

# INSTRUCTION MANUAL

## HIGH POWER CYLINDER

### SHC Series

- Please read this instruction manual carefully before using this product, particularly the section describing safety.
- Retain this instruction manual with the product for further consultation whenever necessary.

# For Safety Use

To use this product safely, basic knowledge of pneumatic equipment, including materials, piping, electrical system and mechanism, is required (to the level pursuant to JIS B 8370 Pneumatic System Rules).

We do not bear any responsibility for accidents caused by any person without such knowledge or arising from improper operation.

Our customers use this product for a very wide range of applications, and we cannot keep track of all of them. Depending on operating conditions, the product may fail to operate to maximum performance, or cause an accident. Thus, before placing an order, examine whether the product meets your applications, requirements, and how to use it.

This product incorporates many functions and mechanisms to ensure safety. However, improper operation could result in an accident. To prevent such accidents, **read this operation manual carefully for proper operation.**

Observe the cautions on handling described in this manual, as well as the following instructions:

## Precautions

- Before performing an overhaul inspection on the actuator, deactivate residual pressure completely.
- While the actuator is operating, do not step into or place hands in the driving mechanism.
- To prevent an electric shock, do not touch the electric wiring connections (exposed live parts) of the actuator equipped with a solenoid valve or switch.

Perform an overhaul inspection with the power off. Also, do not touch these live parts with wet hands.

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SHC Series

Manual No. SM-209275-A

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## 1. UNPACKING

- 1) Make sure that the type No. on the nameplate of the delivered High Power Cylinder matches the type No. you ordered.
- 2) Check the appearance for any damage.
- 3) Stop up the piping port with a sealing plug to prevent the entry of foreign substances into the cylinder. Remove the sealing plug before piping.

## 2. INSTALLATION

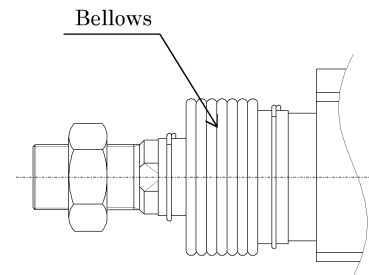
### 2.1 Installation

- 1) The Ambient temperature for this cylinder is -10 to 60°C (No freezing).
- 2) Use cylinder with bellows over its rod within the area with much dust.

● Ambient temperature of bellows Unit : °C

Material of bellows	Max. ambient	Instantaneous max.
J (Polyolefin elastomer)	100	200
L (Silicon rubber glass cloth)	250	400

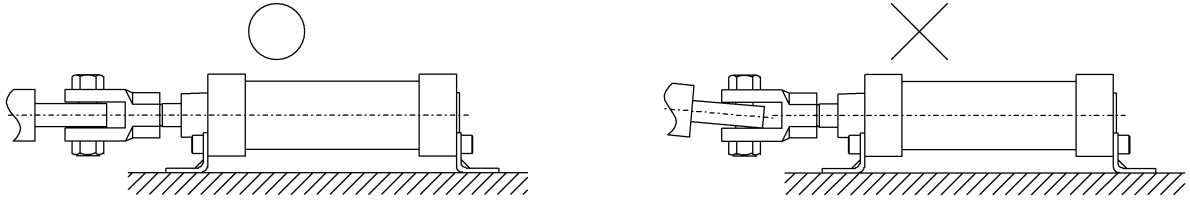
Note : Instantaneous maximum temperature is the temperature when spark and spatter etc. instantaneously contacts to bellows.



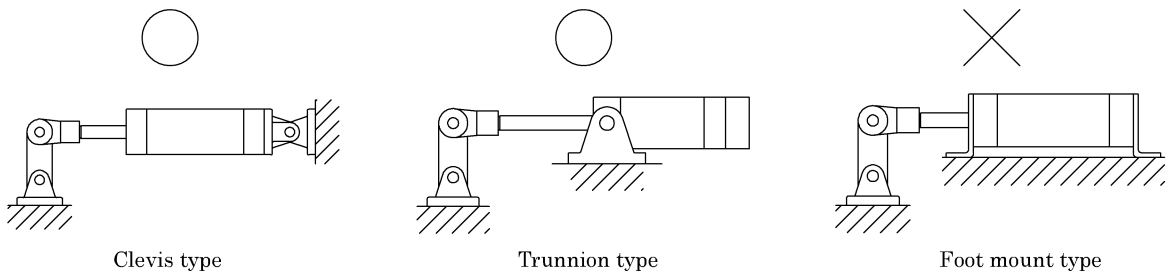
- 3) Carefully avoid other object from hitting the tube. Otherwise, it may get the tube distorted and cause malfunction of the cylinder.
- 4) When cylinder is fixed and rod end is guided:  
In case the piston rod of cylinder and the load are misaligned, the bushes and packings of the cylinder are extremely worn out. Hence, connect them with CKD floating connector (spherical bearing).

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INSTALLATION

- 5) When cylinder is fixed and rod end is connected with pin joint:  
 In case the load acting direction is not parallel with the rod axial center, the rod and tube may get entangled causing seizure, etc. Hence, make sure that the rod axial center and the load transfer direction are aligned to each other.



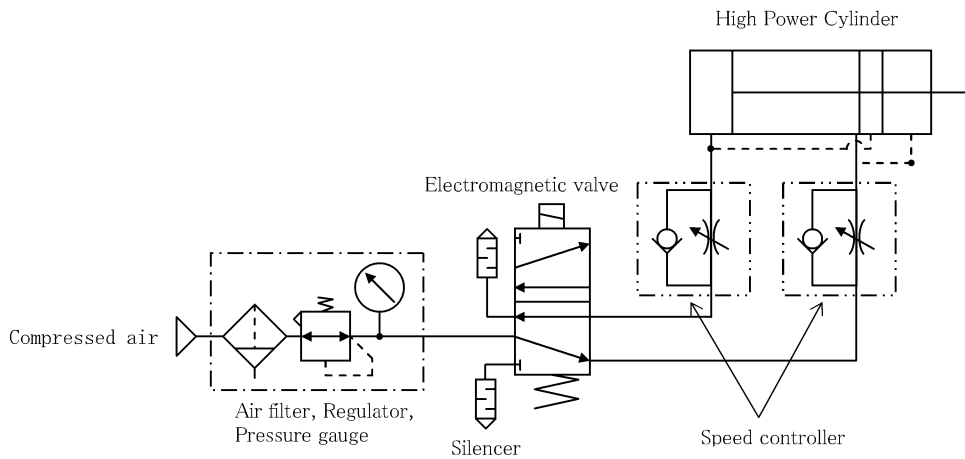
- 6) When the load acting direction changes with the cylinder operation:  
 Use an oscillating cylinder (clevis type or trunnion type) capable of making revolution to a certain angle. Furthermore, install the rod and connecting metal (knuckle) so that it moves in the same direction as the cylinder main body does.



## 2.2 Basic Circuit Chart

- 1) Standard  
Driven as same as general cylinder.

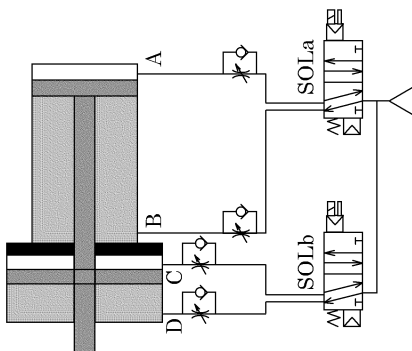
SHC · SHC-K



- 2) Booster section single control  
Using booster control (option symbol A) realizes high cycle that conventional cylinder could not achieve.

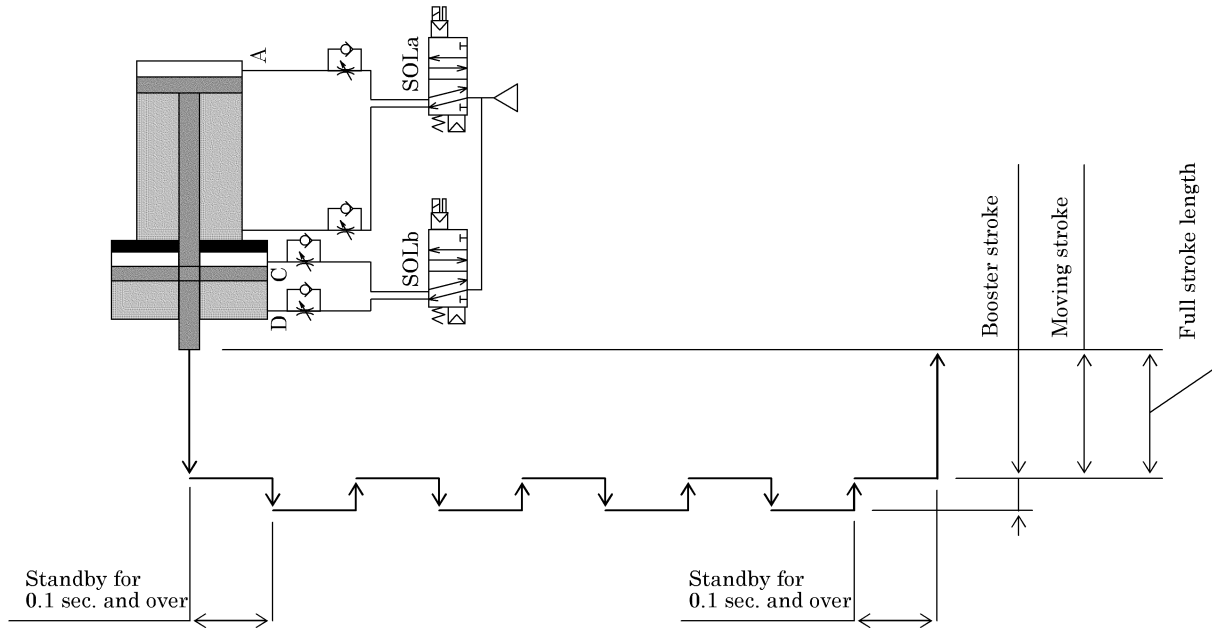
Booster section single control circuit

SHC-K-□-A



Solenoid valve	Moving stroke	Booster stroke
Operation state	SOLa	SOLb
Moving stroke advance	ON	OFF
Moving stroke end	ON	OFF
Standby for 0.1 second over	ON	OFF
Booster stroke advance	ON	ON
Booster stroke return	ON	OFF
Standby for 0.1 second over	ON	OFF
Moving stroke return	OFF	OFF

### Booster section single control operational diagram



※Selection of solenoid valve is as same as selection of conventional cylinder bore size.

Note 1 : When using a manifold, since upward load may allow back pressure form Port D to enter Port B, use individual exhaust spacers, or control a discrete valve.

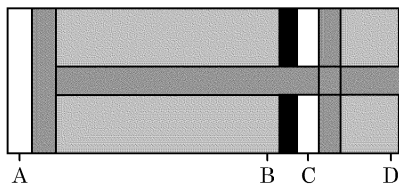
Do not use 5 port valve with 2-position type because speed adjustment is not possible.

Note 2 : Do not pressurize the C port when operation state is the moving stroke advance state.

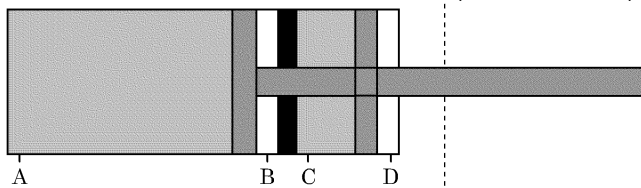
Otherwise, the booster piston and the connection collar may not connect.

### ● Operating conditions

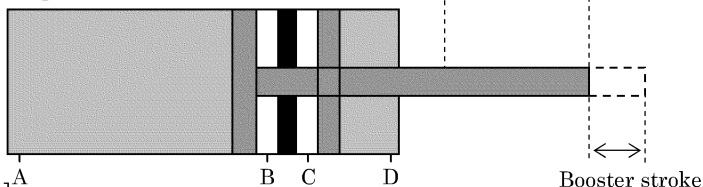
All stroke backward



All stroke advance

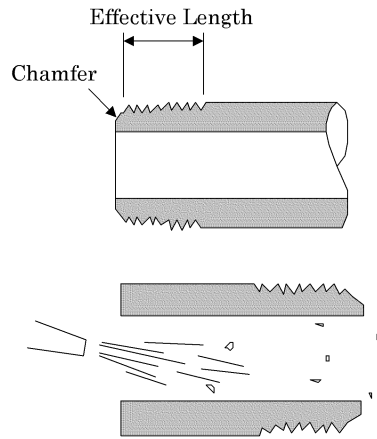


Single control



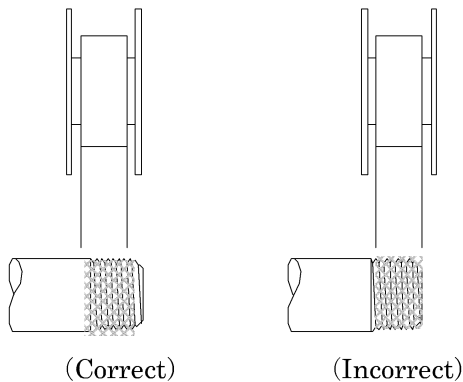
### 2.3 Piping

- 1) For piping beyond the filter, use pipes that are tough against corrosion such as galvanized pipes, nylon tubes, rubber tubes, etc.
- 2) See to it that the pipe connecting cylinder and solenoid valve has effective cross-sectional area which is needed for the cylinder to drive at the specified speed.
- 3) Install filter preferably adjacent to the upper-stream to the solenoid valve for eliminating rust, foreign substance in the drain of the pipe.
- 4) Be sure observe the effective thread length of gas pipe and give a chamfer of approx. 1/2 pitch from the threaded end.
- 5) Flush air into the pipe to blow out foreign substances and chips before piping.

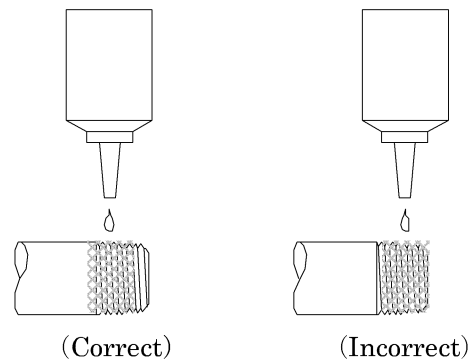


- 6) Refrain from applying sealant or sealing tape approx. two pitches of thread off the tip of pipe to avoid residual substances from falling into piping system.

● Seal Tape



● Sealant (liquid)



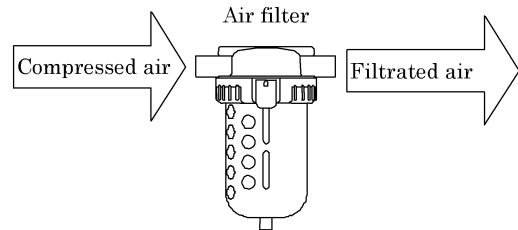
- 7) After connecting pipes, check leakage at the connecting sections with soap water etc. Wipe off detergent completely.



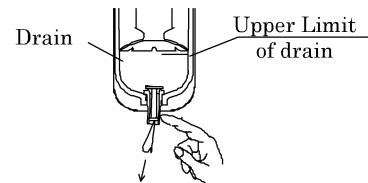
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## 2.4 Fluid

1) It is necessary to use dehumidified air that has been filtered from compressed air. Carefully select an adequate filter that has an adequate filtration rate (preferably  $5 \mu\text{m}$  or less), flow rate and its mounting location (as nearest to the directional control valve as possible).



2) Be sure to drain out the accumulation in the filter periodically.

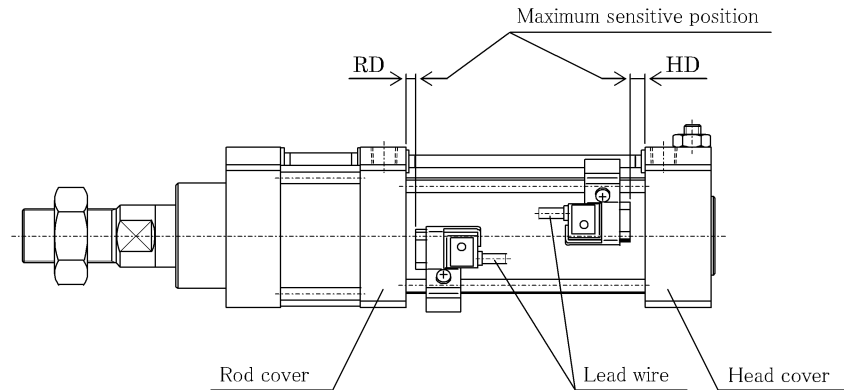


3) Note that the intrusion of carbide for the compressor oil (such as carbon or tarry substance) into the circuit causes malfunction of the solenoid valve and the cylinder. Be sure to carry out thorough inspection and maintenance of the compressor.

4) This cylinder does not require lubrication. It is recommended, however, to use Turbine oil Grade 1, ISO VG32 as a lubricant, if and when lubrication is needed.

## 2.5 Location of mounting Switches on a Cylinder

### 1) Location of mounting switches on a cylinder.



#### (1) At the stroke end

Refer the illustration above. Mount switches within the rod side dimension RD as well as the head side dimension HD for the purpose of having switches function at the points of the maximum sensitive position.

#### (2) Intermediate of stroke

Move the piston where it is anticipated to stop and fix it tentatively. Slide a switch carefully along the side of cylinder over the piston to find out the spot where switch turns on. This type spot should be located on both side of piston. The intermediate spot between those points is of the maximum sensitive position and where the switch is supposed to be installed.

#### (3) Location around the circumference of cylinder

There is no restriction. However,  $90^\circ$  interval around circumference will be the most appropriate location when considered convenient posture of mounting tie rods.

### 2) Operating range

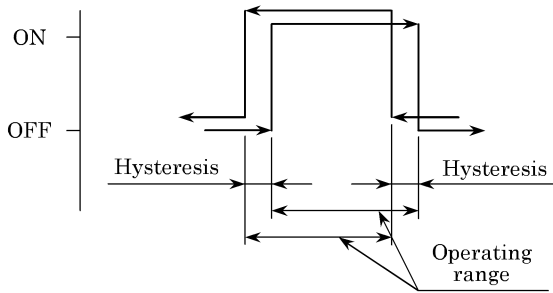
The switch turns on first and turns off as the piston moves along its stroke. Precise operating range deviate slightly depending upon the direction of piston movement as shown right.

The center of the range is the mostly sensitive position. Setting switch at this point eliminates majority of external disturbance and provides the most stable actuation of switch.

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3) Hysteresis

- (1) Precise operating range deviate slightly depending upon the direction of piston movement as shown right.
- (2) Switch is apt to be disturbed its accuracy by external effect when piston stops within this range. Carefully avoid designing stopping location of piston.



(mm)

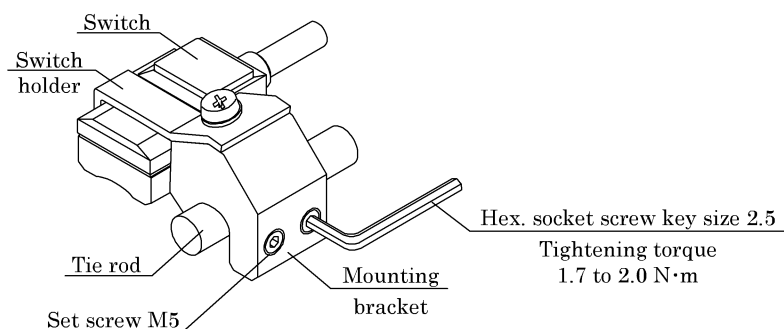
Bore size (mm)	Solid state switch (R1, R2, R2Y, R3, R3Y)				Reed switch (R0, R4, R5, R6)			
	Maximum sensitive position		Operating range	Hysteresis	Maximum sensitive position		Operating range	Hysteresis
	HD	RD			HD	RD		
φ 40	4.0	6.0	6.5~11.5	1.5 or less	4.0	6.0	9.5~12.5	3 or less
φ 50	7.0	4.5	8.0~12.5		7.0	4.5	10.5~14.5	
φ 63	6.0	7.0	7.5~12.5		6.0	7.0	10.5~14.5	
φ 80	11.5	12.0	8.0~13.5		11.5	12.0	11.5~15.5	
φ 100	16.0	12.0	8.0~14.0		16.0	12.0	12.0~16.0	

Bore size (mm)	Reed switch (H0)			
	Maximum sensitive position		Operating range	Hysteresis
	HD	RD		
φ 40	2.5	4.5	4.0~7.0	3 or less
φ 50	5.5	3.0	5.0~7.5	
φ 63	4.5	5.5	5~8.0	
φ 80	10.0	10.5	5~8.0	
φ 100	14.5	10.5	5~8.0	

4) Relocation of switch

Loosen the set screws (2 ea.) for approx. 1/2 to 3/4 turn. It enables the switch to slide along the tie rod without letting screws drop off.

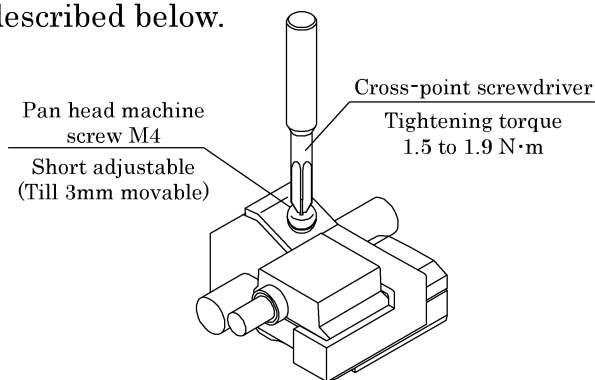
After setting the new location of switch, hold switch holder against the tube surface and tighten set screws to the tie rod. Adequate torque of tightening it is 1.7 to 2.0 N · m. It is considered to be sufficient, as a rule of thumb, when Allen wrench starts bending slightly.



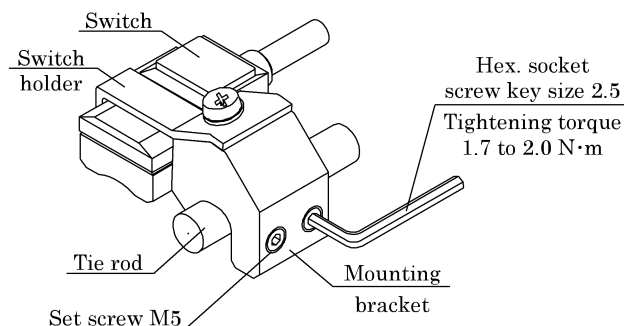
5) Installation of switch

Follow the procedures (1) to (3) as described below.

(1) While holding a switch underneath of switch holder, tighten M4 × 10 pan headed machine screws to mount it on the bracket.



(2) Screw-in the set screws to mount the bracket on the tie rod. While letting the mounting bracket hook the tie rod, slightly screw further until it touches the rod. Thus, it eliminates the whole set of switch from falling off the rod, yet enables to slide the set along the rod. Make use this merit when engaged in adjusting location of the switch set.



(3) To fix the mounting bracket on the tie rod, tighten screws while pressing bracket slightly against tube. Adequate torque of tightening screw is 1.7 to 2.0 N·m. It is considered to be sufficient, as a rule of thumb, when Allen wrench starts bending slightly.

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OPERATION

### 3. OPERATION

#### 3.1 Operating the Cylinder

- 1) The working pressure for this type of cylinder is 0.15 to 0.9 MPa. Operate the system within this range.
- 2) Though the cushion has been adjusted at no load when delivered, adjust the cushion needle when the change of cushion effect is required. Tightening the needle (clockwise) makes cushion more effective. Tighten the needle lock nut all the way after adjustment.

However, if kinetic energy such as load is heavy or speed is too fast, exceeding the values given in Table 1, consider of providing a shock absorber.

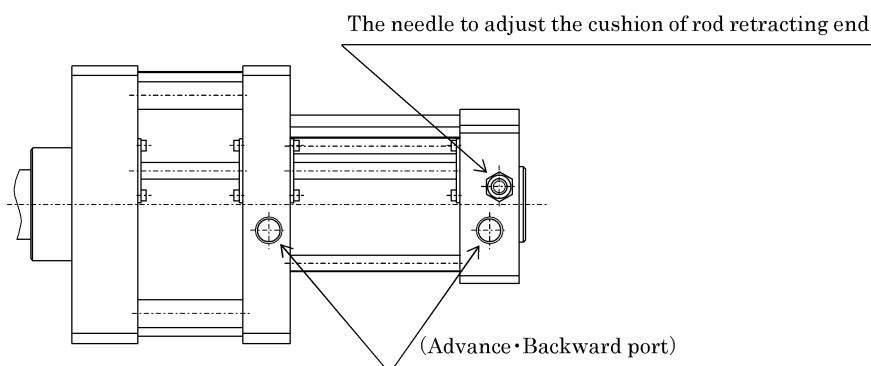


Table 1

Bore size (mm)	Allowable energy absorption (J)	
	Effective air cushion length (mm)	With cushion
φ 40	20.0	5.84
φ 50	22.5	9.99
φ 63	22.5	15.1
φ 80	21.5	25.5
φ 100	30.5	41.0

- 3) Adjust the working piston speed with the speed controller mounted.

## 3.2 How to use the Switches

### 3.2.1 Common items

- 1) **Magnetic environment**  
Do not use a switch other than the strong magnetic field proof switch in a place where strong magnetic field or large current (large magnet or spot welding machine, etc.) exists around the switch mounting position. If a cylinder with the switch is installed in parallel to this product or the magnetic substance moves near the cylinder, the mutual interference may occur and affect the detection accuracy.
- 2) **Lead wire wiring**  
Carefully perform the wiring so that a bending stress or tensile strength does not apply to the lead wire repeatedly.  
Additionally, connect wires for robot having the bending resistance to movable parts.
- 3) **Operating temperature**  
Do not operate the product at a high temperature (Over than 60°C).  
Always avoid operation of the product in a hot place due to temperature characteristics of magnetic and electronics parts.
- 4) **Intermediate position detection**  
When activating the switch halfway of the stroke, the relay may not respond if the working piston speed is too fast.  
When the operation time of the relay is 20 ms, operate the product at a working piston speed of 500 mm/s or less.
- 5) **Impact**  
Do not apply a large vibration or impact to the product when transporting the cylinder, or mounting or adjusting the switch.

### 3.2.2 Reed switch (R0, R4, R5, R6, H0)

1) Lead wire connections

Do not connect the lead wires of the switch to the power supply directly. Always connect the loads in series. For R0 switch, carefully check following items (1), (2).

- (1) When using the switch for DC power supply, connect the brown and blue lines to the positive and negative sides, respectively. If these lines are connected reversely, the switch is activated, but the indicator light is not lit.
- (2) When the switch is connected to an AC relay or a programmable controller input, the indicator light on the switch is not lit if the half-wave rectification is performed in the connected circuit. If this occurs, reverse the polarities of the switch lead wire connection. The indicator light may then be lit.

Note that the R4 and R5 switches have no polarities.

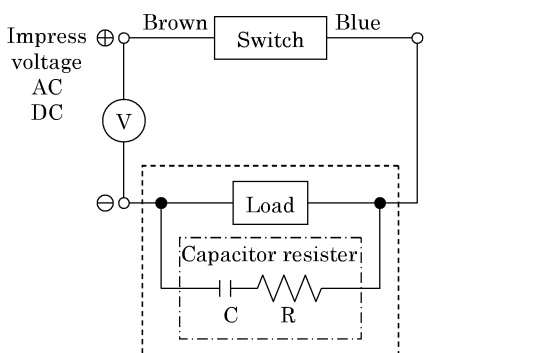
2) Contact protective measures

When an inductive load, such as relay is used or the wire length exceeds that stated in Table 1, always install a contact protective circuit.

Table 1

Switch	Electric power	Length of wire
R0, 5, 6	DC	100m
R0, 5	AC	10m
R4	AC	50m

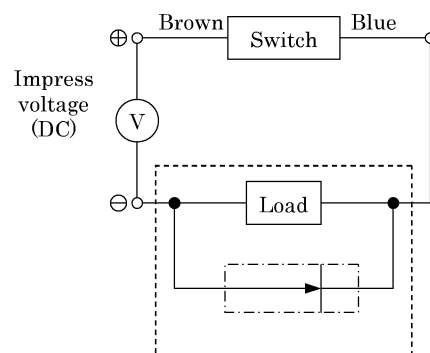
(1) Protective circuit when connecting an inductive type load.



User circuit  
 Protect circuit (Spark absorbing circuit)

Recommended value  
 C (Capacitor) 0.033 to 0.1  $\mu$ F  
 R (Resistor) 1 to 3k $\Omega$   
 XEB1K1 Okaya Denki Mfg or equivalent

Fig.1 When capacitor resistor is used.

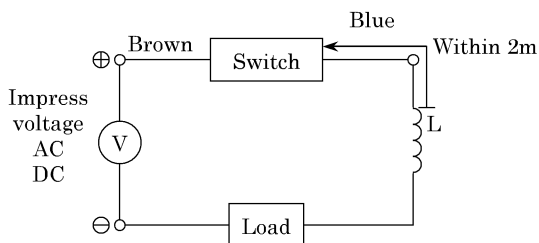


User circuit  
 Protect circuit

Rectifying diode, general use  
 Hitachi Mfg. product V06C or equivalent

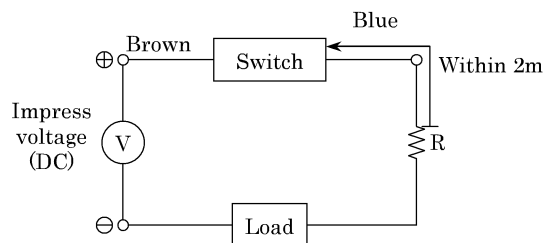
Fig.2 When diode is used.

(2) Protective circuit when the wire length exceeds that stated Table 1



- Choke coil  
L=a couple hundred  $\mu$  H to a couple mH  
surpassing high frequency characteristic
- Install it near by a switch (within 2m).

Fig.3



- Dash current restriction resistor  
R=As much large resistor as the load  
circuit can afford.
- Install it near by a switch (within 2m).

Fig.4

(3) Contact capacity

Do not use a load exceeding the maximum contact capacity of the switch. Additionally, if the current is lower than the rated current value, the indicator light may not be lit. (R0, R6)

(4) Relay

Always use the relays listed below.

- Omron Corporation .....MY type
- Fuji Electric Co., Ltd. ....HH5 type
- Panasonic, Ltd. ....HC type

(5) Series connection

When multiple R0 switches are used with they connected in series, the voltage drop at the switch becomes the sum of voltage drop values of all switches.

Therefore, the voltage applied to the load becomes a voltage that the voltage drop at the switch is subtracted from the power supply voltage. Thus, always check the minimum operating voltage value of the load.

Example: The following shows the voltage drop at the switch when three R0 switches are connected in series.

$$2.4V \times 3 = 7.2 V$$

Since the voltage drop at the R5 switch is 0V, as many switches as required can be connected in series. When one R0 switch is used for checking of operation and R5 switch is used for other switches, they can be used with the voltage drop equivalent to one R0 switch (2.4V). In this case, the indicator light is lit only when all switches are turned ON.

If two R4 switches are connected at 100V AC or three or more R4 switches are connected at 200V AC, the indicator light is not lit. Additionally, the R6 switch cannot be connected in series.





(6) Parallel connection

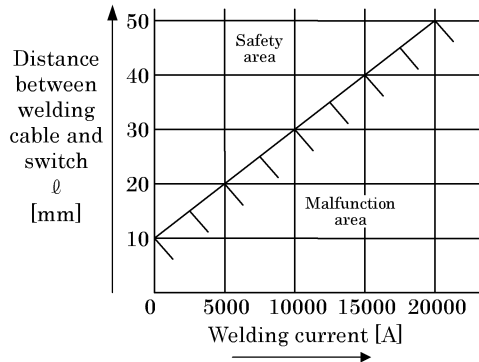
When multiple R0 and R5 switches are connected in parallel, there are no limitations on the number of switches. When multiple R4 and R6 switches are connected in parallel, the leakage current increases for the number of switches. Therefore, carefully check the load specifications to determine the number of switches to be connected.

However, if multiple R0 and R6 switches are turned ON at the same time, the indicator light becomes dark or is not lit. For R4 switch, if even one R4 switch is turned ON, all indicator lights go off.

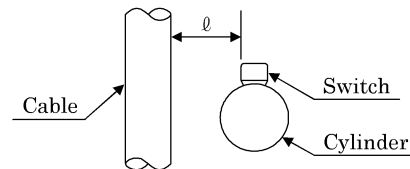
### 3) Strong magnetic field proof switch

- External magnetic field proof performance (spot welding current – switch output malfunction distance characteristics)

In case of H0

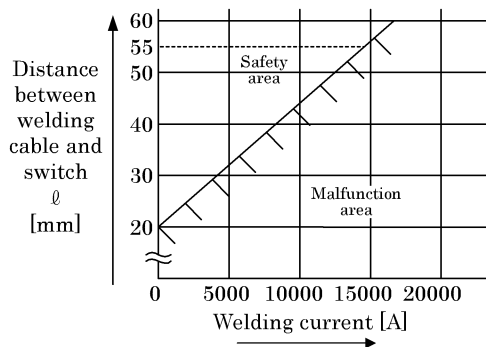


- The characteristics shown on the left may vary depending on the following layout between the cable and switch. (Outside diameter of cable:  $\phi$  36 mm)



- The external magnetic field proof characteristics of H0 are obtained when the switch is mounted in an area of maximum sensitivity position  $\pm 1$  mm.

In case of H0Y



- The external magnetic field proof characteristics of H0Y are obtained when the switch is mounted in its optimal mounting area (green LED lit range).
- For both H0 and H0Y, if two or more welding cables exist and the power is supplied to these cables at the same time, the magnetic flux may increase. Therefore, the characteristics shown on the left may not apply. Additionally, if the switch is located within the loop of the welding cable, the characteristics shown on the left cannot be used.
- The minimum mounting stroke shall be designed to 25 mm or more. If the minimum mounting stroke is 25 mm or less, the performance shown on the left is not satisfied.

### 3.2.3 Solid state switch (R1, R2, R3)

#### 1) Lead wire connections

Do not connect the lead wires of the switch to the power supply directly. Always connect the loads in series.

- (1) For R2 switch, connect the brown and blue lines to the positive and negative sides, respectively. If these lines are connected reversely, the switch and load are always kept activated. In this case, the indicator light is not lit. For R3 switch, pay special attention to Fig. 2 below.
- (2) Always connect the lead wires while referring to the colors shown on the lead wires. At this time, turn OFF the power to the unit in the electrical circuit on the connection side before starting the wire connection work. For R3 switch, if the wiring is performed incorrectly or the load is short-circuited, this may cause the switch, as well as the electrical circuit on the load side to break. Carefully connect the lead wires so that they are not connected incorrectly or short-circuited. Additionally, the work with the power supplied may cause the switch and electrical circuit to break if the work is performed in an incorrect manner even though the incorrect wiring is not performed.

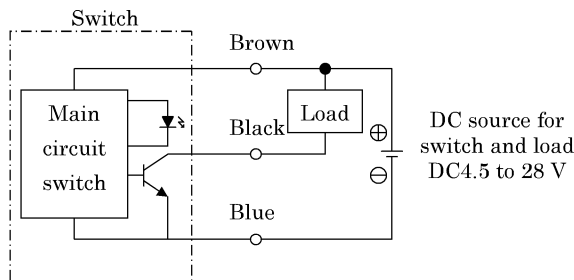


Fig.1 Fundamental circuit Example (1)  
(In case the same source of power is used.)

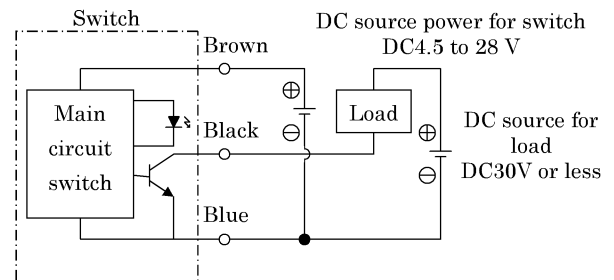


Fig.2 Fundamental circuit Example (2)  
(In case individual sources of power are used.)

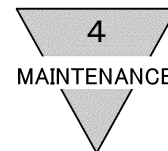
#### 2) Connection load

The R1 switch can be connected to a load, such as AC programmable controller, relay, solenoid, or solenoid valve.

The R2 switch is specially designed as a programmable controller switch. Since this switch uses two wires, it is connected to either the sink input or source input.

The R3 switch can be connected to a load, such as digital IC, microcomputer, programmable controller, relay, solenoid, or solenoid valve.

When selecting or designing a load, carefully check the static electrical characteristics, as well as transient electrical characteristics (rush current when the switch is turned ON or surge voltage when the switch is turned OFF) so that they do not exceed the switch ratings. Additionally, if the electrical characteristics may exceed the switch ratings, appropriate protective measures are taken (surge absorbing element or rush current limiting resistance, etc.).



## 4. MAINTENANCE

### 4.1 Periodical Inspection

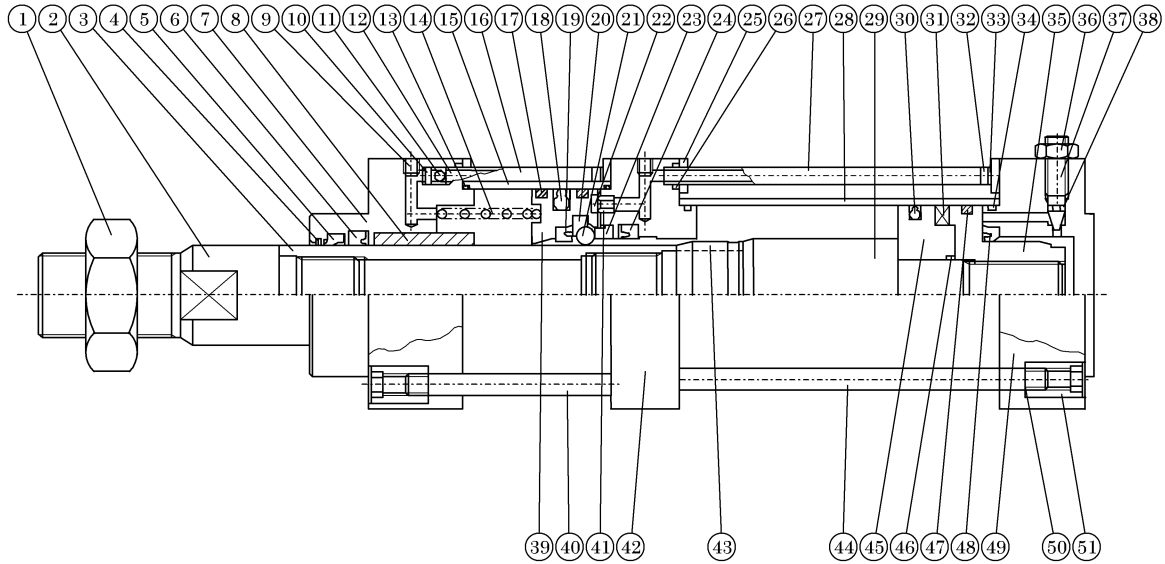
- 1) In order to upkeep the cylinder in optimum condition, carry out periodic inspection once or twice a year.
- 2) Inspection items
  - (1) Check the bolts and nuts fitting the piston rod end brackets and mounting brackets for slackening.
  - (2) Check to see that the cylinder operates smoothly.
  - (3) Check any change of the working piston speed and cycle time.
  - (4) Check for internal and/or external leakage.
  - (5) Check the piston rod for flaw (scratch) and deformation.
  - (6) Check the stroke for abnormality.

See “Trouble shooting”, 5 should there be any trouble found, also carry out additional tightening if bolts, nuts, etc. are slackened.

Do not disassemble this product. Doing so may affect the quality of the connection mechanism since a spring is incorporated in this product. When repairs and/or parts replacement are required, CKD will perform the required service.

## 4.2 Internal Structure

### 1) SHC

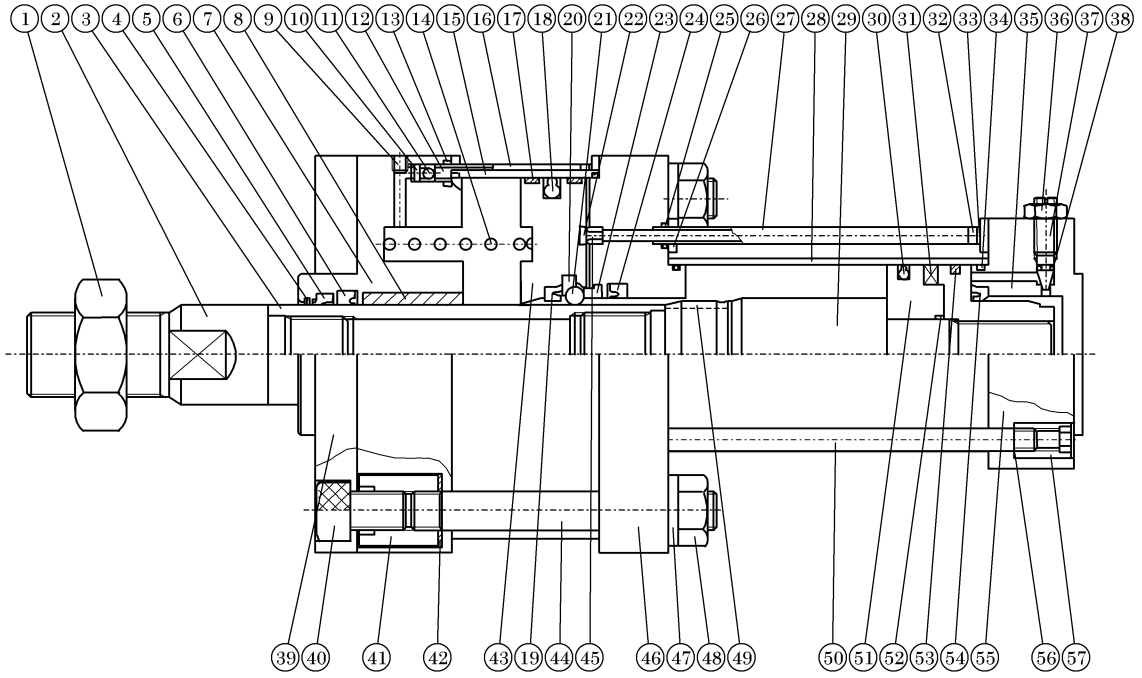


No.	Parts name	Material	Remarks
1	Rod nut	Steel	
2	Cap	Steel	
3	Piston rod	Steel	
4	Metal scraper	Copper alloy	Only G1 type
5	Dust wiper	Nitrile rubber	
6	Rod packing seal (1)	Nitrile rubber	
7	Rod cover	Aluminum alloy	
8	Bush	Copper alloy casting	Oil impregnated
9	Hexagon socket set screw	Alloy steel	
10	Spring pin	Steel	
11	Check ball	Alloy steel	
12	Fixed orifice	Copper alloy	
13	Cylinder gasket (1)	Nitrile rubber	
14	Compression spring	Steel	
15	Booster pipe	Aluminum alloy	
16	Pass-pipe (1)	Stainless steel	
17	Wear ring (1)	Polyacetal	
18	Piston packing seal (1)	Nitrile rubber	
19	Cushion packing seal (1)	Nitrile rubber	
20	Steel ball bearing	Nitrile rubber	
21	Steel ball	Alloy steel	
22	Sealant cushion	Urethane rubber	
23	Paul stopper	Steel	
24	Rod packing seal (2)	Nitrile rubber	
25	Packing gland	Steel	
26	Pass-pipe gasket	Nitrile rubber	
27	Pass-pipe (2)	Stainless steel	
28	Cylinder tube	Aluminum alloy	
29	Connection piston	Steel	
30	Piston packing seal (2)	Nitrile rubber	
31	Magnet	Plastic	
32	Hexagon socket bolt	Alloy steel	
33	Spring washer	Steel	
34	Cylinder gasket (2)	Nitrile rubber	
35	Piston (H)	Aluminum alloy	
36	Needle nut	Copper alloy	
37	Cushion needle	Copper alloy	
38	Needle gasket	Nitrile rubber	
39	Booster piston	Alloy steel	
40	Tie rod (1)	Steel	
41	Valve seat	Copper alloy	
42	Intermediate guard	Aluminum alloy	
43	Connection collar	Alloy steel	
44	Tie rod (2)	Steel	
45	Piston (R)	Aluminum alloy	
46	Piston gasket	Nitrile rubber	
47	Wear ring (2)	Acetar resin	
48	Cushion packing seal (2)	Nitrile rubber	
49	Head cover	Aluminum alloy	
50	Conical spring washer	Steel	
51	Round nut	Steel	

Note : This product can not be disassembled.

4  
MAINTENANCE

2) SHC-K ( $\phi 40 \sim \phi 50$ )

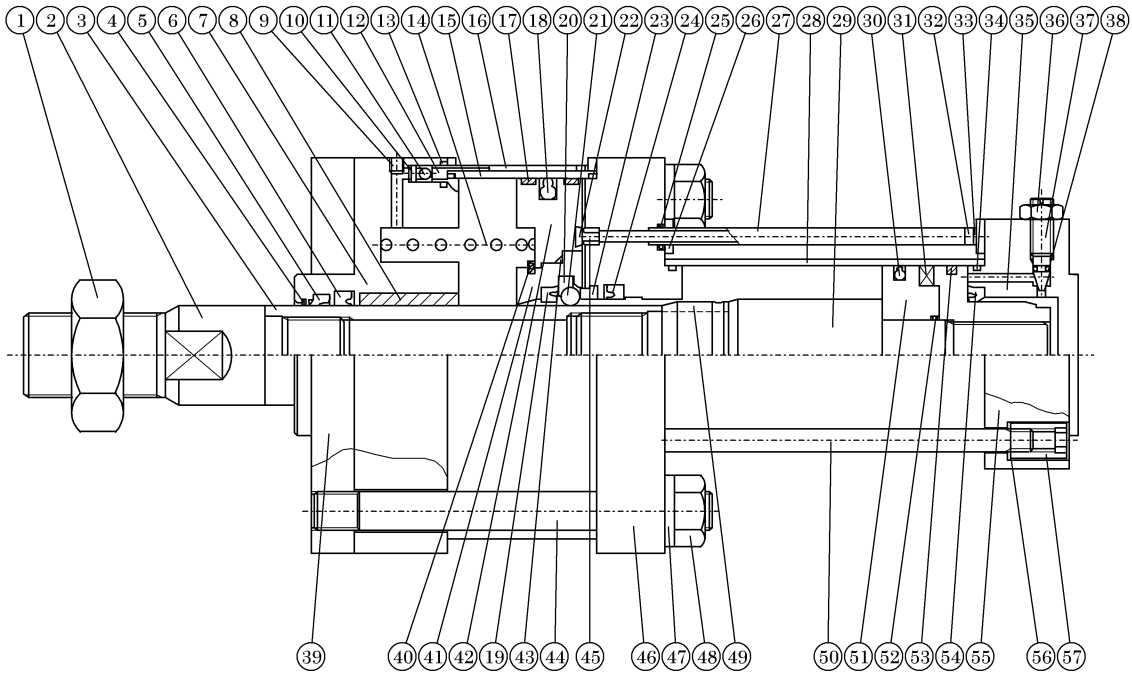


No.	Parts name	Material	Remarks
1	Rod nut	Steel	
2	Cap	Steel	
3	Piston rod	Steel	
4	Metal scraper	Copper alloy	Only G1 type
5	Dust wiper	Nitrile rubber	
6	Rod packing seal (1)	Nitrile rubber	
7	Rod cover	Aluminum alloy	
8	Bush	Copper alloy casting	Oil impregnated
9	Hexagon socket set screw	Alloy steel	
10	Spring pin	Steel	
11	Check ball	Alloy steel	
12	Fixed orifice	Copper alloy	
13	Cylinder gasket (1)	Nitrile rubber	
14	Compression spring	Steel	
15	Booster pipe	Aluminum alloy	
16	Pass-pipe (1)	Stainless steel	
17	Wear ring (1)	Polyacetal	
18	Piston packing seal (1)	Nitrile rubber	
19	Cushion packing seal (1)	Nitrile rubber	
20	Steel ball bearing	Nitrile rubber	
21	Steel ball	Alloy steel	
22	Sealant cushion	Urethane rubber	
23	Ball stopper	Steel	
24	Rod packing seal (2)	Nitrile rubber	
25	Pass-pipe gasket	Nitrile rubber	
26	Packing gland	Steel	
27	Pass-pipe(2)	Stainless steel	
28	Cylinder tube	Aluminum alloy	
29	Connection piston	Steel	
30	Piston packing seal (2)	Nitrile rubber	
31	Magnet	Plastic	
32	Hexagon socket bolt	Alloy steel	
33	Spring washer	Steel	
34	Cylinder gasket (2)	Nitrile rubber	
35	Piston (H)	Aluminum alloy	
36	Needle nut	Copper alloy	
37	Cushion needle	Copper alloy	
38	Needle gasket	Nitrile rubber	
39	FA flange	Steel	
40	Hexagon socket bolt	Alloy steel	
41	Round nut (1)	Steel	
42	Conical spring washer (1)	Steel	
43	Booster piston	Alloy steel	
44	Tie rod (1)	Steel	
45	Valve seat	Copper alloy	
46	Intermediate guard	Aluminum alloy	
47	Washer with the teeth	Steel	
48	Hexagon nut	Steel	
49	Connection collar	Alloy steel	
50	Tie rod (2)	Steel	
51	Piston (R)	Aluminum alloy	
52	Piston gasket	Nitrile rubber	
53	Wear ring (2)	Polyacetal	
54	Cushion packing seal (2)	Nitrile rubber	
55	Head cover	Aluminum alloy	
56	Conical spring washer	Steel	
57	Round nut (2)	Steel	

Note : This product can not be disassembled.



3) SHC-K ( $\phi 63 \sim \phi 100$ )



No.	Parts name	Material	Remarks
1	Rod nut	Steel	
2	Cap	Steel	
3	Piston rod	Steel	
4	Metal scraper	Copper alloy	Only G1 type
5	Dust wiper	Nitrile rubber	
6	Rod packing seal (1)	Nitrile rubber	
7	Rod cover	Aluminum alloy	
8	Bush	Copper alloy casting	Oil impregnated
9	Hexagon socket set screw	Alloy steel	
10	Spring pin	Steel	
11	Check ball	Alloy steel	
12	Fixed orifice	Copper alloy	
13	Cylinder gasket (1)	Nitrile rubber	
14	Compression spring	Steel	
15	Booster pipe	Aluminum alloy	
16	Pass-Pipe (1)	Stainless steel	
17	Wear ring (1)	Polyacetal	
18	Piston packing seal (1)	Nitrile rubber	
19	Cushion packing seal (1)	Nitrile rubber	
20	Steel ball bearing	Nitrile rubber	
21	Steel ball	Alloy steel	
22	Sealant cushion	Urethane rubber	
23	Ball stopper	Steel	
24	Rod packing seal (2)	Nitrile rubber	
25	Pass-pipe gasket	Nitrile rubber	
26	Packing gland	Steel	
27	Pass-pipe (2)	Stainless steel	
28	Cylinder tube	Aluminum alloy	
29	Connection piston	Steel	
30	Piston packing seal (2)	Nitrile rubber	
31	Magnet	Plastic	
32	Hexagon socket bolt	Steel	
33	Spring washer	Steel	
34	Cylinder gasket (2)	Nitrile rubber	
35	Piston (H)	Aluminum alloy	
36	Needle nut	Copper alloy	
37	Cushion needle	Copper alloy	
38	Needle gasket	Nitrile rubber	
39	FA flange	Steel	
40	C type snap ring	Steel	
41	Booster piston (A)	Alloy steel	
42	Booster piston (B)	Steel	
43	Gasket	Nitrile rubber	
44	Tie rod (1)	Steel	
45	Valve seat	Copper alloy	
46	Intermediate guard	Aluminum alloy	
47	Washer with the teeth	Steel	
48	Hexagon nut	Steel	
49	Connection collar	Alloy steel	
50	Tie rod (2)	Steel	
51	Piston (R)	Aluminum alloy	
52	Piston gasket	Nitrile rubber	
53	Wear ring (2)	Polyacetal	
54	Cushion packing seal (2)	Nitrile rubber	
55	Head cover	Aluminum alloy	
56	Conical spring washer	Steel	
57	Round nut	Steel	

Note : This product can not be disassembled.

## 5. TROUBLE SHOOTING

### 1) Cylinder

Trouble	Causes	Remedies
Does not operate.	No pressure or inadequate pressure.	Provide an adequate pressure source.
	Signal is not transmitted to direction control valve.	Correct the control circuit.
	Improper or misalignment of installation.	Correct the installation state and/or change the mounting style.
Does not function smoothly.	Speed is below the low speed limit	Limit the load variation and consider the adoption of low pressure cylinder.
	Improper or misalignment of installation.	Correct the installation state and/or change the mounting style.
	Exertion of transverse (lateral) load.	Install a guide. Revise the installation state and/or change the mounting style.
	Excessive load.	Increase the pressure itself and/or the inner diameter of the tube.
Breakage and/or deformation	Speed control valve is built in the way of "Meter in" circuit.	Change the meter-out circuit of the speed control valve.
	Impact force due to high speed operation	Turn the speed down. Reduce the load and/or install a mechanism with more secured cushion effect (e.g. external cushion mechanism).
	Exertion of transverse load.	Install a guide. Reverse the installation state and/or change the mounting style.

### 2) Switch

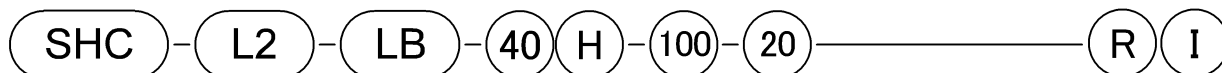
Troubles	Causes	Remedies
Indicator light is not lit.	Deposited contact point	Replace the switch.
	Excessive load than rated capacity	Replace the relay with a recommended one or replace the switch.
	Damaged indicator light	Replace the switch.
	Inadequate incoming signal	Review the external signal circuit and remove the causes.
Switch does not function right.	Broken circuit	Replace the switch.
	Inadequate incoming signal	Review the external signal circuit and remove the causes.
	Improper voltage	Correct voltage to specified.
	Incorrect location of switch	Correct its location.
	Aberrant position of switch	Set it back to original position and tighten the mounting device. Tightening torque is 1.5 to 1.9 N·m
	Incorrect direction of switch mounting	Correct the direction of the switch mounting.
	Relay is unable to respond properly	Replace the relay with a recommended one.
	Excessive load than rated capacity	Replace the relay with a recommended one or replace the switch.
Switch does not return.	Excessive speed of piston if it is to sense an intermediate point of stroke	Reduce the speed of piston.
	Piston is not moving	Make the piston move.
	Deposited contact point	Replace the switch
	Excessive load (relay) than rated capacity	Replace the relay with a recommended one or replace the switch.
	The ambient temperature is out of the specification range	Adjust the ambient temperature within the range of -10 to 60°C
	Existence of a foreign magnetic field	Shield the magnetic field.
	Inadequate incoming signal	Review the external signal circuit and remove the causes.

Note 1. Refer "2.4 Location of mounting Switches on a Cylinder" as for replacing a switch and correcting its location.

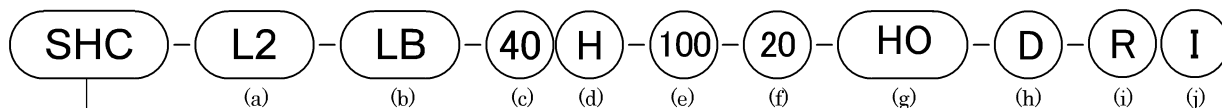
## 6. HOW TO ORDER

### Product Number Coding

- Without Switch



- With Switch



High power cylinder ·

Double acting double force type

(a) Magnet		(b) Mounting style (Note 1)		(c) Bore size (mm)		(d) Cushion	
Blank	For R type switch	00	Basic type	40	φ 40	H	Head end cushion
L2	For H type switch	LB	Axial foot type	50	φ 50	N	No cushion
		FA	Rod end flange type	63	φ 63		
		FB	Head end flange type	80	φ 80		
		CA	Eye bracket type	100	φ 100		
		CB	Clevis bracket type (Pin and snap ring attached)				
		TA	Rod end trunnion type				
		TB	Head end trunnion type				
		TC	Center trunnion type				

(e) Stroke length (mm)			(f) Booster stroke		(g) Switch model no. (Note 2)					
Standard stroke	Maximum stroke		10	10mm	Grommet type	Terminal box type		Switch type	Indicator light	Lead wire
	φ 40	700	20	20mm		Standard type	Splash-proof			
100	φ 40	700						Solid state	1 color indicator type	2-wire
150	φ 50				R1※	R1B	R1A			
200	φ 63	800			R2※	R2B	R2A		1 color indicator type	3-wire
250	φ 80	900			R2Y※	R1YB	R2YA			
300	φ 100	1000			R3※	R3B	R3A		1 color indicator type	
350					R3Y※	R3YB	R3YA			2 color indicator type
400					R0※	R0B	R0A	Reed	1 color indicator type	2-wire
500					R4※	R4B	R4A		Without indicator light	
					R5※	R5B	R5A		1 color indicator type	
					R6※	R6B	R6A		Strong magnetic field proof	
					H0※	—	—			

※ Lead wire length	
Blank	1m (standard)
3	3m (option)
5	5m (option)

※ indicates lead wire length.

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HOW TO ORDER

(h) Switch quantity		(i) Option (Note 3)			(j) Accessory (Note 2)	
R	1 on rod end	Bellows	J	Polyolefin elastomer	I	Rod eye
H	1 on head end		L	Silicon rubber glass cloth	Y	Rod clevis
D	2	Rod end form	Blank	Male thread type (standard)	B11	Eye bracket (for clevis)
T	3		F	Flange type	B21	Clevis bracket (for clevis)
4	4	Piping port position	Blank	Top from rod end (standard)	B12	Eye bracket (for rod eye/clevis)
5	5		R	Right from rod end	B22	Clevis bracket (for rod eye/clevis)
			S	Bottom from rod end		
			T	Left from rod end		
		G1	Metal scraper			
		P6	Copper and PTFE free			
		A	Booster section single control port			

Note 1 : The piping port position R and T cannot be selected for FA(rod side flange type).

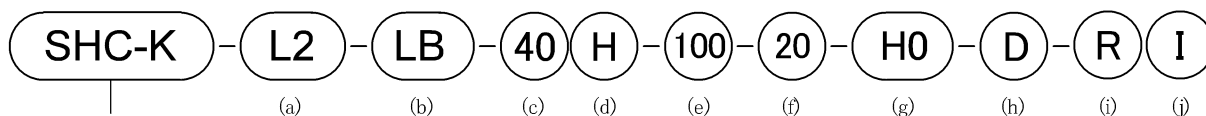
Note 2 : "I" and "Y" can not be selected at the same time.

Note 3 : L (bellows (maximum ambient temperature 100°C) is a custom order.

- Without switch



- With switch



High power cylinder  
Double acting four times force type

(a) Magnet		(b) Mounting style (Note 1)		(c) Bore size(mm)		(d) Cushion	
Blank	For R type switch	LB	Axial foot type	40	φ 40	H	Head end cushion
L2	For H type switch	FA	Rod end flange type	50	φ 50	N	No cushion
		TA	Rod end trunnion type	63	φ 63		
				80	φ 80		
				100	φ 100		

(e) Stroke length (mm)			(f) Booster stroke		(g) Switch model no. (Note 2)						
Standard stroke	Maximum stroke		10	10mm	Grommet type	Terminal box type		Switch type	Indicator light	Lead wire	
						Standard type	Splash-proof				
100	φ 40	700	20	20mm				Solid state	1 color indicator type	2-wire	
150	φ 50				R1※	R1B	R1A				
200	φ 63	800	R2※	R2B	R2A						
250	φ 80	900	R2Y※	R2YB	R2YA						
300	φ 100	1000	R3※	R3B	R3A						
350			R3Y※	R3YB	R3YA						
400			R0※	R0B	R0A	Reed	1 color indicator type	2-wire			
500			R4※	R4B	R4A						
			R5※	R5B	R5A						
			R6※	R6B	R6A						
			H0※	—	—		Strong magnetic field proof				

※Lead wire length	
Blank	1m (standard)
3	3m (option)
5	5m (option)

※ mark indicates lead wire length.

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HOW TO ORDER

(h) Switch quantity		(i) Option (Note 3)			(j) Accessory (Note 2)	
R	1 on rod end	Bellows	J	Polyolefin elastomer	I	Rod eye
H	1 on head end		L	Silicon rubber glass cloth	Y	Rod clevis
D	2	Rod end form	Blank	Male thread type (standard)	B12	Eye bracket (for rod eye/clevis)
T	3		F	Flange type	B22	Clevis bracket (for rod eye/clevis)
4	4	Piping port position	Blank	Top from rod end (standard)		
5	5		R	Right from rod end		
			S	Bottom from rod end		
			T	Left from rod end		
			G1	Metal scraper		
			P6	Copper and PTFE free		
			A	Booster section single control port		

Note 1 : The piping port position R and T cannot be selected for FA(rod side flange type).

Note 2 : "I" and "Y" can not be selected at the same time.

Note 3 : L (bellows (maximum ambient temperature 100°C) is a custom order.

## 7. SPECIFICATION

### 7.1 Product Specifications

Descriptions		SHC				
Bore size	mm	φ 40	φ 50	φ 63	φ 80	φ 100
Actuation		Double acting extended part double force type				
Working fluid		Compressed air				
Max. working pressure	MPa	0.9				
Min. working pressure	MPa	0.2	0.15			
Proof pressure	MPa	1.35				
Ambient temperature		-10 to 60 (No freezing)				
Port size	Rc	1/8	1/4	1/4	3/8	3/8
Stroke tolerance		$^{+1.3}_0$ (to 300)、 $^{+1.7}_0$ (to 1000)、 $^{+2.1}_0$ (1000 to)				
Working piston speed	Cylinder section	50 to 500				
	Booster section	40 to 70				
Cushion		Air cushion				
Lubrication		Not required (use turbine oil Class 1 ISOVG32 if lubricated)				
Rod end allowable energy absorption	(J)	12.2	22.9	31.3	47.2	76.2
Head end allowable energy absorption	(J)	5.84	9.99	15.1	25.5	41.0

Descriptions		SHC-K				
Bore size	mm	φ 40	φ 50	φ 63	φ 80	φ 100
Actuation		Double acting extended part four times force type				
Working fluid		Compressed air				
Max. working pressure	MPa	0.9				
Min. working pressure	MPa	0.2	0.15			
Proof pressure	MPa	1.35				
Ambient temperature		-10 to 60 (No freezing)				
Port size	Rc	1/8	1/4	1/4	3/8	3/8
Stroke tolerance		$^{+1.3}_0$ (to 300)、 $^{+1.7}_0$ (to 1000)、 $^{+2.1}_0$ (1000 to)				
Working piston speed	Cylinder section	50 to 500				
	Booster section	10 to 30				
Cushion		Air cushion				
Lubrication		Not required (use turbine oil Class 1 ISOVG32 if lubricated)				
Rod end allowable energy absorption	(J)	23.3	39.9	60.2	102	164
Head end allowable energy absorption	(J)	5.84	9.99	15.1	25.5	41.0



## 7.2 Switches Specification

Type & Model	Reed switch				
Item	R0			R4	
Applications	For use with relay, programmable controller			For use with high capacity relay, solenoid valve	
Load voltage	DC12/24V	AC110V	AC220V	AC110V	AC220V
Load current	5 to 50mA	7 to 20mA	7 to 10mA	20 to 200mA	10 to 200mA
Internal voltage drop	2.4V or lower			2V or lower	
Indicator light	LED (ON lighting)			Neon light OFF (OFF lighting)	
Leakage current	0mA			1mA or lower	
Lead wire length (Note 1)	1m (Oil-proof vinyl cabtyre cord, 2-wire, 0.3mm <sup>2</sup> )				
Shock resistance	294m/s <sup>2</sup>				
Insulation resistance	20 MΩ or more measuring with DC500V megger tester				
Withstand voltage	No abnormalities should occur after applying AC1,500V for 1 minute				
Ambient temperature	-10 to 60°C				
Degree of protection (Note 3)	For Grommet · IEC Standard IP67, JIS C0920 (water tight type), Oil resistance				

Type & Model	Reed switch				
Item	R5			R6	
Applications	For use with programmable controller, relay, IC circuit (without indicator light), series connection			For use exclusively with programmable controller (with DC self-holding function)	
Load voltage	DC12/24V	AC100V	AC200V	DC24V	
Load current	50mA or lower	20mA or lower	10mA or lower	5 to 50mA	
Internal voltage drop	0V			5V or lower	
Indicator light	None			LED (ON lighting)	
Leakage current	0mA			0.1mA or lower	
Lead wire length (Note 1)	1m (Oil-proof vinyl cabtyre cord, 2-wire, 0.3mm <sup>2</sup> )				
Shock resistance	294m/s <sup>2</sup>				
Insulation resistance	20 MΩ or more measuring with DC500V megger tester				
Withstand voltage	No abnormalities should occur after applying AC1,500V for 1 minute				
Ambient temperature	-10 to 60°C				
Degree of protection (Note 3)	For Grommet · IEC Standard IP67, JIS C0920 (water tight type), Oil resistance				

Type & Model	Reed switch				
Item	H0		H0Y (Bi colors indication)		
Application	For use with programmable controller, relay		For use exclusively with programmable controller		
Load voltage	DC12/24V	AC100V	DC24V		
Load current	5 to 50mA	7 to 20mA	5 to 20mA		
Internal voltage drop	5V or lower		6V or lower		
Indicator light	Green LED (ON lighting)		Red/Green LED (ON lighting)		
Leakage current	10 μ A or lower				
Lead wire length	Standard 1m (2-core fire-resistant cabtyre cord, 0.5mm <sup>2</sup> )				
Shock resistance	294m/s <sup>2</sup>				
Insulation resistance	100 MΩ or more measuring with DC500V megger tester				
Withstand voltage	No abnormalities should occur after applying AC 1,300V for 1 minute				
Ambient temperature	-10 to 60°C				
Degree of protection	IEC Standard IP67, JIS C0920 (water tight type), Oil resistance				

Type & Model	Solid state type switch		
Item	R1	R2	R2Y (2-color)
Applications	For use with programmable controller, relay, compact solenoid valve	For use exclusively with programmable controller	
Power supply voltage	—		
Load voltage	AC85 to 265V	DC10 to 30V	
Load current	5 to 100mA	5 to 30mA (Note 2)	
Current consumption	—		
Internal voltage drop	7V or lower	4V or lower	
Indicator light	LED (ON lighting)		Red/Green LED (ON lighting)
Leakage current	1mA or lower at ac110V 2mA or lower at ac220V	1mA or lower	1.2mA or lower
Lead wire length (Note 1)	Standard 1 m (Oil-proof vinyl cabtyre cord, 2-wire, 0.3mm <sup>2</sup> )		
Shock resistance	980m/s <sup>2</sup>		
Insulation resistance	20 MΩ or more measuring with DC500V megger tester		
Withstand voltage	AC1,500V for 1 minute	AC1,000V for 1 minute	
Ambient temperature	-10 to 60°C		
Degree of protection (Note 3)	For Grommet · IEC Standard IP67, JIS C 0920 (water tight type), Oil resistance		

Type & Model	Solid state type switch	
Item	R3	R3Y (2-color)
Applications	For use with programmable controller, relay, IC circuit, compact solenoid valve	
Power supply voltage	DC4.5 to 28V	
Load voltage	DC30V or lower	DC30V or lower
Load current	200mA or lower	150mA or lower
Current consumption	10mA or lower when it is on at DC24V	16mA or lower when it is on at DC24V
Internal voltage drop	0.5V or lower at 150mA	0.5V or lower
Indicator light	LED (ON lighting)	Red/Green LED (ON lighting)
Leakage current	10 μA or lower	
Output delay time (ON delay, OFF delay) (Note 4)	—	
Lead wire length (Note 1)	Standard 1 m (Oil-proof vinyl cabtyre cord, 3-wire, 0.2mm <sup>2</sup> )	
Shock resistance	980m/s <sup>2</sup>	
Insulation resistance	20 MΩ or more measuring with DC500V megger tester	
Withstand voltage	AC1,000V for 1 minute	
Ambient temperature	-10 to 60°C	
Degree of protection (Note 3)	For Grommet · IEC Standard IP67, JIS C 0920 (water tight type), Oil resistance	

Note 1 : 3m or 5m long lead wire is optionally available.

Note 2 : Maximum value, 30mA is at 25°C of ambient temperature. Load current decreases less than 30mA when the ambient temperature exceeds 25°C.

Note 3 : R※B terminal box is not water-proof. The water-proof R※A type box (Matsushita Denko made) is the order made item.

Note 4 : This shows a period of time between detection of the piston magnet by the magnetic sensor and sending of switch output.

Note 5 : Non-flammable cabtyre cable available as option.

Note : This switch cannot be used under direct-current magnetic field environment.