CKD

Brake Cylinder

JSC4 Series (ø125 to ø180)

INSTRUCTION MANUAL

SM-482241-A/2

- Read this Instruction Manual before using the product.
- Read the safety notes carefully.
- Keep this Instruction Manual in a safe and convenient place for future reference.

CKD Corporation

PREFACE

Thank you for purchasing CKD's **"JSC4 Series" brake cylinder**.
This Instruction Manual contains basic matters such as installation and usage instructions in order to ensure optimal performance of the product. Please read this Instruction Manual thoroughly and use the product properly.
Keep this Instruction Manual in a safe place and be careful not to lose it.

Product specifications and appearances presented in this Instruction Manual are subject to change without notice.

- The product is intended for users who have basic knowledge about materials, piping, electricity, and mechanisms of pneumatic components. CKD shall not be responsible for accidents caused by persons who selected or used the product without knowledge or sufficient training.
- Since there are a wide variety of customer applications, it is impossible for CKD to be aware of all of them. Depending on the application or usage, the product may not be able to exercise its full performance or an accident may occur due to fluid, piping, or other conditions. It is the responsibility of the customer to check the product specifications and decide how the product shall be used in accordance with the application and usage.

SAFETY INFORMATION

When designing and manufacturing any device incorporating the product, the manufacturer has an obligation to ensure that the device is safe. To that end, make sure that the safety of the machine mechanism of the device, the fluid control circuit, and the electric system that controls such mechanism is ensured.

To ensure the safety of device design and control, observe organization standards, relevant laws and regulations, which include the following:

JIS B 8370 (the latest edition)

In order to use our products safely, it is important to select, use, handle, and maintain the products properly.
Observe the warnings and precautions described in this Instruction Manual to ensure device safety.

Although various safety measures have been adopted in the product, customer's improper handling may lead to an accident. To avoid this:

Thoroughly read and understand this Instruction Manual before using the product.

To explicitly indicate the severity and likelihood of a potential harm or damage, precautions are classified into three categories: "DANGER", "WARNING", and "CAUTION".

⚠ **DANGER**	Indicates an imminent hazard. Improper handling will cause death or serious injury to people.
⚠ **WARNING**	Indicates a potential hazard. Improper handling may cause death or serious injury to people.
⚠ **CAUTION**	Indicates a potential hazard. Improper handling may cause injury to people or damage to property.

Precautions classified as "CAUTION" may still lead to serious results depending on the situation.
All precautions are equally important and must be observed.

Other general precautions and tips on using the product are indicated by the following icon.

	Indicates general precautions and tips on using the product.

CONTENTS

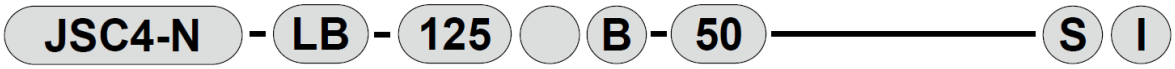
1. PRODUCT OVERVIEW

1.1 Model Number Indication

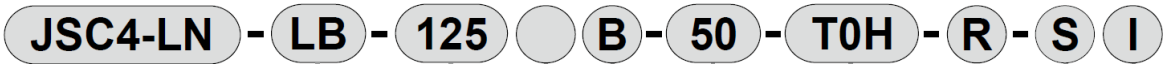
1.1.1 Product model number

■ Example of model number indication

<Without switch>



<With switch>



(a) (b) (c) (d) (e) (f) (g) (h) (i) (j)

(a) Model no.		(b) Mounting style Note 1		(c) Bore size (mm)		(d) Port thread	
JSC4-N	Double-acting, without switch	LB	Axial foot	125	ϕ125	Blank	Rc thread
JSC4-LN	Double-acting, with switch	FA	Rod side flange	140	ϕ140	N	NPT thread (made-to-order)
JSC4-H	Double-acting/ low hydraulic, without switch	FB	Head side flange	160	ϕ160	G	G thread (made-to-order)
JSC4-LH	Double-acting/ low hydraulic, with switch	CA	Clevis eye bracket	180	ϕ180		
JSC4-T	Double-acting/ heat-resistant, without switch	CB	Clevis bracket				
		TC	Intermediate trunnion				
		TA	Rod side trunnion				
		TB	Head side trunnion				

(e) Cushion		(f) Stroke (mm)	(g) Switch model no.	(h) Switch quantity	
B	Both sides cushioned	50	Note 3	R	One on rod side
R	Rod side cushioned	75		H	One on head side
H	Head side cushioned	100		D	Two
N	Without cushion	150		T	Three
		200		4	Four Note 2
		250			
		300			

(i) Option	(j) Accessory	
Note 4	I	Rod eye
	Y	Rod clevis
	B1	Eye bracket
	B2	Clevis bracket

Note 1: The mounting bracket comes attached and shipped with the product.
Note 2: Specify the switch quantity if more than four switches are necessary.

Note3: (g) Switch model no.

(g) Switch model no.			
Lead wire outlet direction		Contact	Lead wire
Straight type	Angled type		
T0H☐	T0V☐	Reed	2-wire
T5H☐	T5V☐		
T8H☐	T8V☐		
T1H☐	T1V☐	Proximity	2-wire
T2H☐	T2V☐		
T3H☐	T3V☐		3-wire
T3PH☐	T3PV☐		
T2WH☐	T2WV☐		2-wire
T2YH☐	T2YV☐		
T3WH☐	T3WV☐		3-wire
T3YH☐	T3YV☐		
T2JH☐	T2JV☐		2-wire
T2YD☐	T2YDT☐		

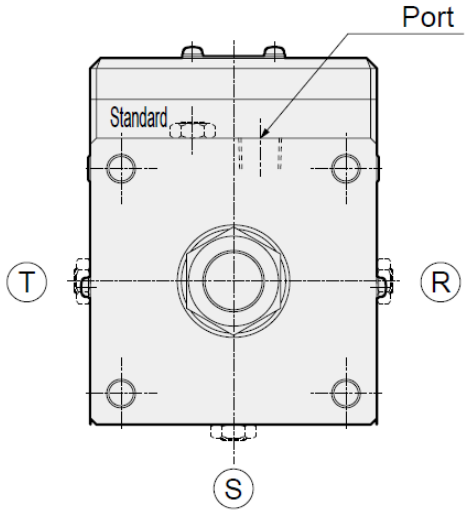
* ☐ represents a lead wire length.

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

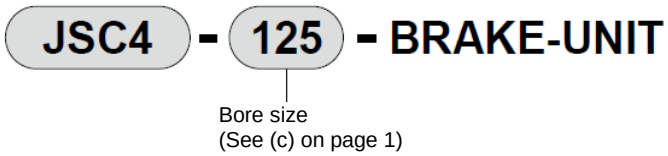
Note4: (i) Option

(h) Option Note 3			
		Max. ambient temperature	Instantaneous max. temperature
J	Bellows	60°C	100°C
K	Bellows	100°C	200°C
L	Bellows	250°C	400°C
M	Piston rod material change (stainless steel)		
Blank	Cushion needle position (standard)		
R	Cushion needle position R		
S	Cushion needle position S		
T	Cushion needle position T		
C2	Cushion equipped with check valve		

<Cushion needle position (facing the rod with the port on the top)>



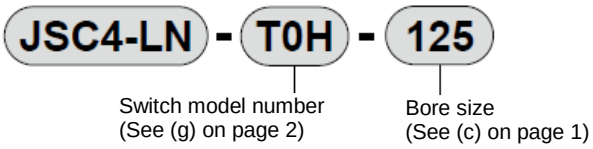
1.1.2 Brake unit model number



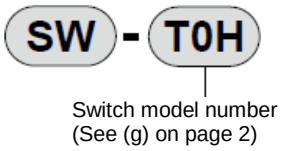
1.1.3 Switch model number

■ T type switch model number

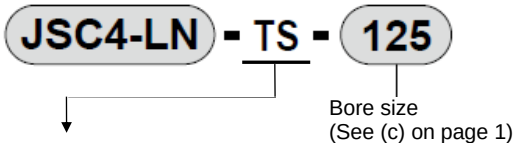
<Switch body + Mounting bracket set>



<Switch body only>



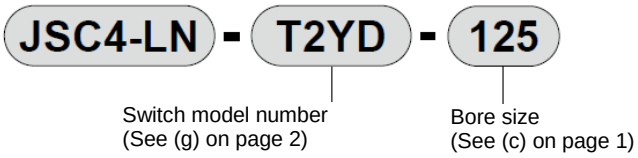
<Mounting bracket set>



Mounting bracket	
TS	T type switch

■ T2YD type switch model number

<Switch body + Mounting bracket set>



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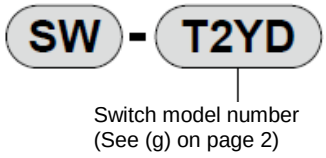
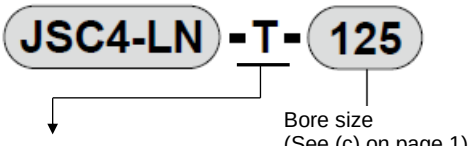


<Mounting bracket set>



Mounting bracket	
T	T2YD type switch

1.2 Specifications

1.2.1 Product specifications

Model no. / Descriptions			JSC4-N JSC4-LN				JSC4-H JSC4-LH				JSC4-T			
Bore size		mm	ø125	ø140	ø160	ø180	ø125	ø140	ø160	ø180	ø125	ø140	ø160	ø180
Actuation			Double-acting				Double acting/ low hydraulic				Double acting/ heat-resistant			
Working fluid			Compressed air				Hydraulic fluid Note 1				Compressed air			
Max. working pressure		MPa	1.0											
Min. working pressure MPa	Brake	MPa	0.3											
	Cylinder	MPa	0.05				0.1				0.05			
Proof pressure		MPa	1.6											
Ambient temperature		°C	−5 to 60 (no freezing)				5 to 50				5 to 120			
Port size	Brake		Rc1/2											
	Cylinder		Rc1/2	Rc3/4			Rc1/2	Rc3/4			Rc1/2	Rc3/4		
Working piston speed		mm/s	50 to 1000 (use within allowable energy absorption)				-				50 to 1000 (use within allowable energy absorption)			
Cushion			With or without cushion can be selected.											
Effective air cushion length		mm	21.6											
Lubrication			Not required If lubrication is necessary, use Class 1 ISO VG32 turbine oil.								Prohibited Note 2			
Stopping accuracy		mm	± 1.0 (300 mm/s at no load)				± 0.2 (50 mm/s at no load)				± 1.0 (300 mm/s at no load)			
Holding force		N	9.6	12.0	15.8	20.0	9.6	12.0	15.8	20.0	9.6	12.0	15.8	20.0
Allowable energy absorption J	With cushion		63.6	91.5	116	152	63.6	91.5	116	152	63.6	91.5	116	152
	Without cushion		Without a cushion, the large energy generated by the external load cannot be absorbed. Use of an external shock absorber is recommended.											

Note 1: The brake is air operated.
Note 2: Apply heat-resistant grease periodically.

1.2.2 Switch specifications

Variation, model no.	Reed 2-wire type						
Descriptions	**T0H/V**		**T5H/V**		**T8H/V**		
Applications	For programmable controller, relay		For programmable controller, relay, IC circuit (without indicator), serial connection		For programmable controller, relay		
Power supply voltage	–						
Load voltage	12/24 VDC	110 VAC	5/12/24 VDC	110 VAC	12/24 VDC	110 VAC	220 VAC
Load current	5 mA to 50 mA	7 mA to 20 mA	50 mA or less	20 mA or less	5 mA to 50 mA	7 mA to 20 mA	7 mA to 10 mA
Current consumption	–						
Internal voltage drop	3 V or less		0.1 V or less		3 V or less		
Indicator	Red LED (Lights up when turned on)		No indicator		Red LED (Lights up when turned on)		
Leakage current	0						
Lead wire [Note 1]	Standard is 1 m (Oil-resistant vinyl cabtyre 2 core cord, 0.2 mm^2)				Standard is 1 m (Oil-resistant vinyl cabtyre 2 core cord, 0.3 mm^2)		
Shock resistance	294 m/s^2 or less						
Insulation resistance	20 MΩ or more with 500 VDC megger				100 MΩ or more with 500 VDC megger		
Withstand voltage	No abnormality after applying 1000 VAC for one minute				No abnormality after applying 1500 VAC for one minute		
Ambient temperature	−10°C to 60°C						
Degree of protection	IP 67 (IEC standard), JIS C 0920 (watertight), oil-resistant						

Variation, model no.	Proximity 2-wire type				
Descriptions	**T1H/V**	**T2H/V**	**T2JH/V**	**T2YH/V**	**T2WH/V**
Applications	For programmable controller, relay, small solenoid valve	Only for programmable controller			
Power supply voltage	–				
Load voltage	85 VAC to 265 VAC	10 VDC to 30 VDC			24 VDC ± 10%
Load current	5 mA to 100 mA	5 mA to 20 mA [Note 2]			
Current consumption	–				
Internal voltage drop	10% or less of load voltage	4 V or less			
Indicator	Red LED (Lights up when turned on)			Red/green LED (Lights up when turned on)	
Leakage current	1 mA or less at 100 VAC 2 mA or less at 200 VAC	1 mA or less			
Lead wire [Note 1]	Standard is 1 m (Oil-resistant vinyl cabtyre 2 core cord, 0.3 mm^2)	Standard is 1 m (Oil-resistant vinyl cabtyre 2 core cord, 0.2 mm^2)	Standard is 1 m (Oil-resistant vinyl cabtyre 2 core cord, 0.3 mm^2)		Standard is 1 m (Oil-resistant vinyl cabtyre 2 core cord, 0.2 mm^2)
Shock resistance	980 m/s^2 or less				
Insulation resistance	100 MΩ or more with 500 VDC megger	20 MΩ or more with 500 VDC megger	100 MΩ or more with 500 VDC megger		20 MΩ or more with 500 VDC megger
Withstand voltage	No abnormality after applying 1500 VAC for one minute	No abnormality after applying 1000 VAC for one minute			
Ambient temperature	−10°C to 60°C				
Degree of protection	IP 67 (IEC standard), JIS C 0920 (watertight), oil-resistant				

Variation, model no. / Descriptions	Proximity 3-wire type		
	T3H/V	T3YH/V	T3WH/V
Applications	For programmable controller, relay		
Power supply voltage	10 VDC to 28 VDC		
Load voltage	30 VDC or less		
Load current	100 mA or less	50 mA or less	
Current consumption	10 mA or less at 24 VDC		
Internal voltage drop	0.5 V or less		
Indicator	Red LED (Lights up when turned on)	Red/green LED (Lights up when turned on)	
Leakage current	10 μA or less		
Lead wire Note 1	Standard is 1 m (Oil-resistant vinyl cabtyre 3 core cord, 0.2 mm^2)	Standard is 1 m (Oil-resistant vinyl cabtyre 3 core cord, 0.3 mm^2)	Standard is 1 m (Oil-resistant vinyl cabtyre 3 core cord, 0.2 mm^2)
Shock resistance	980 m/s^2 or less		
Insulation resistance	20 MΩ or more with 500 VDC megger	100 MΩ or more with 500 VDC megger	20 MΩ or more with 500 VDC megger
Withstand voltage	No abnormality after applying 1000 VAC for one minute		
Ambient temperature	−10°C to 60°C		
Degree of protection	IP 67 (IEC standard), JIS C 0920 (watertight), oil-resistant		

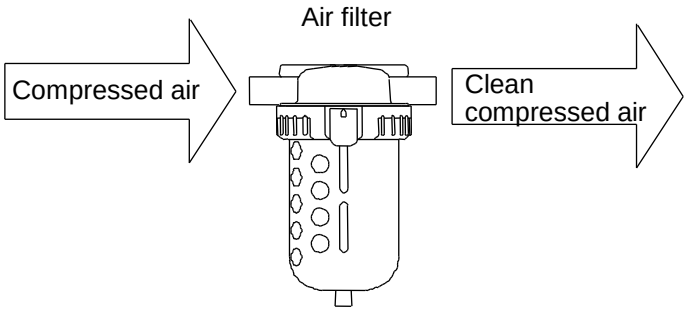
Variation, model no. / Descriptions	Proximity 2-wire type	
	T2YD	T2YDT
Applications	Only for programmable controller	
Power supply voltage	–	
Load voltage	24 VDC ± 10%	
Load current	5 mA to 20 mA	
Current consumption	–	
Internal voltage drop	6 V or less	
Indicator	Red/green LED (Lights up when turned on)	
Leakage current	1 mA or less	
Output delay time Note 3 (On delay, Off delay)	30 ms to 60 ms	
Lead wire Note 1	1 m (Oil-resistant vinyl cabtyre 2 core cord, 0.5 mm^2) (standard)	1 m (Flame-retardant vinyl cabtyre 2 core cord, 0.5 mm^2) (option)
Shock resistance	980 m/s^2 or less	
Insulation resistance	100 MΩ or more with 500 VDC megger	
Withstand voltage	No abnormality after applying 1000 VAC for one minute	
Ambient temperature	−10°C to 60°C	
Degree of protection	IP 67 (IEC standard), JIS C 0920 (watertight), oil-resistant	

Note 1: 3 m and 5 m lead wires are available as options.
Note 2: The maximum load current of 20 mA is the value when the ambient temperature is 25°C.
The current will be lower than 20 mA when the ambient temperature of the switch is higher than 25°C (5 mA to 10 mA at 60°C).
Note 3: The output delay time represents a period of time between the detection of the piston magnet by the magnetic sensor and the switch output.

2. INSTALLATION

2.1 Environment

- Use the product within the following ambient temperature ranges:
  JSC4-N (standard type) −10°C to 60°C (no freezing)
  JSC4-H (low hydraulic type) 5°C to 50°C
  JSC4-T (heat-resistant type) 5°C to 120°C
- When using the product in a dusty environment, use a cylinder equipped with bellows.
- For compressed air, use clean and dry air that has been passed through an air filter.
  Use an air filter in the circuit and be careful with the filtration rate (a filter that removes particles exceeding 5 μm is desirable), flow rate, and mounting position (install the filter near the directional control valve).



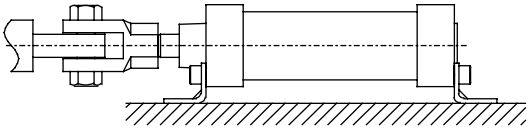
2.2 Unpacking

- Check that the model number ordered and the model number indicated on the product are the same.
- Check the exterior of the product for any damage.
- When storing the product, attach a sealing plug to the piping port to prevent foreign matters from entering the cylinder. Remove the sealing plug before piping.

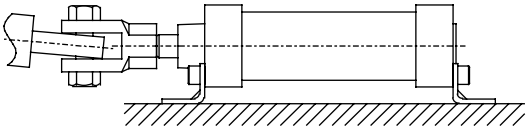
2.3 Mounting

- In order to increase the stopping accuracy, use a guide with low coefficient of friction and little change (such as a ball bearing or a roller bearing) for the guide of the cylinder load.
- Do not tighten the cylinder tube too much or hit the cylinder tube with an object. The tube may become deformed and cause an operation fault.
- When using a cylinder equipped with a cushion, to improve the stopping accuracy, avoid an intermediate stop within 40 mm from the stroke end.
- When the cylinder is secured and the rod end guide is used, connect the rod end guide with a free joint (spherical bearing) manufactured by CKD to align the centers of the cylinder piston rod and the load. If the centers are not aligned, bushings and packings of the cylinder may become worn.
- When the cylinder is secured and the rod end pin joint is used, make sure to align the center of the rod shaft and the direction of the movement of the load. If the direction of the movement of the load is not parallel to the center of the rod shaft, a distortion may occur in the rod or the tube and cause galling or damage.

Correct

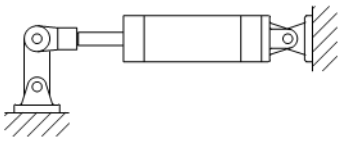


Incorrect



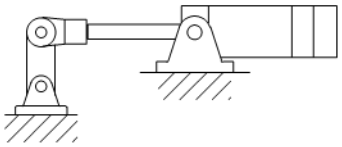
- When the direction of the movement of the load changes during operation, use a movable model (clevis type or trunnion type) with mounting brackets which allow the cylinder to rotate a certain angle. Also, mount the connection bracket (knuckle) at the rod end so that it moves in the same direction as the cylinder body.

Correct



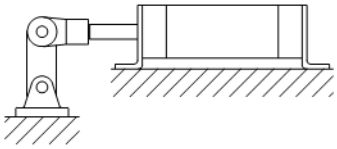
Clevis type

Correct



Trunnion type

Incorrect

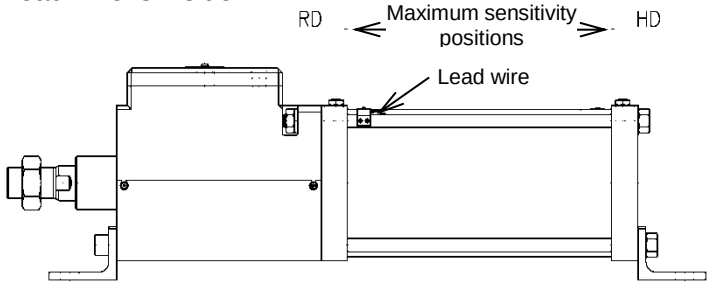


Foot type

2.3.1 Mounting the switch

■ Mounting position

<Mounting the switch at the end of the stroke>
For the switch to function at maximum sensitivity, mount the switch so that its end face is in contact with either the rod cover or the head cover. In addition, mount the switch in the direction as shown in the figure below so that the lead wire is inside.

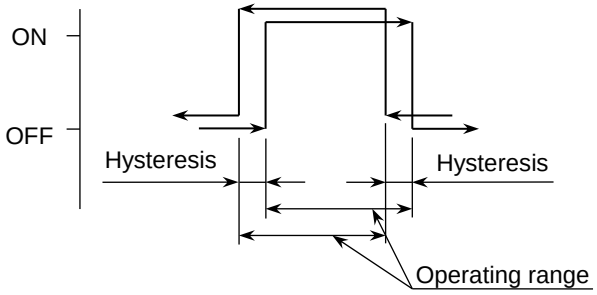


<Mounting the switch at the intermediate position of the stroke>
For the switch to function at an intermediate position of the stroke, secure the piston at the position where the switch needs to function and then slide the switch on the piston back and forth to find the positions where the switch turns on when slid forward and when slid backward. The intermediate point between these two positions is where the switch functions at maximum sensitivity for that piston position and where the switch is to be mounted.

<Mounting the switch in the circumference direction>
There is no restriction with respect to the mounting position in the circumferential direction. Since the switch is mounted to the tie rod, find the desired position for using the switch by turning it in 90° increments and then mount the switch.

■ Operating range

This is the range from where the switch is turned on when the piston moves and to where the switch is turned off when the piston moves farther in the same direction.



■ Hysteresis

This is the distance from where the switch is turned on when the piston moves and to where the switch is turned off when the piston moves in the opposite direction.

■ Operating range and hysteresis

(Unit: mm)

Bore size (mm)	Proximity switch (T2H/T2V, T3H/T3V)		Reed switch (T0H/T0V, T5H/T5V)	
	Operating range (reference value)	Hysteresis	Operating range (reference value)	Hysteresis
ø125	4 to 8	1.5 or less	4 to 10	3 or less
ø140	4 to 8		4 to 10	
ø160	4 to 8		4 to 10	
ø180	4 to 8		4 to 10	

<Factory setting switch mounting position>
The switch is mounted at the maximum sensitivity position (HD or RD) shown in the table below before shipping.

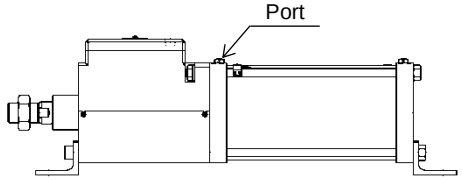
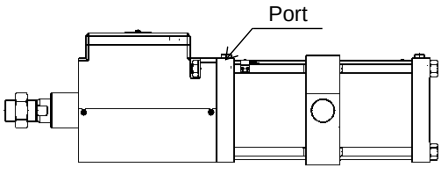
(Unit: mm)

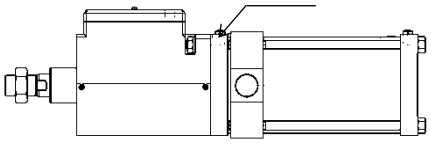
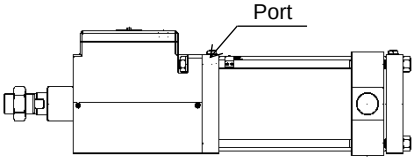
Bore size (mm)	Proximity switch (T2H/T2V, T3H/T3V)		Reed switch (T0H/T0V, T5H/T5V)	
	Max. sensitivity position		Max. sensitivity position	
	RD	HD	RD	HD
ø125	8.5	4	8.5	4
ø140	8.5	7	8.5	7
ø160	10.5	8	10.5	8
ø180	13	9.5	13	9.5

■ Minimum stroke with switch

The table below shows the minimum stroke necessary for the switch to operate properly.

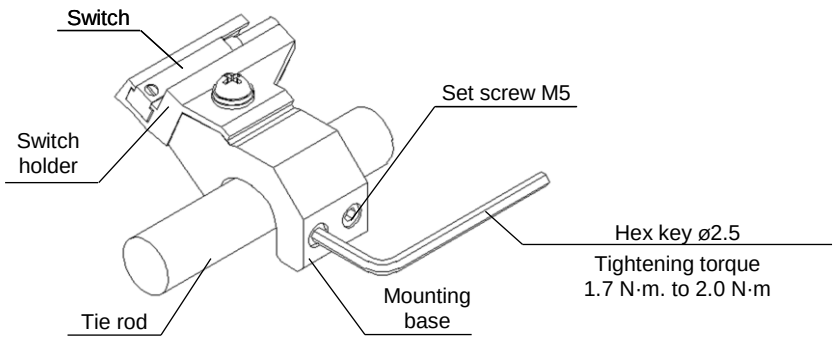
(Unit: mm)

Item	Stroke for when mounted on the same surface	Stroke for when mounted with the center trunnion
Outline / Bore size		
ø125	20 or more	120 or more
ø140		125 or more
ø160		130 or more
ø180		135 or more

Item	Stroke for when mounted with the rod side trunnion	Stroke for when mounted with the head side trunnion
Outline / Bore size		
ø125	70 or more	
ø140	75 or more	
ø160	80 or more	
ø180	85 or more	

2.3.2 Changing the position of the switch

Loosen the two hexagon socket head screws securing the mounting base by a 1/2 to 3/4 turn to move the switch in the direction of the shaft without removing the screws.
After moving the switch to the desired position, gently press the holder so that the switch is in close contact with the cylinder tube and tighten the hexagon socket head screws to secure the mounting base. The tightening torque is 1.7 N·m to 2.0 N·m.



2.3.3 Securing the switch

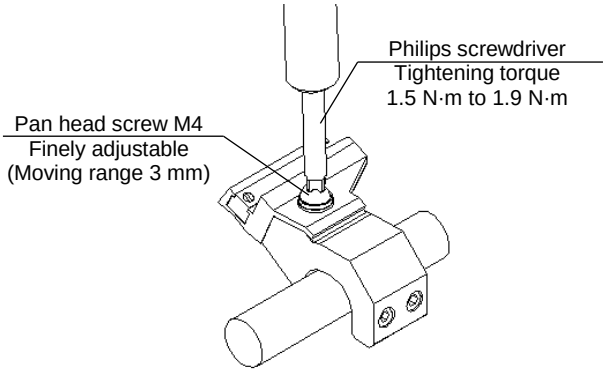
1 Mount the switch to the switch holder and secure them to the mounting base with M4 x 10 pan head screw.

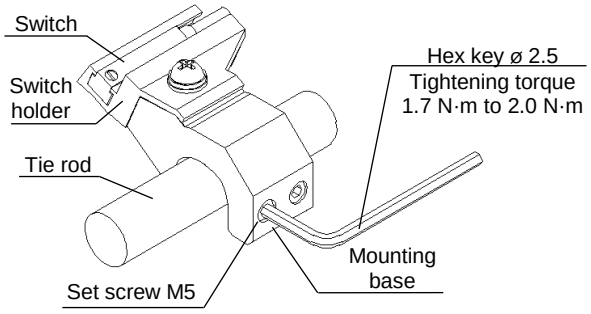
2 Lightly insert two hexagon socket head screws into the holes in the mounting base and insert the mounting base into the tie rod to the desired position for mounting the switch.

3 Lightly tighten the hexagon socket head screws until they reach the tie rod.
This condition allows the switch to be moved in the direction of the shaft without removing it from the cylinder. If it is necessary to change the position of the switch, do so in this condition.

4 Gently press the holder so that the switch is in close contact with the cylinder tube and tighten the hexagon socket head screws to secure the mounting base.

- The tightening torque is 1.7 N·m to 2.0 N·m. When the hex key starts warping while tightening, the screws are tightened enough.





2.4 Piping

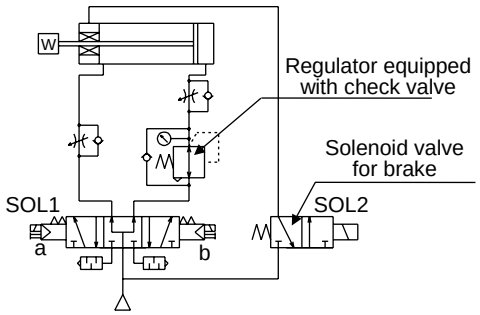
2.4.1 Basic circuit

Observe the following basic matters and set up a circuit by referring to the figures shown below to operate the product properly.

- While the cylinder is stopped, make sure that both ends are pressurized (to prevent the piston rod from popping out when the cylinder starts moving).
- To maintain thrust balance (load included), install a regulator equipped with a check valve on the side with a larger thrust to increase the pressure. (Refer to the calculation formulas indicated with the "★" mark shown in the tables below.)
- Mount the solenoid valve for releasing the brake as close as possible to the brake releasing port.

For horizontal load

Perform piping as shown below so that both ends of the piston are equally pressurized while the cylinder is stopped to prevent the rod from popping out when the brake is released. In addition, install a regulator equipped with a check valve on the head side to maintain the thrust balance.



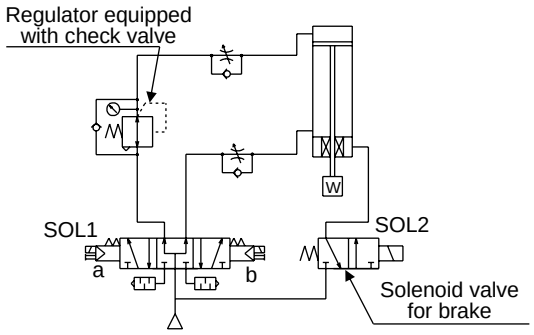
SOL1		SOL2	Actuation state
(a)	(b)		
OFF	OFF	OFF	Stop
ON	OFF	ON	Reverse
OFF	ON	ON	Forward

★ Pressure in the regulator $= \frac{(D^2-d^2)}{D^2} P$

D : Cylinder diameter [mm]
d : Rod diameter [mm]
P : Working pressure [MPa]

For downward vertical load

When the load is downward as shown below, releasing the brake causes the rod to move in the direction of the load. Therefore, install a regulator equipped with a check valve on the head side to decrease the thrust in the direction of the load and maintain the load balance.



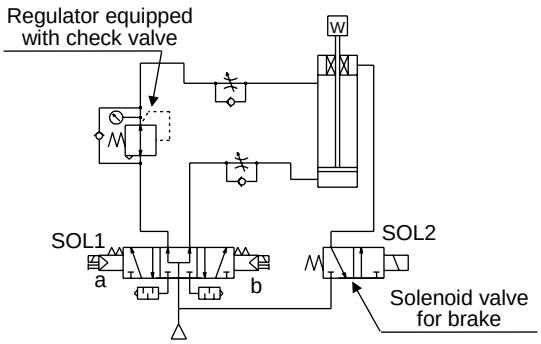
SOL1		SOL2	Actuation state
(a)	(b)		
OFF	OFF	OFF	Stop
ON	OFF	ON	Descend
OFF	ON	ON	Ascend

★ Pressure in the regulator $= \frac{\pi(D^2-d^2)P-4W}{\pi D^2}$

D : Cylinder diameter [mm]
d : Rod diameter [mm]
P : Working pressure [MPa]
W : Load [N]

For upward vertical load

When the load is upward as shown below, releasing the brake causes the rod to move in the direction of the load. Therefore, install a regulator equipped with a check valve on the rod side to decrease the thrust in the direction of the load and maintain the load balance.



SOL1		SOL2	Actuation state
(a)	(b)		
OFF	OFF	OFF	Stop
ON	OFF	ON	Descend
OFF	ON	ON	Ascend

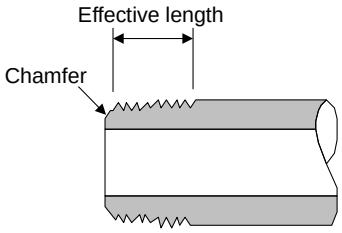
★ Pressure in the regulator $= \frac{\pi D^2P-4W}{\pi(D^2-d^2)}$

D : Cylinder diameter [mm]
d : Rod diameter [mm]
P : Working pressure [MPa]
W : Load [N]

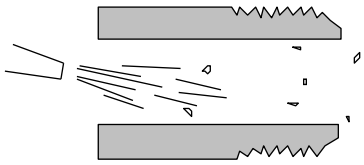
* SOL = solenoid

2.4.2 Piping

- Use pipes that are made of corrosion-resistant materials after the filter such as zinc-plated pipes, nylon tubes, and rubber tubes.
- Use pipes with an effective cross-sectional area that allows the cylinder to achieve the predetermined piston speed.
- Install the filter for removing rust, foreign matters, and drainage from the piping as close as possible to the solenoid valve.
- Observe the effective thread length for the gas pipes.
  In addition, chamfer the threaded end of the pipes by about a 1/2 pitch.



- Before piping, blow air into the pipes to clean the interior and to remove cutting chips and foreign matters.

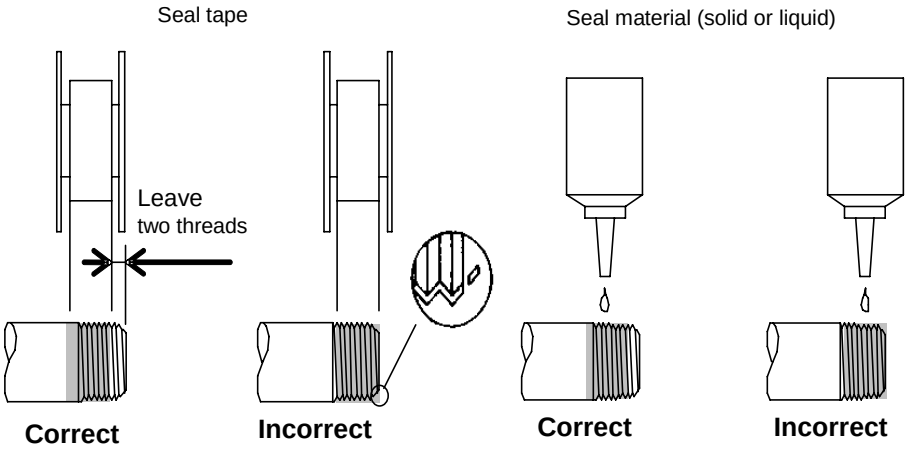


- Use a seal tape or a seal material to stop leakage from piping.
  Apply a seal tape or seal material to the screw threads leaving two or more threads at the pipe end uncovered or uncoated. If the pipe end is fully covered or coated, a shred of seal tape or residue of seal material may enter inside of the pipes or device and cause a failure.

  When using a seal tape, wind it around the screw threads in the direction opposite from the screw threads and press it down with your fingers to attach it firmly.

  When using a liquid seal material, be careful not to apply it to resin parts. The resin parts can become damaged and this may lead to a failure or malfunction.

  Also, do not apply seal material to the internal threads.



2.5 Wiring

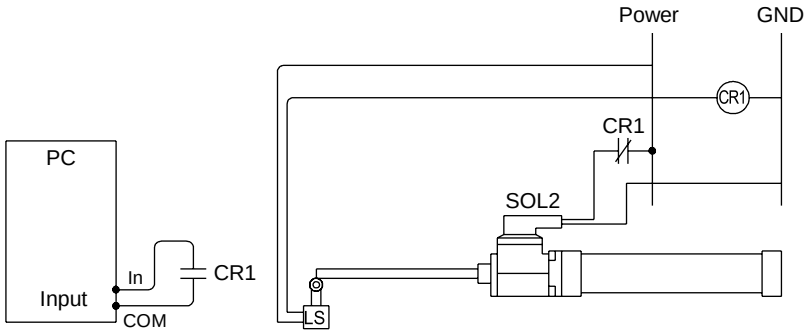
2.5.1 Electric control circuit

Since the control device and the circuit to be used affect the stopping accuracy, observe the following instructions:

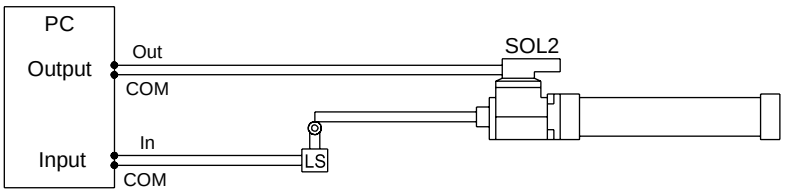
- Use a device with excellent accuracy that has a control circuit with short response time.
- To prevent the piston rod from popping out when the brake is released, make sure that the brake release signal and the cylinder control signal are input at the same time or the brake release signal is input first.
- Use a self-holding circuit for the electric circuit of the stop signal detection switch.
- Use a cylinder switch, roller plunger type limit switch, proximity switch, or photoelectric sensor for the stop signal detection switch.
- When using the programmable controller:
  If the brake and the programmable controller are in the same circuit, the scan time fluctuates (± 20 ms to 30 ms) and causes fluctuations in when the brake is applied. As a result, the stopping accuracy becomes ± 3 mm to 5 mm.
  Do not use the brake and the programmable controller in the same circuit. Directly apply the brake using a relay.

Scan time:	The time for one cycle of a program routine
Fluctuation:	If the cylinder speed is 100 mm/s and the scan time is 30 ms, the fluctuation is ± 1.5 mm

The brake and the programmable controller not in the same circuit (good example)



The brake and the programmable controller in the same circuit (bad example)



2.5.2 Reed switch

■ Connection of lead wires

Do not connect the lead wire of the switch to the power directly. Make sure that the lead wire and the load are connected in serial.
For T0 and T8 switches, observe the following instructions as well:

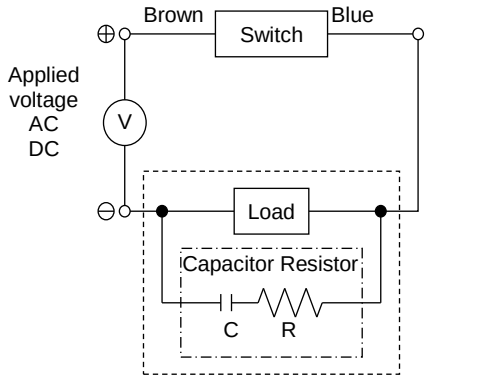
- When the switch is used with DC power, connect the brown wire to the positive side and the blue wire to the negative side. If the polarity of the connection of wires is reversed, the switch will turn on but the indicator will not light up.
- When the switch is connected to the input of a relay or a programmable controller for AC power and the half-wave rectification is performed in those circuits, the indicator on the switch may not light up. In that case, reversing the polarity of the connection of the lead wires of the switch will light up the indicator.

■ Contact protection measures

When the switch is used with an inductive load such as a relay or when the wiring length exceeds the value shown in the table to the right, install a contact protection circuit.

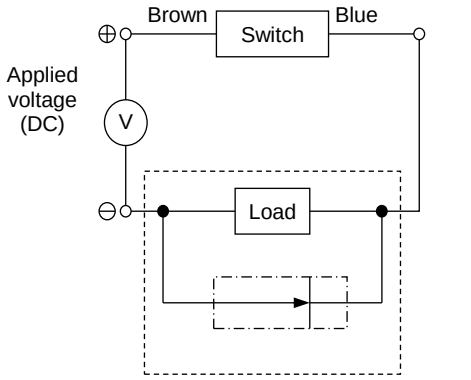
Power	Wiring length
DC	50 m
AC	10 m

<Protection when connecting an inductive load>



Recommended value
C (Capacitor) 0.033 μF to 0.1 μF
R (Resistor)1 kΩ to 3 kΩ
XEB1K1 manufactured by Okaya Electric Industries or equivalent

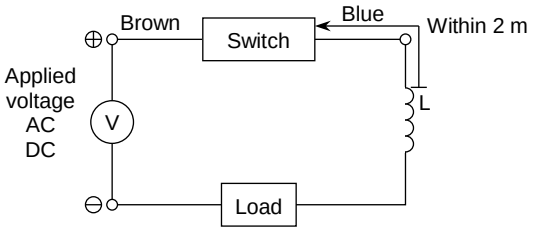
When capacitor and resistor are used



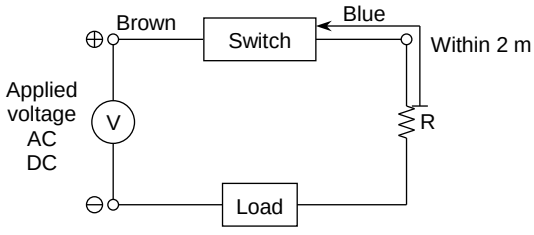
Rectifying diode for general use
V06C manufactured by Hitachi or equivalent

When diode is used

<Protection when the wiring length exceeds the value shown in the table above>



- Choke coil
  L = Several hundred μH to several mH
  Excellent high frequency characteristic
- Wire near the switch (within 2 m).



- Starting current restriction resistor
  R = Highest possible resistance for the load circuit
- Wire near the switch (within 2 m).

■ Contact capacity

Do not use a load that exceeds the maximum contact capacity of the switch. If the current falls below the rated current value, the indicator may not light up.

■ Relay

Use one of the following or equivalent relays:
- Omron Corporation ·····MY type
- Fuji Electric Co., Ltd. ·····HH5 type
- Panasonic Corporation ·····HC type

■ Serial connection

The voltage drop of multiple T0 or T8 switches connected in serial is the sum of the voltage drop of all switches.
The indicator will light up only when all the switches turn on.

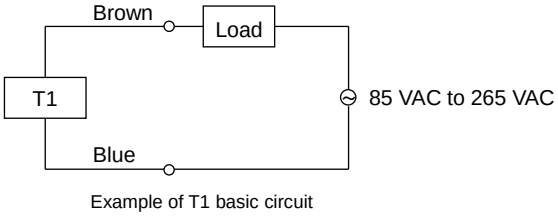
■ Parallel connection

There is no limitation on the number of units that can be connected in parallel. However, the indicator may become dim or not light up for T0 and T8 switches.

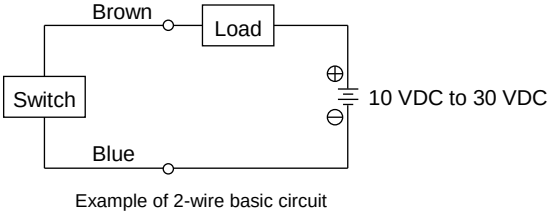
2.5.3 Proximity switch

■ Connection of lead wires

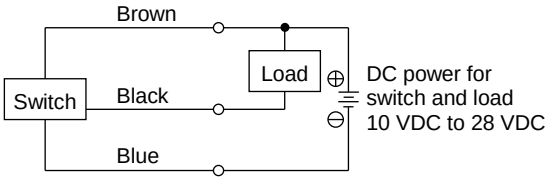
Turn off the power to the device in the electric circuit to which the switch is to be connected and connect the lead wires according to their color. Not turning off the power may cause damage to the electric circuit of the switch load.
If the switch is not wired correctly or the load is short-circuited, it may cause damage not only to the switch but also to the electric circuit on the load side.



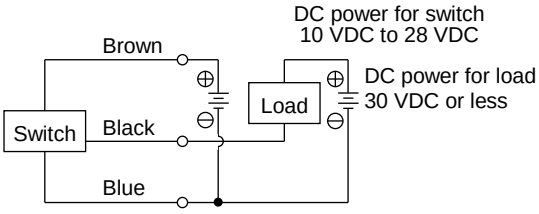
Example of T1 basic circuit



Example of 2-wire basic circuit



Example of 3-wire basic circuit (1)
(When same power is used for switch and load)

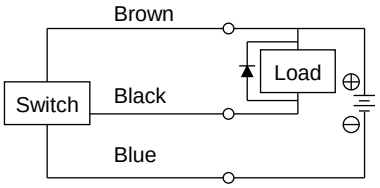


Example of 3-wire basic circuit (2)
(When separate power is used for switch and load)

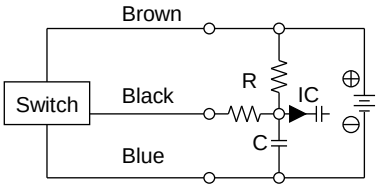
■ Protection of the output circuit

For the following cases, refer to the figures below and install a protection circuit:

- When an inductive load (relay or solenoid valve) is connected and used: See Ex. 1
  Use a surge absorption element since a surge voltage is generated when the switch is turned off.
- When a capacious load (capacitor) is connected and used: See Ex. 2
  Use a current regulating resistor since a starting current is generated when the switch is turned on.
- When the lead wire length exceeds 10 m: See Ex. 3 and 4 (2-wire type), Ex. 5 (3-wire type)

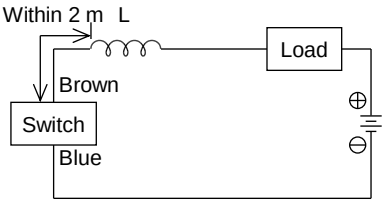


Ex. 1 Using inductive load with surge absorption element (diode). (For diode, use V06C manufactured by Hitachi or equivalent.)



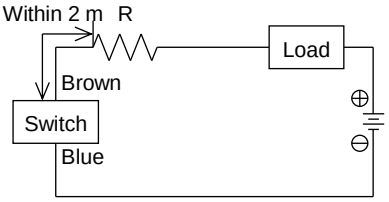
Ex. 2 Using capacious load with current regulating resistor R.
Use the following formula to figure out resistance R (Ω).

$$\frac{V}{0.05} = R\ (\Omega)$$



Ex. 3 - Choke coil
L = Several hundred μH to several mH
Excellent high frequency characteristic

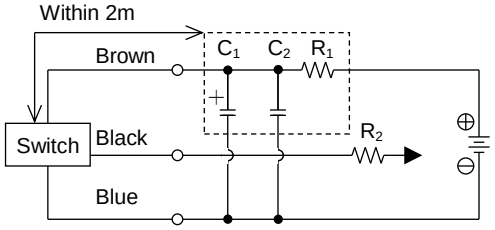
- Wire near the switch (within 2 m).



Ex. 4 - Starting current restriction resistor
R = Highest possible resistance for the load circuit.

.

- Wire near the switch (within 2 m).



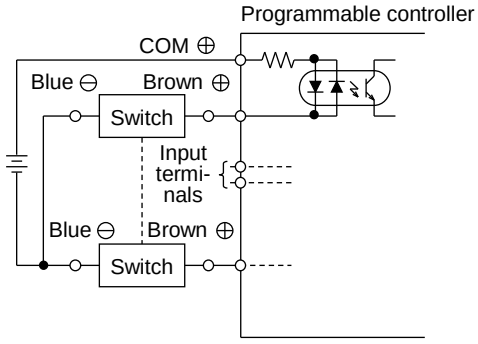
Ex. 5 - Power supply noise absorption circuit
C_1=20 μF to 50 μF electrolytic capacitor
(withstand voltage 50V or more)
C_2=0.01 μF to 0.1 μF ceramic capacitor
R_1=20 Ω to 30 Ω

- Starting current restriction resistor
R_2= Highest possible resistance for the load circuit.

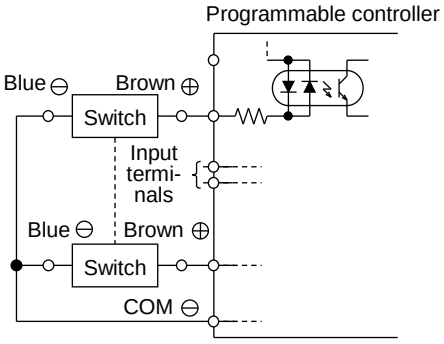
- Wire near the switch (within 2 m)

■ Connection to the programmable controller

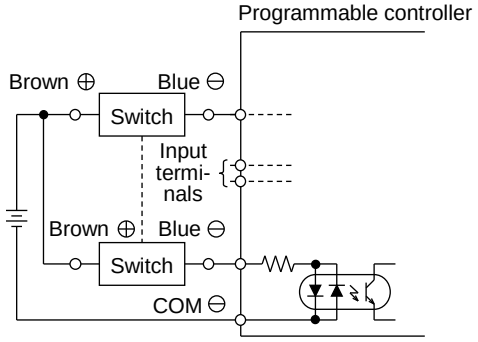
The connection method depends on the type of the programmable controller. Connect as shown below.



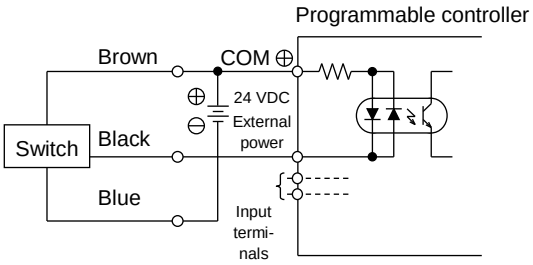
2-wire connection to source input
(external power)



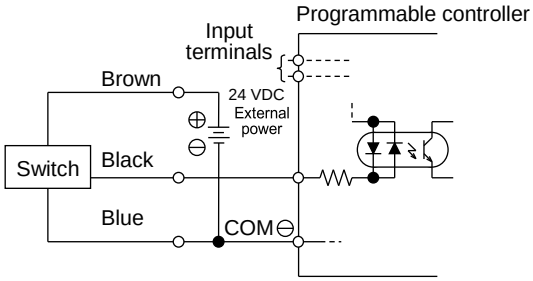
2-wire connection to source input
(internal power)



2-wire connection to sink input
(external power)



3-wire connection to source input
(external power)



3-wire connection to source input
(internal power)

■ Parallel connection

Since the leakage current of a 2-wire type switch increases according to the number of connected units, check the input specifications of the programmable controller, which is a connected load, to determine the number of switches to connect. For the 2-wire type switch, the indicator may become dim or not light up. Although the leakage current of a 3-wire type switch increases according to the number of connected units, the leakage current is very small (10 μA or less) and can generally be ignored. For the 3-wire type switch, the indicator will light up without dimming.

■ Switch for alternating magnetic field (T2YD)

When using the switch with a welding current exceeding 14000 A of alternating current, keep the welding cable at least 35 mm away from the surface of the cylinder tube. (Condition: Outside diameter of cable is ø36)

Alternating magnetic field resistance (when the welding current is 14000 A of alternating current)
The switch for alternating magnetic field (T2YD) can be used if only one welding cable is in contact with the cylinder or the switch. The welding cable must not be in contact with the cylinder or the switch if using two or more welding cables or in a cable loop.

3. USAGE

⚠CAUTION

Do not enter or put your hand in the operating area of the actuator when it is operating.

3.1 Using the Cylinder

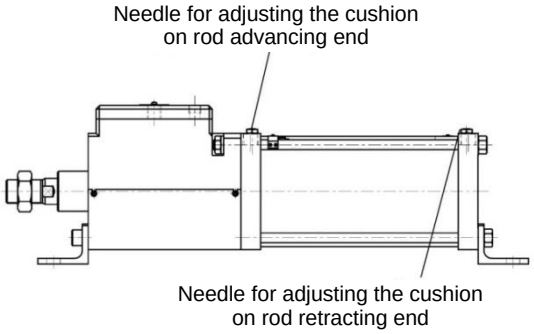
■ Working pressure range

Use the cylinder within the following pressure range:

Model	Brake pressure range	Cylinder pressure range
JSC4-N	0.3 MPa to 1.0 MPa	0.05 MPa to 1.0 MPa
JSC4-H		0.1 MPa to 1.0 MPa
JSC4-T		0.05 MPa to 1.0 MPa

■ How to adjust the cushion

The effectiveness of the cushion has been adjusted with no load before delivery. To adjust the effectiveness of the cushion in accordance with the load, use the cushion needle.
Tighten the needle (clockwise) to increase the effectiveness of the cushion. After adjusting, tighten the needle nut to secure the needle.
If the kinetic energy is larger than the value shown in the table below due to a heavy load or high speed, consider installing an alternative shock absorbing device.



Cushion characteristics table

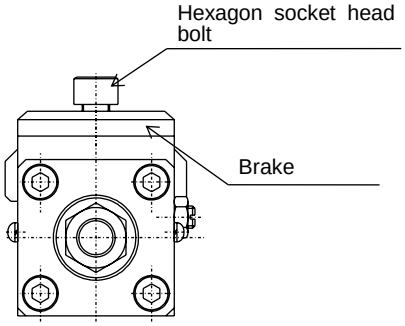
Bore size (mm)	Effective air cushion length (mm)	Allowable energy absorption (J)	
		With cushion	Without cushion
ø125	21.6	63.6	0.371
ø140		91.5	0.386
ø160		116	0.386
ø180		152	0.958

■ Adjustment of the piston speed

Mount a speed controller to adjust the piston speed.

■ How to release the brake manually

Screw a hexagon socket head bolt into the internally threaded hole at the upper part of the brake (next to the brake releasing port) 2 turns to release the brake. (Do not tighten the bolt too much. It may cause a fault in which the brake does not work.)
Remove the hexagon socket head bolt during normal use.



3.2 Using the Switch

■ Magnetic environment

Do not use the switch in a place where there is a strong magnetic field or large current (such as a large magnet or welding machine). If switch mounted cylinders are installed close to each other and in parallel or if magnetic substances are moving close to the cylinder, the magnetic forces may interfere with each other and affect the detection accuracy.

■ Wiring of lead wires

When wiring, be careful not to apply bending stress and tension repeatedly to lead wires.
For movable sections, use wiring material with the same level of bending resistance as the robot wire.

■ Ambient temperature

Do not use the switch in a high temperature environment (60°C or more).
Using the switch in a high temperature environment may affect its performance due to the temperature characteristics of magnetic parts and electronic parts.

■ Intermediate position detection

When the switch is operated at an intermediate position in the length of the stroke, the relay will not respond if the piston speed is too high.
If the operation time of the relay is 20 ms, keep the piston speed at 500 mm/s or less.

■ Shock

Do not subject the product to strong vibrations and shocks when transporting the cylinder and mounting and adjusting the switch.

4. MAINTENANCE AND INSPECTION

⚠ WARNING

Do not touch electrical wiring connections (bare live parts) of actuators equipped with solenoid valves, actuators equipped with switches, and other such actuators.

Do not touch live parts with bare hands.

An electric shock may occur.

⚠ CAUTION

Turn off the power, release the residual pressure and make sure that there is no residual pressure before disassembling or inspecting the actuator.

Plan and perform daily and periodic inspections so that maintenance can be managed properly.

If maintenance is not properly managed, the product's functions may deteriorate significantly and this may lead to faults (such as short service life, damage, and malfunction) or accidents.

4.1 Periodic Inspection

In order to use the product under optimum conditions, perform a periodic inspection once or twice a year.

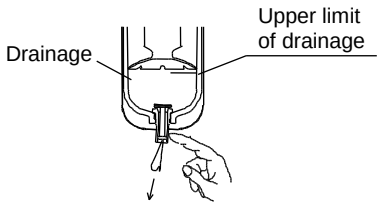
4.1.1 Inspection item

- Looseness of the bolts for mounting the brake
- Actuation of brake release (Whether the brake is released at the minimum working pressure of 0.35 MPa)
- Looseness of the bolts and nuts for mounting the cylinder
- Looseness of the bolts and nuts for mounting the piston rod end brackets and mounting brackets
- Actuation state
- Change in the piston speed and cycle time
- External and internal leakages
- Damage and deformation of the piston rod
- Abnormality in the stroke
- Amount of overrun of the piston rod
- Corrosion inside the port

Check the items above and refer to "5. TROUBLESHOOTING" to correct any abnormality found. If there are loose threaded connections, tighten them.
The brake is an important part of the product and must not be disassembled. To inspect the inside of the brake, contact CKD for an off-site inspection.

4.1.2 Maintenance of the circuit

- Discharge the drainage accumulated in the air filter periodically before it exceeds the specified line.
- Since foreign matters such as carbide (carbon or tar substance) from the compressor oil may contaminate the circuit and cause an operation fault of the solenoid valve or the cylinder, be careful when performing maintenance or inspection of the compressor.
- The product can be used without lubrication. If lubrication is necessary, use Class 1 ISO VG 32 turbine.



4.2 Removing and Mounting

Follow the procedure below to perform maintenance and repairs when a problem such as an air leakage occurs.

4.2.1 How to remove the brake unit

1 Remove the four cover mounting screws (cross recessed pan head screws) with a Philips screwdriver.

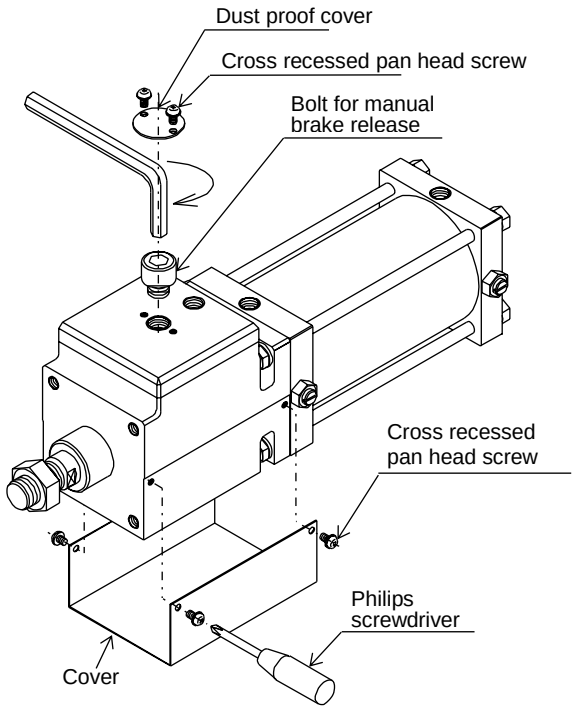
2 Remove the cover by sliding it downward.

3 Remove the two dust proof cover mounting screws (cross recessed pan head screws) and remove the dust proof cover.

4 Screw a hexagon socket head bolt into the exposed internally threaded hole to release the brake manually. Screw in the hexagon socket head bolt 2 to 3 turns.

The dimensions of the hexagon socket head bolt are as shown in the table below.

Bore size (mm)	Nominal diameter and length of screw
ø125	M24 x 16 or more
ø140	M24 x 20 or more
ø160	M24 x 20 or more
ø180	M24 x 24 or more

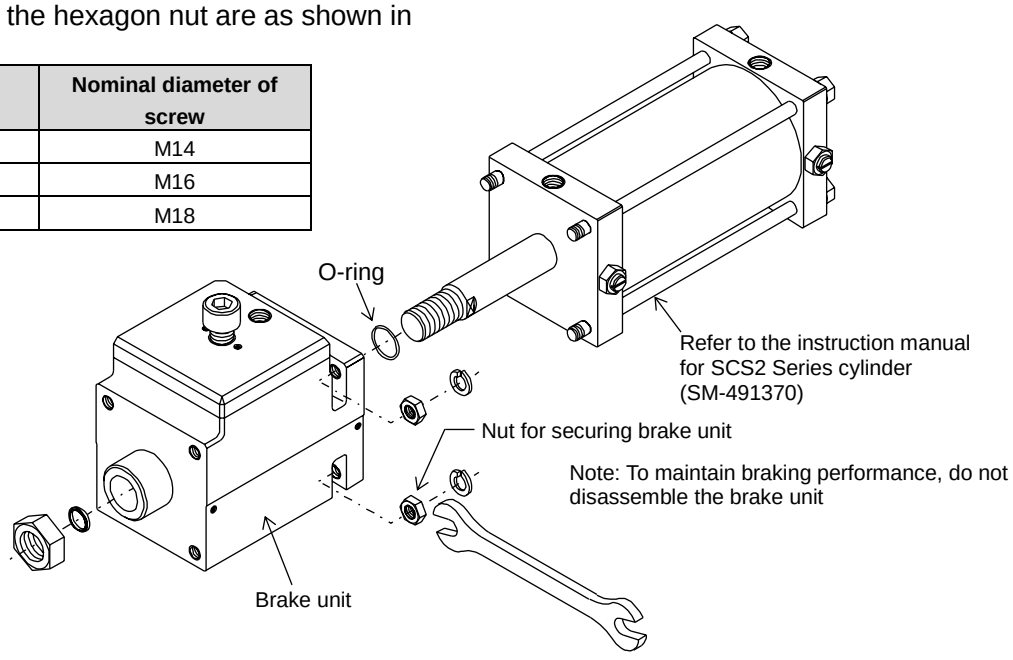


Example: When R is selected for (i) Option

5 Remove the four hexagon nuts for securing the brake unit with a wrench and remove the brake unit.

The dimensions of the hexagon nut are as shown in the table below.

Bore size	Nominal diameter of screw
ø125, ø140	M14
ø160	M16
ø180	M18



Example: When R is selected for (i) Option

4.2.2 How to mount the brake unit

Mount the brake unit by following the steps in "4.2.1 How to remove the brake unit" in reverse order.
Observe the following instructions when mounting:

- Do not apply grease to the piston rod. (Greasing will weaken the holding force of the brake.)
- Apply grease to packings and sliding surface thoroughly.
- Apply grease to the metal seal (O-ring) and install it carefully so as not to damage it.
- When mounting the brake unit, tighten the nuts for securing the brake unit in a diagonal pattern to prevent them from being distorted.
  After tightening, make sure that the piston rod moves smoothly.
- Make sure to remove the hexagon socket head bolt for manual brake release.

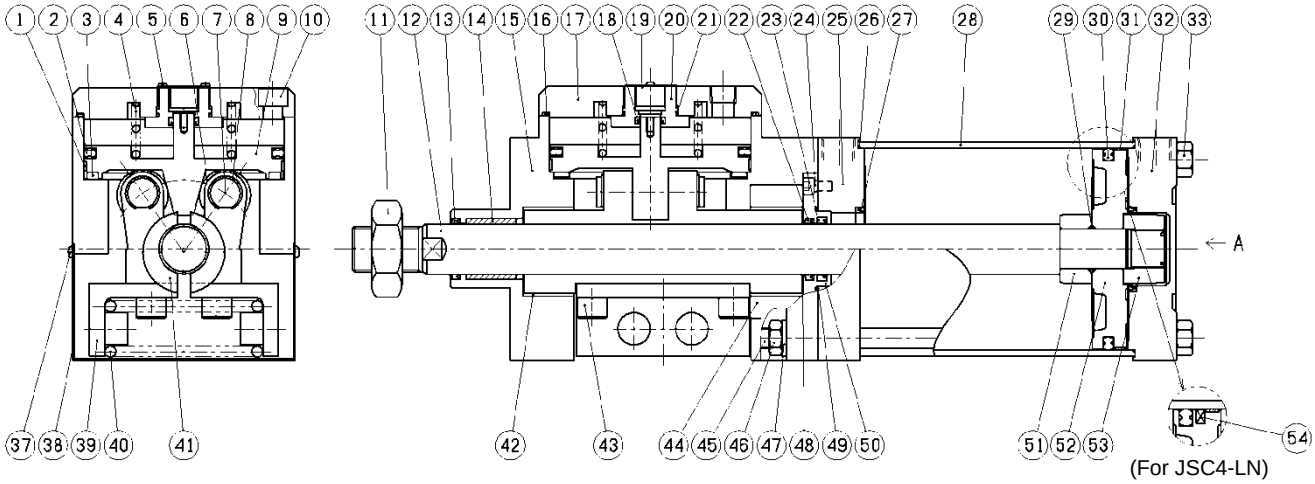
4.2.3 Inspection of parts

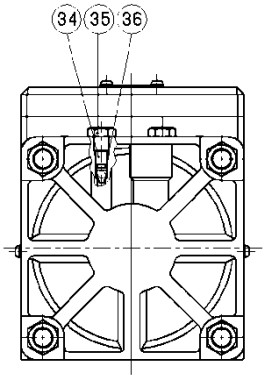
Inspect the parts for problems below. Repair or replace the parts for which abnormalities are found.

- Damage on the inner surface of the tube
- Damage, peeling of plating, and rust on the surface of the piston rod
- Damage and abrasion on the inner surface of the bushing
- Damage, abrasion, and crack on the piston surface
- Looseness of the joint between the piston and the rod
- Crack on both end covers
- Damage and abrasion on the packings of sliding section (dust wiper, rod packing, cushion packing, and piston packing)

4.2.4 Consumable parts

Internal structure





View A

Parts list

No.	Part name	Material	Quantity	Remarks
1	Wear ring	Polyacetal resin	1	
2	Piston packing B	NBR	1	
3	Cushion rubber	Urethane rubber	1	
4	Spring	Steel	1	Coating
5	Cross recessed pan head screw with washer	Steel	2	Zinc chromate
6	Bearing	-	2	
7	Bearing pin	Alloy steel	2	
8	E-type stop ring	Alloy steel	4	Zinc chromate
9	Piston for brake	Cast iron	1	Manganese phosphate
10	Hexagon socket head bolt	Alloy steel	4	Black oxide finish
11	Rod nut	Steel	1	Zinc chromate
12	Piston rod	Steel	1	Industrial chrome plating
13	Dust wiper	NBR	1	
14	Bushing B	Oil-retaining bearing alloy	1	
15	Brake body	Aluminum alloy casting	1	Anodized aluminum
16	Cap gasket	NBR	1	
17	Body cap A	Cast iron	1	Manganese phosphate
18	Rod packing	NBR	1	
19	Dust proof cover	Aluminum alloy	1	Anodized aluminum
20	Body cap B	Cast iron	1	Manganese phosphate
21	O-ring	NBR	1	
22	Dust wiper	NBR	1	
23	Rod packing	NBR	1	
24	Hexagon socket head bolt	Alloy steel	4	Black oxide finish
25	Rod cover	Aluminum alloy casting	1	Chromate
26	Cylinder gasket	NBR	2	
27	Cushion packing	NBR, steel	2	
28	Cylinder tube	Aluminum alloy	1	Hard anodized aluminum
29	Piston gasket	NBR	1	
30	Piston packing	NBR	1	
31	Wear ring	Polyacetal resin	1	
32	Head cover	Aluminum alloy	1	Chromate
33	Hexagon nut	Steel	4	Zinc chromate
34	Cushion needle	Copper alloy	2	
35	Needle nut	Steel	2	Zinc chromate
36	Needle gasket	NBR	2	
37	Cross recessed pan head screw with washer	Steel	4	Zinc chromate
38	Cover	Steel	1	Coating
39	Spring retainer	Steel	2	Manganese phosphate
40	Spring	Alloy steel	2	Black oxide finish
41	Brake metal	Cast iron	1	Nickel plating
42	Bushing A	Dry bearing	2	
43	Hexagon socket head bolt	Alloy steel	4	Black oxide finish
44	Ring	Steel	1	Black oxide finish
45	Hexagon nut	Steel	4	Zinc chromate
46	Toothed washer	Steel	4	Zinc chromate
47	Tie rod	Steel	4	Zinc chromate
48	Thrust washer	Alloy steel	1	
49	Metal gasket	NBR	1	
50	Rod metal	Cast iron	1	Manganese phosphate
51	Cushion ring A	Steel	1	Zinc chromate
52	Piston	Aluminum alloy casting	1	
53	Cushion ring B	Steel	1	Zinc chromate
54	Magnet	Rubber	1	For JSC4-LN

Consumable parts are as follows. Specify the kit number when ordering.

Consumable parts list

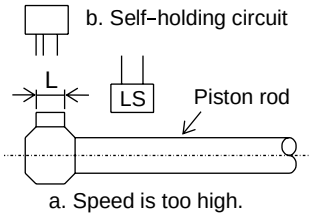
Bore size (mm)	Kit no.	Consumable part no.
ø125	JSC4-N-125K	13, 22, 23, 26, 27, 30, 31, 36, 49
ø140	JSC4-N-140K	
ø160	JSC4-N-160K	
ø180	JSC4-N-180K	

5. TROUBLESHOOTING

5.1 Problems, Causes, and Solutions

5.1.1 Cylinder

If the cylinder does not operate properly, check the table below for a possible solution.

Problem	Cause	Solution
Manual brake does not release.	No pressure or insufficient pressure is applied to brake.	Secure sufficient pressure.
	No signal is input to solenoid valve for brake. (For NO type, signal is input.)	Check the wiring and input the signal. (Check the wiring and turn off the signal.)
	Solenoid valve for brake does not operate.	Check and repair the wiring. Repair or replace the solenoid valve.
	Piston packing for brake is damaged.	Replace the brake unit.
Rod does not stop.	Signal is input to solenoid valve for brake. (For NO type, no signal is input.)	Check the wiring and turn off the signal. (Check the wiring and input the signal.)
	Solenoid valve for brake does not operate.	Check and repair the wiring. Repair or replace the solenoid valve.
	Piston packing for brake is damaged.	Replace the brake unit.
	Manual brake release is in use.	Stop using the manual brake release.
	Rod goes past brake signal sensor dog. a. Cylinder speed is too high. b. Cylinder does not have self-holding circuit.  a. Speed is too high.	a. Lower the speed or make the detection width (L) of the sensor dog longer. b. Change to a self-holding circuit.
	Cylinder switch does not turn on.	Refer to "5.1.2 Switch".
Stopping accuracy is poor.	Effective cross-sectional area of solenoid valve for brake is too small.	Replace it with a solenoid valve that has a larger effective cross-sectional area.
	Pipe between solenoid valve for brake and brake releasing port is too narrow or too long.	Use wider pipe. User shorter pipe. Connect the solenoid valve directly.
	Responsiveness of solenoid valve for brake is bad.	Replace it with a solenoid valve that has good responsiveness.
	Responsiveness of signal detection switch to solenoid valve for brake is bad.	Replace it with a detection switch that has good responsiveness.
	Relay is sequentially operated with brake control signal circuit.	Change the signal circuit. (When using a programmable controller, be careful of the calculation speed (responsiveness).)
	There is play (such as backlash) in brake signal sensor dog.	Correct the backlash.
	Shape of brake signal sensor dog is not good. a. Roller plunger type limit switch is used but inclination exceeds 30°. b. Interlock is set up using sensor dog but its detection length is shorter than overrun amount.	a. A large inclination causes a load fluctuation and leads to poor accuracy. (For a roller lever type, 60° is accepted.) b. When the relay is self-holding, the detection length needs to be as long as the operating time of the relay.

Problem	Cause	Solution
	There is change in cylinder speed. a. Centers (of piston rod, guide, etc.) have become misaligned. b. Inertial load is too large compared to cylinder thrust. (Especially when stop pitch is small.) c. An intermediate stop within 40 mm from stroke end is being done.	a. Use a free joint to align the centers. b. Enlarge the bore size or replace the cylinder with a low hydraulic type model. c. Avoid an intermediate stop within 40 mm from the stroke end.
	Piston rod tends to pop out when it moves. a. Pressure of regulator for pressure balance is not correct. b. There is delay in when to release manual brake.	a. Adjust the pressure of the regulator. b. Release the manual brake earlier. (Also check that air supply is not restricted.)
Stopping accuracy is poor.	There are fluctuations in load. a. Load changes as it moves along curved surface. (Continuous change) b. Load changes due to vertical load. (Stepwise change)	a. Replace the cylinder with a low hydraulic type model. b. Use multiple regulators for pressure balance in the circuit if load fluctuation is small or load fluctuation changes stepwise.
Rod does not operate.	No signal is input to directional control valve.	Repair the control circuit.
	Centers were not aligned when mounted.	Correct the way the cylinder is mounted. Change the mounting style.
	Piston packing is damaged.	Replace the packing.
Rod does not operate smoothly.	Centers were not aligned when mounted.	Correct the way the cylinder is mounted. Change the mounting style.
	Lateral load is applied.	Install a guide. Correct the way the cylinder is mounted. Change the mounting style.
	Speed is lower than minimum working piston speed.	Mitigate load fluctuation. Consider using a low hydraulic cylinder.
	Load is too large.	Increase the pressure. Enlarge the bore size.
	Speed control valve has meter-in circuit.	Change the mounting direction of the speed control valve.
Cylinder is damaged or deformed.	Force of shock due to high-speed actuation is excessive.	Increase the effectiveness of the cushion. Decrease the speed. Lighten the load. Install a more effective cushion mechanism. (external cushion mechanism)
	Lateral load is applied.	Install a guide. Correct the way the cylinder is mounted. Change the mounting style.

If you have any other questions or concerns, contact your nearest CKD sales office or distributor.

5.1.2 Switch

If the switch does not operate properly, check the table below for a possible solution.

Problem	Cause	Solution
Switch turns on but indicator does not blink.	Contact is welded.	Replace the switch.
	Rating of load is exceeded.	Replace the relay with one recommended by CKD or replace the switch.
	Indicator is damaged.	Replace the switch.
	External signal is faulty.	Check the external circuit.
Switch does not turn on.	Cables are disconnected.	Replace the switch.
	External signal is faulty.	Check the external circuit.
	Voltage is wrong.	Use specified voltage.
	Switch is not mounted in right place.	Mount the switch in right place.
	Switch is not positioned correctly.	Position and tighten the switch correctly. Tightening torque: 1.5 N·m to 1.9 N·m.
	Switch is facing opposite direction.	Mount the switch so that it faces the correct direction.
	Load (relay) cannot respond.	Replace the relay with one recommended by CKD.
	Rating of load is exceeded.	Replace the relay with one recommended by CKD or replace the switch.
	Cylinder speed is too high for intermediate position detection.	Lower the speed.
Switch does not turn off.	Piston is not moving.	Move the piston.
	Contact is welded.	Replace the switch.
	Rating of relay is exceeded.	Replace the relay with one recommended by CKD or replace the switch.
	Ambient temperature is too high or too low.	Use the switch at an ambient temperature of −5°C to 60°C.
	Magnetic field is nearby.	Install a magnetic shield.
	External signal is faulty.	Check the external circuit.

* For how to replace or reposition the switch, refer to "2.3 Mounting".

If you have any other questions or concerns, contact your nearest CKD sales office or distributor.

6. WARRANTY PROVISIONS

6.1 Warranty Conditions

■ Warranty coverage

If the product specified herein fails for reasons attributable to CKD within the warranty period specified below, CKD will promptly provide a replacement for the faulty product or a part thereof or repair the faulty product at one of CKD's facilities free of charge.
However, following failures are excluded from this warranty:

- Failure caused by handling or use of the product under conditions and in environments not conforming to those stated in the catalog, the Specifications, or this Instruction Manual.
- Failure caused by incorrect use such as careless handling or improper management.
- Failure not caused by the product.
- Failure caused by use not intended for the product.
- Failure caused by modifications/alterations or repairs not carried out by CKD.
- Failure that could have been avoided if the customer's machinery or device, into which the product is incorporated, had functions and structures generally provided in the industry.
- Failure caused by reasons unforeseen at the level of technology available at the time of delivery.
- Failure caused by acts of nature and disasters beyond control of CKD.

The warranty stated herein covers only the delivered product itself. Any loss or damage induced by failure of the delivered product is excluded from this warranty.

■ Confirmation of product compatibility

It is the responsibility of the customer to confirm compatibility of the product with any system, machinery, or device used by the customer.

■ Others

The terms and conditions of this warranty stipulate basic matters.
When the terms and conditions of the warranty described in individual specification drawings or the Specifications are different from those of this warranty, the specification drawings or the Specifications shall have a higher priority.

6.2 Warranty Period

The product is warranted for one (1) year from the date of delivery to the location specified by the customer.