



Operation Manual

PRODUCT NAME

COMPACT CYLINDER

MODEL/ Series

C(D)Q2 * 12 TO 100 — * Z SERIES

SMC Corporation

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Compact Cylinder / Series CQ2

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*2).

*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

JIS B 8370: General rules for pneumatic equipment.

JIS B 8361: General rules for hydraulic equipment.

JIS B 9960-1: Safety of machinery -- Electrical equipment for machines. (Part 1: General requirements)

JIS B 8433-1993: Manipulating industrial robots - Safety. etc.

*2) Labor Safety and Sanitation Law, etc.



Caution

Caution indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.



Warning

Warning indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.



Danger

Danger indicates a hazard with a high level of risk which, if not avoided, will result in death or serious 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.

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. 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. 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.



Compact Cylinder / Series CQ2

Safety Instructions



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

The warranty period of the product is 1 year in service or 1.5 years after the product is delivered.*3)
Also, the product may have specified durability, running distance or replacement parts. Please consult your nearest sales branch.

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.

Prior to using SMC products, please read and understand the warranty terms and disclaimers noted in the specified catalog for the particular products.

***3) 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).

1. Specifications

1-1. Specifications

Action		Double acting									
Bore size		φ12	φ16	φ20	φ25	φ32	φ40	φ50	φ63	φ80	φ100
Fluid		Air									
Proof pressure		1.5 MPa									
Max. operating pressure		1.0 MPa									
Min. operating pressure		0.07 MPa		0.05 MPa							
Ambient and fluid temperature		Without auto switch: -10 to +70°C (no freezing) With auto switch: -10 to +60°C (no freezing)									
Lubrication		No need (non-lubricant)									
Stroke length tolerance Note 1)		+1.0 0 mm				+1.0 0 mm (Stroke: up to 100mm)					
						+1.4 0 mm (Long stroke: 101 to 300mm)					
Cushion		With or without [Rubber cushion as standard for long stroke (101 to 300mm)]									
Piston speed		0.05 to 0.5 m/sec									
Allowable kinetic energy	Standard	0.022J	0.038J	0.055J	0.09J	0.15J	0.26J	0.46J	0.77J	1.36J	2.27J
	With cushion	0.043J	0.075J	0.110J	0.18J	0.29J	0.52J	0.91J	1.54J	2.71J	4.54J

Action	Single acting						
Bore size	φ12	φ16	φ20	φ25	φ32	φ40	φ50
Fluid	Air						
Proof pressure	1.5 MPa						
Max. operating pressure	1.0 MPa						
Min. operating pressure	0.25 MPa		0.18 MPa		0.17 MPa	0.15 MPa	0.13 MPa
Ambient and fluid temperature	Without auto switch: -10 to +70°C (no freezing) With auto switch: -10 to +60°C (no freezing)						
Lubrication	No need (non-lubricant)						
Stroke length tolerance Note 1)	+1.0 0 mm						
Cushion	Non						
Piston speed	0.05 to 0.5 m/sec						
Allowable kinetic energy	0.022J	0.038J	0.055J	0.09J	0.15J	0.26J	0.46J

Note 1) The stroke length tolerance does not allow for the change of the bumper.



Warning

1) Understand the features of the product before using.

The CQ2 low profile cylinder (hereinafter referred to as the “product”) is designed to minimize various dimensions including the total length for downsizing the whole machine and saving its space. Therefore, when it is used in the same way as the existing cylinders, not only the original performance cannot be maintained long, but also damage and accident can results in some operating conditions.

2) Confirm the specifications.

The product is designed only for use in industrial 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.) Contact SMC in advance for non-industrial use or using with a fluid other than compressed air.

3) A deceleration circuit or shock absorber etc., may be required.

When a driven object is operated at high speed or the load is heavy, a cylinder's cushion will not be sufficient to absorb the shock. Install a deceleration circuit before the end of stroke to reduce the speed before cushioning, or install an external shock absorber to relieve the shock. In this case, the rigidity of the machinery should also be examined.

2. Installation and Handling

2-1. Air supply

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

Warning

1) Use clean air.

Do not use compressed air which contains chemicals, synthetic oils containing organic solvents, salts or corrosive gases, etc., as this can cause damage or malfunction.

Caution

2) Install air filters.

Install air filters close to the upstream side of the valve. A filtration degree of 5mm or less should be selected.

3) Install an aftercooler or air dryer before the filter and take appropriate measures.

Do not use compressed air containing a lot of condensate, which can cause the operating failure of the product and other pneumatic equipment. Install an aftercooler or air dryer before the filter and take appropriate measures.

4) Use the product within the specified range of fluid and ambient temperature.

When operating at temperature below 5oC, water in the circuit may freeze and cause breakage of seal or malfunction. Corrective measures should be taken to prevent the product from freezing.

The allowable temperature range of the standard cylinder is;

- Without switch (-10 to 70°C (No freezing)
- With switch (-10 to 60°C (No freezing)

Note) The difference in the temperature range with and without the switch is due to the operating temperature range of the built-in magnet and the switch, which is -10 to 60oC. All of the seals are the same.

Keep this range for using. If the product is used at a temperature outside of this range, it can be worn excessively by the hardened seals, resulting in air leakage, and lubrication grease can lose its original performance and cause lubrication failure.

For the details of compressed air mentioned above, refer to SMC catalog "Compressed Air Purification System".

5) Lubrication of non-lubricating cylinder

Install a lubricator in the circuit, and use Class 1 turbine oil (with no additive) ISO VG32. Once lubricant is used in the system, lubrication must be continued because the original lubricant applied during manufacturing will be washed away.

2-2 Design

Warning

1) There is a possibility of dangerous sudden action by air cylinders if sliding parts of machinery are twisted due to external forces, etc.

In such cases, human injury may occur, such as by catching hands or feet in the machinery, or damage to the machinery itself may occur. Design the machinery to avoid such dangers.

2) A protective cover is recommended to minimize the risk of personal injury.

If a driven object and moving parts of a cylinder are in close proximity, personal injury may occur. Design the system to avoid contact with the human body.

3) Securely tighten all stationary parts and connected parts so that they will not become loose.

When a cylinder operates with high frequency or a cylinder is installed where there is a lot of vibration, ensure that all parts remain secure.

4) Please design the system so that it will not apply an external force over the maximum force to the product.

The product can break or it may lead to injury or damage to equipment.

5) The product generates a large force, which needs to be considered for appropriate rigidity of a mounting base.

It may lead to injury or damage to equipment.

6) Do not synchronize only cylinders.

Air is a compressive fluid, and difficult to control for velocity since affected by the fluctuation of the supply pressure, load, temperature and lubrication condition, and the deviation of the performance in individual cylinder, and the change of components over time. It is possible to synchronize multiple cylinders for a short period of time by adjusting them with a speed controller. However, the synchronization could be failed easily due to changes of various conditions. When the synchronization is failed, the difference in position will apply an excessive force to the piston rod. The force will be a lateral load, which can cause uneven wear of the seals, the abrasion of the bushing and the gal between the cylinder tube and piston. For this reason, avoid designing the system in such way that it will be synchronized only by cylinders. If the synchronized use is unavoidable, provide a guide with high rigidity and high precision to prevent the failure of synchronization against the difference in force of cylinders.

7) Consider the possibility of a reduction in the circuit air pressure that could be caused by power outages.

When a cylinder is used in the 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 outage, etc.

Therefore, safety equipment should be installed to prevent damage to machinery and human injury.

Suspension equipment and lifting devices also require a measure to prevent a drop.

8) Consider a possible loss of power source.

Measures should be taken to protect against human injury and equipment damage in the event that there is a loss of power to equipment controlled by air pressure, electricity or hydraulics, etc.

9) Consider emergency stop.

Design the system so that when it is stopped by a safety device for abnormal conditions, such as a power outage or manual emergency stop, human injury and/or damage to machinery and equipment will not be caused.

10) Consider the action when operation is restarted after an emergency stop or abnormal stop.

Design the machinery so that human 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.

11) Intermediate stop

It is difficult for this product to make a piston stop at the required intermediate position accurately and precisely by a 3 position closed center type directional control valve due to 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. Contact SMC if it is necessary to hold the stopped position for extended periods of time.

! Caution

1) Operate the product within a range such that the piston will not collide and be damaged at the stroke end.

If the piston with inertia force is expected to stop by collision to the cover at the stroke end, use it within a range that will not cause damage. Refer to 3-6 Allowable kinetic energy.

2-3. Mounting and Installation

! Caution

1) Do not apply excessive lateral load to the piston rod.

The load applied to the piston rod should be in an axial direction all the time. If a lateral load is unavoidable, keep the lateral load to the bushing 1/20 or less of the maximum cylinder force.

(1) Single rod

Calculation of allowable lateral load

$$f_B = \frac{F}{20}, F = \frac{\pi}{4} D^2 \cdot P$$

$$f_R \leq \frac{L_1}{L_1 + (L_2 + \text{Stroke})} \cdot f_B$$

F: Maximum force (MPa)

f_B : Maximum load applied to the bushing (N)

D: Bore size (mm)

P: Maximum operating pressure (MPa)

f_R : Allowable lateral load (N)

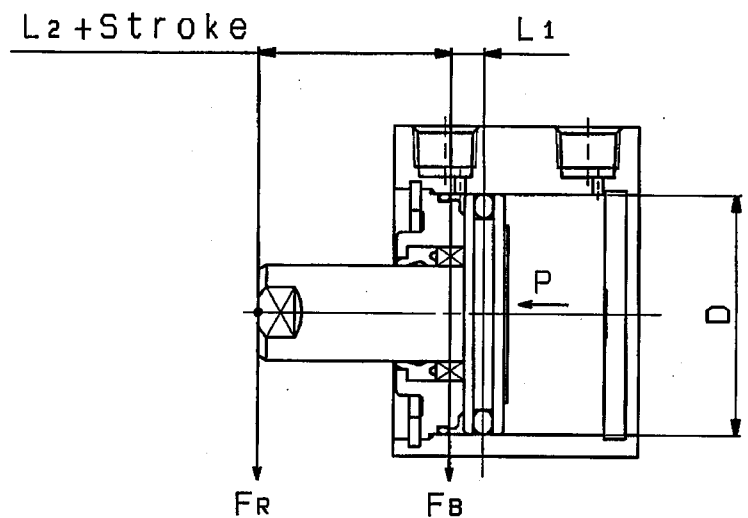


Fig. 1

Table 1 Without auto switch

D (mm)	L1 (mm)	L2 (mm)	fB (N)	Stroke range (mm)
12	6.3	9.8	5.65	5 to 30
16	6.5	10.0	10.1	
20	7.6	9.9	15.7	5 to 50
25	8.7	10.8	24.5	
32	8.9	13.3	40.2	5 to 50
	13.9			51 to 100
	24.2	22.5		101 to 300
40	7.7	19.4	62.8	5 to 50
	12.7			51 to 100
	26.7	24.3		101 to 300
50	7.5	19.5	98.2	10 to 50
	12.5			51 to 100
	25.0	26.5		101 to 300
63	8.5	20.5	156	10 to 50
	13.5			51 to 100
	26.5	27.5		101 to 300
80	11.2	24.3	251	10 to 50
	16.2			51 to 100
	30.0	31.5		101 to 300
100	13.5	28.7	393	10 to 50
	18.5			51 to 100
	32.0	36.0		101 to 300

Note 2) When the load is connected at the rod end, add the distance to the center of gravity of the load to the L2 dimension.

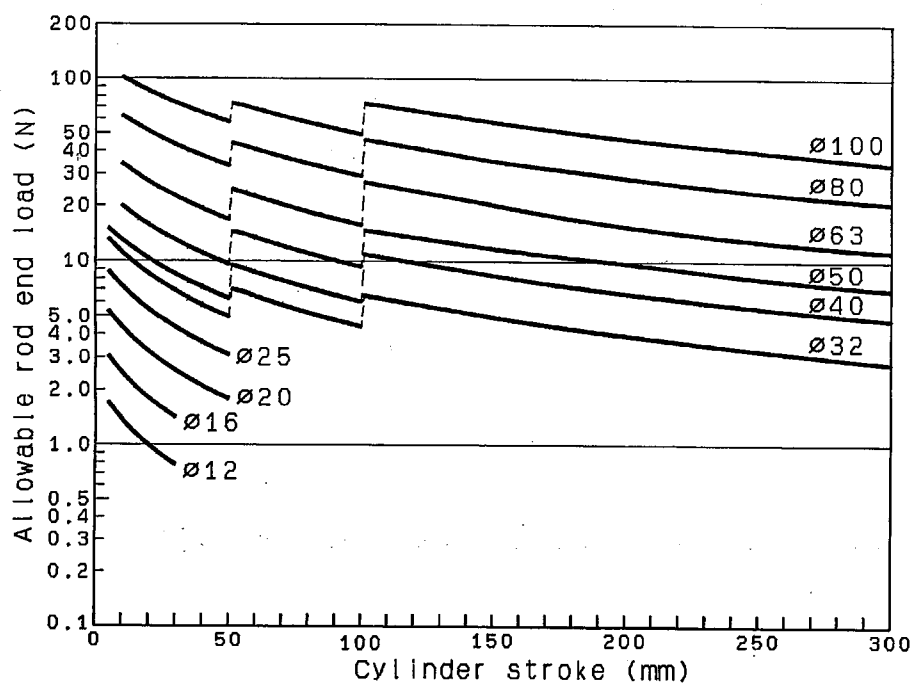


Fig. 2 Allowable lateral load at rod end (single rod/without switch)
The bold solid lines in Fig. 2 show allowable lateral load to cylinders.

Table 2 With auto switch

D (mm)	L1 (mm)	L2 (mm)	fB (N)	Stroke range (mm)
12	9.9	9.8	5.65	5 to 30
16	11.5	10.0	10.1	
20	13.6	9.9	15.7	5 to 50
25	13.7	10.8	24.5	
32	13.9	13.3	40.2	5 to 100
	24.2	22.5		101 to 300
40	12.7	19.4	62.8	5 to 100
	26.7	24.3		101 to 300
50	12.5	19.5	98.2	10 to 100
	25.0	26.5		101 to 300
63	13.5	20.5	156	10 to 100
	26.5	27.5		101 to 300
80	16.2	24.3	251	10 to 100
	30.0	31.5		101 to 300
100	18.5	28.7	393	10 to 100
	32.0	36.0		101 to 300

Note 3) When the load is connected at the rod end, add the distance to the center of gravity of the load to the L2 dimension.

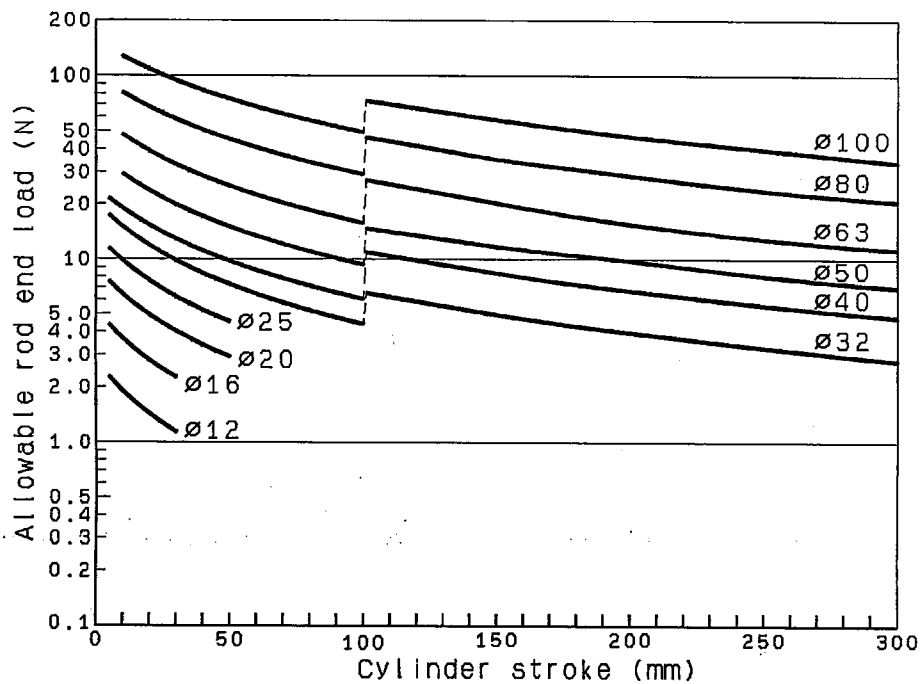


Fig. 3 Allowable lateral load at rod end (single rod/with switch)
The bold solid lines in Fig. 3 show allowable lateral load to cylinders.

(2) Double rod

Calculation of allowable lateral load

$$f_B = \frac{F}{20}, F = \frac{\pi}{4} D^2 \cdot P$$

$$f_R \leq \frac{L_1}{(L_1 + \text{Stroke}) + (L_2 + \text{Stroke})} \cdot f_B$$

F: Maximum force (MPa)

f_B: Maximum load applied to the busing (N)

D: Bore size (mm)

P: Maximum operating pressure (MPa)

f_R: Allowable lateral load (N)

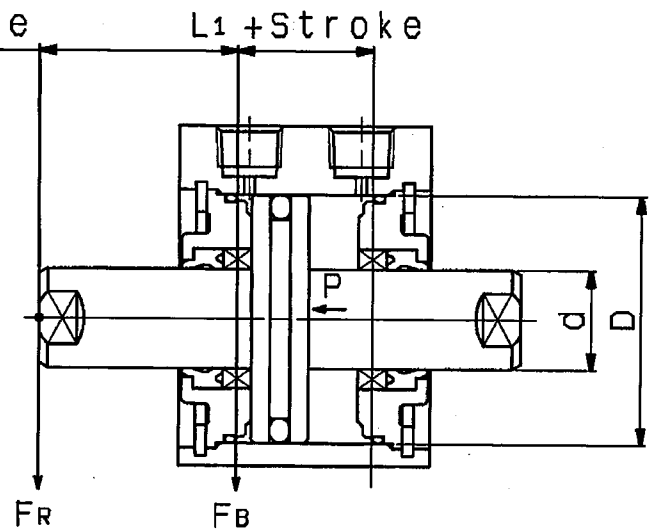


Fig. 4

Table 3

D (mm)	d (mm)	L1 (mm)		L2 (mm)	f _B (N)	Stroke range (mm)
		Without auto switch	With auto switch			
12	6	12.6	19.8	9.8	4.24	5 to 30
16	8	13.0	23.0	10.0	7.54	
20	10	15.3	27.3	9.9	11.8	5 to 50
25	12	17.5	38.0	10.8	18.9	
32	16	17.8	27.8	13.3	30.2	5 to 50
		27.8				51 to 100
40	16	15.5	25.5	19.3	52.8	5 to 50
		25.5				51 to 100
50	20	17.5	27.5	19.5	82.5	10 to 50
		27.5				51 to 100
63	20	17.0	27.0	20.5	140	10 to 50
		27.0				51 to 100
80	25	22.5	32.5	24.3	227	10 to 50
		32.5				51 to 100
100	30	27.0	37.0	28.7	357	10 to 50
		37.0				51 to 100

Note 4) When the load is connected at the rod end, add the distance to the center of gravity of the load to the L2 dimension.

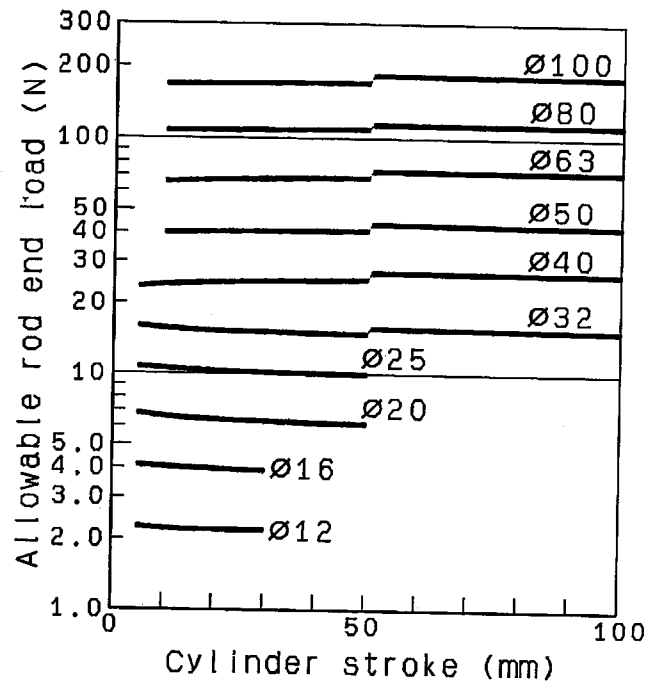


Fig. 5 Allowable lateral load at rod end (double rod/without switch)
The bold solid lines in Fig. 5 show allowable lateral load to cylinders.

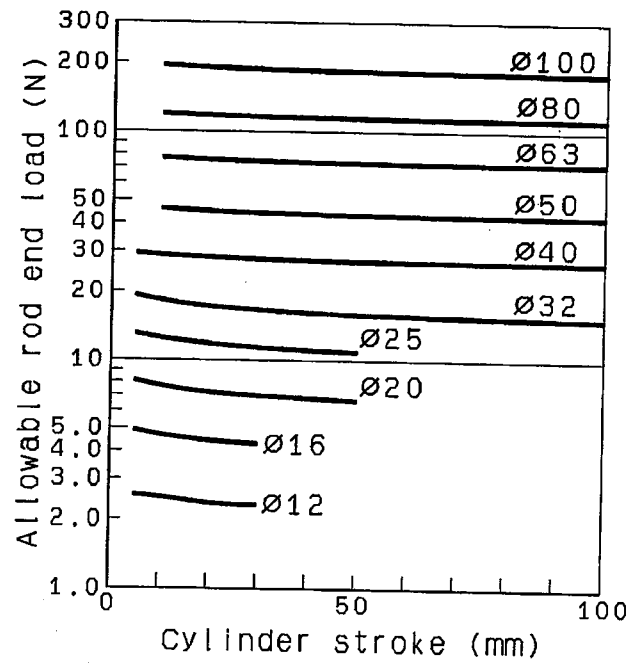


Fig. 6 Allowable lateral load at rod end (double rod/with switch)
The bold solid lines in Fig. 6 show allowable lateral load to cylinders.

2) Make sure to connect the piston rod and the load so that their axial center and movement directions match.

If they do not match, stress could be applied to the rod and the tube, causing the inner surface of the tube, the bushing, the rod surface, and the seals to wear and to become damaged.

3) When an external guide is used, connect the piston rod end and the load in such a way that there is no interference at any point within the stroke.

4) Do not strike or grasp the sliding parts of the cylinder tube and piston rod with other objects.

Cylinder bores are manufactured to precise tolerances, so that even a slight deformation may cause faulty operation. Moreover, scratches or dents, etc. in the piston rod may lead to damaged seals and cause air leakage.

5) Do not use the product until you verify that the equipment can operate properly.

After installation, repair or reconstruction, apply operating pressure and power to the equipment and perform appropriate functional and leakage tests to make sure the equipment is mounted properly.

6) Do not let foreign matter such as cutting chips get into the product from the supply port.

When the product is installed to the machine at a field, the debris from drilled mounting holes can get in the supply port of the product, which is placed below, and take sufficient care to prevent it.

7) When mounting and removing the load, be sure to fix the cylinder at the wrench flat of the piston rod.

In particular, when the load is removed from the double rod type, this instruction must be followed. If the piston rod is not fixed at the load side, the jointed (screwed) part of the piston rod can be loosen.

8) Shorten the length of piping.

If the product piping is too long, the vapor generated by the adiabatic expansion volume in the tube becomes larger than that in the product, and it cannot be exhausted to the air and remains in tubing. It is accumulated by repeated operation and forms water drops. As grease inside the product is washed away, lubrication deteriorates, which can wear the seals and cause air leakage and increased friction resistance resulting in operation failure. Take the following measures to prevent air leakage and malfunction.

- (1) Make the tubing between solenoid valve and cylinder as short as possible so that the generated mist is surely exhausted into atmosphere. As a guide,

Conversion value for volume inside the cylinder under atmospheric pressure $\times 0.7 \leq$ volume inside the piping

- (2) Release the exhaust pressure directly into atmosphere by installing the speed exhaust controller ASV or quick exhaust valve to cylinder.

- (3) Set the piping port downwards so that moisture inside the piping does not go back to cylinder easily.

2-4. Environment

Warning

1) Do not use in environments where there is a danger of corrosion.

Refer to the construction drawings regarding product materials.

2) Install a cover over the rod if it is used in an area that is dusty, or in an environment in which water or oil splashes on the cylinder.

3) Avoid high humid place for the storage of the product.

Store the product in a place without a lot of humidity and with the piston rod retracted and prevent the occurrence of rust.

Caution

4) Before piping

Confirm that chips, cutting oils, dusts, etc., in contact with piping is cleaned up or air blown (flushed) before piping.

5) Sealant tape

When installing piping or fitting into a port, prevent cutting chips and sealant material from getting inside the piping. If a sealant tape is used, leave 1.5 to 2 threads exposed.

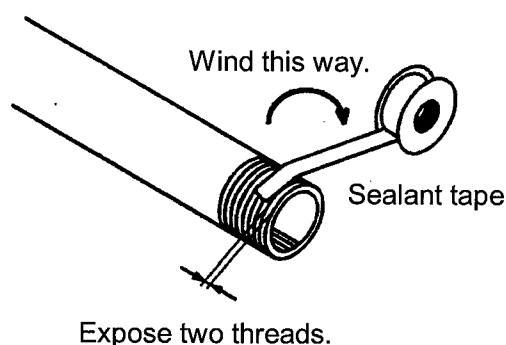


Fig. 7

2-5 Speed control

When the piston speed is adjusted, install SMC's AS series speed controller near the air supply port to adjust to the specified speed. There are two types speed adjustments, one is to restrict air supplied to the product and the other is to restrict air exhausted from the product, and normally, the meter-out type should be adopted.

Caution

Piston speed should be controlled gradually from low speed to the specific speed with a speed controller.

2-6 Allowable kinetic energy

The product is shortened in the entire length and lightened from the existing cylinders, and these changes make it less tolerant to the kinetic energy and lateral load. Confirm the allowable kinetic energy and lateral load before using and keep them.

When an inertia load is actuated, keep the kinetic energy of the product lower than the values given in the table below. The range surrounded with the bold solid line in Fig. 8 shows the relation between the allowable load weight and maximum piston speed.

Table 4 Piston speed and kinetic energy

Bore size (mm)		12	16	20	25	32	40	50	63	80	100
Piston speed (m/s)		0.05 to 0.5									
Allowable kinetic energy (J)	Without cushion	0.022	0.038	0.055	0.09	0.15	0.26	0.46	0.77	1.36	2.27
	With cushion	0.043	0.075	0.110	0.18	0.29	0.52	0.91	1.54	2.71	4.54

$$\text{Kinetic energy } E(J) = \frac{(m1+m2) \cdot V^2}{2}$$

m1: Weight of product moving part [kg]

m2: Load weight [kg]

V: Piston speed [m/s]

Refer to the catalogue for the detail of the weight of product moving part.

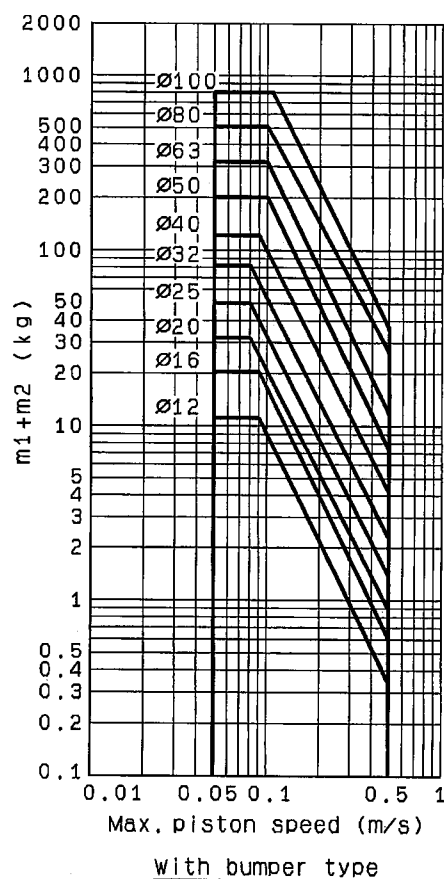
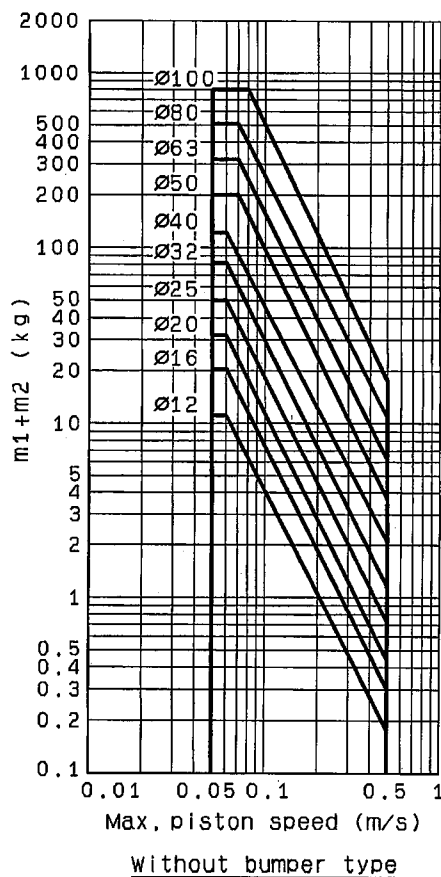


Fig. 8 Operating range and kinetic energy

2-7. Direction control

To switch the cylinder operating direction, select an applicable solenoid valve from SMC's various kinds of solenoid valves.

Warning

1) Design a circuit to prevent sudden extension of a driven object.

When the product is actuated by an exhaust center type directional control valve or 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, a driven object will extend at high speed. In such cases, human injury may occur, such as by catching hands or feet in the machinery, or damage to the machinery itself may occur. Select equipment necessary and design the machinery to avoid such extension.

2) Intermediate stop

It is difficult for this product to make a piston stop at the required intermediate position accurately and precisely by a 3 position closed center type directional control valve due to 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. Contact SMC if it is necessary to hold the stopped position for extended periods of time.

2-8. Auto switches

Refer to the catalogue for the type of applicable auto switches and specifications.) Also, for the handling of the auto switch, refer to the Operation Manual of the auto switch.

2-8-1. Proper mounting position for the stroke end detection

Table 5 Appropriate mounting position of auto switch/Double acting and single rod (mm)

Auto switch model Bore size (mm)	D-A9■ D-A9■V		D-M9■ D-M9■V D-M9■W D-M9■WV D-M9■AL D-M9■AVL		D-A73 D-A80		D-A72/A7■H/A80H D-A73C/A80C/F7■ D-F79F/J79/F7■V D-J79C/F7■W D-J79W/F7■WV D-F7BAVL/F7BAL		D-F7NTL		D-A79W		D-P3DW■	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
12	2	3	6	7	4.5	5.5	5	6	10	11	2	3	-	-
16	5	2.5	9	6.5	7.5	5	8	5.5	13	10.5	5	2.5	-	-
20	5	3.5	9	7.5	7.5	6	8	6.5	13	11.5	5	3.5	-	-
25	5.5	4	9.5	8	8	6.5	8.5	7	13.5	12	5.5	4	-	-
32	8	5	12	9	9	6	9.5	6.5	14.5	11.5	6.5	3.5	2.5	0
40	12	7.5	16	11.5	13	8.5	13.5	9	18.5	14	10.5	6	6.5	2
50	10	10.5	14	14.5	11	11.5	11.5	12	16.5	17	8.5	9	4.5	4.5
63	12.5	13.5	16.5	17.5	13.5	14.5	14	15	19	20	11	12	7	7.5
80	15.5	18	19.5	22	16.5	19	17	19.5	22	24.5	14	16.5	10	12
100	20	23	24	27	21	24	21.5	24.5	26.5	29.5	18.5	21.5	14.5	17.5

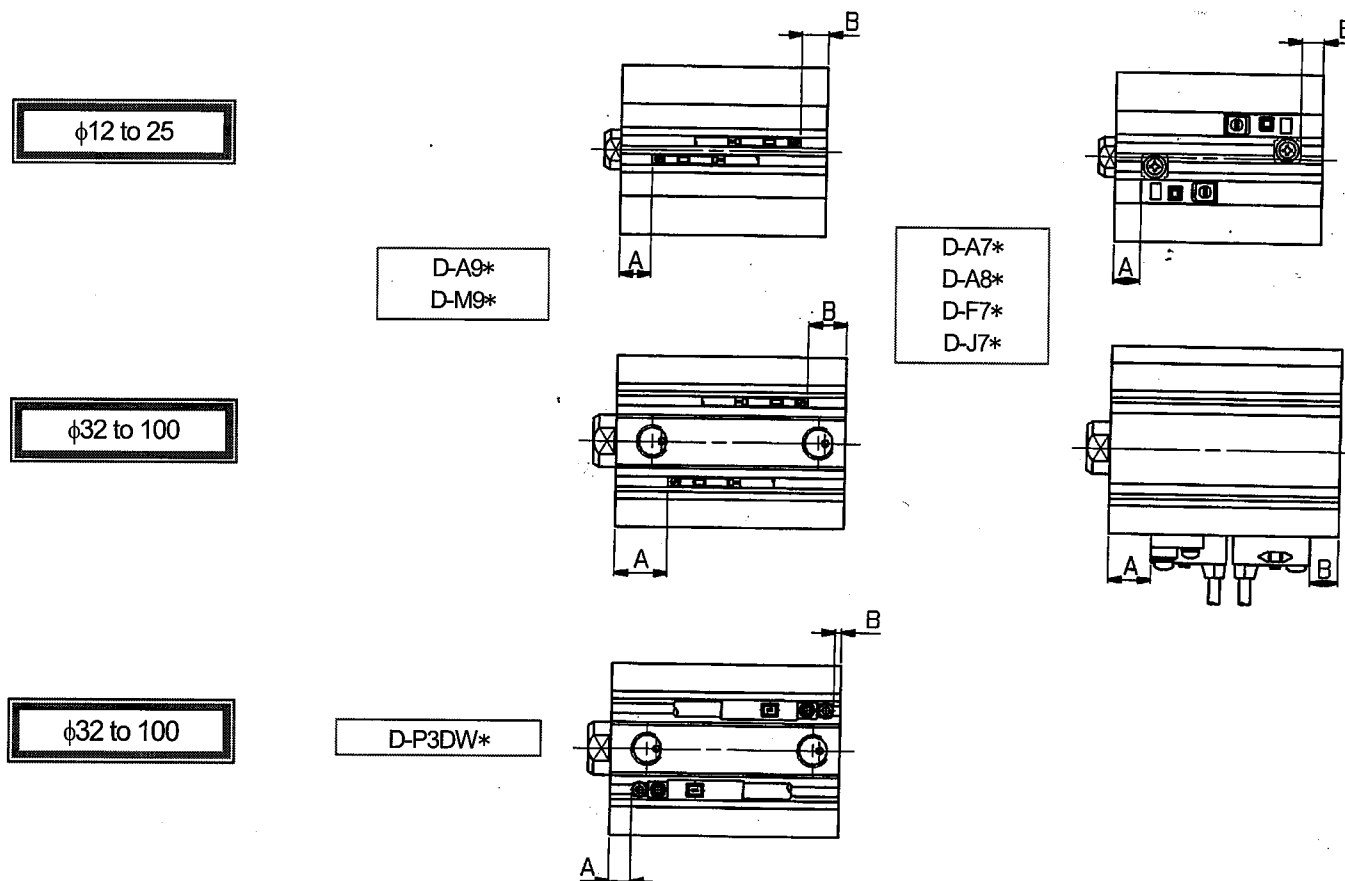


Fig. 9 Appropriate mounting position of auto switch

Table 6 Appropriate mounting position of auto switch/Double acting and double rod (mm)

(mm)

Auto switch model Bore size (mm)	D-A9■ D-A9■V		D-M9■ D-M9■V D-M9■W D-M9■WV D-M9■AL D-M9■AVL		D-A73 D-A80		D-A72/A7■H/A80H D-A73C/A80C/F7■ D-F79F/J79/F7■V D-J79C/F7■W D-J79W/F7■WV D-F7BAVL/F7BAL		D-F7NTL		D-A79W		D-P3DW■	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
12	2	7.5	6	11.5	4.5	10	5	10.5	10	15.5	2	7.5	-	-
16	5	8	9	12	7.5	10.5	8	11	13	16	5	8	-	-
20	5	10	9	14	7.5	12.5	8	13	13	18	5	10	-	-
25	5.5	10.5	9.5	14.5	8	13	8.5	13.5	13.5	18.5	5.5	10.5	-	-
32	8	12.5	12	16.5	9	13.5	9.5	14	14.5	19	6.5	11	2.5	7
40	12	18	16	22	13	19	13.5	19.5	18.5	24.5	10.5	16.5	6.5	12.5
50	10	20.5	14	24.5	11	21.5	11.5	22	16.5	27	8.5	19	4.5	14.5
63	12.5	19.5	16.5	23.5	13.5	20.5	14	21	19	26	11	18	7	13.5
80	15.5	25.5	19.5	29.5	16.5	26.5	17	27	22	32	14	24	10	19.5
100	20	30.5	24	34.5	21	31.5	21.5	32	26.5	37	18.5	29	14.5	25

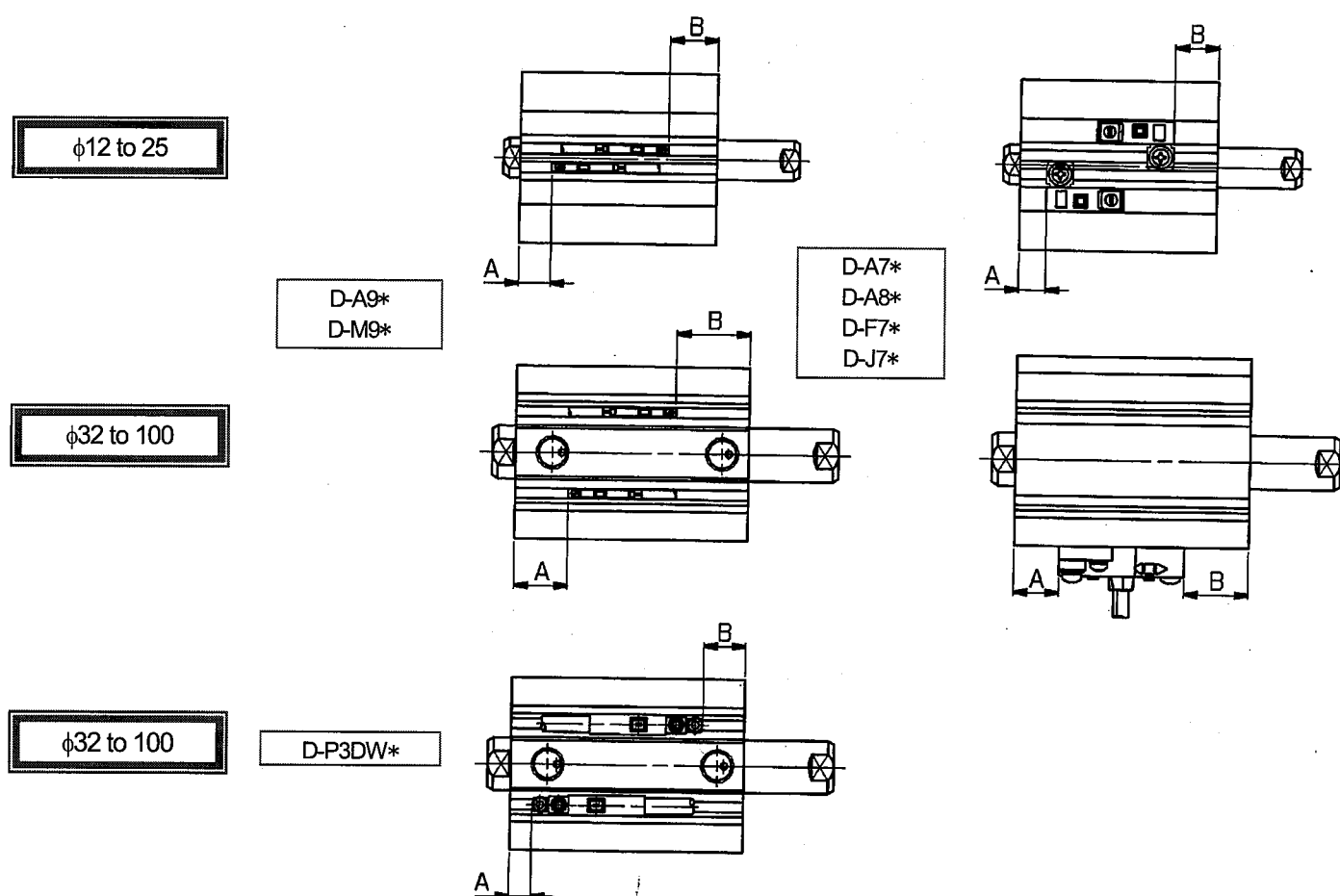


Fig. 10 Appropriate mounting position of auto switch

Table 7 Appropriate mounting position of auto switch/Single acting

(mm)

Auto switch model Bore Size (mm)	D-A9■ D-A9■V		D-M9■ D-M9■V D-M9■W D-M9■WV D-M9■AL D-M9■AVL		D-A73 D-A80		D-A72/A7■H/A80H D-A73C/A80C/F7■ D-F79F/J79/F7■V D-J79C/F7■W D-J79W/F7■WV D-F7BAVL/F7BAL		D-F7NTL		D-A79W	
	A	B	A	B	A	B	A	B	A	B	A	B
12	2	3 (7.5)	6	7 (11.5)	4.5	5.5 (10)	5	6 (10.5)	10	11 (15.5)	2	3 (7.5)
16	5 (3)	2.5 (4.5)	9 (7)	6.5 (8.5)	7.5 (5.5)	5 (7)	8 (6)	5.5 (7.5)	13 (11)	10.5 (12.5)	5 (3)	2.5 (4.5)
20	5	3.5	9	7.5	7.5	6	8	6.5	13	11.5	5	3.5
25	5.5	4	9.5	8	8	6.5	8.5	7	13.5	12	5.5	4
32	8	5	12	9	9	6	9.5	6.5	14.5	11.5	6.5	3.5
40	12	7.5	16	11.5	13	8.5	13.5	9	18.5	14	10.5	6
50	10	10.5	14	14.5	11	11.5	11.5	12	16.5	17	8.5	9

Note 5) The value in () is for the spring-extended type.

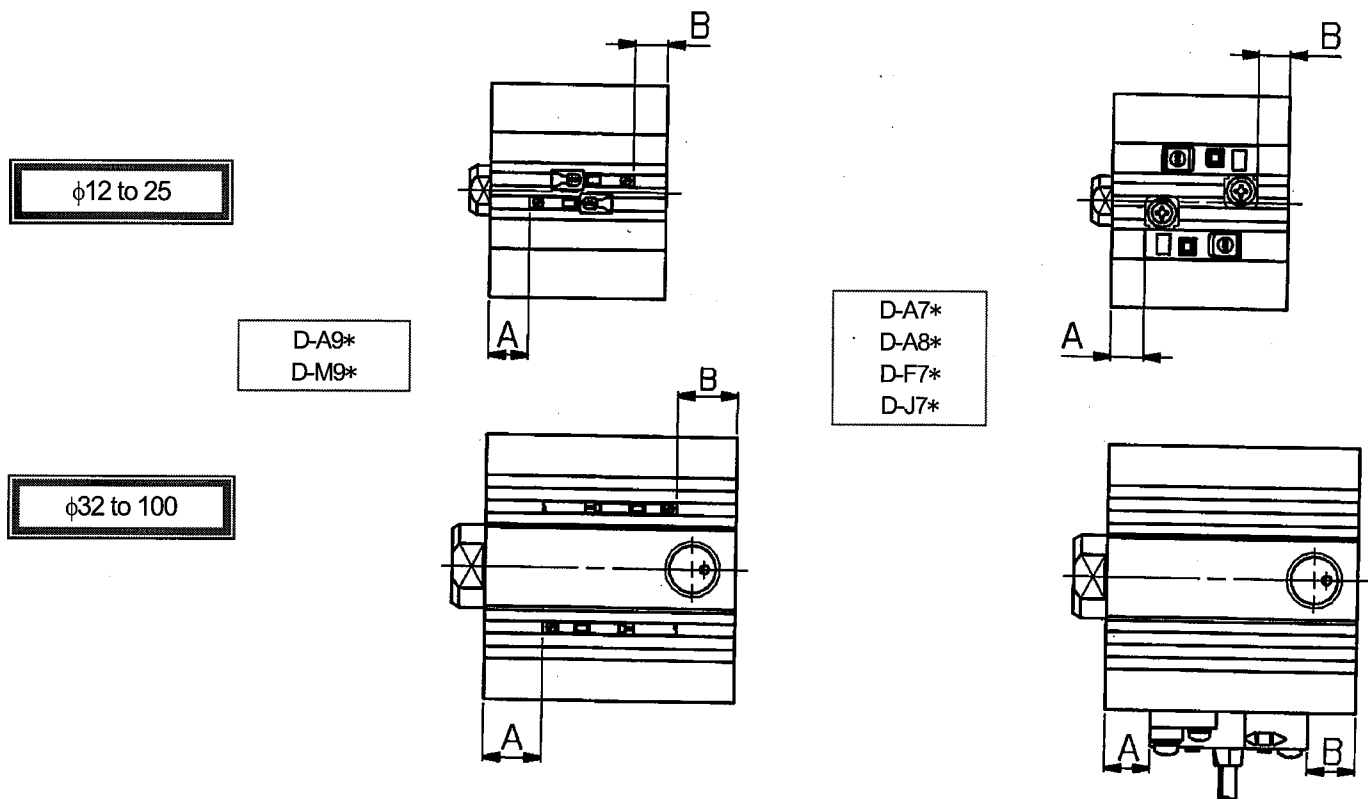


Fig. 11 Appropriate mounting position of auto switch

Table 8 Appropriate mounting position of auto switch/Long stroke type

(mm)

Auto switch model Bore size (mm)	D-A9■ D-A9■V		D-M9■ D-M9■V D-M9■W D-M9■WV D-M9■AL D-M9■AVL		D-A73 D-A80		D-A72/A7■H/A80H D-A73C/A80C/F7■ D-F79F/J79/F7■V D-J79C/F7■W D-J79W/F7■WV D-F7BAVL/F7BAL		D-F7NTL		D-A79W		D-P3DW■	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
32	8.5	16.5	12.5	20.5	9.5	17.5	10	18	15	23	7	15	3	11
40	12	22.5	16	26.5	13	23.5	13.5	24	18.5	29	10.5	21	6.5	17
50	10	25.5	14	29.5	11	26.5	11.5	27	16.5	32	8.5	24	4.5	19.5
63	12.5	24.5	16.5	28.5	13.5	25.5	14	26	19	31	11	23	7	18.5
80	15.5	30.5	19.5	34.5	16.5	31.5	17	32	22	37	14	29	10	24.5
100	18.5	37	22.5	41	19.5	38	20	38.5	25	43.5	17	35.5	13	31

φ32 to 100

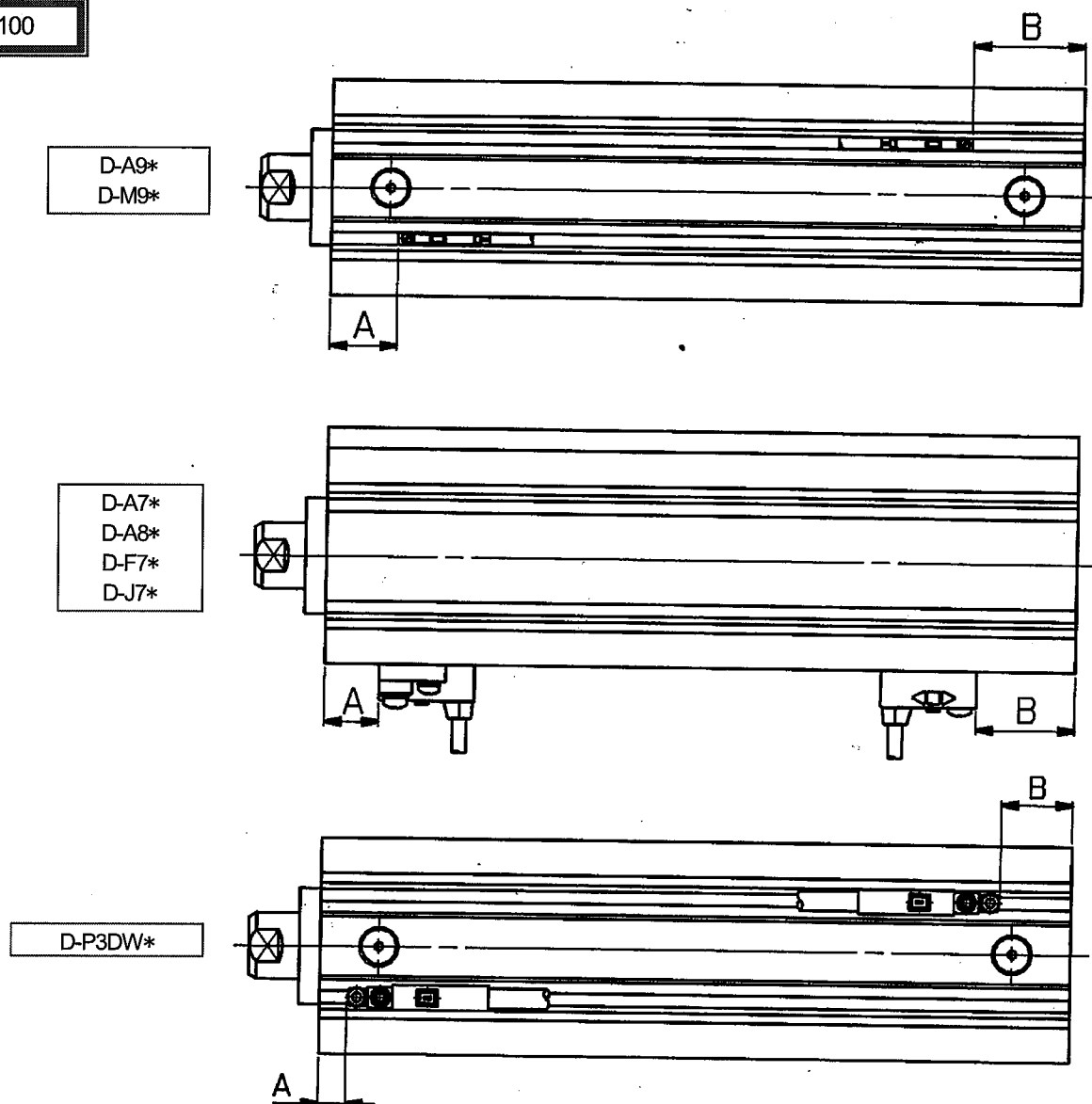


Fig. 12 Appropriate mounting position of auto switch

2-8-2. Minimum stroke for auto switch

If the auto switch is used for the minimum stroke, and mounted in an appropriate place, it can turn on all over the entire stroke when it is mounted alone, or when there are two pieces, they can turn on simultaneously in the middle of stroke. In that case, refer to 3-8-3. Mounting of auto switch and adjust the mounting position of the auto switch(es).

Table 8 Minimum stroke for auto switch

No. of mounted auto switch	D-M9■V D-F7■V D-J79C	D-A9■V D-A7■ D-A80 D-A73C D-A80C	D-A9■	D-M9■WV D-M9■AVL D-F7■WV D-F7BAVL	D-M9■ D-M9■W D-M9■AL D-A7■H D-A80H D-F7■ D-J79	D-A79W	D-F7■W D-J79W D-F7BAL D-F79F D-F7NTL	D-P3DW■
1 pc.	5	5	10	10	15	15	20	15
2 pcs.	5	10	10	15	15	20	20	15

2-8-3. Mounting of auto switch

(1) D-M9■ and D-A9■

To mount the auto switch, insert it to the mounting groove of the cylinder from the direction shown in Fig. 13, set in an appropriate place, and tighten by the associated mounting screws. For the tightening of the mounting screws, use a watchmakers screwdriver with the handle diameter of about 5 to 6 mm. The tightening torque is 0.05 to 0.15Nm for D-M9■ and 0.10 to 0.20Nm for D-A9■. Rotate roughly additional 90 degree from the position in which the tightening feeling went out.

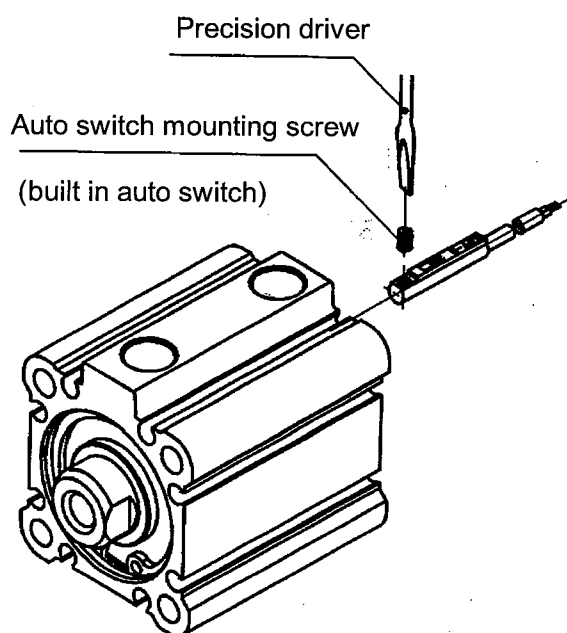


Fig. 13

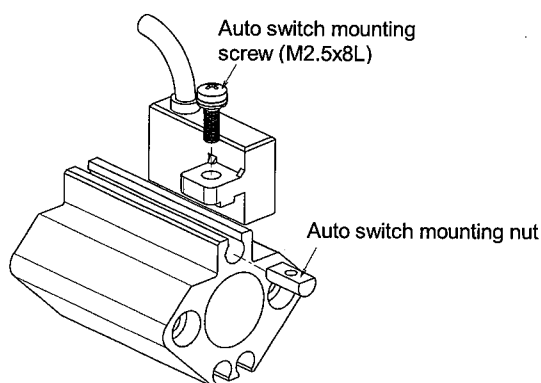
(2) D-A7■■■, D-A80■■■, D-F7■■■ and D-J79■■■

$\phi 12$ to 25

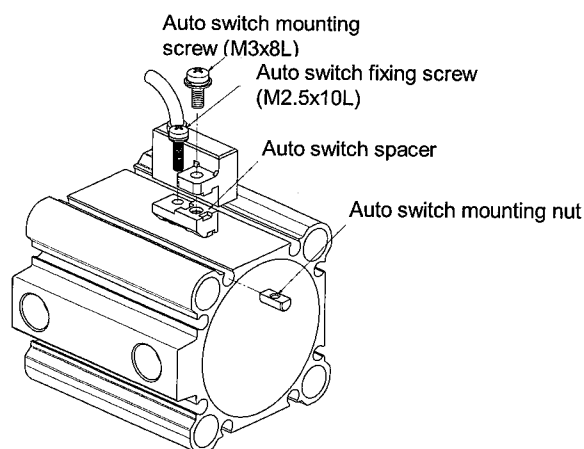
1. Insert the auto switch mounting nut into the auto switch mounting slot on the cylinder tube, and place it in the roughly estimated setting position.
2. Engage the ridge on the auto switch mounting arm with the recess in the cylinder tube rail, and slide it to the position of the auto switch mounting nut.
3. Gently screw the auto switch mounting screw into the thread of the auto switch mounting nut through the mounting hole on the auto switch mounting arm.
4. Confirm where the mounting position is, and tighten the auto switch mounting screw to fix the auto switch. The tightening torque of the M2.5 screw must be 0.25 to 0.35N.
5. The detection position can be changed under the conditions in step 3.

$\phi 32$ to 100

1. Insert the nut into the auto switch mounting slot on the cylinder tube, and place it in the roughly estimated setting position.
2. With the lower tapered part of the auto switch spacer facing the outside of the cylinder tube, line up the M2.5 through hole with the M2.5 female of the auto switch mounting nut.
3. Gently screw the auto switch mounting nut fixing screw (M2.5) into the thread of the auto switch mounting nut through the mounting hole.
4. Engage the ridge on the auto switch mounting arm with the recess in the auto switch spacer.
5. Tighten the auto switch mounting screw (M3) to fix the auto switch. The tightening torque of the M3 screw must be 0.35 to 0.45 Nm.
6. Confirm where the mounting position is, and tighten the auto switch fixing screw (M2.5) to fix the auto switch mounting nut. The tightening torque of M2.5 screw must be 0.25 to 0.35Nm.)
7. The detection position can be changed under the conditions in step 5.



$\phi 12$ to 25



$\phi 32$ to 100

Fig. 14

Table 10 Part number of auto switch mounting bracket

Bore size (mm)	Part no. of mounting bracket	Remarks
12, 16, 20, 25	BQ4-012	<ul style="list-style-type: none"> • Auto switch mounting screw • Auto switch mounting nut
32, 40, 50, 63, 80, 100	BQ5-032	<ul style="list-style-type: none"> • Auto switch fixing screw • Auto switch mounting screw • Auto switch spacer • Auto switch mounting nut

Note 6) When the magnet is built in, two auto switch mounting brackets are enclosed.

3. Maintenance



Caution

1) Mounting and removal of retaining ring

Use appropriate pliers (C retaining ring mounting tool) for mounting and removing the retaining ring.

Even if the appropriate pliers (C retaining ring mounting tool) is used, the ring will slip off from the end of the pliers, and cause injury or damage to peripheral equipment. Additionally, ensure the retaining ring is mounted properly into the retaining ring groove before supplying air.

3-1 Replacement of seals

a) Disassembly of cylinder

(1) Cleaning of external surface

Remove dusts and foreign matters from external surfaces to prevent them from entering the cylinder during disassembly. In particular, the surface of the piston rod and the collar should be cleaned carefully.

(2) Removal of retaining ring

Use appropriate pliers (basic internal retaining ring mounting tool) for removing the retaining ring. Pay attention that the ring will slip off from the end of the pliers, and cause injury or damage to peripheral equipment.

(3) Disassembly

Pull out the piston rod together with the collar through the bolt or nut mounted to the piston rod end, and take the collar out from the piston rod. At that time, take care not to damage the internal surface of the cylinder tube and the bushing of the collar.

b) Removal of seals

(1) Rod seal

Insert the fine driver from the back of the rod cover and collar to pull out the rod seal. Do not damage the seal groove on the collar at this time.

(2) Piston seal

As the piston seal groove is deep, push out the seal manually, without using the precision screwdriver, and pull out the seal stood out. (Fig. 15)

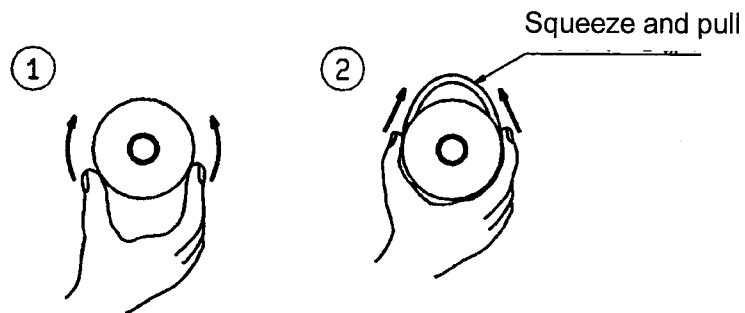


Fig. 15 Piston seal

(3) Tube gasket

Push out and pull out the gasket stood out manually.

c) Application of grease

(1) Rod seal and piston seal

Apply grease around the replacement seal. Fill grease in the groove. (Fig. 16)



Fig. 16 Rod seal

(2) Tube gasket

Apply grease thinly.

(3) Parts of cylinder

Apply grease to the sliding part of each part.(Fig. 17)

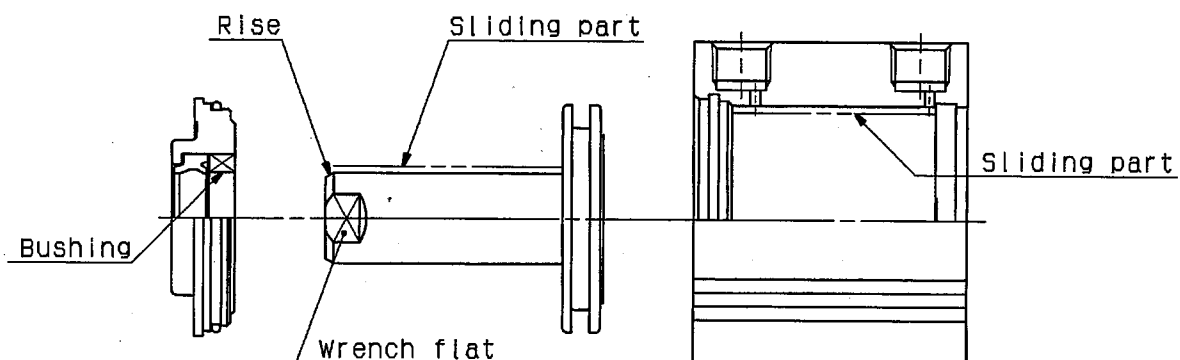


Fig. 17

d) Mounting of seal

(1) Rod seal

Mount the seal in the correct direction. (Fig. 18)

After mounting, apply grease to the seal and bushing evenly.

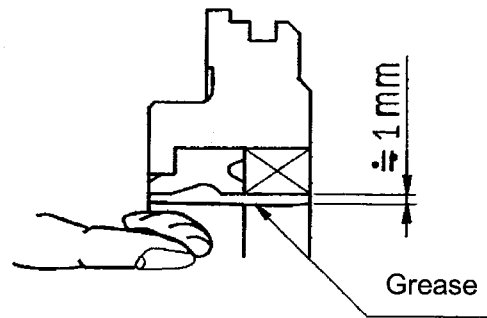


Fig. 18 Rod seal

(2) Piston seal

Mount without twisting. After mounting, apply grease to the external circumference of the seal, and the gap to the mounting groove.

(3) Tube gasket

Mount with care not to drop.

e) Assembly of cylinder

(1) Insertion of collar to piston rod

Apply grease to the piston rod end or 30° angled raise and wrench flat, and insert the collar gently with care not to damage the rod seal.

(2) Insertion of piston and collar to cylinder tube

Apply grease to appropriate parts of the cylinder tube, and insert the piston and collar gently without any damage to them by the retaining ring groove.

(3) Mounting of retaining ring

Use appropriate pliers (basic internal retaining ring mounting tool) for mounting the retaining ring. Pay attention that the ring will slip off from the end of the pliers, and cause injury or damage to peripheral equipment. Additionally, ensure the retaining ring is mounted properly into the retaining ring groove.

(4) Check of assembly

Check there is no air leakage at the seal and the minimum operating pressure can realize smooth operation.

3-2 Checks

3-2-1 Daily check

- 1) Whether the operation is smooth or not.
- 2) Change of piston speed and cycle time.
- 3) Proper stroking

3-2-2 Regular check

- 1) Looseness of mounting bolts and rod end nuts
- 2) Looseness of mounting frame and excessive deflection
- 3) Whether the operation is smooth or not.
- 4) Change of piston speed and cycle time.
- 5) External leakage
- 6) Proper stroking
- 7) Scratches on piston rod
- 8) Scratches on external surfaces
- 9) Whether drainage in the air filter is regularly discharged or not.

Check the above points at least, and retighten or contact the sales representative if any failure is found.



Warning

1) Maintenance should be performed according to the items above.

Improper handling can cause damage and malfunction of equipment and machinery.

2) Removal of equipment, and supply/exhaust of compressed air

When equipment is serviced, first confirm that measures are in place to prevent dropping of driven objects and run-away of equipment, etc. Then cut the supply pressure and power, and exhaust all compressed air from the system using its residual pressure release function.

When machinery is restarted, check that operation is normal with actuators in the proper positions.

3-3 Consumable parts

3-3-1 Replacement parts

The replacement parts can be ordered as shown below.

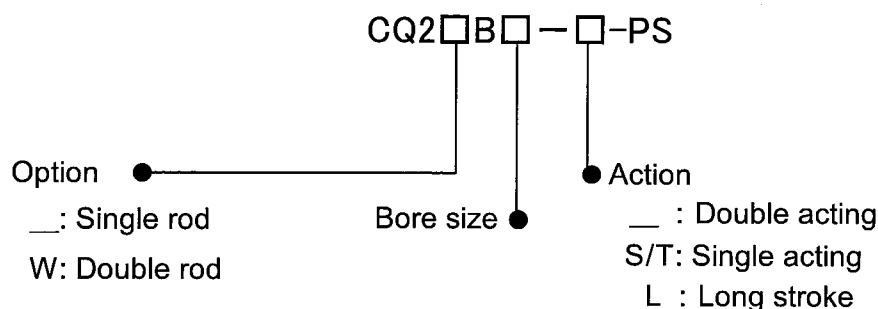


Table 11 Seal kit

		Part no.	Including and quantity		
			Rod seal	Piston seal	Tube gasket
Single rod	Double acting	CQ2B□-PS	1	1	1
	Spring retracted	CQ2B□-S-PS	—	1	—
	Spring extended	CQ2B□-T-PS	1	1	1
	Long stroke	CQ2B□-L-PS	1	1	2
Double rod		CQ2WB□-PS	2	1	2

The delivered rod seal is not enclosed for storage independently, and must be used for 1 year. When storage for a longer period is expected, enclose it by packaging (by putting into a polyethylene bag and

3-3-2 Storage of seals

- 1) Enclose seals by packaging and store.
- 2) Avoid locations exposed to direct sunlight and high temperature and humidity.
In particular, isolate from equipment that can generate heat, radiation and ozone.
- 3) Do not stack a lot of seals, and deform or damage it by putting a heavy object on it.
- 4) White particles can emerge from the surface of seals during storage, but they do not affect its performance.

3-3-3.

When adding grease during the replacement of seals or maintenance of the cylinder, use a grease package.

Table 12 Grease package

Part no.	Grease weight
GR-S-010	10g
GR-S-020	20g

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.

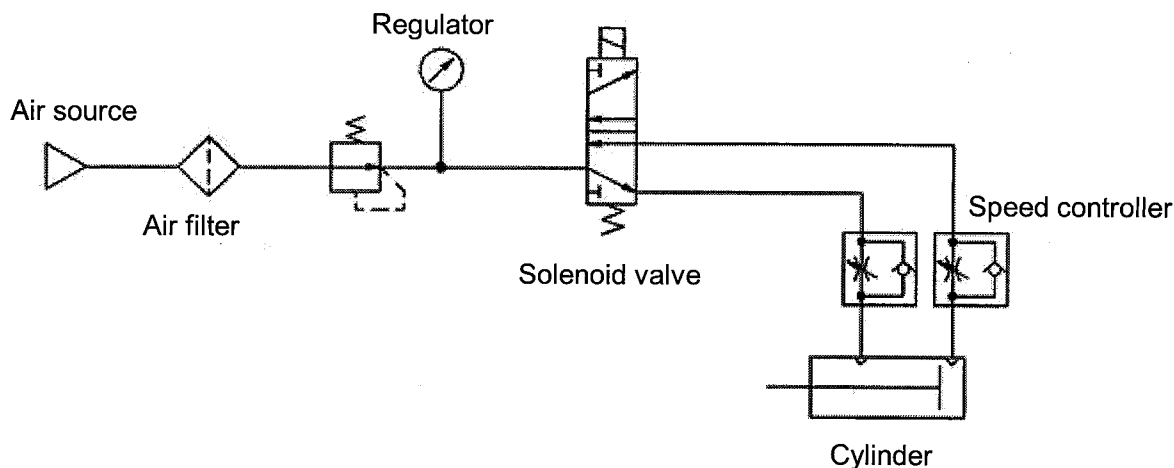


Fig. 19 Air circuit

5. Troubleshooting

Trouble	Possible cause	Countermeasures	Referential section
Operation is not smooth. Force has decreased. Does not operate.	Shortage of grease at sliding part	Add grease. The following causes are possible. <ul style="list-style-type: none"> - Grease was washed away by the moisture such as condensate. - Lubrication has been stopped on the way. - There is the splash of liquids in environment. 	3-3 2-1 2-4
	Misalignment between work piece and cylinder axis or guide axis of work piece and cylinder axis	Make alignment. Confirm the cylinder can operate smoothly without air supplied. Also, review the use of a floating joint.	2-3
	Deformation of piston rod	Replace the cylinder with the new one. The following causes are possible. <ul style="list-style-type: none"> - The cylinder and load are misaligned. - Excessive lateral load was applied. - Excessive kinetic energy was applied. - Excessive force was applied when the load was mounting. 	2-2 2-3

Trouble	Possible cause	Countermeasures	Referential section
Operation is not smooth. Force has decreased. Does not operate.	Air leakage (Wear of seal)	Replace the seal with the new one. The following causes are possible. - The cylinder and load are misaligned. - Excessive lateral load was applied. - The specified operating range is exceeded. - Grease gets short. - Foreign matters has entered.	3-1
	Insufficient air pressure	Supply appropriate pressure. The following cases are possible. - Source pressure has lowered. - The setting of the regulator is inadequate. - Piping is clogged.	1-1 2-1
	Operation at low speed	Keep the specified range.	1-1
	Insufficient cylinder force	Increase the operating pressure or bore size. The resistance of the cylinder and mechanism needs to be considered to decide the load rate.	1-1
	Inappropriate system composition	Use tubes, fittings, directional control valves and speed controllers of appropriate size.	2-1 2-2
	Failure of equipment other than product	Investigate concerned components one by one. The following causes are possible. - The directional control valve has failed. - The speed controller is not adjusted properly. - The speed controller has failed. - Piping is clogged. - The filter is clogged, etc.	2-1 2-2 2-4 2-5 2-7
There is damage on parts.	Operation at high speed	Adjust the speed by the speed controller and keep the specified range.	1-1 2-5
	Excessive load	Keep the specified allowable kinetic energy range.	2-6
	Lateral load	Keep the specified allowable lateral load.	2-3
	Excessive external force	Interference with the mechanics, eccentric load and over load can deform the product. Remove these factors.	2-3

6. Basic construction

Fig. 20 Double acting/single rod

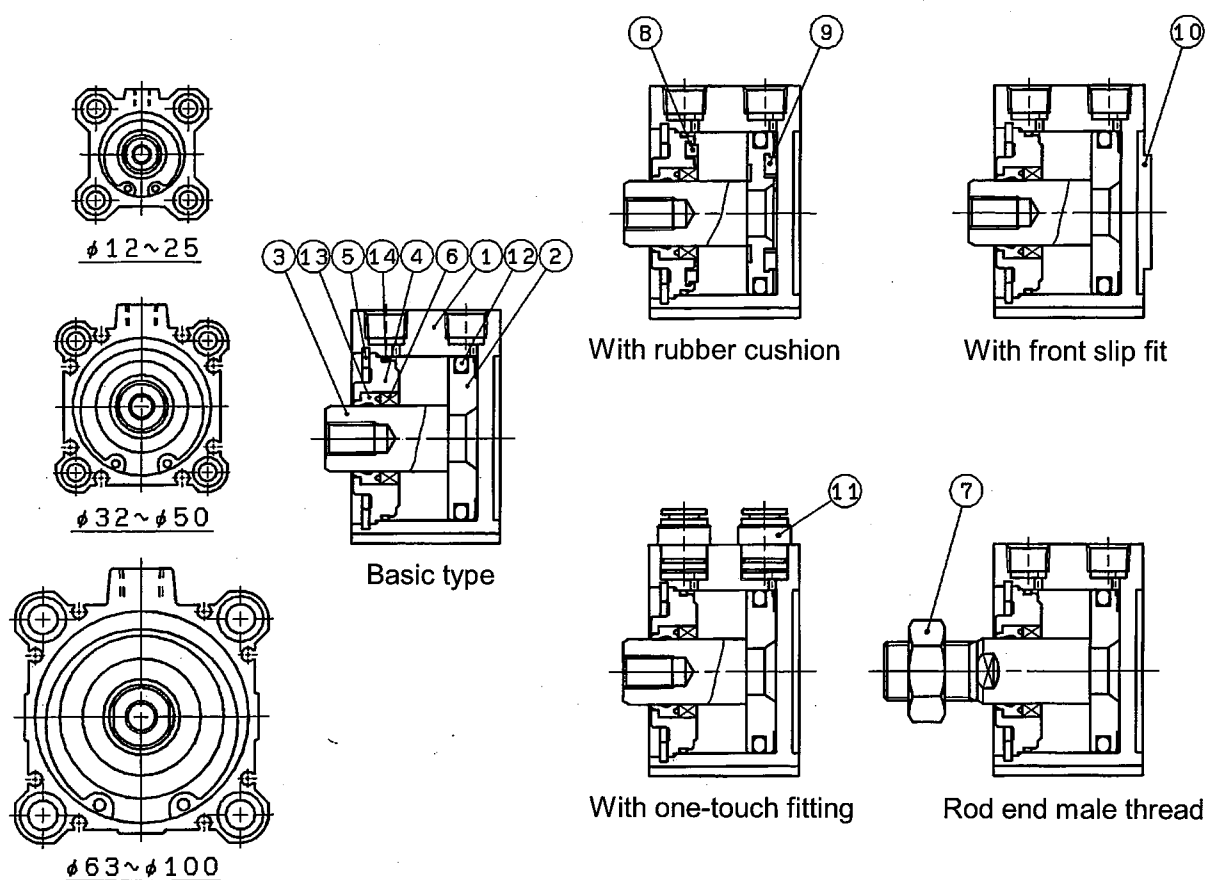
Fig. 21 Single acting/single rod

Fig. 22 Double acting/double rod

Fig. 23 With auto switch

Fig. 24 Double acting/single rod (long stroke)

Fig. 20 Double acting/single rod

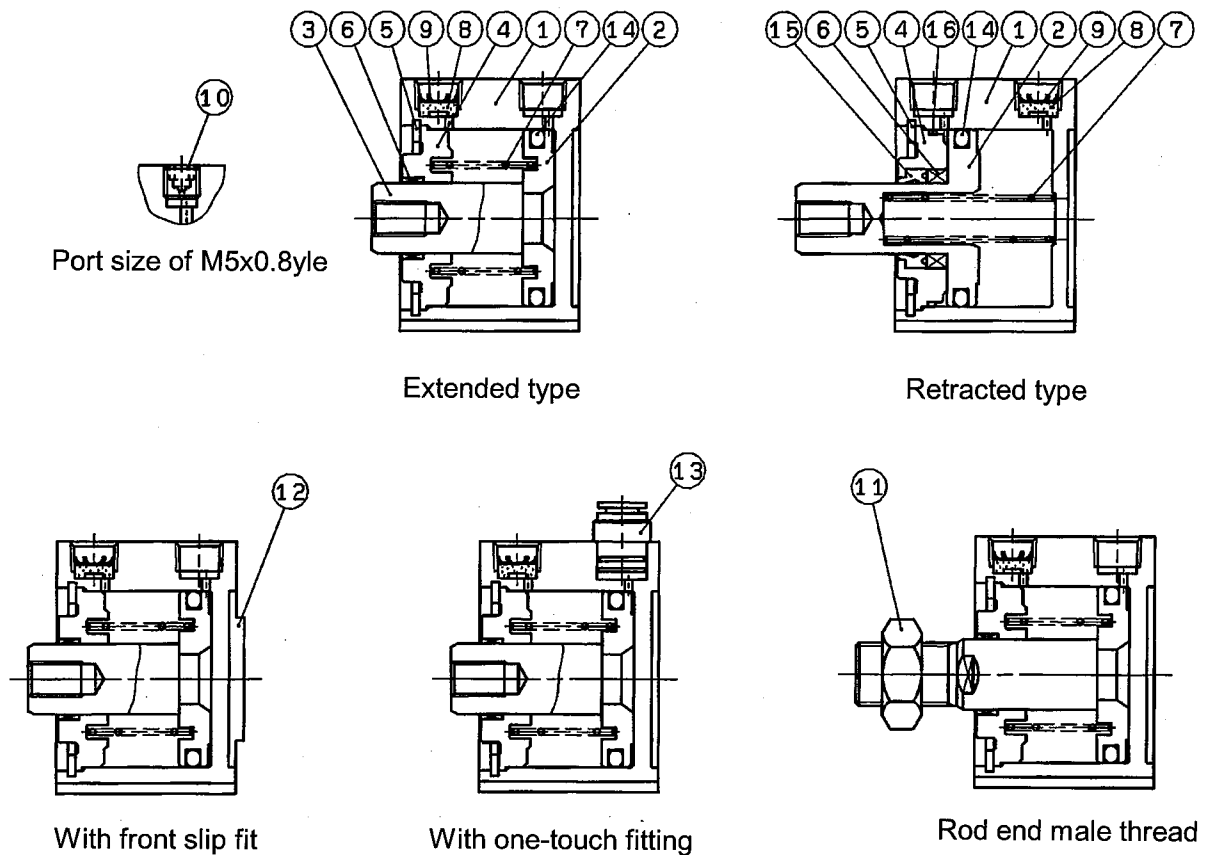


Parts list

No.	Description	Material	Remarks
1	Cylinder tube	Aluminum alloy	Hard anodized
2	Piston	Aluminum alloy	Chromated
3	Piston rod	Stainless steel	φ12 to 25
		Carbon steel	φ32 to 100, Hard chromating plated
4	Collar	Aluminum alloy	φ12 to 40, Anodized
		Aluminum alloy casting	φ50 to 100, Paint after chromated
5	Retaining ring	Carbon tool steel	Phosphate film
6	Bushing	Phosphor bronze alloy	For φ50 or more.
7	Rod end nut	Carbon steel	Nickel plated
8	Bumper A	Urethane	
9	Bumper B	Urethane	
10	Slip fit ring	Aluminum alloy	φ12 to 100, Anodized
11	One-touch fitting	—	φ32 to 63
12	Piston seal	NBR	
13	Rod seal	NBR	
14	Tube gasket	NBR	

* For the inside diameter of φ12 with a rubber cushion, the piston and piston rod are integrated (stainless steel).

Fig. 21 Single acting/single rod

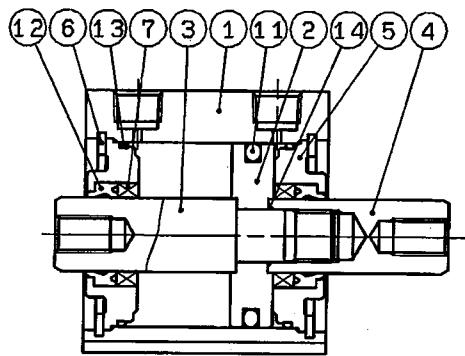


Parts list

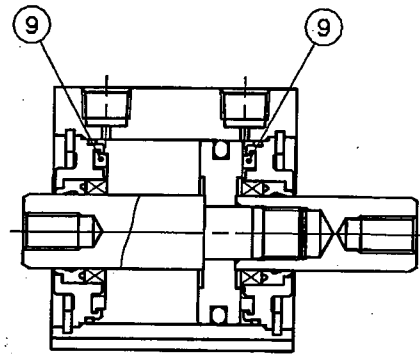
No.	Description	Material	Remarks
1	Cylinder tube	Aluminum alloy	Hard anodized
2	Piston	Aluminum alloy	Chromated
3	Piston rod	Stainless steel	φ12 to 25
		Carbon steel	φ32 to 100, Hard chromating plated
4	Collar	Aluminum alloy	φ12 to 40, Anodized
		Aluminum alloy casting	φ50, Paint after chromated
5	Retaining ring	Carbon tool steel	Phosphate film
6	Bushing	Phosphor bronze alloy	For φ50 or more.
7	Return spring	Piano wire	Zinc chromated
8	Bronze element	Sintered metal BC	For port size of Rc1/8 and Rc1/4.
9	Retaining ring	Carbon tool steel	
10	Plug with fixed orifice	Alloy steel	For port size of M5x0.8.
11	Rod end nut	Carbon steel	Nickel plated
12	Slip fit ring	Aluminum alloy	φ20 to 50, Anodized
13	One-touch fitting	—	φ32 to f50
14	Piston seal	NBR	
15	Rod seal	NBR	
16	Tube gasket	NBR	

* For the retraction type (T type), the piston and piston rod are integrated (stainless steel).

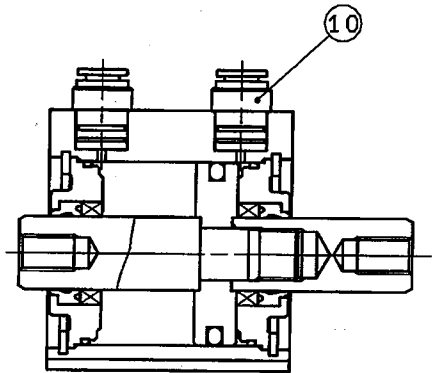
Fig. 22 Double acting/double rod



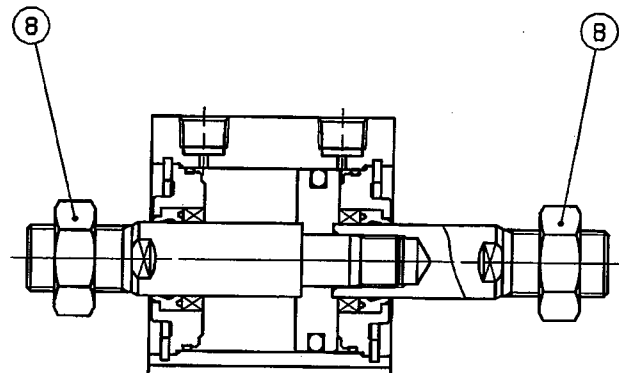
Basic type



With rubber cushion



With one-touch fitting

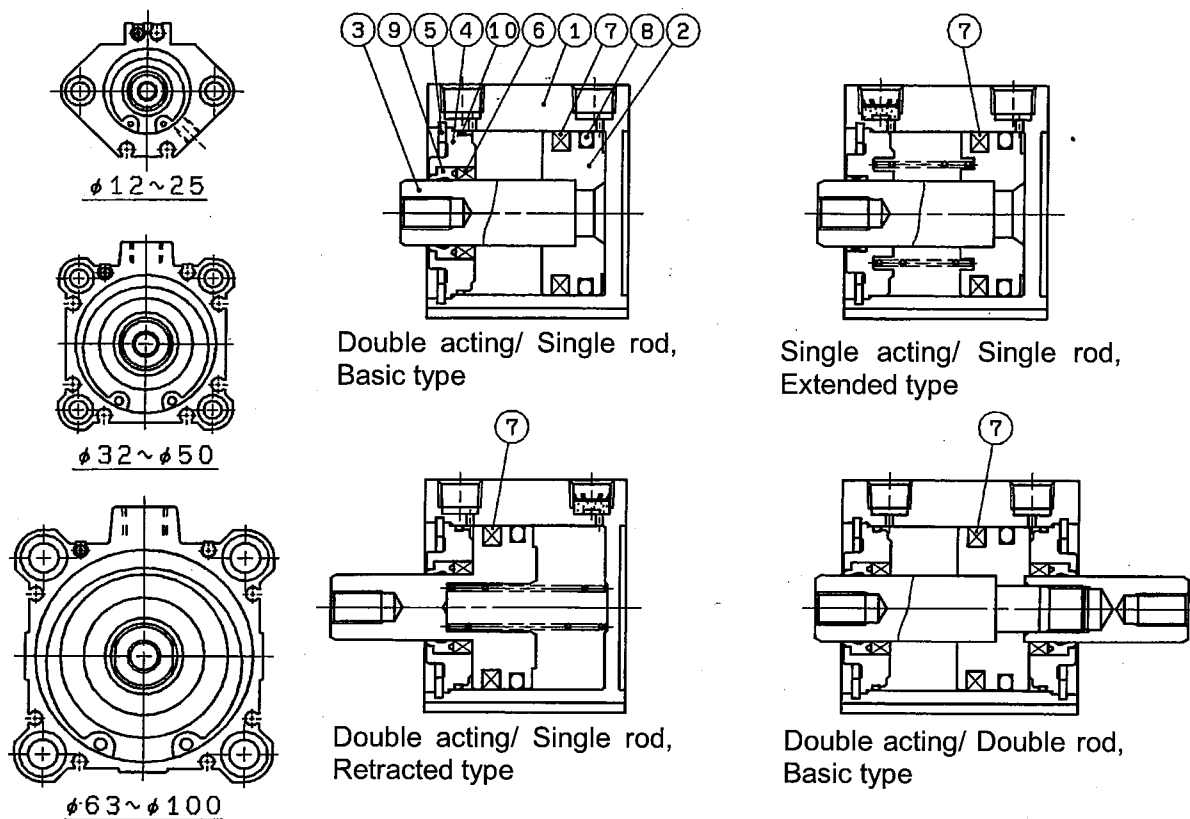


Rod end male thread

Parts list

No.	Description	Material	Remarks
1	Cylinder tube	Aluminum alloy	Hard anodized
2	Piston	Aluminum alloy	Chromated
3	Piston rod A	Stainless steel	φ12 to 25
		Carbon steel	φ2 to 100, Hard chromating plated
4	Piston rod B	Stainless steel	φ12 to 25
		Carbon steel	φ2 to 100, Hard chromating plated
5	Collar	Aluminum alloy	φ12 to 40, anodized
		Aluminum alloy casting	φ50 to 100, Paint after chromated
6	Retaining ring	Carbon tool steel	Phosphate film
7	Bushing	Phosphor bronze alloy	For φ50 or more.
8	Rod end nut	Carbon steel	Nickel plated
9	Bumper	Urethane	
10	One-touch fitting	—	φ32 to 63
11	Piston seal	NBR	
12	Rod seal	NBR	
13	Tube gasket	NBR	
14	Piston gasket	NBR	

Fig. 23 With auto switch

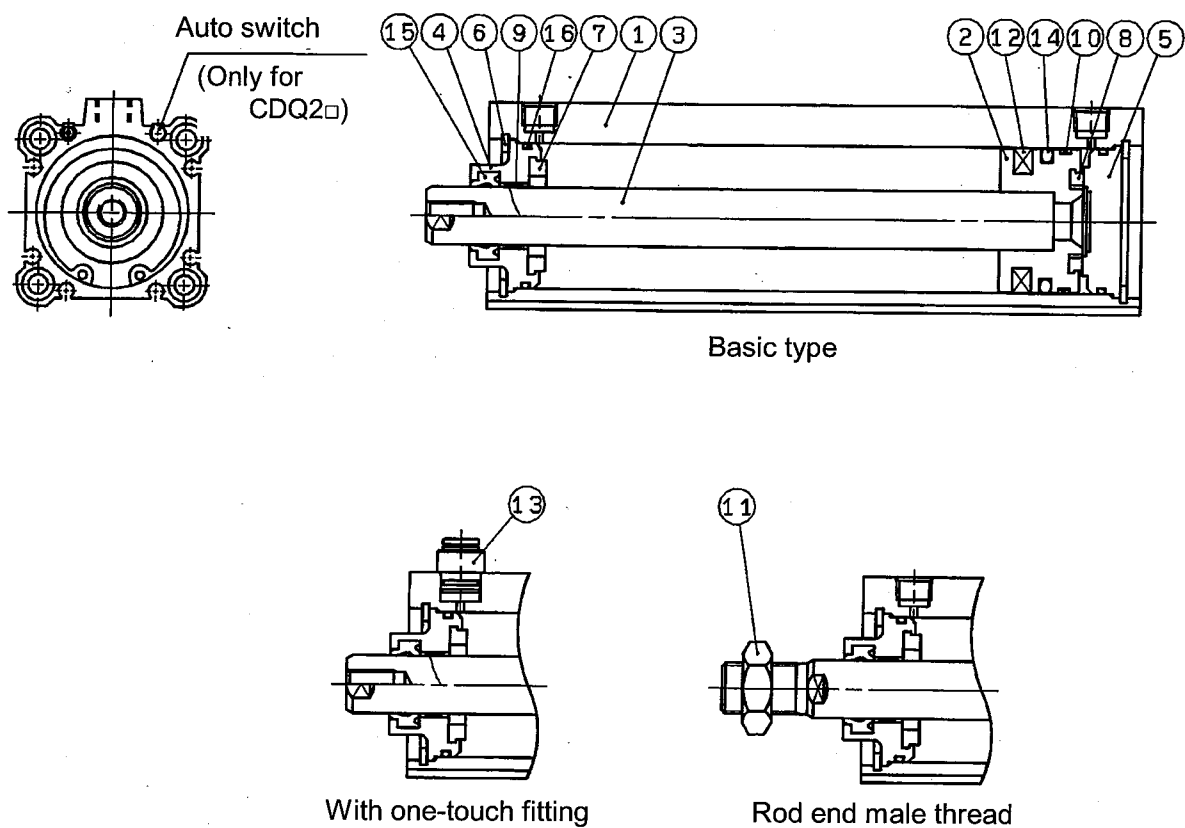


Parts list

No.	Description	Material	Remarks
1	Cylinder tube	Aluminum alloy	Hard anodized
2	Piston	Aluminum alloy	Chromated
3	Piston rod	Stainless steel	φ12 to 25
		Carbon steel	φ32 to 100, Hard chromating plated
4	Collar	Aluminum alloy	φ12 to 40, Anodized
		Aluminum alloy casting	φ50 to 100, Paint after chromated
5	Retaining ring	Carbon tool steel	Phosphate film
6	Bushing	Phosphor bronze alloy	For φ50 or more.
7	Magnet	—	
8	Piston seal	NBR	
9	Rod seal	NBR	
10	Tube gasket	NBR	

* The above figure is with the auto switch (D-M9*) mounted.

Fig. 24 Double acting/single rod (long stroke)



Parts list

No.	Description	Material	Remarks
1	Cylinder tube	Aluminum alloy	Hard anodized
2	Piston	Aluminum alloy	Chromated
3	Piston rod	Carbon steel	Hard chromating plated
4	Collar	Aluminum alloy	Anodized
5	Bottom plate	Aluminum alloy	Anodized
6	Retaining ring	Carbon tool steel	Phosphate film
7	Bumpber A	Urethane	
8	BumpberB	Urethane	
9	Bushing	Lead-bronze casting	
10	Wearing	Resin	
11	Rod end nut	Carbon steel	Nickel plated
12	Magnet	—	Only for CDQ2□
13	One-touch fitting	—	φ32 to 63
14	Piston seal	NBR	
15	Rod seal	NBR	
16	Tube gasket	NBR	

* The above figure is with the auto switch (D-M9*) mounted.

Revision history

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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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