

# **Instruction Manual**

## **Flat Cylinder**

### **FC\***

- Be sure to read this instruction manual before using the product.
- In particular, read the safety instructions carefully.
- Keep this instruction manual in a safe place so that it can be taken out and read immediately when needed.

## To Use This Product Safely

To use this product safely, you need to have basic knowledge of pneumatic equipment, including materials, pipes, electricity, and mechanisms (a level that conforms to Japanese Industrial Standards JIS B 8370, General rules for pneumatic systems).

We cannot be held responsible for any accidents caused by persons without knowledge or by improper handling.

There are a wide variety of ways in which customers may use this product, and it is impossible for us to grasp them all. Depending on the conditions of use, the product may not perform as intended or may lead to an accident. Be sure to check the product specifications and understand the proper usage before deciding to use it.

Although various safety measures have been taken for this product, improper handling by the customer may lead to an accident. To prevent this from happening, be **sure to read the instruction manual carefully and fully understand its contents before using the product.**

In addition to the handling precautions described in the main text, also note the following items.



### Caution

- When disassembling and inspecting the actuator, be sure to release the residual pressure and check it before performing the work.
- Do not reach into or put your hands inside the actuator drive when the actuator is in operation.
- There is a risk of electric shock if you touch the electrical wiring connections (bare live parts) of actuators with solenoid valves or actuators with switches. Before disassembling or inspecting the product, be sure to turn off the power. Do not touch the live part with wet hands.

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FC\*

Flat Cylinder

Instruction Manual No. SM-6997-A

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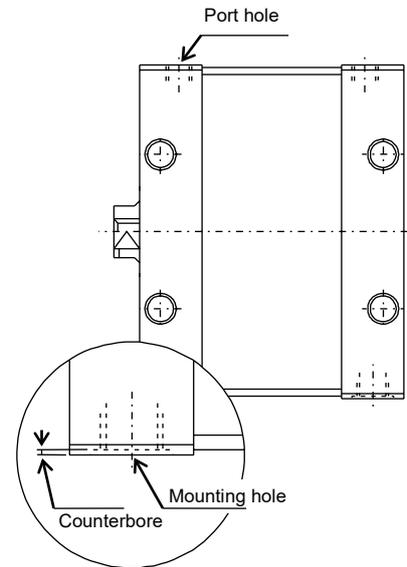
## 1. Unpacking

- 1) Check that the model number of the product you ordered is the same as the model number on the product nameplate.
- 2) Check that there is no external damage.
- 3) When storing the product, keep it in the individual box to prevent foreign matter from getting inside the product, and take it out from the box when piping.

## 2. Matters Related to Installation

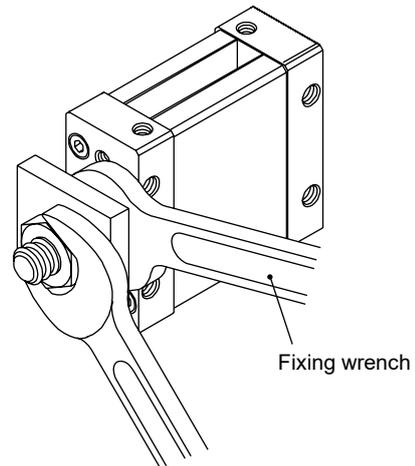
### 2.1 Installation

- 1) The ambient temperature range for this cylinder is -10 to 60°C.  
Use within this temperature range.
- 2) Mounting is possible on all sides except the port side, but be careful not to confuse the port holes with the mounting holes on the opposite side.  
(The mounting holes are the ones with a 0.5 mm deep counterbore.)



- 3) The rod end threads are available in male and female types. Use the appropriate type according to your application.
- 4) When mounting a load on the rod end, observe the following precautions.

- (1) For female rod end threads  
Use a standard tool (hexagon wrench) to secure the wrench flats at the end of the rod and tighten them.
- (2) For male rod end threads  
Use a wrench to secure the wrench flats at the rod end.  
Be careful not to apply a load-tightening torque directly to the cylinder body (piston section). Compared to female threads, male threads have a larger diameter, resulting in higher torque that may damage the piston.



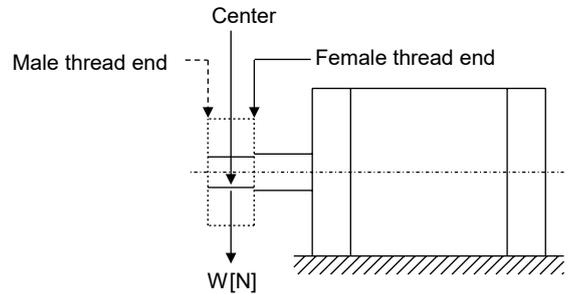
- 5) When the direction of load movement is not parallel to the rod axis, it may cause twisting of the rod, leading to wear of the bearings and packings. Depending on the operating conditions, the cylinder may be damaged. Therefore, connect it using our free joint.

### 6) Horizontal load

When using the cylinder horizontally, use it within the values obtained from the table below.

[ st. unit: mm ]  
[Unit: N]

φ25	Standard type	$W = 383 / (33 + \text{st.})$
	K type	$W = 638 / (40.5 + \text{st.})$
φ32	Standard type	$W = 672 / (35.5 + \text{st.})$
	K type	$W = 1090 / (43 + \text{st.})$
φ40	Standard type	$W = 1120 / (39.5 + \text{st.})$
	K type	$W = 1780 / (47 + \text{st.})$
φ50	Standard type	$W = 2060 / (40 + \text{st.})$
	K type	$W = 3090 / (53 + \text{st.})$
φ63	Standard type	$W = 4410 / (51 + \text{st.})$
	K type	$W = 6040 / (58.5 + \text{st.})$



Note: This diagram shows the case where the load is applied at the above positions.

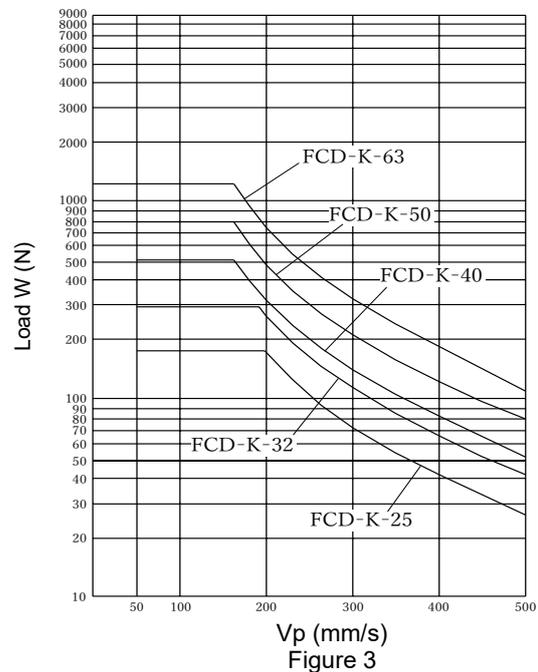
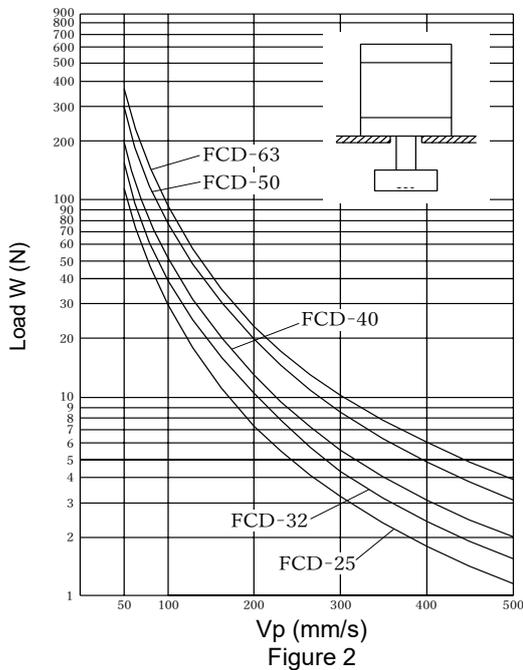
Figure 1

### 7) Allowable absorbed energy

The absorbed energy of this cylinder is as shown in the table below.

Size	Allowable absorbed energy (J)	
	No cushion (FCD-□) (FCD-L-□)	With cushion (FCD-K-□) (FCD-KL-□)
Equivalent to φ25	0.015	0.034
Equivalent to φ32	0.02	0.54
Equivalent to φ40	0.026	0.67
Equivalent to φ50	0.04	1.02
Equivalent to φ63	0.05	1.56

When selecting a load, use the ranges in Figures 2 and 3 as a guide.



○ If the load exceeds this condition, use an external shock absorber or a similar device.

- 8) Always apply the load to the piston rod in the axial direction. Avoid using it in a way that applies rotational torque. If unavoidable, use it within the allowable rotational torque range shown below.

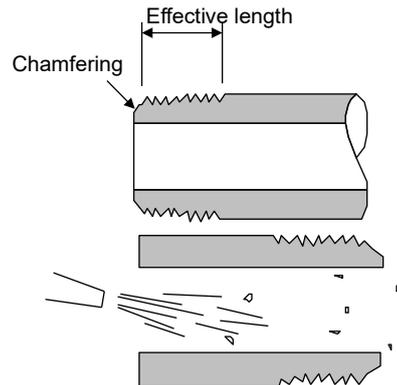
	FCD-(L)-25	FCD-(L)-32	FCD-(L)-40	FCD-(L)-50	FCD-(L)-63
Allowable rotational torque (N·m)	1	1.6	2.5	3.9	5.9

Avoid using the product in a way that applies a sudden rotational torque or that causes the direction of the torque load to change abruptly.

- 9) Do not leave single-acting types (FCS/FCH) pressurized. If the piston is left pressurized and the pressure is released, the piston rod may not return to its original position by spring force.

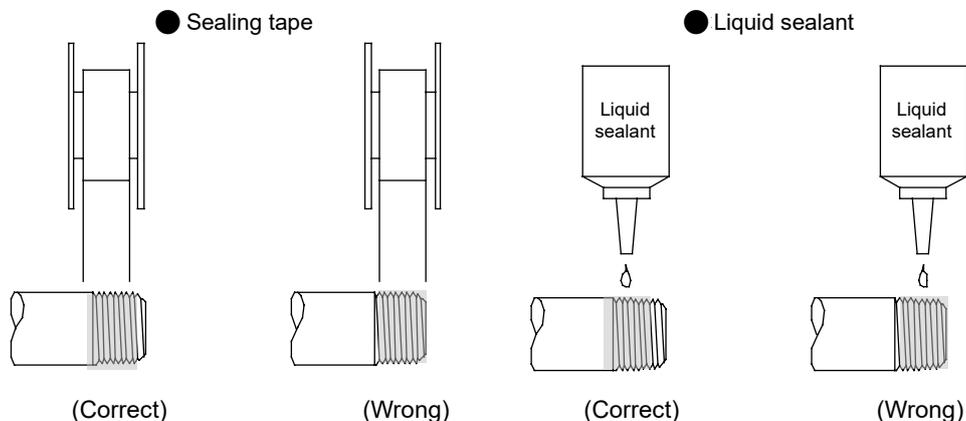
## 2.2 Piping

- 1) For piping downstream of the filter, use corrosion-resistant materials such as galvanized pipe, nylon tube, or rubber hose.
- 2) Use piping between the cylinder and solenoid valve with an effective cross-sectional area sufficient for the cylinder to achieve the specified piston speed.
- 3) To remove rust, foreign matter, and drainage from inside the pipe, install the filter as close to the solenoid valve as possible.
- 4) Maintain the effective thread length of the gas pipe. In addition, chamfer the screw tip by about half a pitch.



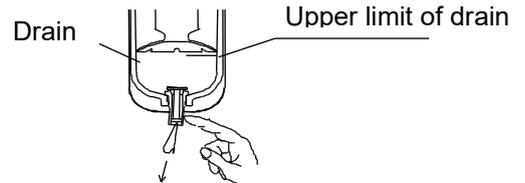
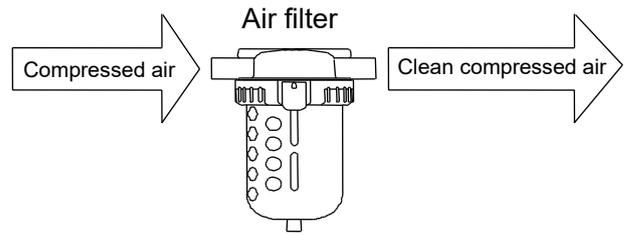
- 5) Before piping, flush the inside of the pipe with air to remove foreign matter, chips, etc.

- 6) Use sealing tape or sealant for piping, but apply it about two threads back from the screw tip. Take care to prevent any tape fragments or sealant residue from entering the pipe or equipment interior.



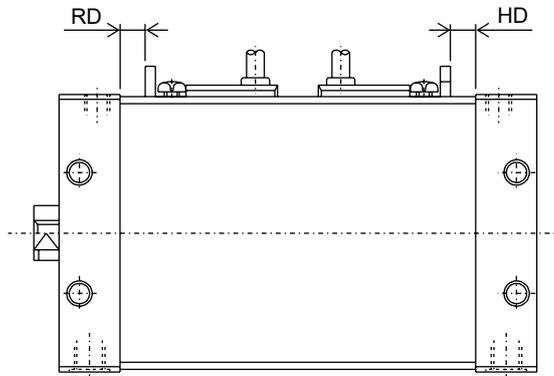
### 2.3 About the fluid used

- 1) Use clean, moisture-free compressed air having been passed through an air filter. Thus, use an air filter in the pneumatic circuit, paying attention to the filtration level (preferably 5 μm or less), flow rate, and installation position (as close as possible to the directional control valve).
- 2) Periodically discharge the drain accumulated in the filter before it exceeds the specified line.
- 3) If carbon deposits (carbon or tar-like substances) from compressor oil contaminate the circuit, solenoid valves and cylinders will malfunction. Take sufficient care in the maintenance and inspection of the compressor.
- 4) This cylinder can be used without lubrication. If lubrication is required, use turbine oil type 1 ISOVG32.



### 2.4 About switch installation

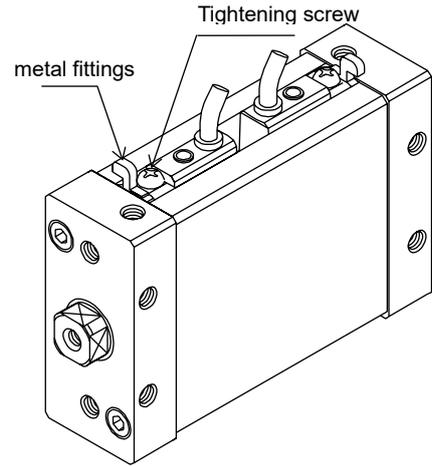
- 1) The cylinder switch is set at the position shown in the table below (maximum sensitivity position) at the time of shipment, but check the setting position before use. If you have purchased the cylinder body and switch separately, or if you use an additional switch, perform the same check.



	FCD-L, FCH-L, FCD-DL		FCS-L		FCD-KL		Switch mounting position	
	RD	HD	RD	HD	RD	HD	Mounting on a different surface	Mounting on the same surface
φ25	0	0	3.5	0	6	1	34 strokes or less	35 strokes or more
φ32			4.5		0.5	7		
φ40		3						
φ50		7		29 strokes or less			30 strokes or more	
φ63		4.5	4.5					

- 2) The minimum stroke for mounting this switch is 10 mm for one switch and 15 mm for two switches (mounted on different surfaces). Furthermore, when mounting the switches on the same surface, the minimum stroke is 35 mm for FCD-25 and FCD-32, and 30 mm for FCD-40, FCD-50, and FCD-63.

- 3) To move the switch, loosen the tightening screw (pan head screw), move the switch body and metal fittings along the cylinder tube, and tighten at the specified position.
- 4) To replace the switch, loosen the tightening screw (pan head screw) and remove the switch from the metal fitting. At this time, leave the metal fitting on the cylinder. Next, fit the replacement switch into the metal fitting and secure it in place with the set screw. (The tightening torque of the pan head screw should be 0.5 to 0.7 N·m.)



- 5) If you install the switch at the middle position of the stroke, follow the procedure below.

① M0V, M2V, M3V, M5V

Fix the piston at the stopping position and move the switch back and forth along the piston rod to find the position where the switch first turns ON. The midpoint between these two positions is the position of maximum sensitivity, and this is the mounting position.

② Two-color display type non-contact switches M2WV and M3WV

Move the switch and secure it in the position where the green light is on. This is the most sensitive position and the optimal installation position.

The two-color display type non-contact switches indicate the operating range with a red light and the maximum sensitivity range (highest installation position) with a green light. This makes it extremely easy to set the switch. However, since the switch conducts even when the red light is on, there is no problem in using it.

6) Operating range

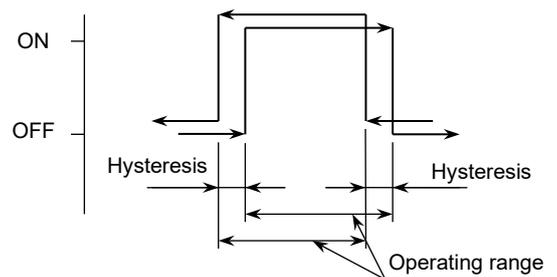
This is the range in which the piston moves, the switch turns ON, and then, as it continues to move in the same direction, the switch turns OFF.

The center of the operating range is the position of maximum sensitivity. Setting this position as the piston stop position makes it less susceptible to external disturbances and stabilizes switch operation.

7) Hysteresis

- (1) The distance from the position where the piston moves to turn the switch ON, to the position where it moves in the opposite direction and turns it OFF.

- (2) If the piston stops during this movement, the switch operation becomes unstable and is susceptible to external disturbances.



Operating range, Hysteresis (unit: mm)

Model number	Tube inner diameter (mm)	Non-contact switches (M2V, M2WV, M3V, M3WV)				Contact switches (M0V, M5V)	
		Operating range		Hysteresis		Operating range	Hysteresis
		1-color	2-color	1-color	2-color		
FCS-L	φ25	9 to 12	6 to 11	1.5 or less	1.0 or less	7 to 8.5	3.0 or less
FCH-L	φ32	9 to 12	6 to 11			7 to 8.5	
FCD-L	φ40	8.5 to 12	6 to 11			7 to 8.5	
FCD-DL	φ50	8 to 12	6 to 11			6.5 to 8.5	
FCD-KL	φ63	8 to 12	6 to 11			6.5 to 8.5	

## 3. How to Use

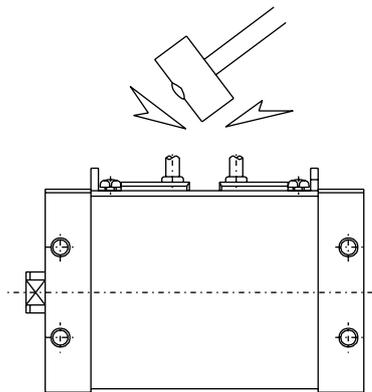
### 3.1 How to use the cylinder

- 1) The supply pressure to the cylinder is as stated in the product specifications. Use it within this operating pressure range.
- 2) Since there is no cushion, kinetic energy cannot be absorbed. If the kinetic energy is large, install an external stopper.
- 3) Install a speed controller to adjust the piston speed.

### 3.2 How to use the switches

#### 3.2.1 General notes

- 1) Magnetic environment  
Avoid using in areas with strong magnetic fields or large currents (large magnets, spot welding machines, etc.). When cylinders with switches are installed in close proximity to each other in parallel, or when a magnetic object moves very close to a cylinder, they may interfere with each other, affecting detection accuracy.
- 2) Lead wire protection  
Be careful when wiring to avoid repeated bending stress and tensile force on the lead wires. For moving parts, use cables with good bending resistance, such as robot cables.
- 3) Ambient temperature  
Do not use at high temperatures (above 60°C).  
Avoid using magnetic components and electronic components in high-temperature environments due to their temperature characteristics.
- 4) Middle position detection  
When activating the switch mid-stroke, be aware that if the piston speed is too high, the relay will fail to respond.  
(Example) If the relay operating time is 20 ms, the piston speed should be 500 mm/s or less.
- 5) Impact  
When transporting the cylinder or installing or adjusting the switch, do not subject it to large vibrations or shocks.



### 3.2.2 Precautions for non-contact switches (M2V, M2WV, M3V, M3WV)

#### 1) Lead wire connection

Connect correctly according to the color coding of the lead wires. Be sure to turn off the power to the device on the connected electrical circuit before performing the work.

Incorrect wiring or short-circuiting the load will not only damage the switch but also the electrical circuit on the load side. Even if there is no faulty wiring, working while the power is on may result in damage to the switch load electrical circuit depending on the work procedure.

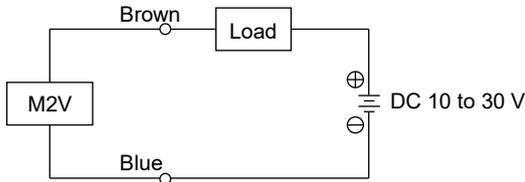


Figure 1. M2V (M2WV) basic circuit example

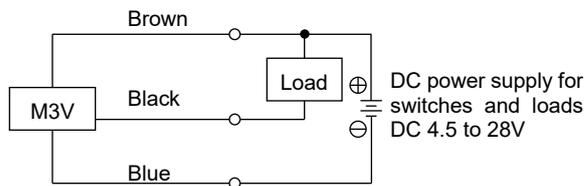


Figure 2. M3V (M3WV) Basic circuit example (1)  
(When the switch power supply and load power supply are the same)

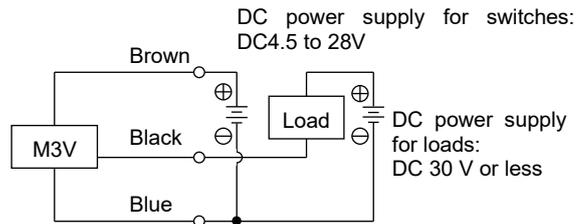


Figure 3. M3V (M3WV) Basic circuit example (2)  
(When the switch power supply and load power supply are different)

#### 2) Output circuit protection

When connecting and using inductive loads (relays and solenoid valves), surge voltages will be generated at switch-off. Therefore, be sure to install the protection circuit shown in Figure 4.

When connecting and using a capacitive load (capacitor), inrush current occurs at switch-on. Therefore, be sure to install the protection circuit shown in Figure 5.

If the lead wire length exceeds 10 m, be sure to install a protective circuit as shown in Figures 6 and 7 (for M2V) and Figure 8 (for M3V).

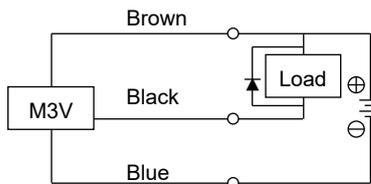


Figure 4. An example of using a surge-absorbing element (diode) for an inductive load. Use V06C diode by Hitachi, Ltd. or equivalent.

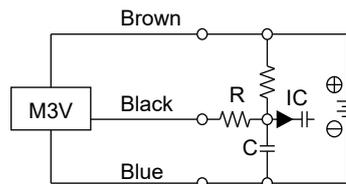


Figure 5. Example of a capacitive load with a current-limiting resistor R.  
In this case, use a resistance R (Ω) equal to or greater than the following formula:

$$\frac{V}{0.15} R(\Omega)$$

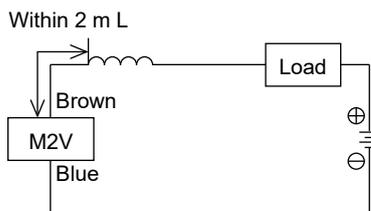


Figure 6. • Choke coil  
L = several hundred μH to several mH  
With excellent high-frequency characteristics  
• Wire close to the switch (within 2 m)

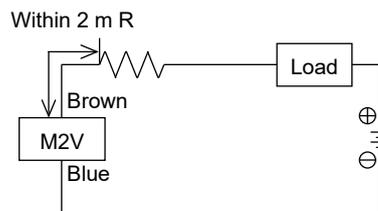


Figure 7. • Inrush current limiting resistor  
R = As large a resistance as the load circuit allows  
• Wire close to the switch (within 2 m)

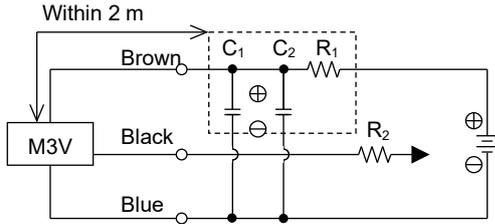


Figure 8. • Power supply noise absorption circuit  
 $C_1=20$  to  $50 \mu\text{F}$  Electrolytic capacitor (withstand voltage 50 V or higher)  
 $C_2 = 0.01$  to  $0.1 \mu\text{F}$ , Ceramic capacitor  
 $R_1=20\sim 30\Omega$   
 • Inrush current limiting resistor  
 $R_2=$  Use as large a resistance as the load circuit allows  
 • Wire close to the switch (within 2 m)

### 3) Connecting to the programmable controller (sequencer)

The connection method varies depending on the type of programmable controller. Refer to Figures 9 to 13 for the connection.

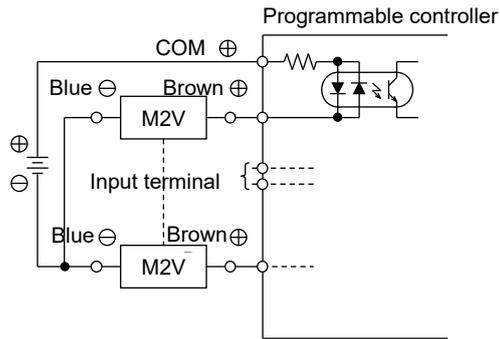


Figure 9. Example of connecting M2V (M2WV) to source input (external power supply) type

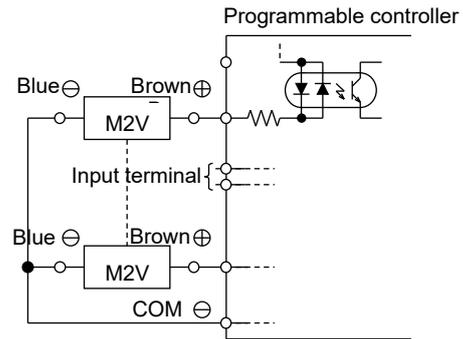


Figure 10. Example of connecting M2V (M2WV) to source input (built-in power supply) type

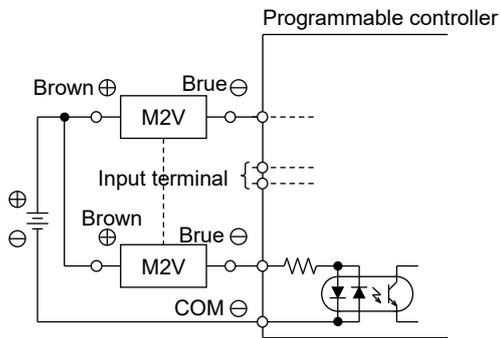


Figure 11. Example of M2V connection to sink input type

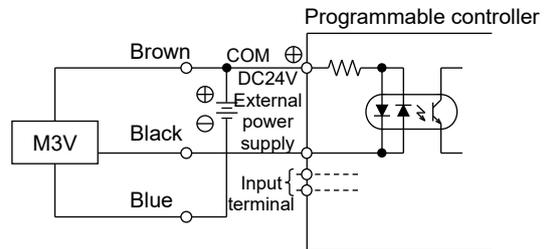


Figure 12. Example of connecting M3V (M3WV) to source input (external power supply) type

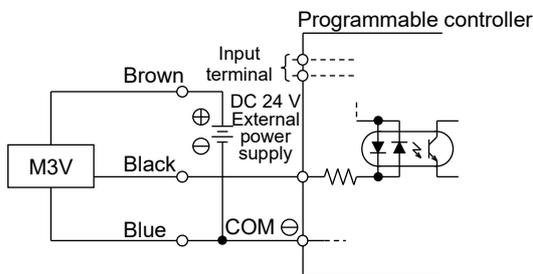


Figure 13. Example of connecting M3V (M3WV) to source input (built-in power supply) type

Note that the M3V switch cannot be connected to a source load input sequencer.

4 ) Series connection

When multiple M2V and M2WV switches are connected in series, the voltage drop across the switches is the sum of the voltage drops across all the connected switches. The voltage applied to the load side is the power supply voltage minus the voltage drop across the switch. Therefore, determine the number of connections after checking the input specifications of the programmable controller, which is the load. Please contact us if you wish to use multiple M3V switches connected in series.

5 ) Parallel connection

The leakage current of M2V and M2WV switches increases with the number of switches connected, so check the input specifications of the programmable controller before deciding how many to connect. However, the indicator lamp may be dim or may not light up.

The leakage current of the M3V and M3WV switches increases with the number of connected switches, but since the leakage current value is very small (10  $\mu$ A or less), this does not pose a problem in normal use. The indicator lamp will not dim or go out.

### 3.2.3 Points to note for contact switches (M0V, M5V)

#### 1) Lead wire connection

Do not connect the switch lead wire directly to the power supply. Be sure to connect the load in series. For M0V, note the following points (1) and (2).

- (1) When using for DC, connect the brown wire to the + side and the blue wire to the - side. If connected in reverse, the switch will operate, but the indicator lamp will not light up.
- (2) When connecting to an AC relay or programmable controller input, if half-wave rectification is performed in such a circuit, the switch indicator lamp may not light up. In this case, reversing the polarity of the switch lead wire connection will turn on the indicator lamp.

#### 2) Contact protection

When using with an inductive load such as a relay, or when the wiring length exceeds the values in Table 1, be sure to provide a contact protection circuit.

Table 1.

Power supply	Wiring length
DC	100 m
AC	10m

#### (1) Protection when connecting inductive loads

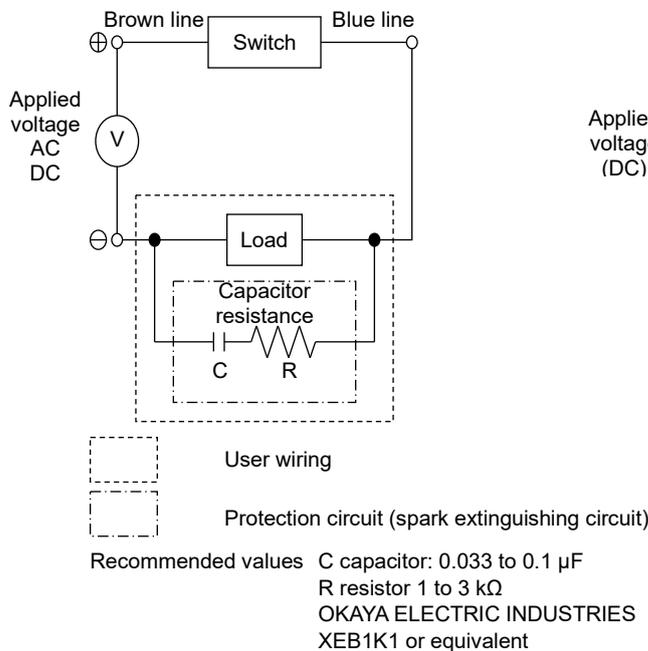


Figure 1. When using a capacitor and resistor

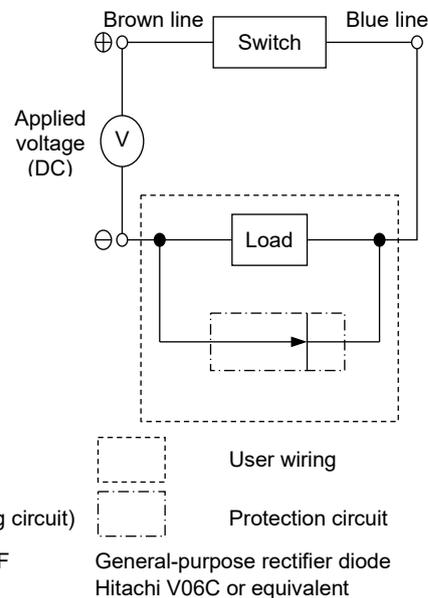


Figure 2. When using a diode

#### (2) Protection when the wiring route length exceeds the values in Table 1

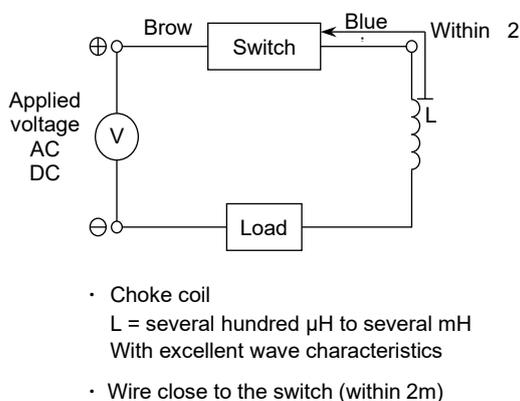


Figure 3

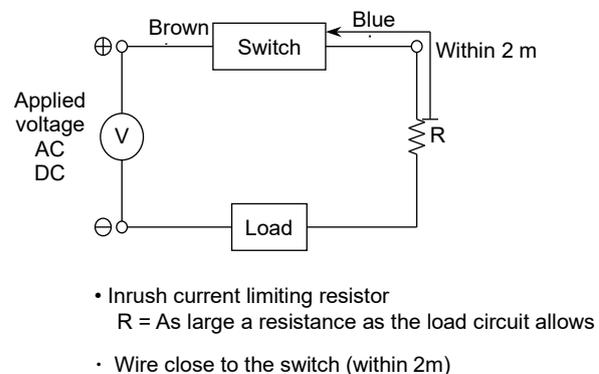


Figure 4

- 3 ) Contact capacity  
Avoid using loads that exceed the switch's maximum contact capacity. When the current falls below the rated value, the indicator lamp may not light up.
- 4 ) Relay  
Use the following equivalent relays:
- |               |          |
|---------------|----------|
| OMRON         | MY type  |
| Fuji Electric | HH5 type |
| Panasonic     | HC type  |
- 5 ) Series connection  
When multiple M0V switches are connected in series, the voltage drop across the switches is the sum of the voltage drops across all connected switches.  
For operation check purposes, if you use one M0V and the others are M5V, the voltage drop will be about the same as that of one M0V (approximately 2.4V).  
The indicator lamp turns on only when all the switches are ON.
- 6 ) Parallel connection  
When connecting multiple switches in parallel, there is no limit to the number of switches that can be connected. However, in the case of M0V, the switch indicator lamp may dim or fail to illuminate.

## 4. Maintenance

### 4.1 Periodic inspection

(1) To keep the cylinder in optimal condition, inspect it once or twice a year.

(2) Inspection items

- Ⓐ Looseness of the piston rod end fittings, cylinder fixing bolts, cylinder assembly bolts, etc.
- Ⓑ Is the operation smooth?
- Ⓒ Changes in piston speed and cycle time.
- Ⓓ External and internal leakage
- Ⓔ Scratches and deformations on the piston rod.
- Ⓕ Abnormalities in the stroke.
- Ⓖ Changes in the rotational looseness of the piston rod.
- Ⓗ Looseness or misalignment of the pan head screws used to secure the switch.
- Ⓘ Cracks or fractures in the switch lead wires or at the junction with the switch section.
- ⓷ Adhesion of magnetic substances such as cutting chips near the switch mounting area.

Check the above items, and if any abnormalities are found, refer to “5 Malfunctions and Countermeasures.” If any looseness is found, tighten it further.

### 4.2 Disassembling

1) This cylinder can be disassembled.

If a problem such as air leakage occurs, disassemble it while referring to the internal structure diagram and replace the parts listed in the consumable parts list.

### 4.3 Assembly

1) Clean each part.

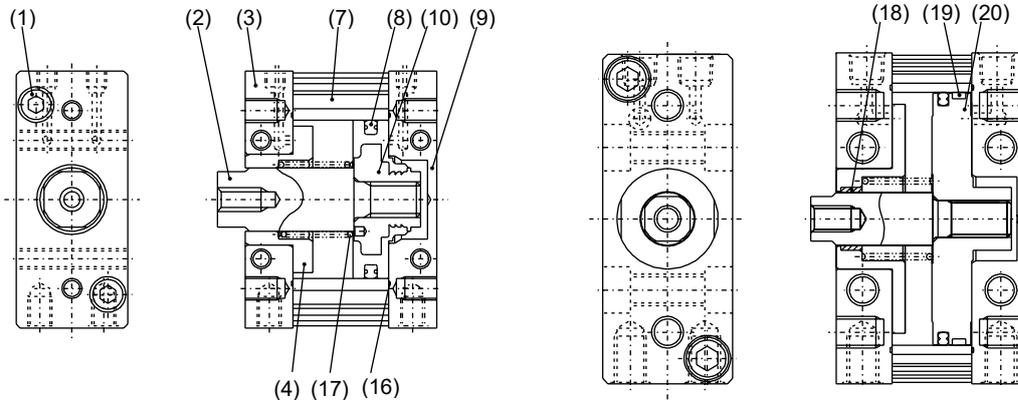
2) After cleaning, carefully reassemble in the reverse order of disassembly.  
Damage to packings in particular can cause malfunctions and air leaks.

3) Apply high-quality grease (lithium soap-based grease) to the inner surface of the cylinder tube, the outer surface of the piston, and packings.

#### 4.4 Internal structure and list of consumable parts

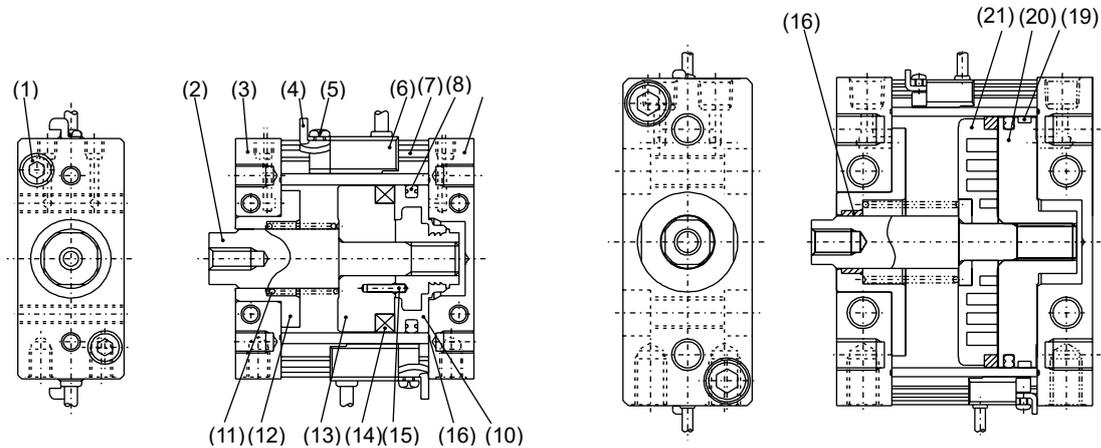
• FCS-φ25 to φ50 (Single acting, push type)

• φ63 equivalent



• FCS-L-φ25 to φ50 (Single acting, push type, with switch)

• φ63 equivalent



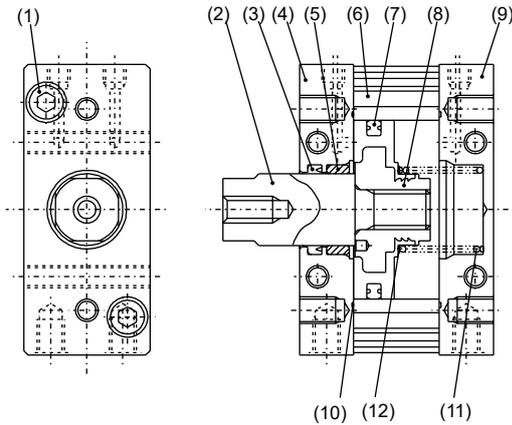
Part No.	Part name	Material	Part No.	Part name	Material
1	Hexagon socket head bolt	Steel	11	Spring	Steel
2	Piston rod	Steel	12	Bush spacer	Aluminum alloy
3	Rod cover	Aluminum alloy	13	Magnet spacer	Aluminum alloy
4	Switch mounting bracket	Stainless steel	14	Magnet	Plastic magnet
5	Cross-recessed pan head screw	Steel	15	Spring pin	Steel
6	Switch		16	Cover gasket	Nitrile rubber
7	Tube	Aluminum alloy	17	Spring seat	Stainless steel
8	Piston packing	Nitrile rubber	18	Bush Note 1	Aluminum alloy
9	Head cover	Aluminum alloy	19	Wear ring	Acetal resin
10	Piston	Aluminum alloy die-cast + polyacetal	20	Piston	Aluminum alloy
			21	Magnet spacer	Polyacetal resin

Note 1: For non-purple specifications, the material is special aluminum.

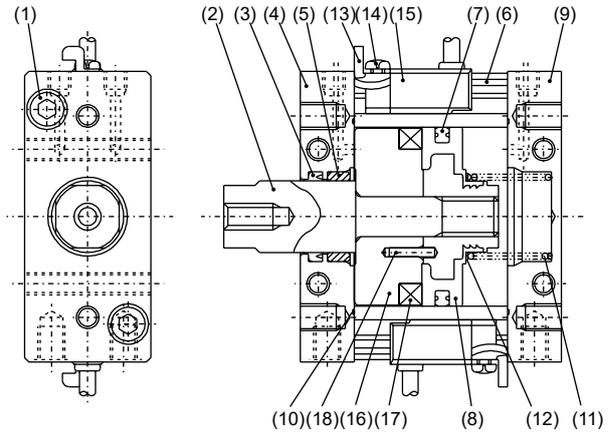
#### Consumable parts list (common for with and without switch)

Tube inner diameter (mm)	Kit Number	Consumable part number
Equivalent to φ25	FCS-25K	(8) (16)
Equivalent to φ32	FCS-32K	
Equivalent to φ40	FCS-40K	
Equivalent to φ50	FCS-50K	
Equivalent to φ63	FCS-63K	

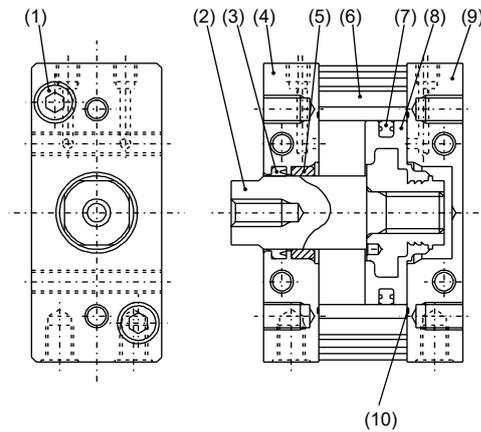
• FCH (Single acting, pull type)



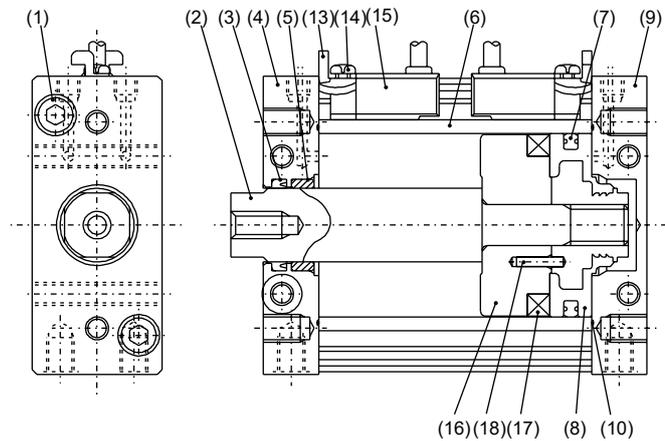
• FCH-L (Single acting, pull type, with switch)



• FCD (Single acting, double acting type)



• FCD- (Single acting, double acting type, with switch)



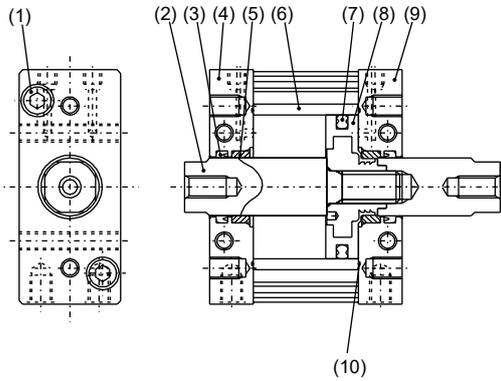
Part No.	Part name	Material	Part No.	Part name	Material
1	Hexagon socket head bolt	Steel	10	Cover gasket	Nitrile rubber
2	Piston rod	Steel	11	Spring	Steel
3	Rod packing	Nitrile rubber	12	Spring seat	Stainless steel
4	Rod cover	Aluminum alloy	13	Switch mounting bracket	Stainless steel
5	Bush <small>Note 1</small>	Special bearing material	14	Cross-recessed pan head screw	Steel
6	Tube	Aluminum alloy	15	Switch	
7	Piston packing	Nitrile rubber	16	Magnet spacer	Aluminum alloy
8	Piston	Aluminum alloy die-cast + Polyacetal	17	Magnet	Plastic magnet
9	Head cover	Aluminum alloy	18	Spring pin	Steel

Note 1: For non-purple specifications, the material is special aluminum.

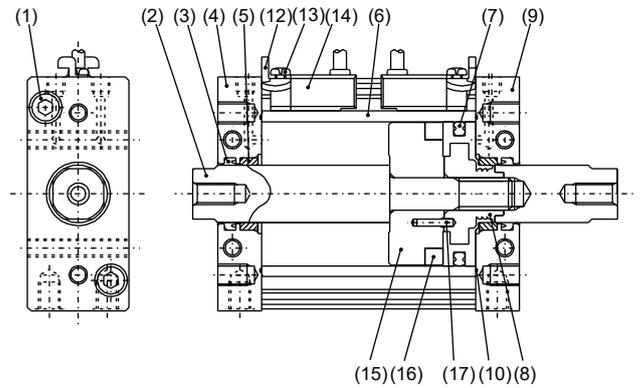
Consumable parts list (common for with and without switch)

Tube inner diameter (mm)	Kit No.	Consumable part number
Equivalent to $\phi 25$	FCD-25K, FCH-25K	(3) (7) (10)
Equivalent to $\phi 32$	FCD-32K, FCH-32K	
Equivalent to $\phi 40$	FCD-40K, FCH-40K	
Equivalent to $\phi 50$	FCD-50K, FCH-50K	
Equivalent to $\phi 63$	FCD-63K, FCH-63K	

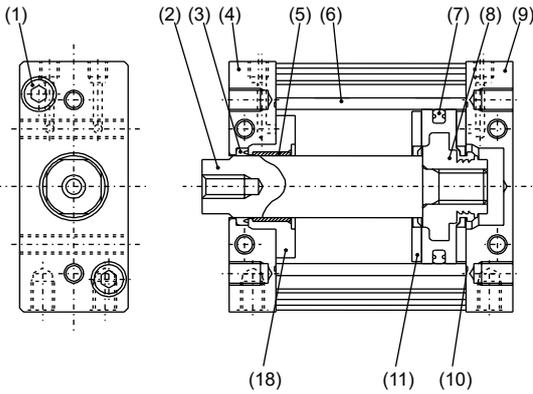
• FCD-D (double acting, double rod type)



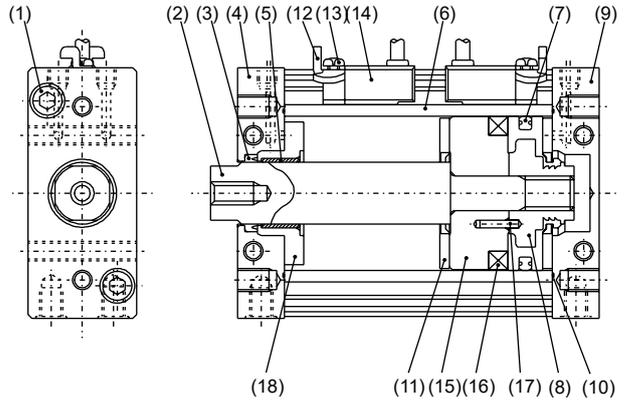
• FCD-DL  
(double acting, double rod type, with switch)



• FCD-K (double acting, with cushion)



• FCD-KL  
(double acting, with cushion, with switch)



Part No.	Part name	Material	Part No.	Part name	Material
1	Hexagon socket head bolt	Steel	10	Cover gasket	Nitrile rubber
2	Piston rod	Steel	11	Cushion rubber	Urethane rubber
3	Rod packing	Nitrile rubber	12	Switch mounting bracket	Stainless steel
4	Rod cover	Aluminum alloy	13	Cross-recessed pan head screw	Steel
5	Bush <small>Note 1</small>	Special bearing material	14	Switch	
6	Tube	Aluminum alloy	15	Magnet spacer	Aluminum alloy
7	Piston packing	Nitrile rubber	16	Magnet	Plastic magnet
8	Piston	Aluminum alloy die-cast + Polyacetal	17	Spring pin	Steel
9	Head cover	Aluminum alloy	18	Bush spacer	Aluminum alloy

Note 1: For non-purple specifications, the material is special aluminum.

Consumable parts list (common for with and without switch)

Tube inner diameter (mm)	Kit No.	Consumable part number
Equivalent to $\phi 25$	FCD-D-25K	(3) (7) (10)
Equivalent to $\phi 32$	FCD-D-32K	
Equivalent to $\phi 40$	FCD-D-40K	
Equivalent to $\phi 50$	FCD-D-50K	
Equivalent to $\phi 63$	FCD-D-63K	

Tube inner diameter (mm)	Kit No.	Consumable part number
Equivalent to $\phi 25$	FCD-K-25K	(3) (7) (10) (11)
Equivalent to $\phi 32$	FCD-K-32K	
Equivalent to $\phi 40$	FCD-K-40K	
Equivalent to $\phi 50$	FCD-K-50K	
Equivalent to $\phi 63$	FCD-K-63K	

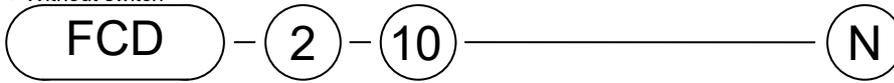
## 5. Malfunctions and Countermeasures

Malfunction	Cause	Countermeasure
Not working	No pressure, insufficient pressure	Securing a pressure source
	No signal to the directional control valve	Correcting the control circuit
	Misalignment of mounting	Correcting the installation condition Change of mounting method
	Damaged piston packing	Replacing the packing
Not working smoothly	Lower than the specified piston speed	Mitigating the load fluctuations
	Misalignment of mounting	Correcting the installation condition Change of mounting method
	Lateral load is applied. Or excessive rotational load	Provide a guide Correcting the installation condition Change of mounting method
	Heavy load	Increase pressure Increase tube inner diameter
	The speed control valve is set to the meter-in circuit	Change the speed control valve to the meter-out circuit
Damage/Deformation	Impact force due to high-speed operation	Reduce the speed Reduce the load Provide a more reliable cushioning mechanism (external cushion mechanism)
	Lateral load is applied	Provide a guide Correcting the installation condition Change the mounting method
	Torque applied to the rod exceeds the allowable value.	Reduce the torque value. Increase the cylinder size. Provide a guide.
Switch does not operate	Switch mounting position is misaligned.	Reset the switch to the HD/RD position in Section 2.4 "Switch Mounting Position."
	Switch is electrically damaged.	Review the circuit to prevent overcurrent and overvoltage. (Replace the switch) Investigate whether the lead wires are excessively bent and causing an internal short circuit. (Replace the switch)
	Switch is mechanically damaged.	Replace the switch Remove external obstacles.
	Magnetic flux distribution of the switch activation magnet is abnormal.	Remove magnetic substances (e.g., large amounts of iron powder) around the switch.

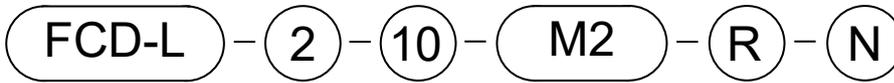
## 6. Model number display method

### 6.1 Product model number display method

- Without switch



- With switch



(a)(b)

(c)

(d)

(e)

(f)

(a) Model number		(b) Tube inner diameter (mm)	
FCS	Single-acting push type	25	φ25
FCH	Single-acting pull type	32	φ32
FCD	Double-acting type	40	φ40
FCD-D	Double acting double rod type	50	φ50
FCD-K	Double-acting with cushion	63	φ63

(c) Stroke (mm)														
Model number		FCS					FCH					FCD	FCD-D	FCD-K
Tube inner diameter (φ)		25	32	40	50	63	25	32	40	50	63	All bore sizes		
5	5	•	•				•	•				•	•	•
10	10	•	•	•	•	•	•	•	•	•		•	•	•
15	15											•	•	•
20	20			•	•	•			•	•	•	•	•	•
25	25											•	•	•
30	30											•	•	•
40	40											•	•	•
50	50											•	•	•

(d) Switch model number				* Lead wire length	
M2V*	Non-contact	Single-color display	2-wire	No symbol	1 m (standard)
M2WV*		2-color display		3	3 m (Option)
M3V*		Single-color display	3-wire	5	5 m (option)
M3WV*		2-color display			
M0V*	With contact	Single-color display	2-wire		
M5V*					

\* Indicates the lead wire length.

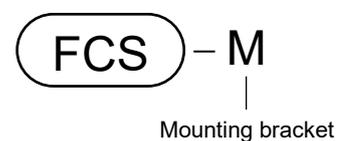
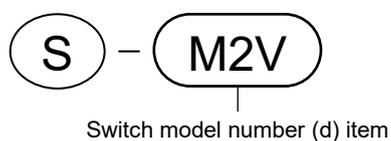
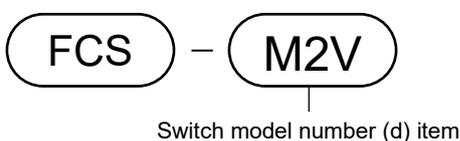
(e) Number of switches							(f) Option	
Model number		FCS	FCH	FCD	FCD-D	FCD-K	M	Piston rod material change
R	With one on rod side	•	•	•	•	•	N	Male thread at rod end
H	With one on head side	•	•	•	•	•	R	With spigot joint
D	With two	•	•	•	•	•	P6	Non-purple specification (without copper-based or Teflon-based materials)
T	With 3 pieces			•	•	•		

### 6.2 Parts model number display method

- Switch body + complete set of mounting brackets

- Switch body only

- Complete set of mounting brackets



## 7. Product specifications

### 7.1 Product specifications

#### 1) Cylinder specifications

Model number Item	FCS FCS-L	FCH FCH-L	FCD FCD-L	FCD-D FCD-DL	FCD-K FCD-KL	
Operating method	Single-acting push type	Single-acting pull type	Double-acting type	Double acting double rod type	Double-acting with cushion	
Working fluid	Compressed air					
Maximum operating pressure MPa	0.7					
Minimum operating pressure MPa	0.12		0.07	0.10	0.07	
Withstanding pressure MPa	1.05					
Ambient temperature °C	-10 to 60 (no freezing)					
Tube inner diameter (Connection port size) (mm)	Equivalent to $\phi 25$ (M5)	Equivalent to $\phi 32$ (M5)	Equivalent to $\phi 40$ (Rc1/8)	Equivalent to $\phi 50$ (Rc1/8)	Equivalent to $\phi 63$ (Rc1/4)	
Stroke tolerance (mm)	$+0.5$ (up to 50) $0$					
Piston speed (mm/s)	50-500					
Cushion	None				Rubber cushion	
Lubrication	Not required (use turbine oil ISOVG32 for lubrication)					
Allowable absorption energy J	Without cushion	0.015	0.02	0.026	0.04	0.05
	With cushion	0.034	0.54	0.67	1.02	1.56

Note: Do not leave the moving cylinder pressurized. If left pressurized, the piston rod may not return to its original position by spring force when the pressure is released.

#### 2) Anti-rotation accuracy and allowable rotational torque

Item	Equivalent to $\phi 25$	Equivalent to $\phi 32$	Equivalent to $\phi 40$	Equivalent to $\phi 50$	Equivalent to $\phi 63$
Anti-rotation accuracy (Note 2) Degree	$\pm 1^\circ$	$\pm 0.8^\circ$	$\pm 0.5^\circ$	$\pm 0.5^\circ$	$\pm 0.5^\circ$
Allowable rotational torque N·m	1	1.6	2.5	3.9	5.9

Note 1: Avoid using the product in a way that applies rotational torque suddenly or changes the direction of the torque load suddenly.

Note 2: The value of "non-rotational accuracy" indicates the amount of play that does not include deformation of the piston or piston rod, and is therefore the value at 10% of the "allowable rotational torque."

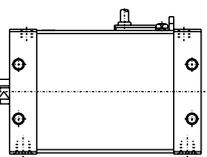
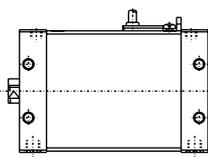
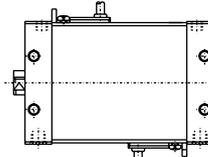
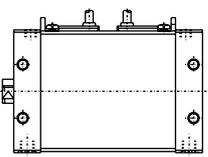
#### 3) Stroke

Model number	Tube inner diameter (mm)	Standard stroke (mm)	Maximum stroke (mm)	Minimum stroke (mm)
FCS	Equivalent to $\phi 25$ or $\phi 32$	5, 10	10	1
FCH	Equivalent to $\phi 40$ , $\phi 50$ or $\phi 63$	10, 20	20	
FCD	$\phi 25$ , $\phi 32$ , $\phi 40$	5, 10, 15, 20, 25, 30, (35), 40, (45), 50	50	
FCD-D			150	
FCD-K	Equivalent to $\phi 50$ or $\phi 63$			

Note 1: Values in ( ) indicate options. Intermediate strokes: Available in 1 mm increments.

Note 2: The minimum stroke varies depending on the switch mounting method. Refer to the table below.

#### Minimum stroke with switch

With 1 switch		With 2 switches	
When mounted on rod side	When mounted on head side	When mounted on a different surface	When mounted on the same surface
			
10 mm		15mm	35 mm (FCD-25, 32, 40, 50) 30 mm (FCD-63)

## 7.2 Switch specifications

Type / Model number	Contact switch			
Item	M0V		M5V	
Application	For programmable controllers and relays		Programmable controller, relay IC circuit (without indicator lamp), for series connection	
Load voltage	DC12 / 24V	AC110V	DC5 / 12 / 24V	AC110V
Load current	5-50 mA	7-20mA	50 mA or less	20 mA or less
Internal voltage drop	2.4 V or less		0 V	
Indicator lamp	LED (lit when ON)		No indicator lamp	
Leakage current	0 mA			
Lead wire length (Note 1)	Standard 1m (oil-resistant vinyl cabtire cable, 2-core, 0.2mm <sup>2</sup> )			
Impact resistance	294 m/s <sup>2</sup>			
Insulation resistance	100 MΩ or more with DC500V megger			
Withstanding voltage	No abnormalities observed after applying AC 1000 V for 1 min			
Ambient temperature	- 10 to 60°C			
Protective structure	IEC standard IP67, JIS C 0920 (immersion proof), oil-resistant			

Type / Model number	Non-contact switch	
Item	M2V	M2WV
Application	For programmable controllers only	
Power supply voltage	-	
Load voltage	DC 10-30 V	
Load current	5-30mA	
Current consumption	-	
Internal voltage drop	4V or less	
Indicator lamp	LED (lit when ON)	Red / Green LED (lit when ON)
Leakage current	1mA or less	
Lead wire length (Note 1)	Standard 1 m (oil-resistant vinyl cabtyre cable, 2-core, 0.2 mm <sup>2</sup> )	
Impact resistance	980 m/s <sup>2</sup>	
Insulation resistance	100 MΩ or more with DC500V megger	
Withstanding voltage	No abnormalities observed after applying AC 1000 V for 1 min	
Ambient temperature	- 10 to 60°C	
Protective structure	IEC standard IP67, JIS C 0920 (immersion proof), oil-resistant	

Type / Model number	Non-contact switch	
Item	M3V	M3WV
Application	For programmable controllers, relays, IC circuits, and small solenoid valves	
Power supply voltage	DC4.5-28V	DC10-28V
Load voltage	DC 30 V or less	
Load current	200 mA or less	150 mA or less
Current consumption	10 mA or less at DC24V	15 mA or less at DC24V
Internal voltage drop	0.5V or less	
Indicator lamp	LED (lit when ON)	Red/Green LED (lit when ON)
Leakage current	10 μA or less	
Lead wire length (Note 1)	Standard 1 m (oil-resistant vinyl cabtyre cable, 3-core, 0.15 mm <sup>2</sup> )	
Impact resistance	980 m/s <sup>2</sup>	
Insulation resistance	100 MΩ or more with DC500V megger	
Withstanding voltage	No abnormalities observed after applying AC 1000 V for 1 min	
Ambient temperature	- 10 to 60°C	
Protective structure	IEC standard IP67, JIS C 0920 (immersion proof), oil-resistant	

Note 1: Lead wires are also available as options in 3 m and 5 m lengths.