CKD

SM－384404－A

INSTRUCTION MANUAL

LINEAR SLIDE CYLINDER

LCM Series

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

CKD Corporation
Ver.2

For Safety Use

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

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

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

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

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

⚠ CAUTION :

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

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LCM Series
Linear Slide Cylinder
Manual No. SM-384404-A

1. UNPACKING

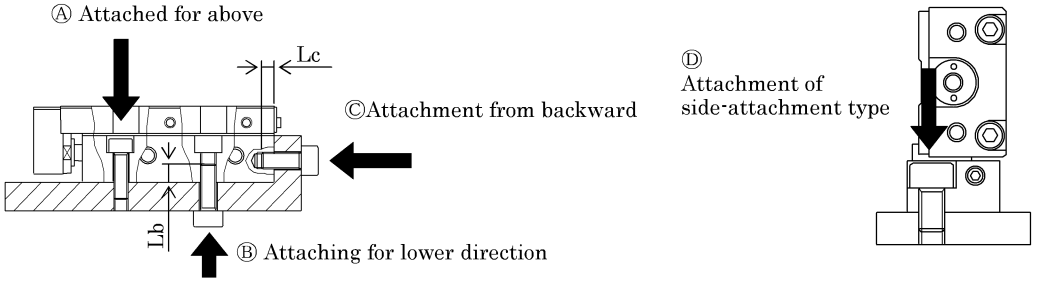
1) Make sure that the type No. on the nameplate of the delivered Selex Cylinder matches the type No. you ordered.
2) Check the appearance for any damage.
3) After opening the package, store the cylinder, away from heat and moisture, to prevent rusting.

2. INSTALLATION

2.1 Installation

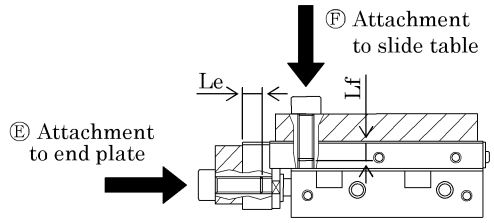
1) The ambient temperature for this cylinder is 0 to 60℃.
Always operate the cylinder within this temperature range.

2) Use the bolt threaded length and tightening torque below when installing the main body.



Item	Ⓐ		Ⓑ			Ⓒ			Ⓓ	
	Bolt	Torque (N・m)	Bolt	Torque (N・m)	Thread L b(mm)	Bolt	Torque (N・m)	Thread L c(mm)	Bolt	Torque (N・m)
LCM-4.5	M2×0.4	0.32	M2.5×0.45	0.65	3.5 or less	M2×0.4	0.32	2.5 or less	M3×0.5	1.14
LCM-6	M2.5×0.45	0.65	M3×0.5	1.14	5 or less	M2.5×0.45	0.65	2.5 or less	M3×0.5	1.14
LCM-8	M2.5×0.45	0.65	M3×0.5	1.14	5.5 or less	M3×0.5	1.14	3 or less	M4×0.7	2.7

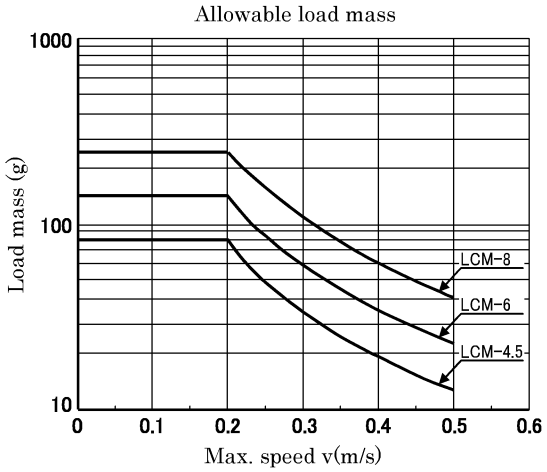
3) Use the bolt threaded length and tightening torque below when installing the jig onto the slide table or end plate.



Item	Ⓔ			Ⓕ		
	Bolt	Torque (N・m)	Thread Le (mm)	Bolt	Torque (N・m)	Thread Le (mm)
LCM-4.5	M3×0.5	0.63	4.5 or less	M3×0.5	0.63	4 or less
LCM-6	M3×0.5	0.63	5.5 or less	M3×0.5	0.63	4 or less
LCM-8	M3×0.5	0.63	5.5 or less	M3×0.5	0.63	5 or less

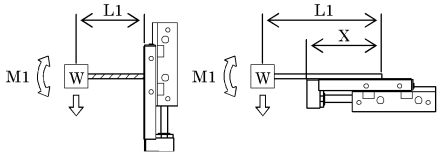
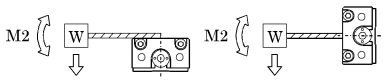
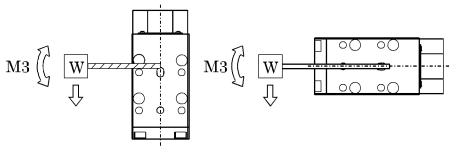
2.2 Allowable Load

1) The load mass (W) to be attached to the table surface depends on the working piston speed. Confirm that the mass is in the lower left side of the following graph.



2) Calculate the action moment (M1, M2, M3) in each direction, and confirm that the values are within the specified range in the table below.

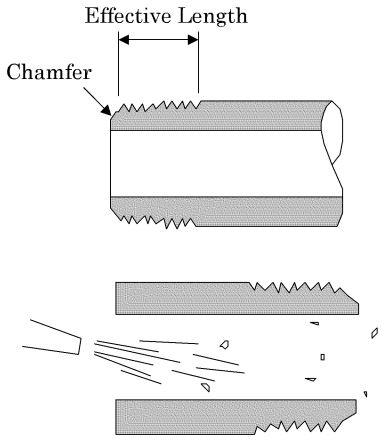
Bore size	Bending moment M1max (N・m)	Radial moment M2max (N・m)	Twist moment M3max (N・m)
ϕ 4.5	0.24	0.22	0.29
ϕ 6	0.28	0.23	0.34
ϕ 8	0.28	0.38	0.34

Direction	Figure	Formula
M1 moment		M1=L1×W
M2 moment		M2=L2×W
M3 moment		M3=L3×W

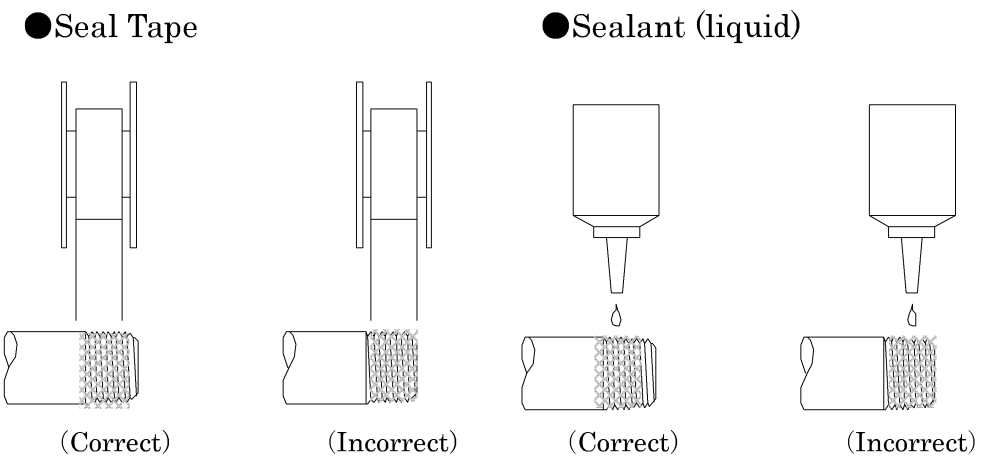
Bore size	Stroke length	X (mm)		
		Standard	With buffer	Clean room spec.
ϕ 4.5	5	30	40	35
	10			
ϕ 6	5	31.5	41.5	36.5
	10			
	15	36.5	46.5	41.5
ϕ 8	5	31.5	41.5	36.5
	10			
	15	41.5	51.5	46.5
	20			

2.3 Piping

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

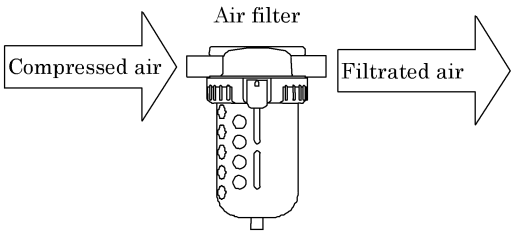


6) Refrain from applying sealant or sealing tape approx. two pitches of thread off the tip of pipe to avoid residual substances from falling into piping system.

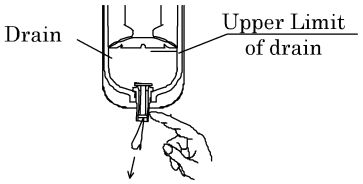


2.4 Fluid

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



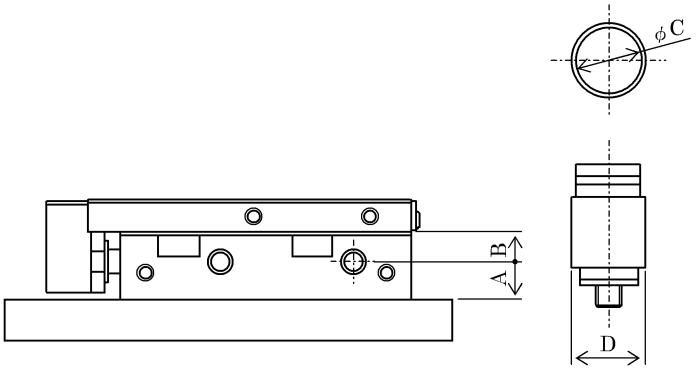
2) Be sure to drain out the accumulation in the filter periodically.



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

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

5) Because the usable piping joint has limitations, for using it, see the note below.



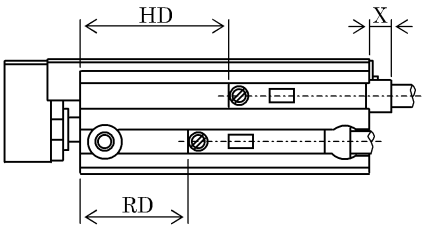
Item / Bore size (mm)	Port dia.	Port dimension A	Port dimension B	Available joints	Joint OD C	Joint gasket diameter D
ϕ4.5	M3×0.5	3	3	PG-S2-M3	5.5 (opposite side of hexagon)	ϕ5.5
				PG-S2-M3-S	ϕ4.9	
				PG-L2-M3	5.5 (opposite side of hexagon)	
				FTS4-M3	4.5 (opposite side of hexagon)	ϕ4.8
				FTL4-M3 (※)	□5	
ϕ6	M3×0.5	4.5	3.5	PG-S2-M3	5.5 (opposite side of hexagon)	ϕ5.5
				PG-S2-M3-S	ϕ4.9	
				PG-L2-M3	5.5 (opposite side of hexagon)	
				FTS4-M3	4.5 (opposite side of hexagon)	ϕ4.8
				FTL4-M3	□5	
ϕ8	M3×0.5	5	4	PG-S2-M3	5.5 (opposite side of hexagon)	ϕ5.5
				PG-S2-M3-S	ϕ4.9	
				PG-L2-M3	5.5 (opposite side of hexagon)	
				FTS4-M3	4.5 (opposite side of hexagon)	ϕ4.8
				FTL4-M3	□5	

2.5 Location of Mounting Switches on a Cylinder

1) Location of mounting switches on a cylinder.

(1) At the stroke end

Refer the illustration above. Mount switches within the rod side dimension RD as well as the head side dimension HD (Refer to 9 page) for the purpose of having switches function at the points of the maximum sensitive position.



(2) Intermediate of stroke

Move the piston where it is anticipated to stop and fix it tentatively slide a switch carefully along the side of cylinder over the piston to find out the spot where switch turns on.

This type spot should be located on both side of piston. The intermediate spot between those posits is of the maximum sensitive position and where the switch is supposed to be installed.

- Moving the switch

  Loosen the tightening screw (pan head small screw), and move the switch along the cylinder tube. Tighten at the required position.
- Exchange the switch

  Loosen its mounting screws then slide the switch all the way out of the groove on the cylinder side. Slide new one back to the groove. Locate its setting point and tighten mounting screws. (Apply screw setting torque to 0.03 to 0.08 N・m)

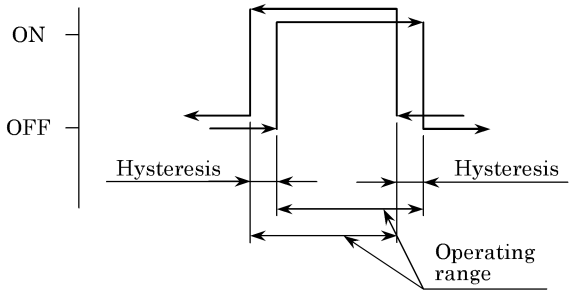
2) Operating range

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

3) Hysteresis

(1) Precise operating range deviate slightly depending upon the direction of piston movement as shown right.

(2) Switch is apt to be disturbed its accuracy by external effect when piston stops within this range. Carefully avoid designing stopping location of piston.



Maximum sensitive position, operating range and hysteresis

Bore size (mm) \ Max. sensitive Position		Stroke length				Solid state 1 color indicator switch (F2H/V,F3H/V)			Solid state 2 color indicator switch (F2YH/V,F3YH/V)		
		5	10	15	20	Projection dimensions (X)	Operating range	Hysteresis	Projection dimensions (X)	Operating range	Hysteresis
ϕ4.5	RD	12	7	—	—	—	1 to 3	1 or less	—	2 to 4	1 or less
	HD	17	17	—	—	2.7			7.2		
ϕ6	RD	13	8	8	—	—			—		
	HD	18	18	23	—	2.7			7.2		
ϕ8	RD	13	8	13	8	—			—		
	HD	18	18	28	28	2.7			7.2		

※ Cylinder is shipped ex-factory having switches mounted at HD & RD locations respectively.

※ Projecting length for axial lead wire.

3. OPERATION

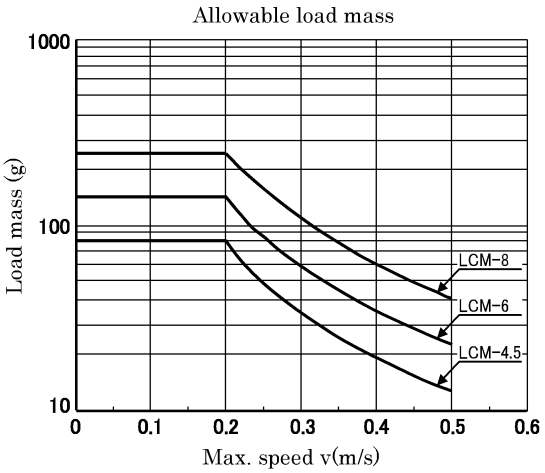
3.1 Operating the Cylinder

1) The working pressure for this type of cylinder is specified in “Product Specifications”. Operate the system within this range.

2) The allowable absorbed energy is shown below. If the kinetic energy is too large, provide the external stopper.

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

● Graphs for Tolerable kinetic energy



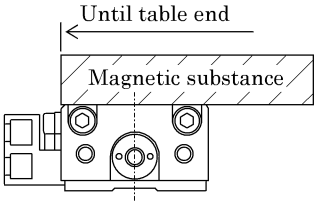
Additional external cushion is required to operate the cylinder within the area of right and upper plotted curve.

3.2 How to Use the Switches

3.2.1 Common Items

1) Magnetic environment
Do not use a switch other than the strong magnetic field proof switch in a place where strong magnetic field or large current (large magnet or spot welding machine, etc.) exists around the switch mounting position. If a cylinder with the switch is installed in parallel to this product or the magnetic substance moves near the cylinder, the mutual interference may occur and affect the detection accuracy.

2) Workpiece
If a magnetic work is attached, the dimension shall be small enough that the work does not protrude from the table edge on the switch side.



3) Lead wire wiring
Carefully perform the wiring so that a bending stress or tensile strength does not apply to the lead wire repeatedly.
Additionally, connect wires for robot having the bending resistance to movable parts.

4) Operating temperature
Do not operate the product at a high temperature (Over than 60℃).
Always avoid operation of the product in a hot place due to temperature characteristics of magnetic and electronics parts.

5) Intermediate position detection
When setting the cylinder switch at mid-stroke and driving a load when the piston changes, if the speed is too fast, the cylinder switch will function but operation time will be too short and the load may not respond correctly.

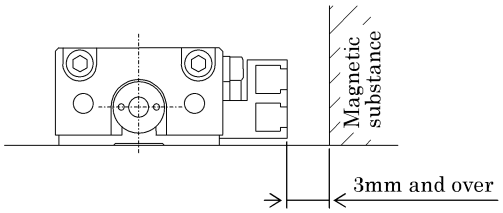
The maximum detectable working piston speed is :

$$V\,(\mathrm{mm/s}) = \frac{\text{Cylinder switch operation range (mm)}}{\text{Load operation time (s)}}$$

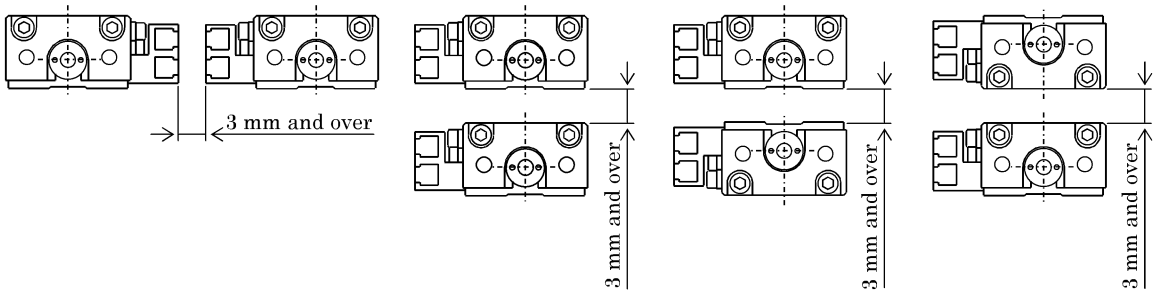
Refer to the minimum value of the table on page 7 4) about cylinder switch operating range.

5) Impact
Do not apply a large vibration or impact to the product when transporting the cylinder, or mounting or adjusting the switch.

6) The cylinder may malfunction if a magnetic substance, such as a steel plate, is nearby. Move the magnetic substance to at least 10 mm from the cylinder. (Same clearance for all diameters)



7) The cylinder switch may malfunction if cylinders are installed adjacently. Separate cylinders by the following distances. (Same clearance for all bore size)



3.2.1 Operational Cautions, Solid state switch (F2, F3)

1) Connection of lead cord

Comply with the color coding specified on the illustrations. Be sure to turn the power off before starting connecting work.

An erroneous wiring or short circuiting of load causes damage to not only switches, but also load side circuit. Wiring work without shutting electricity off may cause damage to the load side circuit

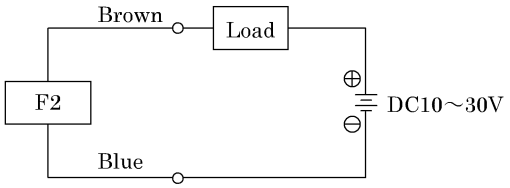


Fig.1 Fundamental circuit Example

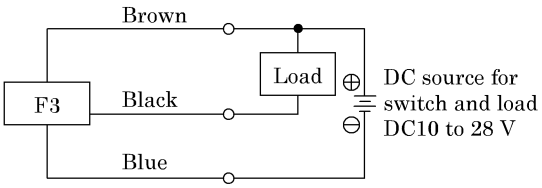


Fig.2 Fundamental circuit Example (1)
(In case the same source of power is used.)

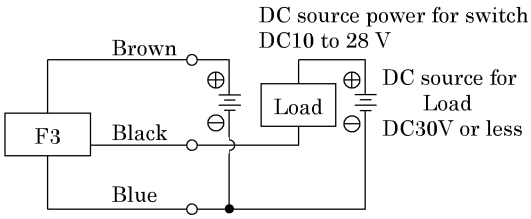


Fig.3 Fundamental circuit Example (2)
(In case individual sources of power are used.)

2) Output circuit protection

Install some protective circuit as illustrated in Fig. 4 when inducing type load (Relay or solenoid valve) are to be used because those types apt to generate surge current switch off.

Install some protective circuit as illustrated in Fig. 5 when capacitor type load (Capacitor type) are to be used, because these types apt to generate a dash current when turning the switch ON.

Install some protective circuit as illustrated in Fig. 6 or 7 (in case of model F2) and Fig 8 (in case of model F3).

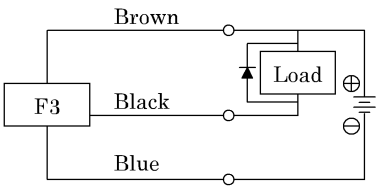
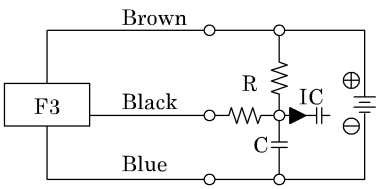


Fig.4 An example of using inducing load together with surge absorptive element (diode). (Hitachi Mfg. made diode V06C or equivalent is recommended.)



Flg.5 An example of using capacitor type load together with current regulating resister R.
Comply with the following formula to figure out required R.

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

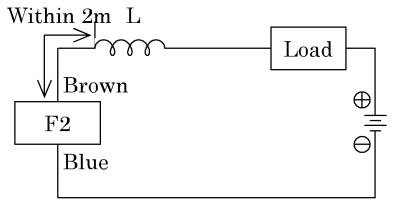


Fig.6 ・Choke coil
L = a couple hundred μH to a couple mH surpassing high frequency characteristic
・Install it near by a switch (within 2m).

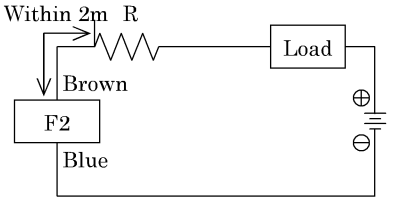


Fig.7 ・Dash current restriction resister.
R = As much large resister as the load circuit can afford.
・Install it near by a switch (within 2m).

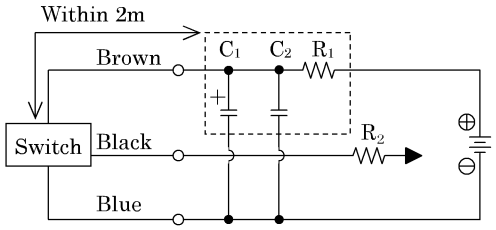


Fig8 ・Electric power noise absorptive circuit.
C_1=20 to 50 μF electrolytic capacitor
(Withstand voltage 50V or more)
C_2=0.01 to 0.1 μF ceramic capacitor
R_1=20 to 30 Ω

・Dash current restriction resister.
R_2=As much large resister as the load circuit can afford.
・Install it nearby the switch (Within 2m)

3) Connection to programmable controller (Sequencer).
Type of connection varies depending upon the model of the programmable controller. Refer to the following Fig. 9 to 13 respectively.

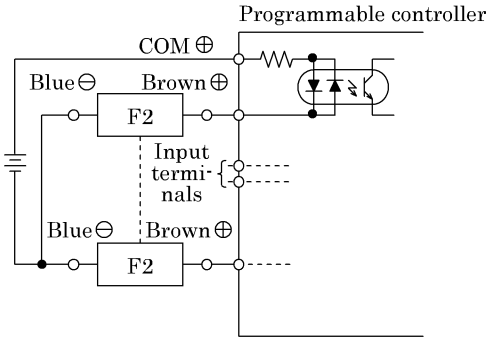


Fig.9 An example of F2 connection to source input type (an external power source)

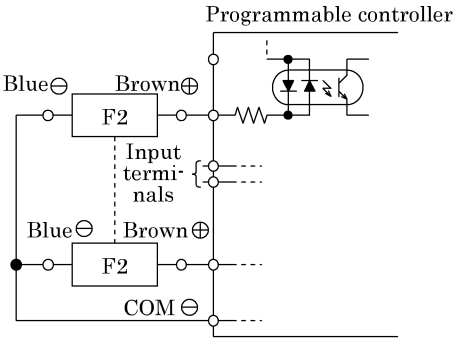


Fig.10 An example of F2 connection to source input type (an internal power source)

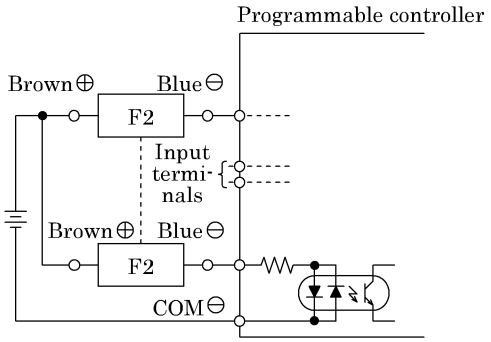


Fig.11 An example of F2 connection to sink input type

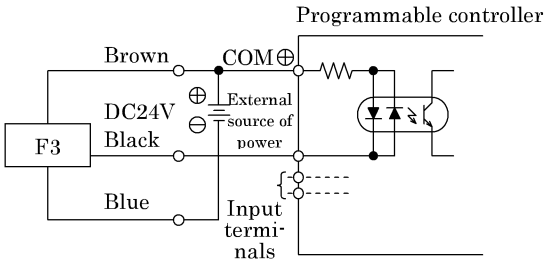


Fig.12 An example of F3 connection to source input type (an external power source)

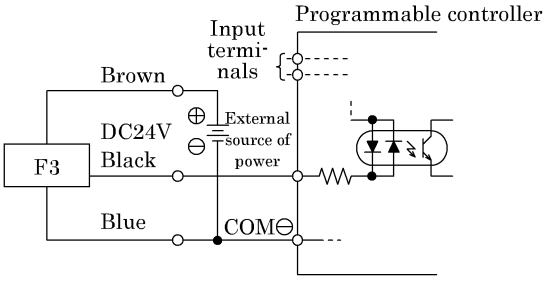


Fig.13 An example of F3 connection to source input type (an internal power source)

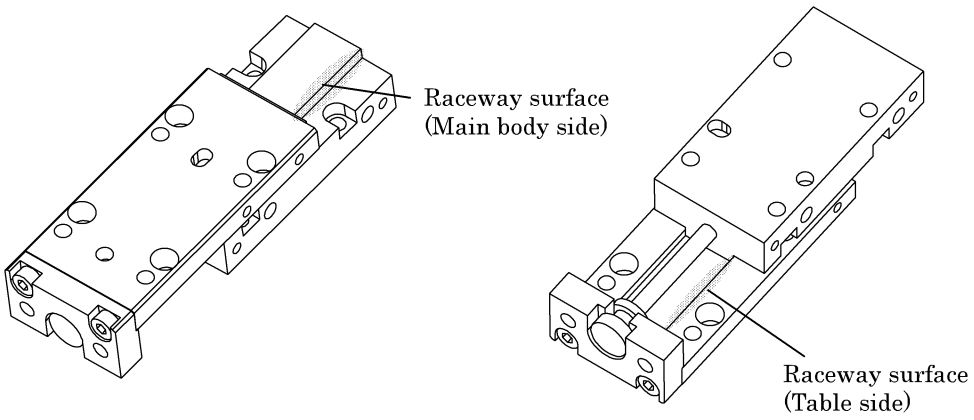
4. MAINTENANCE

4.1 Periodical Inspection

1) In order to upkeep the cylinder in optimum condition, carry out periodic inspection once or twice a year. Apply CGL grease (Nippon Thompson) to the track rail's tracks of the guide after six months of use or 3,000,000 operations, whichever is sooner.
2) Inspection items
   (1) Check to see that the cylinder operates smoothly.
   (2) Check any change of the working piston speed and cycle time.
   (3) Check for internal and/or external leakage.
   (4) Check the piston rod for flaw (scratch) and deformation.
   (5) Check the stroke for abnormality.

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

3) Instruction grease applied
   Push the cylinder, and apply grease to the ball track surface on the table side and rail side. Slide the table several times after applying grease so that the grease can be entirely applied to the ball and track surface.



4.2 Disassembling

1) This cylinder is not disassembled.

5. TROUBLE SHOOTING

1) Cylinder

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

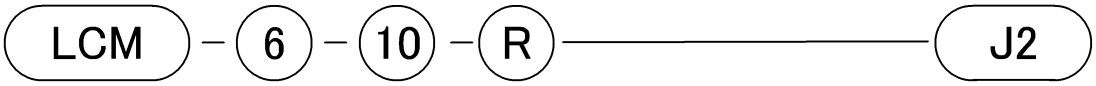
2) Switch

Troubles	Causes	Remedies
Indicator light is not lit.	Deposited contact point	Replace the switch.
	Excessive load than rated capacity	Replace the relay with a recommended one or replace the switch.
	Damaged indicator light	Replace the switch.
	Inadequate incoming signal	Review the external signal circuit and remove the causes.
Switch does not function right.	Broken circuit	Replace the switch.
	Inadequate incoming signal	Review the external signal circuit and remove the causes.
	Improper voltage	Correct voltage to specified.
	Incorrect location of switch	Correct its location.
	Aberrant position of switch	Set it back to original position and tighten the mounting device.
	Incorrect direction of switch mounting	Correct the direction of the switch mounting.
	Relay is unable to respond properly	Turn the speed down. Replace the relay with a recommended one.
	Excessive load than rated capacity	Replace the relay with a recommended one or replace the switch.
Switch does not return.	Piston is not moving	Make the piston move.
	Deposited contact point	Replace the switch
	Excessive load (relay) than rated capacity	Replace the relay with a recommended one or replace the switch.
	The ambient temperature is out of the specification range	Adjust the ambient temperature within the range of 0 to 60℃
	Existence of a foreign magnetic field	Shield the magnetic field.
	Inadequate incoming signal	Review the external signal circuit and remove the causes.

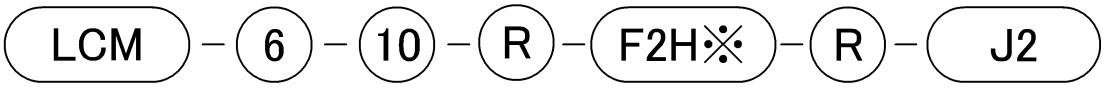
6. HOW TO ORDER

6.1 Product Number Coding

● Without switch



● With switch



(a) (b) (c) (d) (e) (f)

(a) Bore size (mm)		(b) Stroke length (mm)					(c) Piping direction	
4.5	φ4.5	Item	stroke	Bore size			R	Right viewed from rod end
6	φ6			φ4.5	φ6	φ8	L	Left viewed from rod end
8	φ8	5	5mm	○	○	○		
		10	10mm	○	○	○		
		15	15mm	—	○	○		
		20	20mm	—	—	○		

○ : Standard, — : Not available

(d) Switch model No.					(e) Switch quantity	
Axial lead wire	Radial lead wire	Switch type	Indicator light	Lead wire	R	One on rod end
					H	One on head end
F2H※	F2V※	Solid state	1 color indicator	2 wire	D	Two
F3H※	F3V※			3 wire		
F2YH※	F2YV※		2 color indicator	2 wire		
F3YH※	F3YV※			3 wire		

※ Lead wire length	
Blank	1m (Standard)
3	3m (Optional)

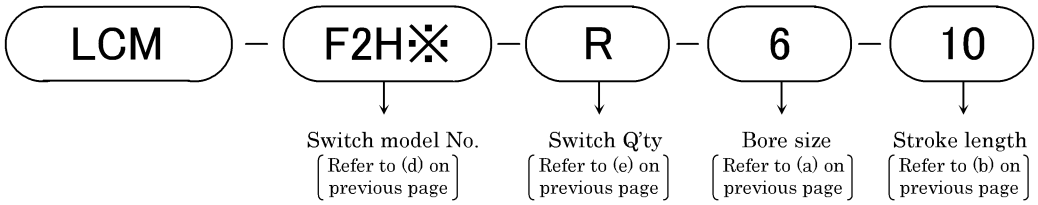
(f) Option	
B	With buffer
M note1	With magnet
F1 note1, 2	Magnet + swith rail (one switch groove)
F2 note 1	Magnet + swith rail (two switch grooves)
J※	Dowel pin attached (※ indicates pin number)

Note 1: Selection not required when designating the switch type.
Note 2: Selectable if φ4.5 is selected.

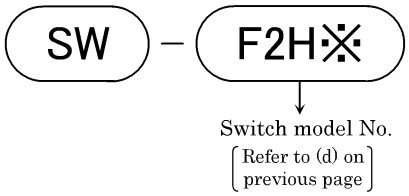
6.2 Component Parts Model Coding

1) Switch

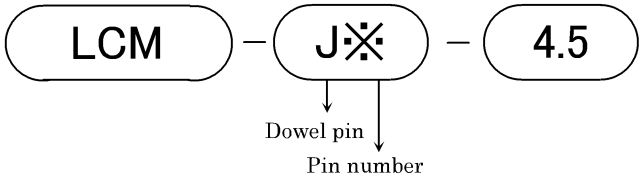
Switch body + switch rail + magnet



Only switch body



2) How to order discrete dowel pin



7. SPECIFICATION

7.1 Product Specifications

Descriptions		LCM		
Bore size mm		φ4.5	φ6	φ8
Actuation		Double acting		
Working fluid		Compressed air		
Max. working pressure MPa		0.7		
Min. working pressure MPa		0.2		0.15
Proof pressure MPa		1.05		
Ambient temperature ℃		0 to 60		
Port size	Main body side	M3		
Stroke tolerance mm		+1.0 0		
Working piston speed mm/s		30 to 500		
Cushion		None	Rubber cushion	
Lubrication		Not required (when lubricating, use turbine oil Class one ISOVG 32.)		

7.2 Switch Specifications

1) Type of switch and applications

Model / Descriptions			Applications (Purpose)
Solid state	2 wire	F2H	DC programmable controller
		F2V	
	3 wire	F3H	DC programmable controller, relay
		F3V	
	2 wire	F2YH	DC programmable controller
		F2YV	
	3 wire	F3YH	DC programmable controller, relay
		F3YV	

Note: T※H designates lead cord outlet is straight out type as well as T※V designates lead cord outlet is L shape type.

2) Switch specifications

Descriptions	Solid state 2 wire	Solid state 3 wire
	F2H, F2V	F3H, F3V
Applications	Programmable controller	Programmable controller, relay
Power supply voltage	—	DC10 to 28V
Load voltage	DC10 to 30V	DC30V or less
Load current	5 to 20mA (Note1)	100mA or less
Current consumption	—	10 mA or less at DC 24V (at ON state)
Internal voltage drop	4V or less	0.5V or less
Indicator light	Yellow LED (ON lighting)	
Leakage current	1mA or less	10 μA or less
Lead wire length (standard)	Standard 1m (Oil resistant vinyl cabtire code 2 conductor 0.15mm²)	Standard 1m (Oil resistant vinyl cabtire code 3 conductor 0.15mm²)
Shock resistance	980m/s²	
Insulation resistance	20MΩ over at DC 500V megger	
Withstand Voltage	No failure at AC 1000V for one minute	
Ambient temperature	−10 to 60℃	
Degree of protection	IEC standards IP67, JIS C0920 (water tight type), oil resistance	

Descriptions	Solid state 2 wire	Solid state 3 wire
	F2YH, F2YV	F3YH, F3YV
Applications	Programmable controller	Programmable controller, relay
Power supply voltage	—	DC10 to 28V
Load voltage	DC24±10%	DC30V or less
Load current	5 to 20mA (Note1)	50mA or less
Current consumption	—	10 mA or less at DC 24V (at ON state)
Internal voltage drop	4V or less	0.5V or less
Indicator light	Red / Green LED (ON lighting)	
Leakage current	1mA or less	10 μA or less
Lead wire length (standard)	Standard 1m (Oil resistant vinyl cabtire code 2 conductor 0.15mm²)	Standard 1m (Oil resistant vinyl cabtire code 3 conductor 0.15mm²)
Shock resistance	980m/s²	
Insulation resistance	100MΩ over at DC 500V megger	
Withstand Voltage	No failure at AC 1000V for one minute	
Ambient temperature	−10 to 60℃	
Degree of protection	IEC standards IP67, JIS C0920 (water tight type), oil resistance	

Note1: The maximum load current 20mA is applied at 25°C. The current will be lower than 20mA if ambient temperature around switch is higher than 25°C.
(5 to 10mA at 60℃.)