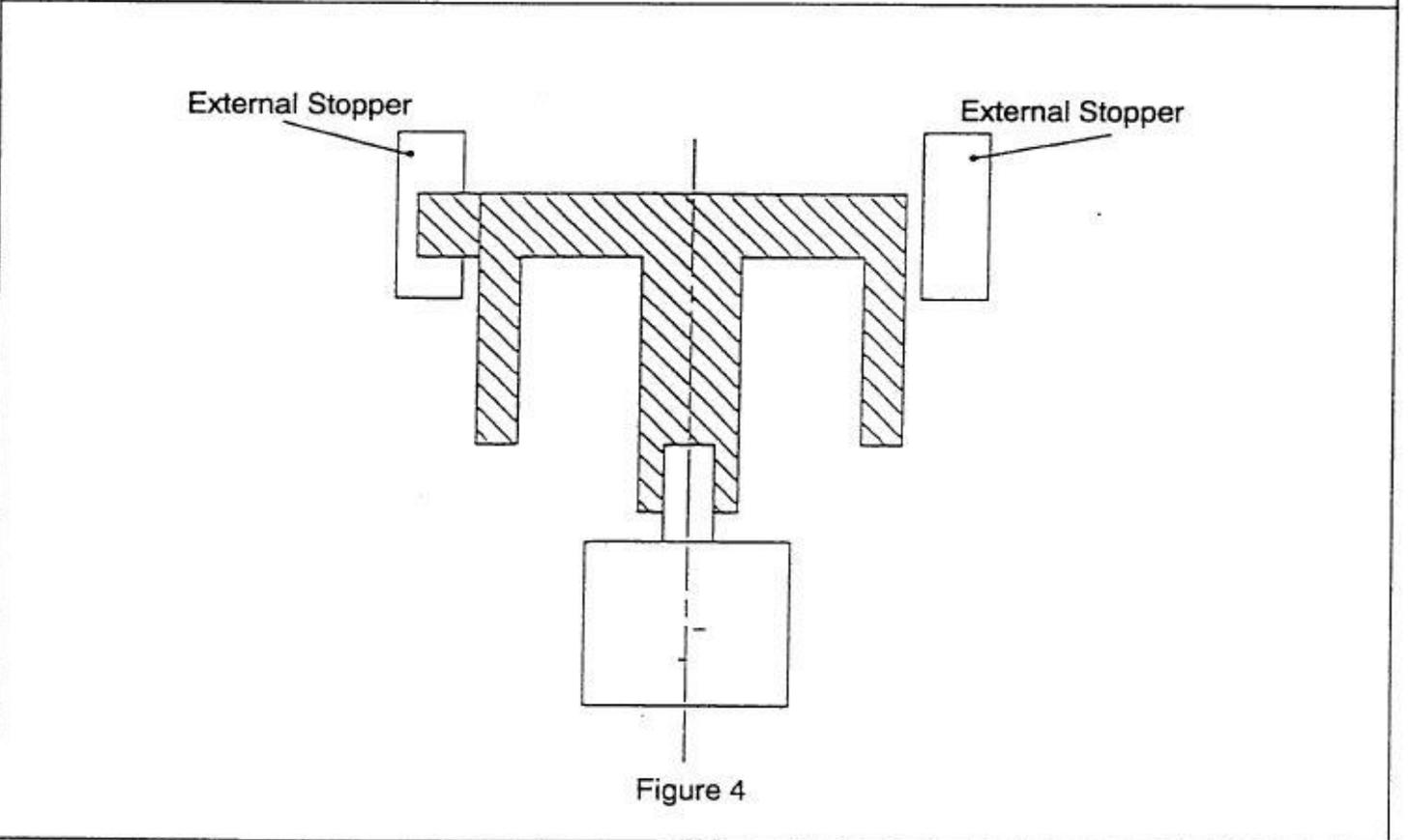
※Rotary Actuator itself has a slight angular error due to the construction, use external stopper when accurate positioning is required.



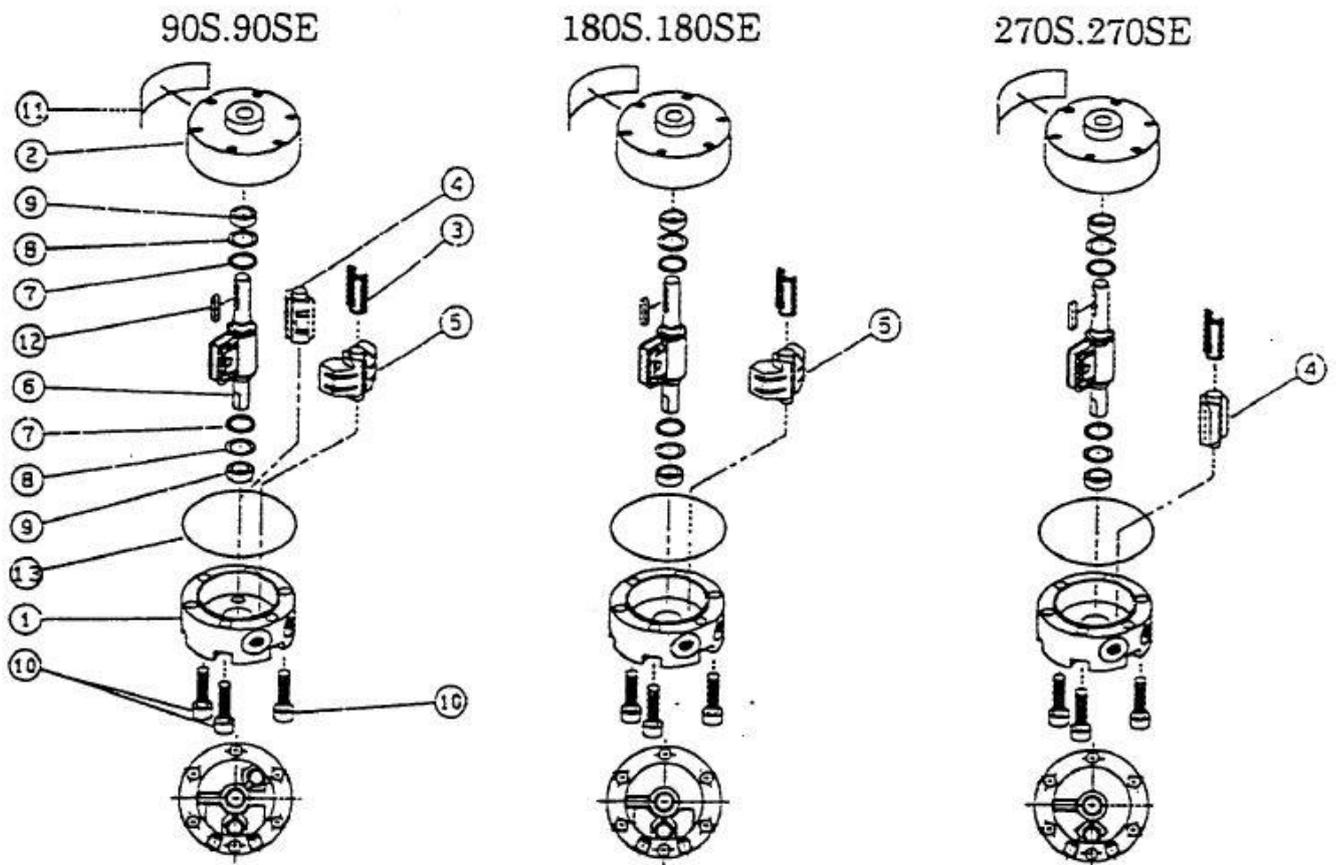
Correct position	 <p data-bbox="1069 1377 1292 1413">External stopper</p>
Incorrect position	 <p data-bbox="893 1462 1109 1498">External stopper</p> <p data-bbox="997 1541 1364 1709">The external stopper works as a fulcrum, resulting in the load's inertia force being applied to the shaft as a bending moment.</p>
Incorrect position	 <p data-bbox="869 2027 1085 2063">External stopper</p> <p data-bbox="268 1870 598 2033">When buffer such as Shock Absorber is used, or when load is within allowable energy range, single rod can be used.</p> <p data-bbox="1005 1798 1364 2000">If an external stopper is installed to the shaft on the opposite side of the load, the inertia force generated by the load is applied directly to the shaft.</p>



Even when external stopper cannot be used, kinetic energy of load may be decreased by changing rotation speed, load mass and load shape to use the product. Figure 4 shows an example of lightening.



6. Maintenance and Check



- Be sure to install Air Filter to clean supply air.
- Do not disassemble the actuator. When disassembling it for unavoidable reason, follow the procedures below while preventing dust and/or foreign matter from entering.
[Since increase in internal leakage causes malfunction in most cases, recheck speed controller.
It is recommended to use stable speed adjusting range (refer to “Speed Adjusting Range” on page 1).]

CRB2BW40-90S,90SE

[How To Disassemble]

- ① Remove Parallel Key ⑫.
- ② Remove Hexagon Socket Head Cap Screw ⑩.
- ③ Secure either Body (A) ① or Body (B) ② and push out Vane Shaft ⑥, then separate Body (A) from Body (B).
- ④ Remove Vane Shaft ⑥, Stoppers ④ and ⑤.

[How To Assemble]

- ① Mount O-ring ⑬ and Vane Shaft ⑥ to Body (B) ②.
- ② Mount Stopper Packing ③ to Stopper ⑤.
- ③ Mount Stoppers ④ and ⑤ to Body (B) ② . (Note: Be careful of stopper position)
- ④ Insert Body (A) ① into Vane Shaft ⑥.
- ⑤ Tighten Body (A) ① and Body (B) ② with Hexagon Socket Head Cap Screw ⑩.
(Tightening torque: 4 to 6 N · m)

[Notes]

- ① Since any product disassembled will not be guaranteed, fully understand the internal construction before disassembling.
- ② Exercise caution not to damage packing when reassembling.
- ③ Use caution to prevent damage to sliding surfaces of Body (A) ①, Body (B) ② and Vane Shaft ⑥.
- ④ Rubber of Vane Shaft ⑥ cannot be removed due to baking adhesion.

7. Troubleshooting

Failure	Possible causes	Countermeasures
Actuator does not operate. Adjust speed controller and check that rotation speed of Actuator is within the specified speed adjusting range.	Stable speed adjusting range is not satisfied.	Use the product within the specified speed adjusting range.
	Increase in internal leakage due to internal packing damage caused by foreign matter and/or oil.	Replace the vane shaft and stopper packing (In general, the product requires replacement).
	Sealing failure of internal packing or increase in internal resistance due to the use out of the specified operating temperature range (Including freezing).	Use the product within the specified operating temperature range (In some cases of sealing failure, the vane shaft and stopper packing require replacement).
	Failure of peripheral components: a. Improper adjusting of speed controllers. b. Malfunction of solenoid valves. c. Air supply shortage due to clogging of air filter. d. Decrease in pressure due to failure of regulator.	Use special products (including measures against problems of pneumatic circuit).
Shaft breakage	Large load energy: a. Large load mass. b. Fast operating speed. c. Long rotation radius.	Replace the shaft. a. Use the product with the allowable energy range. b. Install cushioning device and external stopper to absorb impact energy.
	External force other than load energy is applied.	Replace the shaft. Avoid excessive external force.
	Offset load due to de-centering.	Replace the shaft.
Rotation angle failure	Breakage of the connection part of the rotation axis or internal stopper.	Replace the connection part or product.
Bearing breakage	Overload (Loads in radial and thrust directions are too heavy).	Replace bearing: Make radial and thrust loads be within the allowable range.
	Offset load due to decentering.	Replace bearing: Correct de-centering.
	Large vibration.	Replace bearing: Absorb vibration.
External leakage	Sealing failure of O-ring due to bearing damage and/or shaft bending.	Replace the bearing and/or shaft. Relieve external force.
	O-ring damage due to foreign matter and/or oil.	Replace the O-ring.
Internal leakage (Excluding increase in internal leakage due to life)	Packing damage due to foreign matter and/or oil.	Replace the vane shaft and stopper packing (In general, the product requires replacement). Prevent foreign matter and oil entrance.
	Sealing failure of packing due to the use out of the specified operating temperature range.	Replace the vane shaft and stopper packing (The product requires replacement especially for the use at high temperature). Use the product within the specified operating temperature range.

Notice on Trouble and Troubleshooting

1. Life is excluded from the causes.
2. Consult SMC for any causes other than those in the table above (except life) since the product may require disassembling check.

Revision history

A : [Safety Instructions] Revision of sentences.
B : The contents have been revised to the latest version.

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Note: Specifications are subject to change without prior notice and any obligation on the part of the manufacturer.

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