Doc. no.C96*-OM0002Q

Operation Manual

PRODUCT NAME

Air cylinder

MODEL / Series / Product Number

CP96S＊32&100－＊C

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)[*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.

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.

1. Specifications

1-1 Specifications

Fluid	Air
Proof pressure	1.5MPa
Max. operating pressure	1.0MPa
Min. operating pressure	0.05MPa
Ambient and fluid temperature	-20 to +70°C. -10 to +60°C with built-in magnet (No freezing)
Lubrication	Not required (non-lube)
Stroke length tolerance	Up to 500st $^{+2.0}_{0}$ mm 501st to 1000st $^{+2.4}_{0}$ mm 1001st to 1500st $^{+2.8}_{0}$ mm 1501st to 2000st $^{+3.2}_{0}$ mm
Cushion	Air cushion and bumper cushion
Piston speed	50 to 1000mm/sec
Action	Double acting

Use the actuator with allowable kinetic energy or less.
{Refer to 2-6. Allowable kinetic energy (Page 9)}

⚠Warning 2

- **Confirm the specifications.**
  These products 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.
- **Confirm the applicable specification range.**
  These product specifications apply to standard strokes, including intermediate strokes.
  Product specifications may not apply to long stroke and order-made products (-XB☐, -XC☐).

2. Installation and Handling

2-1. Air supply

The compressed air supplied to the cylinder should be filtered by SMC AF series air filter and regulated to the specified set pressure by SMC AR series regulator.

⚠Warning 2

- **Type of fluids**
  Use compressed air.
- **When there is a large amount of drainage.**
  Compressed air containing a large amount of drainage can cause malfunction of pneumatic equipment. An air dryer or water separator should be installed upstream from filters.
- **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. It causes 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.
- **Use clean air.**
  Do not use compressed air that contains chemicals, synthetic oils including organic solvents, salt or corrosive gases, etc, as it can cause damage or malfunction.

⚠ Caution 2

- When low dew point 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. Consider using low dew point products such as 25A-series.
- **Install an air filter.**
  Install an air filter upstream near the valve. Select an air filter with a filtration size of 5 μm or smaller.
- **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 drainage can cause malfunction of pneumatic equipment such as valves.
  Therefore, take appropriate measures to ensure air quality, such as by providing an aftercooler, air dryer, or water separator.
- **Ensure that the fluid and ambient temperature are within the specified range.**
  When operating at temperatures below 5°C, water in the circuit may freeze and cause breakage of seals or malfunction. Corrective measures should be taken to prevent freezing.
- **Lubricating the non-lube type cylinder**
  The cylinder has been lubricated for life at the factory and can be used without any further lubrication.
  However, in the event that it is additionally lubricated, be sure to use class 1 turbine oil (with no additive) ISO VG32. Do not use machine oil or spindle oil.
  Stopping lubrication later may lead to malfunction because the new lubricant will displace the original lubricant. Therefore, lubrication must be continued once it has been started.
  If turbine oil is used, refer to the corresponding Material Safety Data Sheet (MSDS).

  For detailed information regarding the quality of the compressed air described above, refer to SMC's "Air Cleaning Systems".

2-2. Design

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

⚠ Warning

- **There is a danger of sudden action by cylinders if sliding parts of machinery are twisted, etc., and changes in forces occur.**
  In such cases, human injury may occur; e.g., by catching hands or feet in the machinery, or damage to the machinery itself may occur. Therefore, the machine should be designed to operate smoothly and to avoid such dangers.
- **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.
- **Be certain that the secured portions will not loosen.**
  Be certain to adopt a reliable connecting method if the cylinder is used very frequently or if it is used in a location that is exposed to a large amount of vibration.
- **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 cylinder's cushion to absorb the shock.
  Therefore, provide a speed-reduction circuit to reduce the cylinder's 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.
- **Design the system so that it will not apply an external force over the maximum force to the product.**
  The product can break, causing a risk of injury or damage to equipment.
- **The product generates a large force. Install on a sufficiently rigid mounting base, taking this force into consideration.**
  There is a risk of injury or damage to equipment.

- **Consider the possibility of a reduction in the circuit air pressure caused by a power failure.**
  When a cylinder is used in a clamping mechanism, the work piece may come off due to a decrease in clamping force because of a decrease in the circuit pressure caused by a power failure, etc. Therefore, safety equipment should be installed to prevent damage to machinery and injury. Suspension equipment and lifting devices also require measures to prevent dropping.
- **Consider the possibility of power source related malfunction that could occur.**
  For the equipment that rely on power sources such as compressed air, electricity, or hydraulic pressure, adopt a countermeasure to prevent the equipment from causing a hazard to humans or damage to the equipment in the event of malfunction.
- **Consider the behavior of the rotary actuator in the event of an emergency stop.**
  Devise a safety 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 outage, the movement of the cylinder will not cause a hazard to humans or damage the equipment.
- **Avoid synchronized operation using cylinders only.**
  Even if multiple pneumatic cylinders are initially set to the same speed, their speed may vary due to changes in operating conditions. Therefore, avoid designs where a single load is moved by synchronizing multiple cylinder operations.
- **Consider the action when operation is restarted after an emergency stop or abnormal stop.**
  Design the machinery so that injury or equipment damage will not occur upon restart of operation. When the cylinder has to be reset at the starting position, install manual safety equipment.
- **Intermediate stop**
  It is difficult for this product to make a piston stop at the required intermediate position accurately and precisely using a 3 position closed center type directional control valve, due to the compressibility of air. Furthermore, since valves and cylinders are not guaranteed for zero air leakage, it may not be possible to hold a stopped position for extended periods of time.

⚠Caution 2

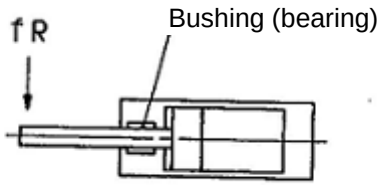
- **Avoid having a large gap between the clevis and mating bushing, as this exposes the pin to a bending load.**
- **Do not touch the cylinder during high speed and high frequency operation of the cylinder.**
  When the cylinder is operating at a high speed and high frequency, the cylinder tube surface temperature increases, and may cause a burn.
- **Do not use the air cylinder as an air-hydro cylinder.**
  If working fluid of the air cylinder is turbine oil, oil leakage can result.
- **Grease is applied to cylinder.**
- **The base oil of grease may seep out.**
  The base oil of grease in the cylinder may seep out from the tube, cover, or rod sliding part depending on the operating conditions (ambient temperature of 40°C or more, pressurized condition, low frequency operation, etc.). Be especially careful when a clean environment is required.

2-3. Mounting and Installation

The foot mounting cylinder has a hole in the foot to drive a pin into for accurate positioning and fixing.

⚠Caution

- **Do not apply excessive lateral load to the piston rod.**
  The bold solid lines in Fig. 1 show the allowable lateral load on the cylinder for a certain stroke length.
  Refer to Table 1 Maximum Allowable Kinetic Energy.(Page 9)



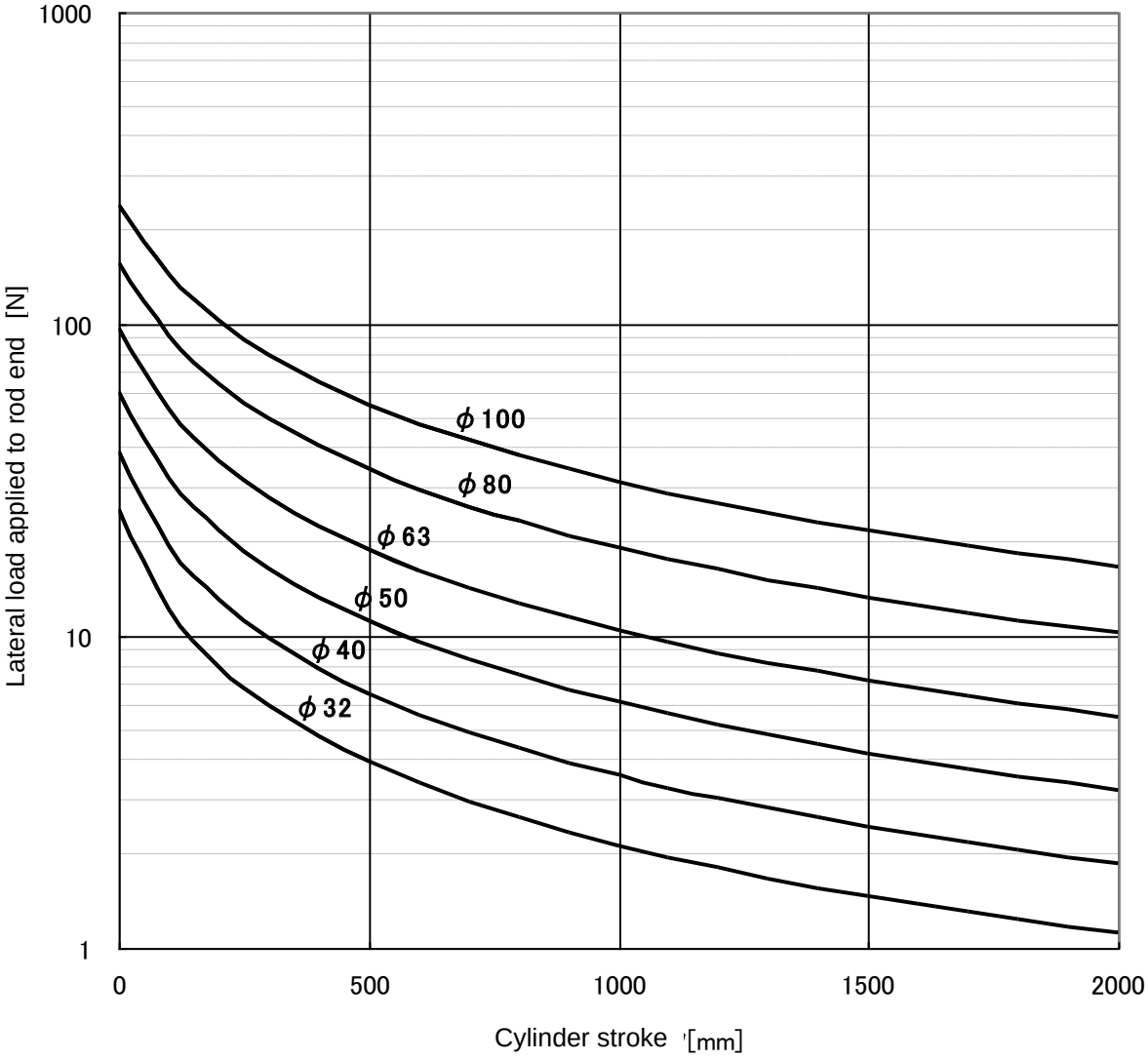


Fig. 1 Allowable lateral load applied to rod end

⚠ Caution

- **Be certain to align the rod axis with the load and direction of movement when connecting.**
  When not properly aligned, the rod and tube may be twisted, and damage may be caused due to wear on areas such as the inner tube surface, bushings, rod surface and seals.
- **When an external guide is used, connect the rod end and the load in such a way that there is no interference at any point within the stroke.**
- **Do not scratch or gouge the sliding parts of the cylinder tube or piston rod, etc., by striking or grasping them with other objects.**
  Cylinder bores are manufactured to precise tolerances, so that even a slight deformation may cause malfunction. Also, scratches or gouges, etc., in the piston rod may lead to damaged seals and cause air leakage.
- **Prevent the seizure of rotating parts.**
  Prevent the seizure of rotating parts (pins, etc.) by applying grease.

- **Do not use the product until you can verify that equipment can operate properly.**
  Verify correct mounting by function and leak tests properly after compressed air and power are connected following mounting or repair.
- **Cantilever fastening**
  If a cylinder is actuated at high speed when mounted with one side fastened and one side free (basic type, flange type, direct mount type), the bending moment may act on the cylinder due to vibration at the stroke end, causing damage to the cylinder. In such cases, install a mounting bracket to suppress vibration of the cylinder body, or reduce piston speed until the cylinder body does not vibrate at the stroke end. Also, use a mounting bracket when moving the cylinder body, or mounting a long stroke cylinder horizontally with one-sided fastening.
- **Do not apply excessive lateral load to the piston rod.**
  Calculation for excessive lateral load:

[3] Minimum operating pressure value after the device is mounted (MPa) = Cylinder's minimum operating pressure (MPa) + {Load weight(N)

× Guide friction coefficient / Cylinder's cross section (mm^2)}

If the product is found to operate smoothly with the calculated pressure, it has been determined that the alignment of the guides have not created additional loading on the cylinder.

- **Do not let foreign matter such as cutting chips get into the product from the supply port.**
  When the product is installed on a machine on site, the debris from drilled mounting holes can get in the supply port of the product. Take sufficient care to prevent this.

2-4. Environment

⚠Warning

- **Do not use in an atmosphere having corrosive gases, chemicals, sea water, water, water steam, or where there is direct contact with any of these.**
- **Do not expose the product to direct sunlight for an extended period of time.**
- **Do not use in a place subject to heavy vibration and/or shock.**
- **Do not mount the product in locations where it is exposed to radiant heat.**
- **Do not use in dusty locations or where water or oil, etc., splash on the equipment.**
- **When using auto switches, do not operate in an environment with strong magnetic fields.**
- **A decrease in grease base oil may be accelerated by the properties of compressed air used in pneumatic equipment, the external environment, or operating conditions, etc., and the resulting drop in lubricating performance may have an effect on equipment service life.**
- **Avoid storing the product in humid conditions.**
  Store the product with the piston rod retracted and avoid humidity, in order to prevent generation of rust.

⚠Caution [2]

- Machined part of the piston rod and tie rod are not plated. Be careful there is possibility to occur rust during usage or long term storage.
- **Preparation before piping**
  Before piping, perform air blow (flushing) or cleaning to remove any cutting chips, cutting oil, dust, etc. from the piping and fitting.
- **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.

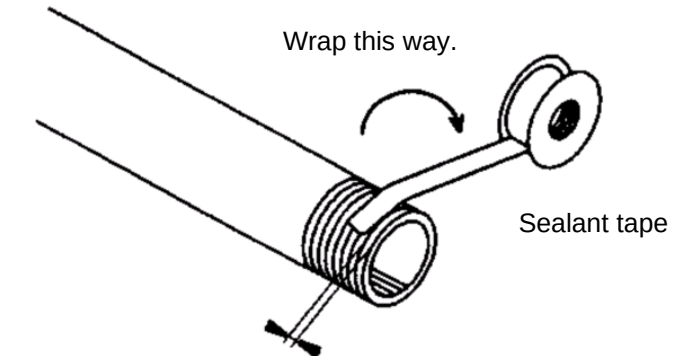


Fig. 2 Sealant tape

2-5. Speed control

1) When the cylinder speed is adjusted, install SMC AS Series Speed controllers around the air supply to adjust to the specified speed.

2) When speed controllers are used for adjusting speed, there are two cases, one is regulating the supply air to the cylinder (meter-in control), and another is regulating the exhaust air from the cylinder (meter-out control). In the former case, cylinder operation will be unstable. Generally, the latter case is applied.

⚠Caution

⊙ **Piston speed should be controlled gradually from low speed to the specified speed with a speed controller fully closed.**

2-6. Allowable kinetic energy

⚠Warning

⊙ **Use the actuator with allowable kinetic energy (Table 1) or less.**
Operation with a kinetic energy over the allowable value can break the product and cause injury or damage to equipment. If excessive kinetic energy is expected, install an external absorber to prevent impact to the body of the product. In this case, please verify the rigidity of the equipment carefully.

Table 1

		ϕ32	ϕ40	ϕ50	ϕ63	ϕ80	ϕ100
Allowable kinetic energy(J)	Air cushion	2.3	3.6	6.1	11.4	21.1	31.7
	Non cushion	1.1	1.8	3.6	6.0	12.0	12.0

⚠Caution

⊙ **When the product is equipped with a bumper cushion, note that there will be a slight bounce at the stroke end.**

2-7. Cushion

⚠Caution

- Cylinder cushions are adjusted properly at the time of shipment. However, readjust the cushion valve on the cover when the cylinder is put into service based upon working load and operating speed.
- When the cushion valve is turned clockwise, the cushion contracts and its effectiveness is increased, and when the cushion valve is turned counterclockwise, the cushion expands and its effectiveness is decreased.
- If the cushion valve is fully closed throughout operation, the piston may bounce at the stroke end, not move full stroke, or the cushion seal may be damaged due to excessive pressure. Therefore, do not use the cushion cover in such manner.
- Check that the screw of the cushion valve is screwed in. The cushion valve may lurch if the screw is not fitted properly.

⚠Warning

- **Do not open the cushion valve beyond the number of allowable rotation (Table 2).**

  Although, it is crimped as a cushion valve retention mechanism, do not open the cushion valve beyond the number of the allowable rotation. If the cushion valve is opened beyond the number of the allowable rotation, it will come out from the cover when air is supplied.

  The allowable rotation is the number of rotations from a fully closed state of the restrictor of the cushion valve to a fully opened state.

- **The screw tightening and untightening torque for cushion valve should be allowable torque (table 2) or less.**

  If the screw tightening and untightening torque exceed allowable torque, the valve will be broken when fully closed, or the screw meshing will come over the retention mechanism and the valve will come out when fully opened.

Table 2

Bore size (mm)	Cushion valve With across flats	Hexagon wrench	No. of allowable rotation	Allowable torque
32,40	2	JIS 4648 Hexagon wrench key 2	4 turns	0.02N・m
50,63	2	JIS 4648 Hexagon wrench key 2	4.5 turns	0.02N・m
80,100	3	JIS 4648 Hexagon wrench key 3	5.5 turns	0.06N・m

- **Use the air cushion at the end of cylinder stroke.**

  Activate the air cushion when operating the cylinder. If this is not done, the piston rod assembly or the tie-rods will be damaged when the allowable kinetic energy exceeds the values shown in Table 1 (page 9).

2-8. Control of direction

To switch the operating direction of the cylinder, mount an applicable solenoid valve selected from SMC's range of solenoid valves.

⚠Warning

- **Design a circuit to prevent sudden action of a driven object.**

  When the product is actuated by an exhaust center type directional control valve or when one side of the piston is pressurized with air exhaust, such as when the product is started after the exhaust of the residual pressure from the circuit, driven objects may act suddenly at high speed. In such cases, injury may occur, such as hands or feet getting caught in the machinery, or damage to the machinery itself may occur. Design the machinery to avoid such dangers.

2-9-1. Mounting bracket

- Bracket mounting bolt should be tightened while keeping all the tension equal.
- When they are tightened , please use proper tightening torque. {(Refer to Table 8 (P20))
- Before mounting a support bracket, make sure the product is aligned by placing on the leveled surface.
  It is recommended to secure the mounting screws temporarily to insure alignment before tightening with the specified torque.

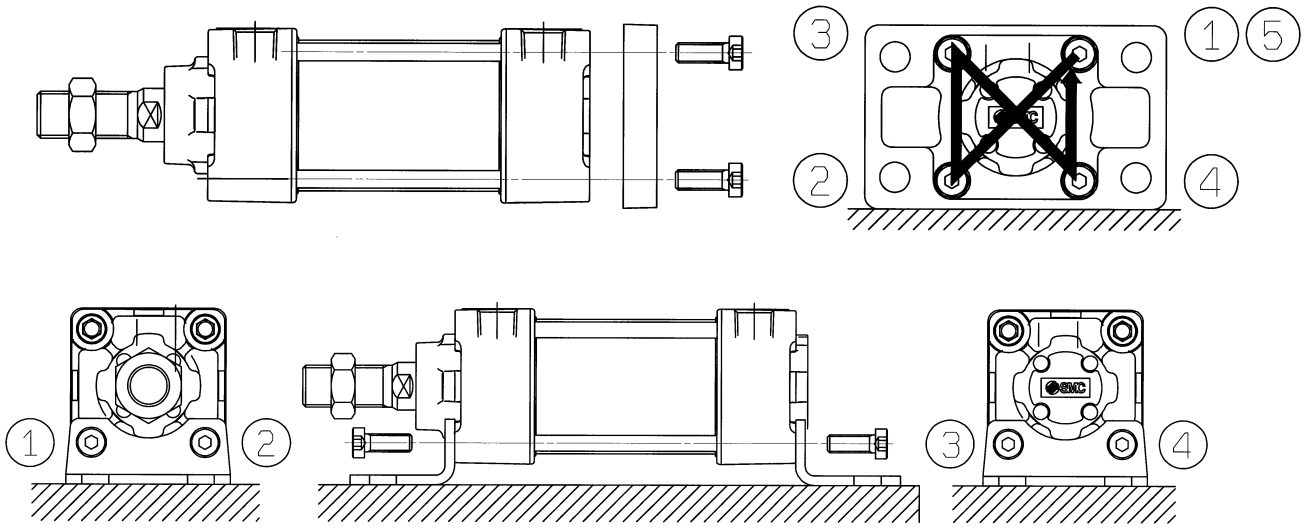


Fig. 3 Order for tightening mounting screws

2-9-2. Auto switches

When an auto switch is mounted or its set position is changed, refer to Fig. 4.

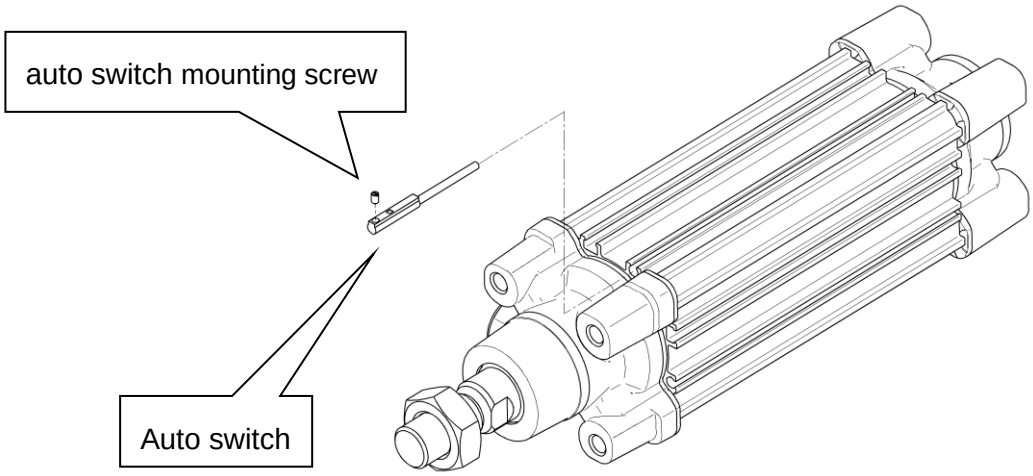
⚠Caution

- **Tighten mounting screws to the appropriate torque.**
- **The auto switch can only be used for cylinders with a built-in magnet for auto switch (e.g. CP96SDB).**
- **The mounting of the switch is limited depending on stroke.**
  (See page 14, Table 5.)

< Applicable Auto switches >

Solid state auto switch D-M9N(V)・M9P(V)・M9B(V)
D-M9NW(V)・M9PW(V)・M9BW(V)
D-M9NA(V)・M9PA(V)・M9BA(V)
Reed auto switch D-A90(V)・A93(V)・A96(V)

Figure 4. How to Mount and Move the Auto Switch



Please use a watchmaker's screwdriver with a handle diameter of 5 to 6 mm when tightening the auto switch mounting screw.
A torque of 0.05 to 0.15 N・m should be used for D-M9□, M9□W, M9□AL, and 0.10 to 0.20 N・m for D-A9□.
Once the screw starts to feel tight, tighten it further by approximately another 90°.

Note) D-M9□□ and A9□ type cannot be mounted on square groove of the CP96 series.

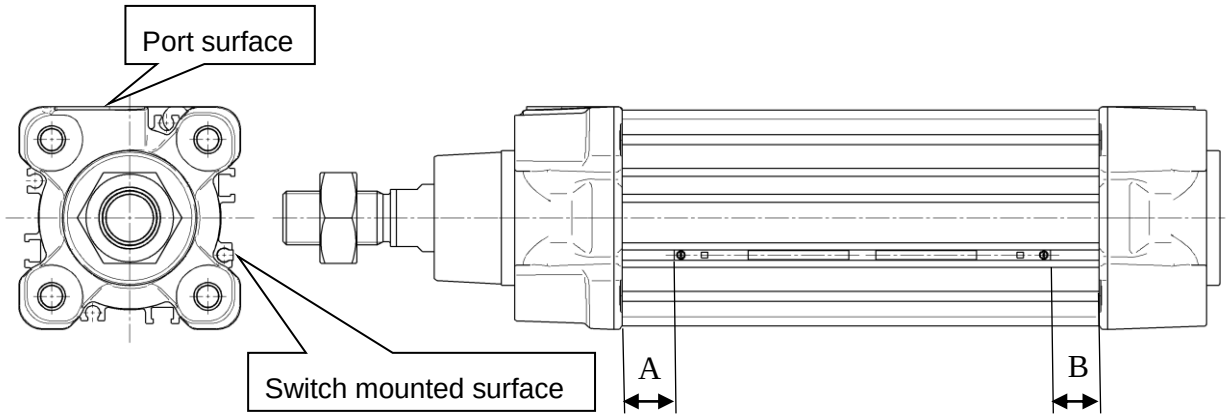
Table 3 **Operating Range**

[mm]

Auto switch model	Bore size					
	32	**40**	**50**	**63**	**80**	**100**
D-M9□(V) **D-M9□W(V)** **D-M9□A(V)**	4	4	5	6	5.5	6
D-A9□(V)	7	8	8.5	9.5	9.5	10.5

* Values which include hysteresis are for guideline purposes only, they are not a guarantee (assuming approximately ±30% dispersion) and may change substantially depending on the ambient environment.
* The D-M9□V/M9□WV/M9□AV/A9□V are mountable on ø32 to ø63.

Table 4 **Auto Switch Proper Mounting Position (Detection at stroke end)**



Auto Switch Proper Mounting Position [mm]

Auto switch model / Bore size	D-M9□(V) D-M9□W(V) D-M9□A(V)		D-A9□(V)	
	A	B	A	B
32	14	10.5	10	6.5
40	14	14	10	10
50	15.5	14.5	11.5	10.5
63	16.5	15.5	12.5	11.5
80	21.5	18	17.5	14
100	21.5	19	17.5	15

* Adjust the auto switch after confirming the operating conditions in the actual setting.
* The D-M9□V/M9□WV/M9□AV/A9□V are mountable on ø32 to ø63.

Table 5 **Minimum Stroke for Auto Switch Mounting**

[mm]

Auto switch model	Number of auto switches	32	40	50	63	80	100
D-M9□ **D-M9□W**	2 (Same surface)	50					
	1, 2 (Different surfaces)	10					
	n	10 + 40 (n – 2)					
D-M9□V **D-M9□WV**	2 (Same surface)	40					
	1, 2 (Different surfaces)	10					
	n	10 + 30 (n – 2)					
D-M9□A	2 (Same surface)	55	50				
	1, 2 (Different surfaces)	15	10				
	n	15 + 40 (n – 2)	10 + 40 (n – 2)				
D-M9□AV	2 (Same surface)	40					
	1, 2 (Different surfaces)	10					
	n	10 + 30 (n – 2)					
D-A9□	2 (Same surface)	50					
	1, 2 (Different surfaces)	10					
	n	10 + 40 (n – 2)					
D-A9□V	2 (Same surface)	40					
	1, 2 (Different surfaces)	10					
	n	10 + 30 (n – 2)					

* n = 3, 4, 5…
* The D-M9lV/M9lWV/M9lAV/A9lV are mountable on ø32 to ø63.

Other than the applicable auto switches listed in "How to Order", the following auto switches are mountable.
Refer to the **Web Catalog** or Best Pneumatics for the detailed specifications.

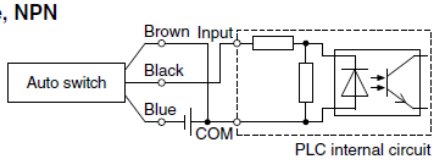
Type	Model	Electrical entry	Features	Applicable bore size
Solid state	**D-M9NV, M9PV, M9BV**	Grommet (Perpendicular)	—	ø32 to ø63
	D-M9NWV, M9PWV, M9BWV		Diagnostic indication (2-color indicator)	
	D-M9NAV, M9PAV, M9BAV		Water-resistant (2-color indicator)	
Reed	**D-A93V, A96V**		—	
	D-A90V		Without indicator light	

* Normally closed (NC = b contact) solid state auto switches (D-M9□E(V)) are also available. For details, refer to the **Web Catalog** or Best Pneumatics.
* With pre-wired connector is also available for solid state auto switches. For details, refer to the **Web Catalog** or Best Pneumatics.

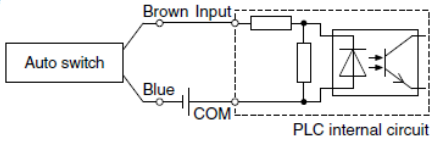
Auto switch Connection and Example

Sink Input Specifications

3-wire, NPN

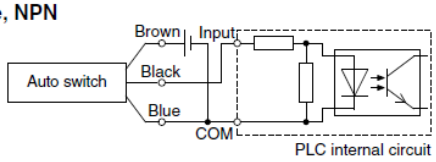


2-wire

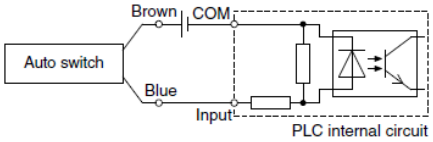


Source Input Specifications

3-wire, NPN



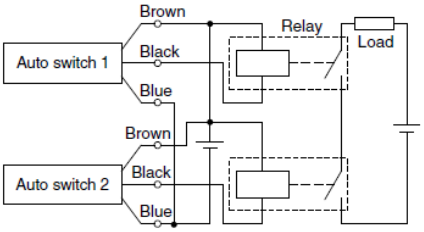
2-wire



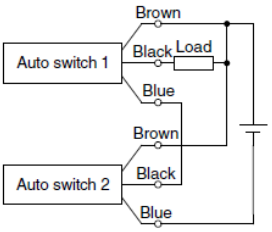
Connect according to the applicable PLC input specifications, as the connection method will vary depending on the PLC input specifications.

Example of AND (Series) and OR (Parallel) Connection

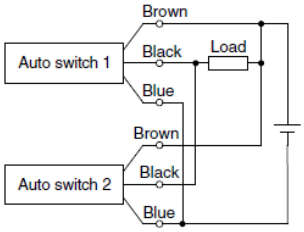
3-wire, AND connection for NPN output (Using relays)



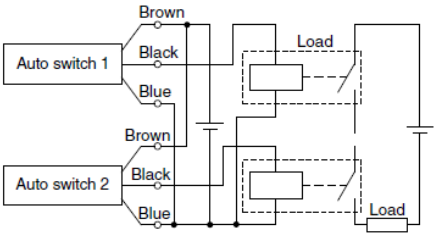
(Performed with auto switches only)



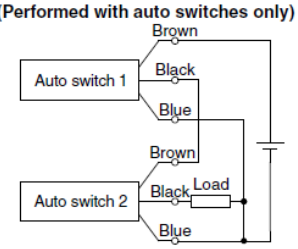
3-wire, OR connection for NPN output



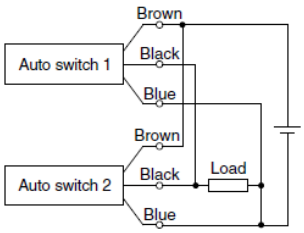
3-wire, AND connection for NPN output (Using relays)



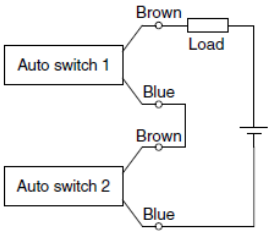
(Performed with auto switches only)



3-wire, OR connection for PNP output



2-wire, AND connection

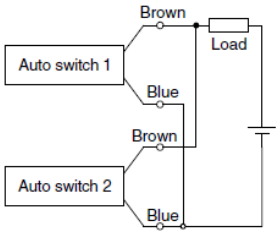


When two auto switches are connected in series, malfunction may occur because the load voltage will decrease in the ON state.The indicator lights will light up when both of the auto switches are in the ON state.

Load voltage at ON = Power supply voltage – Residual voltage x 2 pcs.
= 24 V – 4 V x 2 pcs.
= 16 V

Example: Power supply voltage 24 VDC
Auto switch internal voltage drop 4 V

2-wire, OR connection



(Solid state)
When two auto switches are connected in parallel, malfunction may occur because the load voltage will increase in the OFF state.

Load voltage at OFF = Leakage current x 2 pcs. x Load impedance
= 1 mA x 2 pcs. x 3 kΩ
= 6 V

Example: Load impedance 3 kΩ
Auto switch leakage current 1 mA

(Reed)
Because there is no leakage current, the load voltage will not increase in the OFF state. However, depending on the number of auto switches in the ON state, the indicator lights may sometimes grow dim or not light up, due to the dispersion and reduction of the current flowing to the auto switches.

3. Maintenance

3-1. Checks

The following checks are required for proper cylinder operation.

1) Smooth operation
2) Changes in piston speed and cycle time
3) Abnormal stroke
4) Looseness of mounting bolt and rod end nuts
5) Looseness of mounting frame and excessive deflection
6) Internal and external leakage (Change in output)
7) Damage to the piston rod sliding surface
8) Clogging and discharge drainage of the air filter
9) Lubrication of rotating parts (double knuckle joint, clevis pin, etc.)
10) Position of auto switches

When any abnormality is found as a result of checking the points above, eliminate causes and take necessary measures such as retightening screws and the application of grease. Contact SMC sales if it is necessary to repair the cylinder.

⚠Warning

- **As a minimum, maintenance should be performed according to the above items. Perform additional maintenance as necessary.**
  Improper handling can cause damage and malfunction of equipment and machinery.
- **Removal of equipment, and supply/exhaust of compressed air.**
  Ensure that drop prevention measures and safe lock out of the moving parts are taken, the power of the facility and supply air is shut off and the compressed air in the system is exhausted before removing the equipment.
  Before restarting the equipment, confirm that measures are taken to prevent sudden action.

3-2. Replacement of seals

It is possible to replace the rod seal, piston seal, cushion seal, cylinder tube gasket and wear ring.

Contact SMC sales if it is necessary to replace parts other than those mentioned above.

⚠Warning

- **Only people who have sufficient knowledge and experience are allowed to replace seals.**
  The person who disassembles and reassembles the cylinder is responsible for the safety of the product.

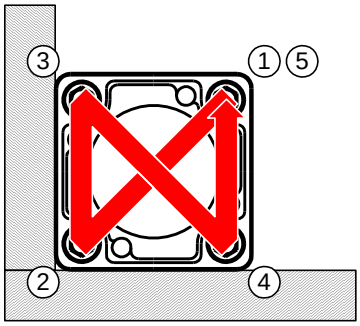
⚠Caution

- **When replacing seals, carefully handle parts to prevent injury to your hands or fingers on the corners of parts.**

3-2-1. Disassembly / Reassembly

⚠ C a u t i o n

- **Disassemble and assemble the cylinder on a clean cloth in a clean location. Perform on a clean cloth.**
- **Make sure no particles are present. Do not scratch the seals.**
- **A tie-rod nut should be fitted on the shorter thread to the end of tie-rod by hand. And affix to the cylinder.**
- **Another tie-rod nut should be mounted on the cover at the opposite side of the first tie-rod nut. Tighten the tie-rod nuts so that their tension is even. Refer to the appropriate tightening torque shown in Table 6. For mounting brackets, refer to Table 8 on page 20.**



Tie rod tightening order.

Table 6 Tightening torque

Bore size	Width across flats	Tightening torque[N・m]
32,40	6	4 to 5.6
50,63	8	8.6 to 12.1
80,100	14	15.2 to 21.1

3-2-2. Removal of seals

1) Rod seal and cushion seal

Insert a precision screwdriver from the front of the cover to pull out the seal as shown in Fig. 5.

⚠ C a u t i o n

- **Take care not to damage the seal groove of the cover at this time.**

2) Piston seal

Wipe off grease around piston seal first to make seal removal easier.

As shown in Fig. 6, hold the piston seal with one hand and push it into the groove so that the piston seal can be lifted off and pulled out without using a precision screwdriver.

The groove of the rod cover is deep, so if the rod seal is removed with a precision screwdriver, it might be damaged.

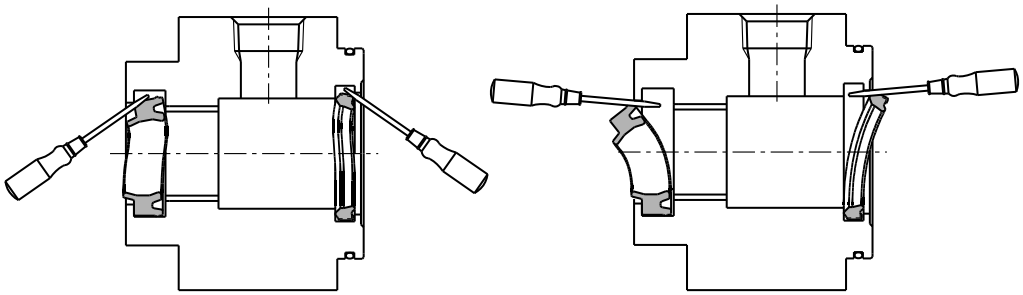


Fig 5. Remove rod seal

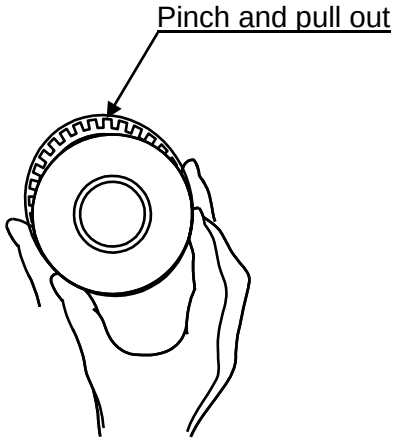


Fig 6. Remove piston seal

3) Tube gasket

Pull out with the precision screwdriver.

3-2-3. Grease

⚠ Caution

⊙ **Use SMC's recommended grease.**
Grease pack part number: GR-S-010 (10g), GR-S-020 (20g)

1) ① Rod seal

Apply a thin layer of grease to all surfaces of the new seal to make it easy to mount the rod seal and improve sealing.

Fill the groove of the seal with grease, which is necessary for operation.

2) ② Piston seal

Apply a thin layer of grease to the all surfaces of the piston seal to make it easy to mount the seal.

3) ⑤ Cushion seal ⑦ Tube gasket

Apply a thin layer of grease to all surfaces of the tube gasket to make it easy to mount the gasket.

4) Parts of cylinder

Grease is applied to the locations shown in Fig. 7. The amount of grease per cylinder of 100 stroke is shown in attached table 7. Roughly, one scoop with a forefinger is approximately 3g.

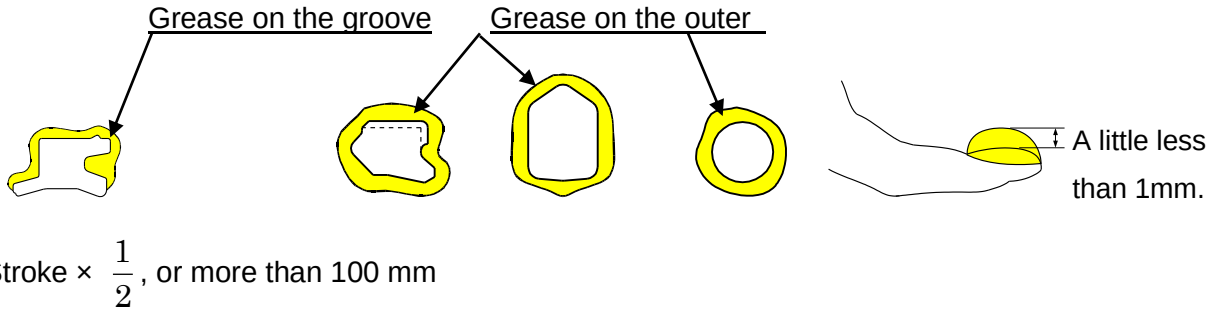


Fig. 7 Position for application of grease

Table 7 Amount of grease units: g

Stroke \ Bore	Φ32	Φ40	Φ50	Φ63	Φ80	Φ100	Position for grease
At 100st	3 to 4	3 to 4	3 to 5	4 to 5	6 to 8	8 to 10	① ② ③ ④ ⑤ ⑥ ⑦
50st added	1	1	1	1.5	2	3	③ ④

3-2-4. Mounting of seals

1) Rod seal, Cushion seal (Fig.7, ① ⑤)

Pay attention to the mounting direction of the seal.

Apply grease all over the seal and inner surface of the bushing as shown in Fig. 8. If it is difficult to apply grease, for example to a small bore diameter, use a precision screwdriver. Do not scratch any surface with the screwdriver.

2) Piston seal (Fig. 7, ②)

Mount with care not to twist the piston seal. Apply grease to the seal groove and outer circumference by rubbing grease into them as shown in Fig. 9.

3) Tube gasket (Fig. 7, ⑦)

Mount with care not to twist the tube gasket.

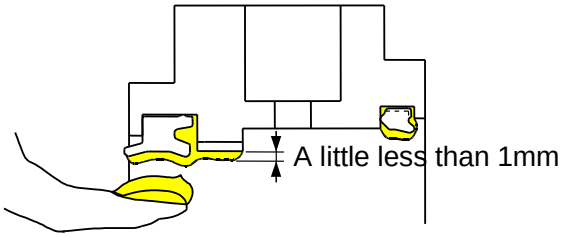


Fig8. Rod seal

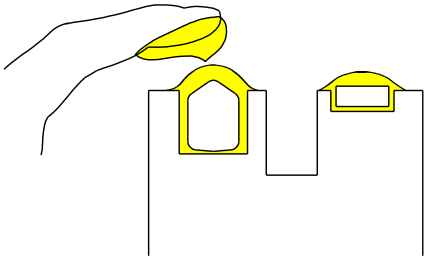
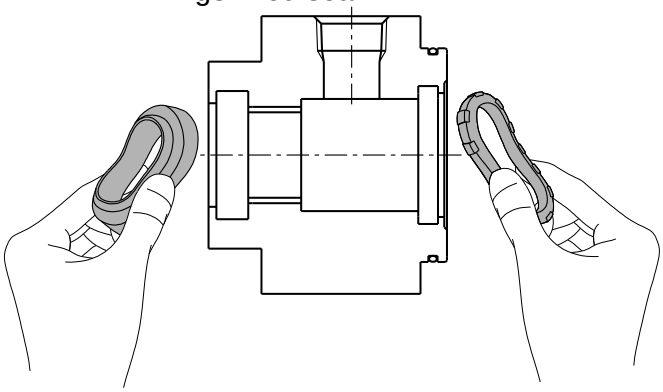
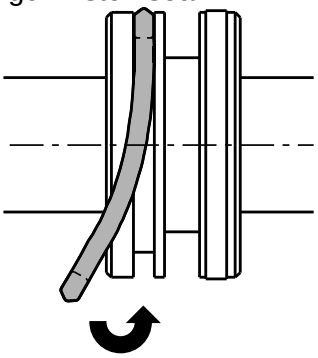


Fig9. Piston seal



Mount rod seal and cushion seal



Mount piston seal

4) Use a socket wrench when the bracket is replaced.
If other tools are used, the nut or other parts may be deformed or the work efficiency may decrease. For applicable sockets, please refer to the table below.

Table 8

Bore size(mm)	Width across flats	Tightening torque(N･m)
32,40	4	4.8
50,63	5	10.4
80,100	6	18.2

5)When replacing mounting brackets, tie-rod nuts on the cylinder body become loosened.

Mount the mounting bracket after tightening the tie-rod nut with the appropriate tightening torque again .

6) The trunnion type cylinder requires mounting accuracy.
The trunnion type cylinder may lose dimensional accuracy and malfunction when it is disassembled and reassembled because the axial center of the trunnion and that of the cylinder will not be aligned easily.

⚠ C a u t i o n

- **Confirm that there is no problem with operation and air tightness after assembly.**

3-3. Consumable parts

3-3-1. Replacement parts

	ϕ32	ϕ40	ϕ50	ϕ63	ϕ80	ϕ100
Seal kit no.	CS95-32	CS95-40	CS95-50	CS95-63	CS95-80	CS95-100
Contents of the seal kit	Rod seal 1 pc. Piston seal 1 pc. Cushion seal (large size) 2 pcs. Cushion seal (small size) 1 pc. Cylinder tube gasket 2 pcs. Wearing 1 pc.					

Note 1) Seal kits include grease pack.
Grease pack part number: GR-S-010(10g) , GR-S-020 (20g)
Note 2) The cushion seals are used in the following combinations of either:
Large size (1 pc.) + Small size (1 pc.) (See Fig. 11-1)
Large size (1 pc.) + Large size (1 pc.) (See Fig. 11-2)
Therefore, 1 pc. of either size will be left.

⚠ Caution

- **The seal is not delivered in sealed packaging for storage independently, so it must be used within 1 year.**

3-3-2. Storage of seals

⚠ Caution

- **Store seals in sealed packaging such as polyethylene bag and place it in a box.**
- **Avoid locations exposed to direct sunlight and high temperature and humidity. In particular, isolate from equipment that can generate heat, radiation and ozone.**
- **Do not stack a lot of seals, or deform or damage seals by putting a heavy object on top of them.**
- **White particles can emerge from the surface of the seal during storage, but they do not affect its performance.**

3-4. Troubleshooting

Failure	Cause	Countermeasure
Piston rod does not move smoothly.	Centers are not aligned for mounting.	・Align and adjust for mounting, and change brackets.
	Lateral load is applied.	・Mount proper guide. ・Modify mounting conditions and/or change brackets.
	Operating below the lower speed limit	・Eliminate causes of load fluctuation.
	Load factor is too high.	・Raise pressure. ・Use larger cylinder.
	Speed controller is meter-in control.	・Change to meter-out control.
	Cushion valve is over-tightened or fully closed.	・Readjust cushion valve.
Damage and/ or deformation	Impact applied due to high speed operation	・Adjust cushion. ・Reduce the speed. ・Reduce the load. ・Mount external shock absorber.
	Lateral load is applied.	・Mount proper guide. ・Modify mounting conditions.

4. Basic Circuit for Cylinder Operation

The basic circuit for operating the product with air filter, regulator, solenoid valve and speed controller (meter-out) is shown in the following figure.

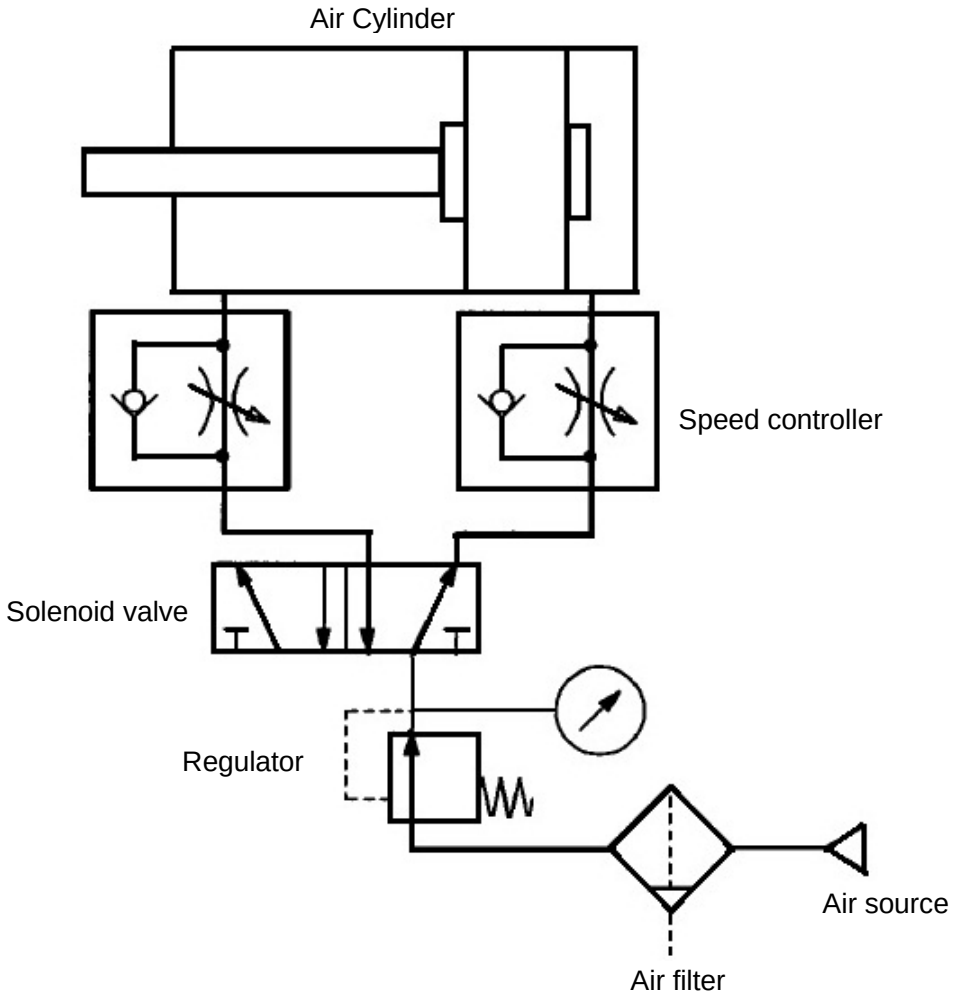
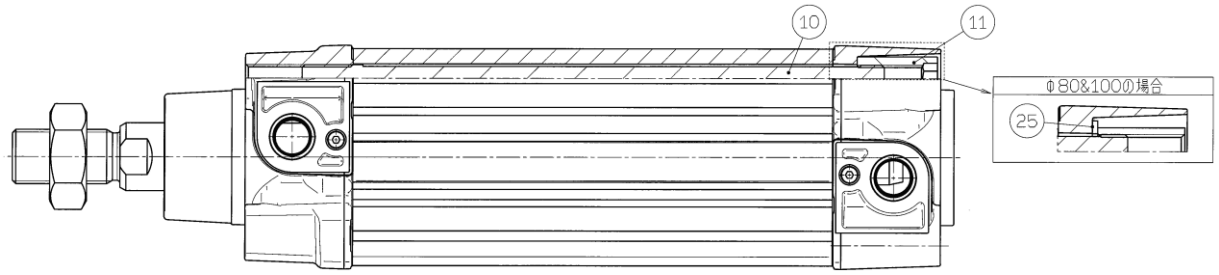


Fig. 10 Basic Circuit

5. Construction



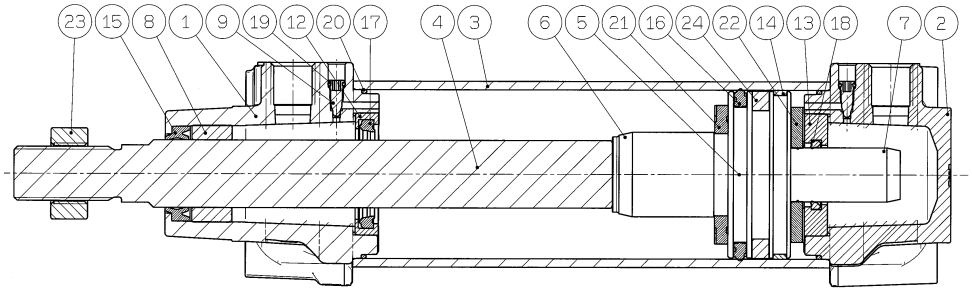


Fig. 11-1

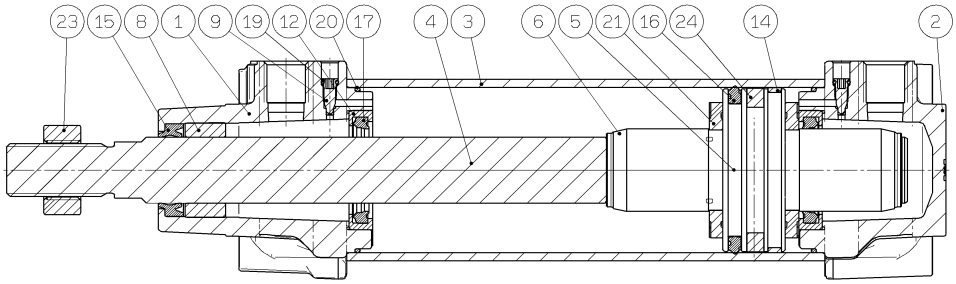


Fig. 11-2

Fig. 11 Standard product: Double acting/single rod

Table 9 Parts list

No.	Description	Qty	No.	Description	Qty
1	Rod cover	1	14	Wear ring	1
2	Head cover	1	15	Rod seal	1
3	Cylinder tube	1	16	Piston seal	1
4	Piston rod	1	17	Cushion seal A	1(2)
5	Piston	1	18	Cushion seal B	1(0)
6	Cushion ring A	1(2)	19	Cushion valve seal	2
7	Cushion ring B	1(0)	20	Cylinder tube gasket	2
8	Bushing	1	21	Bumper A	1(2)
9	Cushion valve	2	22	Bumper B	1(0)
10	Tie rod	4	23	Rod end nut	1
11	Tie rod nut	4	24	Magnet	(1)
12	Cushion seal holder A	1(2)	25	Flat washer	4
13	Cushion seal holder B	1(0)			

Revision history
1. P2,P3 Changed Safety Instructions.
2. P4 to P6 and P8 Changed Installation and Handling.
3. P8 Changed Load weight(kg)⇒Load weight(N)

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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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