Safety Precautions

Be sure to read this section before use.

When designing and manufacturing equipment using CKD products, the manufacturer is obligated to ensure that the safety of the mechanism, pneumatic control circuit and/or water control circuit and the system that runs the electrical controls are secured.
It is important to select, use, handle and maintain CKD products appropriately to ensure their safe usage.
Observe warnings and precautions to ensure device safety.
Check that device safety is ensured, and manufacture a safe device.

⚠ WARNING

1 This product is designed and manufactured as a general industrial machine part.
It must be handled by an operator having sufficient knowledge and experience.

2 Use this product in accordance with specifications.

This product must be used within its stated specifications. In addition, never modify or additionally machine this product.
This product is intended for use in general industrial machinery equipment or parts. It is not intended for use outdoors (except for products with outdoor specifications) or for use under the following conditions or environments. (Note that this product can be used when CKD is consulted prior to its usage and the customer consents to CKD product specifications. The customer should provide safety measures to avoid danger in the event of problems.)

❶ Use for applications requiring safety, including nuclear energy, railways, aircraft, marine vessels, vehicles, medical devices, devices or applications in contact with beverages or foodstuffs, amusement devices, emergency cutoff circuits, press machines, brake circuits, or safety devices or applications.
❷ Use for applications where life or assets could be significantly affected, and special safety measures are required.

3 Observe organization standards and regulations, etc., related to the safety of the device design and control, etc.

ISO4414,JIS B 8370(Pneumatic fluid power - General rules and safety requirements for systems and their components)
JFPS2008(Principles for pneumatic cylinder selection and use)
Including the High Pressure Gas Safety Act, Industrial Safety and Health Act, other safety rules, organization standards and regulations, etc.

4 Do not handle, pipe, or remove devices before confirming safety.

❶ Inspect and service the machine and devices after confirming safety of the entire system related to this product.
❷ Note that there may be hot or charged sections even after operation is stopped.
❸ When inspecting or servicing the device, turn OFF the energy source (air supply or water supply), and turn OFF power to the facility. Discharge any compressed air from the system, and pay enough attention to possible water leakage and leakage of electricity.
❹ When starting or restarting a machine or device that incorporates pneumatic components, make sure to secure system safety, such as pop-out prevention measures.

5 Observe the warnings and cautions on the following pages to prevent accidents.

■ Precautions are ranked as “DANGER”, “WARNING”, and “CAUTION” in this section.

⚠ DANGER: In the case where the product operation is mishandled and/or when the urgency of a dangerous situation is high, it may lead to fatalities or serious injuries.

⚠ WARNING: A dangerous situation may occur if handling is mistaken, leading to fatal or serious injuries.

⚠ CAUTION: A dangerous situation may occur if handling is mistaken, leading to minor injuries or property damage.

Note that some items indicated with “CAUTION” may lead to serious results depending on the conditions.
All items contain important information and must be observed.

Warranty

1 Warranty period

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

2 Warranty coverage

If the product specified herein fails for reasons attributable to CKD within the warranty period specified above, 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:

1) 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 the Instruction Manual.
2) Failure caused by use of the product exceeding its durability (cycles, distance, time, etc.) or caused by consumable parts.
3) Failure not caused by the product.
4) Failure caused by use not intended for the product.
5) Failure caused by modifications/alterations or repairs not carried out by CKD.
6) Failure caused by reasons unforeseen at the level of technology available at the time of delivery.
7) 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.

Note: For details on the durability and consumable parts, contact your nearest CKD sales office.

3 Compatibility check

The customer is responsible for confirming the compatibility of CKD products with the customer's systems, machines and equipment.

Precautions for export

1 Security Trade Control

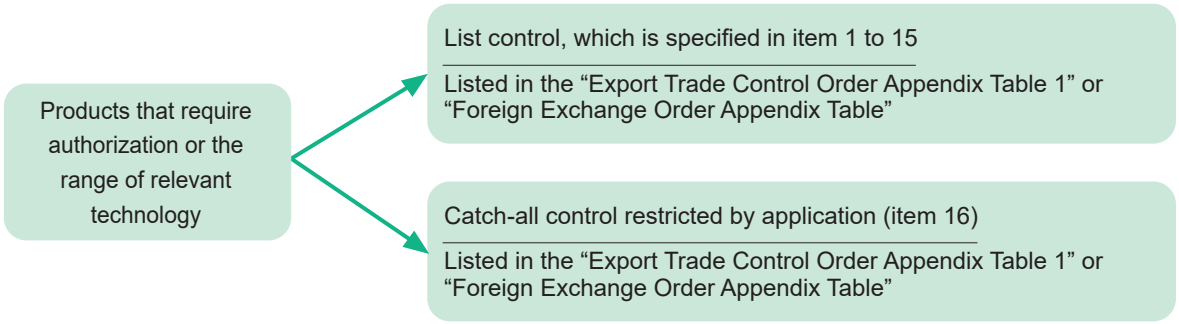
The products in this catalog and their related technologies may require approval before export or provision.

For the sake of maintaining world peace and safety, there may be cases in which approval under the Foreign Exchange and Foreign Trade Control Law is required in advance, depending on the country to where the product or related technology is being exported or provided.

The scope of products and related technologies requiring approval are listed in the Export Trade Control Order Appendix Table 1 or Foreign Exchange Order Appendix Table.

The Export Trade Control Order Appendix Table 1 and Foreign Exchange Order Appendix Table contain the following two types of information.

· "List controls" specified for items 1 to 15
· "Catch-all controls" that do not indicate specifications by item, but restriction by application (Section 16)



An application for approval is received by the Security Export Licensing Division of the Ministry of Economy, Trade and Industry or local bureaus of the Ministry of Economy, Trade and Industry.

2 Products and related technologies in this catalog

The products and related technologies in this catalog are subject to the catch-all control of the Foreign Exchange and Foreign Trade Control Law.

When exporting or providing the products or related technologies in this catalog, ensure that they are not used for arms or weapons.

3 Contact

Contact your local CKD Sales Office for information on the Security Trade Control of products and related technologies in this catalog.

* Refer to Intro Page 80 for cylinder switch.

Design/selection

1. Checking the specifications

⚠ WARNING

■ Use the product in the range of conditions specified for the product.
The product in this catalog is designed for use only in a compressed air system. Use with pressure or temperature exceeding the specifications range may result in damage or operation faults. (Refer to specifications) Contact CKD when using fluids other than compressed air and low hydraulic pressure.

■ If dimensional accuracy is required, contact CKD for specific details.
The dimensional tolerance of the pneumatic cylinder is adjusted based on JIS B 8368.
If higher accuracy is required, contact CKD in advance.

2. Safety design

⚠ WARNING

■ With the cylinder, there is the risk of the piston rod popping out in cases when a change of force occurs due to disruption of the sliding portions of the machine.
This could cause physical harm, such as pinched hands or feet, or mechanical damage. Adjust the machines so that they operate smoothly and design so that physical harm will be avoided.

■ If there is a risk of bodily injury, install a protective cover.
If the cylinder's drive section could cause bodily injury, install a protective cover. Design a structure that prevents person(s) from entering the cylinder's operating range or coming into contact with those sections directly.

■ Consider the possibility that the circuit pressure may be decreased by electrical power failure.
When using a cylinder in clamp mechanisms, blackouts, etc., may cause the circuit pressure to drop, reducing the clamping force and risking falling workpieces. Incorporate a safety device that prevents physical harm or mechanical damage. Suspension mechanisms and lifting devices should also be considered for position locking.

■ Consider the possibility of power source failure.
For devices controlled with power sources such as pneumatics, hydraulics, or electricity, take measures to prevent bodily injury or machine damage if power fails.

■ Design the operating circuit at emergency stop.
If one side of the piston is pressurized after the air in the cylinder is released, such as when the cylinder is driven by an exhaust center type directional control valve, or during startup after the residual pressure in the circuit is discharged, the driven object will pop out at high speed. This could cause physical harm, such as pinched hands or feet, or mechanical damage. Design with a circuit to prevent popping out.

■ Consider the operation status at emergency stop.
If the safety device is activated and the machine stops during a system failure such as emergency stop or power outage, design the system so that physical harm or damage to the workpiece/device/equipment does not occur due to cylinder operation.

■ Consider the operation status when restarting after emergency stop or abnormal stop.
Design the system so that bodily injury or equipment damage will not occur when restarting.
If there is a need to reset the cylinder to the starting position, design a safe control device.

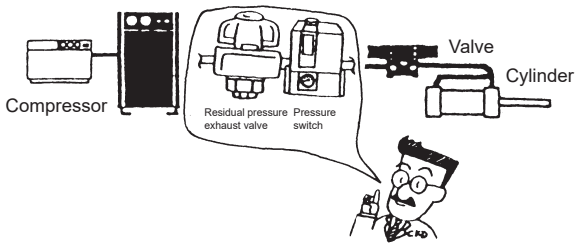
■ Take measures to prevent physical harm or property damage in the event of failure of this product.

⚠ CAUTION

■ Do not use in a range where the piston could collide with the stroke end and break.
If a piston collides against the cover at the stroke end and stops due to inertia, use within the range of allowable absorbed energy.

■ Mount a speed controller on the cylinder.
Use each cylinder within the applicable working piston speed range.

■ Install a "pressure switch" and "residual pressure exhaust valve" on the device's compressed air supply side.
● The pressure switch will disable operation until the set pressure is reached. The residual pressure exhaust valve releases compressed air into the pneumatic pressure circuit to prevent accidents caused by operation of pneumatic components under residual pressure.



■ Position locking cylinder load factor must be 50% or less.

3. Design by application

⚠ WARNING

■ If requiring deceleration circuit and shock absorber.
If the driven object moves at high speeds or is very heavy, it may be difficult to absorb impact with the cylinder cushion alone. Take measures to ease impact by installing a deceleration circuit before the cushion or by using an external shock absorber. The machine's rigidity must also be considered.

■ If inertia, vibrations, etc., are generated
When mounting the cylinder on a moving object (X-axis module, pallet, etc.), design while keeping in mind the inertia and vibration that are generated when the moving object is stopped.

■ Intermediate stop
When braking the cylinder's piston with a 3-position closed center directional control valve, air compressibility may make it difficult to stop as accurately as when using low hydraulics. In addition, since valves and cylinders do not guarantee zero air leakage, holding the stop position for long periods may not be possible. Consult with CKD when requiring a stop position to be held for long periods.

4. Working environment

⚠ WARNING

■ Install the product where it will not be exposed to rain, water, direct sunlight, or high temperatures.

■ Do not use this product in a corrosive environment.
Use in such an environment could lead to damage or operation failure.
Though piston rods, tie rods, etc. used in the cylinder are plated materials, machining parts (thread surface width, cut surface) are not plated. Implement measures as necessary since rust occurs even in normal environments.

■ Attach a cover in dusty places or places exposed to water, oil, Coolant, or coolant.
Use a rubber scraper if extremely dusty. Use a coolant proof if liquid could splatter onto the product.

■ If ambient temperature is 5°C or below, moisture in the circuit could freeze and lead to misoperation, etc.

⚠ CAUTION

■ When using the cylinder with valve with AC voltage, a thrumming noise may be heard depending on the working conditions. If the noise is a problem because of the working environment, select DC voltage.

■ Some models use oil-impregnated bearings, and oil may be discharged outside of the cylinder. Do not use in places susceptible to oil.

5. Durability

⚠ WARNING

■ Durability differs based on working conditions and model characteristics.

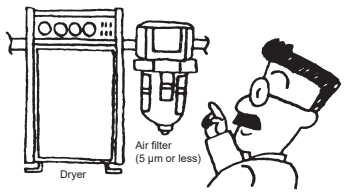
6. Pneumatic source

⚠ WARNING

■ Use clean dry compressed air.
Do not use the compressed air if it contains chemicals, synthetic oils containing organic solvents, salt, or corrosive gas, as it can cause damage and/or operation failure.

⚠ CAUTION

■ Use dry compressed air that does not cause moisture inside the piping.



- Moisture will occur if the temperature drops in the pneumatic piping or pneumatic components.
- If the piping volume is larger than the cylinder volume (atmospheric pressure-converted volume), the compressed air in the cylinder will not be completely exhausted when changing with the solenoid valve. This compressed air will condense, form water drops, and cause drainage.
- Operation faults could occur if moisture enters the air flow path of pneumatic components and temporarily blocks passage.
- Moisture could cause rust, making the pneumatic components fail.
- The drain will flush the lubricant oil and cause a lubrication defect.

■ Ultra dry air is not suitable for standard pneumatic components. Use ultra dry air compatible devices.
- Ultra dry compressed air will shorten the life of pneumatic components.
- Use a solenoid valve for DC voltage drive.

■ Use compressed air that does not contain oil oxides, tar, carbon, etc., from the air compressor.
- If oil oxides, tar, or carbon enter the pneumatic components and solidify, resistance at the sliding section will increase, leading to operation failure.
- If the supplied lubricant mixes with oil oxides, tar, carbon, etc., the sliding section of the pneumatic component could be worn down.

■ Use compressed air that does not contain solid foreign matter.
- Solid foreign matter in compressed air could enter the pneumatic components and cause wear at the sliding section or hydraulic locking. Install a 5 µm or less air filter.
- Regularly perform compressor maintenance and inspection.

7. How to use

⚠ CAUTION

■ Since it is pre-lubricated, it can be used without lubrication. Lubricate with Class 1 turbine oil (non-additive) ISO VG32 for lubrication. If stopped in the middle, it leads to malfunction as the initial lubricant is used up, so be sure to continue lubrication for operation.
Decide on lubrication or no-lubrication specifications for the pneumatic components and ensure that implementation of the corresponding method is reliably managed.

■ Provide intermediate support for a cylinder with long stroke.
If the cylinder has a long stroke, provide an intermediate support to prevent rod damage due to rod drooping, tube sag, vibration, or external loads.

■ Use within the max. stroke for the mounting format.
Refer to Ending Page 70.

■ Speed changes occur at startup in the cylinder with air cushion.

When the cushion ring slips off the cushion packing at startup, speed changes occur in the cylinder with air cushion.
As the changes may increase depending on conditions such as the speed controller's layout and adjustment, piping diameter, air pressure, and cushion needle opening, consult CKD if prevention is required.

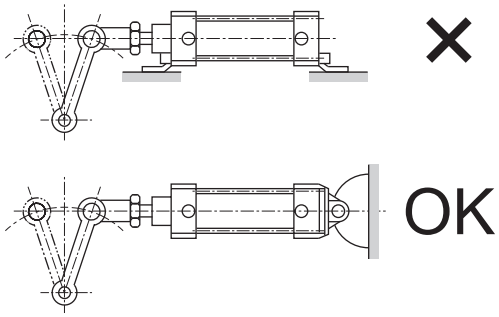
■ Make every effort to avoid using multiple synchronized cylinders.

If not synchronized, the piston rod could twist and lead to malfunctions. If synchronized operation is required, be sure to provide a rigid guide device separately.

■ For mounting of clevis and trunnion, check for free rotation without interference during full stroke operation of the cylinder before use.

■ Use an oscillating cylinder (clevis or trunnion) that can rotate at the cylinder angle, if the load movement direction changes with the operation. Install the bracket at the end of the rod so that it moves in the same direction as the cylinder body.

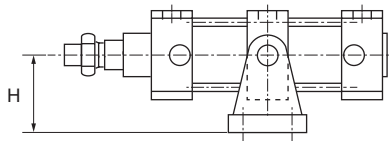
■ Do not couple the fixed cylinder with a rotating arm for use. In this case, connect an oscillating cylinder to the arm.



■ To avoid damage to the piston rod end thread or wear and seizing of the bush, etc., connect the end of the piston rod and load with a floating fitting or simplified floating fitting so twisting does not occur at any position in the stroke.

■ If the gap between clevis or trunnion and the corresponding bearing is large, the pins and shaft will bend. Therefore, keep this gap relatively small. (Recommended fit: H10/e8)

■ In the figure below, if the height H from the mounting surface of the bearing bracket to the bearing position is high, a large force is generated on the bracket mounting parts by the cylinder force, causing damage to bolts, etc.



■ The cylinder may have small amounts of oil oozing out from the sliding section/packing/gasket. Do not use in places susceptible to oil.

■ Precautions for use of pressure relief port
The exhaust port (P72) cannot be used for vacuum treatment. The reverse cannot be performed as well. Be sure not to do this because this could cause dispersion of particles or malfunctions.

8. Securing of space

⚠ CAUTION

■ Secure sufficient space around the cylinder for installation, removal, wiring, and piping work.

9. Statement in the instruction manual

⚠ CAUTION

■ Indicate the maintenance conditions in the device's instruction manual.

● The product's performance may drop too low to maintain an appropriate safety level depending on usage conditions, working environment and maintenance status. With correct maintenance, the product functions can be used to the fullest.

Mounting, installation and adjustment

1. Installation

⚠WARNING

■ Protect the load from falling or toppling when the cylinder is installed or removed.

⚠CAUTION

■ Remove the cylinder packaging and dust-proof seal of the piping port just before starting piping.
- Removing the dust-proof seal of the piping port before the piping work starts could allow foreign matter to enter the cylinder from the piping port and cause failure or misoperation.

■ Use suspension fittings if the cylinder weighs 15 kg or more.

■ Do not hit the cylinder tube and piston rod sliding section with anything or sandwich objects between them, causing scratches or dents.
The bore size is manufactured with precise tolerance, and operation faults could occur with even the slightest deformation. Scratches or dents on the sliding portion of the piston rod will cause damage of the packing, etc., and may lead to air leakage.

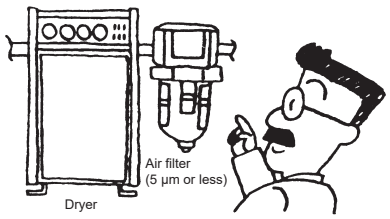
■ If the direction that the load moves in is not parallel to the piston rod shaft center, the piston rod and body (tube) could twist and cause the piston rod to pop out. Twisting can cause seizing, damage, etc. Always align the piston rod shaft center and load movement direction.

■ Prevent seizing at rotating sections.
Apply grease to rotating sections (pins, etc.) to prevent seizing.

2. Pneumatic source

⚠CAUTION

■ Install a pneumatic filter just before the pneumatic component in the circuit.
- To remove moisture in the pipes, attach an air dryer and filter. Install a filter near the directional control valve (primary side) to remove rust, foreign matter and drainage.



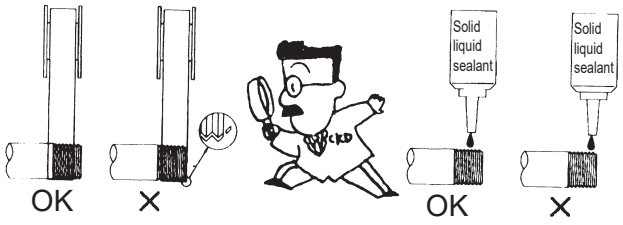
■ When supplying compressed air after connecting pipes, do not suddenly apply high pressure.
- The pipe connection could dislocate, causing the pipe tube to fly out, leading to accidents.
- If compressed air is supplied too slowly, sealing pressure may not be generated by the sealing mechanism in the solenoid valve. This can lead to air leaks.
- The cylinder may operate suddenly.

3. Piping

⚠CAUTION

■ When piping, refer to the instruction manual and make sure not to use the wrong connection port.
- This could cause improper operation.

■ When connecting pipes, wrap sealing tape clockwise from the inside position to within 2 threads from the pipe end.
- If sealing tape protrudes from the pipe threads, it could be cut when screwing the bolts in. This could cause the tape to enter the valve, causing failures.



■ Check that the piping connected to the cylinder is not dislocated due to vibration, looseness, or tension.
- Cylinder speed cannot be controlled if pneumatic circuit exhaust piping is dislocated.
- When using the chuck holding mechanism, the chuck may be released, creating a hazardous state.

■ Observe the following precautions when using nylon tubes or urethane tubes for piping material.
- Use flame-resistant tubes or metal pipes in an environment where spattering may occur.

■ Use corrosion-proof materials such as galvanized pipes, stainless steel pipes, nylon pipes or rubber pipes for piping material.

■ Use appropriate torque to tighten the pipes when connecting them.

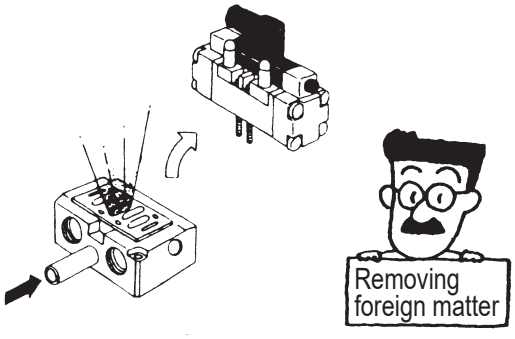
- The purpose is to prevent air leakage and damage to bolts.
- First tighten the bolts by hand to ensure that the threads are not damaged, then use a tool.

[Reference value] Refer to instruction manual.

Port thread	Tightening torque (N·m)
M3	0.3 to 0.6
M5	1 to 1.5
Rc 1/8	3 to 5
Rc 1/4	6 to 8
Rc 3/8	13 to 15
Rc 1/2	16 to 18
Rc 3/4	19 to 40
Rc 1	41 to 70

■ Always flush just before piping pneumatic components.

- Any foreign matter that has entered during piping must be removed so it does not enter the pneumatic components.



4. Pre-operation confirmation

⚠ WARNING

■ Check load and cylinder installation connection for looseness and other abnormalities before starting operation.

■ Do not use the device until proper operation is confirmed.
After installation, repair, or modification, connect compressed air or electric power and conduct appropriate functional and leakage inspection to confirm that installation is correct.

■ Confirm that there is no machine interference and that the actuation system is normal.

■ Confirm that there is no abnormality in device operation, and gradually raise and set pressure.

■ If operation is started while the exhaust side is at atmospheric pressure, the rod could pop out and cause a dangerous situation. Apply pressure to the cylinder chamber on the exhaust side before starting.

⚠ CAUTION

■ Before supplying compressed air after connecting pipes, check that there are no air leaks at any pipe connections.

- Apply a leakage detection agent to pipe connections with a brush and check that there are no air leaks.

■ Be sure to read the instruction manual carefully.
Read carefully and fully understand contents before starting use. Store so as to allow confirmation at any time.

5. Adjustment

⚠ WARNING

■ When adjusting speed with the speed controller, gradually open the needle from the closed state and adjust.
If speed is adjusted in the opened state, the rod could pop out, creating a hazard.

■ The effect of the cushion with air cushion is adjusted at shipment. However, re-adjust the cushion needle for use in accordance with the size of the load and piston speed.
Gradually open the needle from the closed state and adjust the effect of the cushion. If the cushion needle is loosened too much, the cushion cannot function and may fall off.
After making adjustments, tighten the needle nut (hex nut) to fix the unit in place.
Use kinetic energy within the allowable value.
The product may be damaged if allowable values are exceeded.

■ When the cylinder is in operation, do not enter or put your hand into its operating range.

Use/maintenance

1. Maintenance and inspection

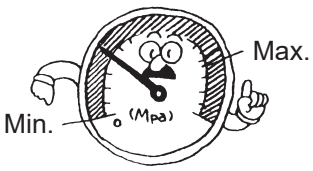
⚠WARNING

■ Refer to the instruction manual and conduct careful maintenance and inspection.
Incorrect handling could result in device or system damage or operation faults.

⚠CAUTION

■ Conduct daily inspections and regular inspections to ensure that maintenance control is done correctly.
● If maintenance is not correctly managed, the product's functions could deteriorate markedly and lead to a shortened service life, faults and accidents.

(1) Supplied compressed air pressure control
● Is the set pressure supplied?
Does the pressure gauge indicate the set pressure while the equipment is operating?



(2) Pneumatic filter control
● Is the drain correctly discharged?
Is the bowl or element clean enough to use?

(3) Control of compressed air leaks from piping connections
● Is the state of the connection, especially at movable sections, normal?

(4) Solenoid valve operational status control
● Are operations delayed? Is exhaust normal?

(5) Control of pneumatic actuator operation
● Is operation smooth?
Is the end stop state normal?
Is coupling with the load normal?

(6) Lubricator control
● Is the oil volume adjustment normal?

(7) Lubricant control
● Is the lubricant that is being supplied an official item?

■ Do not use if air leakage rate increases or the device does not operate correctly.
● After repair or modification, connect compressed air and electricity, and conduct functional and leakage inspection to confirm that operation is normal.

■ When restarting after not using for a long period of time, check that operation is normal.

■ Replace repair parts beyond the rated service life with new parts during periodic inspection.
Do not use repair parts after 5 years or more of storage.

■ Store repair parts in a cool, dark place not exposed to direct sunlight.

■ If the lubrication of the sliding surface is worsened or dry, periodically grease up the lithium grease (standard) or fluorine grease (heat resistance, low-speed, low friction, P7, etc.). Before applying grease, remove any foreign matter on the sliding surface. Contact CKD if the working grease is unknown.

2. Influence of fluorine grease

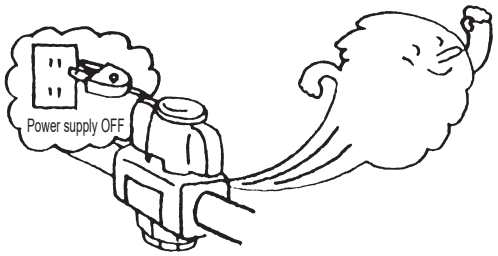
⚠WARNING

■ Smoking with hands smeared with the fluorine grease of cylinders using fluorine grease (such as heat resistance, low-speed, low friction, P7) could generate harmful gases and cause physical harm.

3. Removal

⚠WARNING

■ Component removal and supply/exhaust of compressed air
Before removing the device, take measures to prevent the driven object from falling or running out of control, and shut OFF air and power. Exhaust all compressed air in the system beforehand. Before restarting, confirm that measures are taken to prevent popping out.



■ When removing double rod cylinder load, lock the load side piston rod using the WAF (Width Across Flats) on the end.If the load side piston rod is not locked, note that the fastening part (screw-in part) of the piston rod may loosen.

■ Take measures so that the load does not fall or drop when the cylinder is removed.

4. Disassembly/assembly

⚠WARNING

■ Remove cylinders from the equipment before disassembly.

■ Products must be disassembled and assembled by qualified personnel.
After disassembling or reassembling, carry out leakage inspections and operation inspections before reassembling to the device.

■ Note that when disassembling a single acting cylinder, the spring could cause parts to pop out.

■ Use appropriate pliers (C-snap ring mounting tool) to install and remove rod metal.

■ Even in cases when appropriate pliers (C-snap ring mounting tool) are used, be careful as the snap ring may pop out at the tip of the pliers (C-snap ring mounting tool) and cause physical or equipment damage.
In addition, when mounting the unit, be sure that the unit fits securely into the snap ring groove before supplying air.

⚠ CAUTION

■ When performing maintenance such as repair part replacement, etc., disassemble or reassemble in a test bench with clean atmosphere free of dust, and carry out functional inspections to check whether the device is operating normally.

Design/selection

⚠ WARNING

■ Application, load current, voltage, temperature, impact, environment, etc., exceeding the specifications will result in damage or operation faults. Use the device as instructed in specifications.

■ Never use this product in an explosive gas atmosphere. The cylinder switch does not have an explosive-proof structure. Never use in an explosive gas atmosphere as explosions or fires could result.

⚠ CAUTION

■ Take care when using this product for an interlock circuit.

When using the cylinder switch for an interlock signal requiring high reliability, provide a double interlock by installing a mechanical protection function or a switch (sensor) other than a cylinder switch as a guard if problems occur.

Regularly inspect and confirm that the interlock activates correctly.

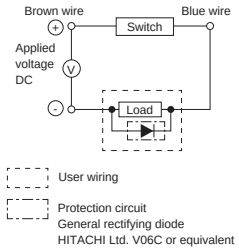
■ Pay attention to the contact capacity.

Do not use a load that exceeds the switch's specified voltage and current. This may lead to failure.

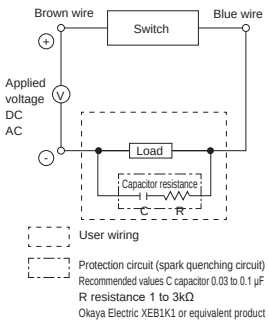
■ Pay attention to the contact protection circuit. (Reed switch)

● When an inductive load (relay or solenoid valve) is connected, a surge voltage is generated when the switch is turned OFF. Provide a contact protection circuit.

● Diode used



● Capacitor and resistance used



● When a capacitive load is connected, starting current is generated when the switch is turned ON. Provide a contact protection circuit.

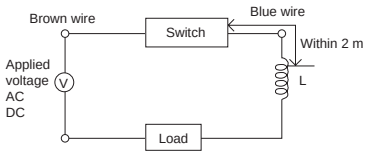
● If the wiring increases, the wiring capacity will be reached and a rush current will occur, damaging the switch or shortening the service life. Provide a contact protection circuit if the wiring length exceeds Table 1.

If using at 200 VAC with T8, contact CKD since the usable wiring length may be shortened.

Switch	Voltage	Wiring length
M, T, K, H, V, F, ETO types	DC	50 m
M, T, K, H, V, ETO types	AC	10 m
RO, 5, 6, EO types	DC	100 m
RO, 5, EO types	AC	10 m
R4 type	AC	50 m

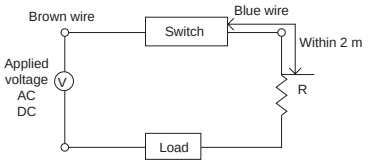
Table 1

● Choke coil used



● Choke coil
L = Several hundred μH to several mH
Item with outstanding high frequency characteristics

● Resistance used



● Rush current limiting resistor
R = Largest resistor tolerated by load circuit side

For specifications of contact protection circuits, refer to Ending Page 27.

■ Avoid using in an environment constantly exposed to water.

● Insulation failure can cause malfunctions.

■ Avoid using this product in environments containing oil or chemicals.

● The cylinder switch may be adversely affected (insulation failure, malfunction caused by swelling of the filled resin, hardening of lead wire sheath, etc.) if used in an environment containing oil, coolant, cleaning fluid, or chemicals. Consult with CKD.

● A coolant proof cylinder switch is available. Refer to “Guide to pneumatic devices compatible with coolants” (No. CC-N-375A) for details.

■ Do not use in a high-impact environment.

For reed switch, if a strong impact (294 m/s^2 or more) is applied while in use, the contact may malfunction by momentarily (1 ms or less) being connected or disconnected. It may be necessary to use a proximity switch depending on the working environment. Consult with CKD.

■ Do not use this product in surge generating areas.

If there are devices and components (solenoid type lifters, high frequency induction furnace, motors, etc.) around the cylinder with proximity switch that generate a large surge, consider surge protection of the source as it may lead to deterioration or damage of the switch internal circuit element.

■ Be careful of accumulation of iron powder and contact with magnetic substances.

If a large amount of iron chips such as cutting chips or welding spatter accumulate or if magnetic objects (material attracted to magnets) contact the cylinder with a cylinder switch, the cylinder will be demagnetized and cylinder switch operations may be inhibited.

⚠CAUTION

■ Pay attention to the proximity of cylinders, etc.

- When installing more than one cylinder with switches in parallel, keep sufficient distance between the cylinder tubes according to the cylinder specifications.
  Mutual magnetic interference may cause the switch to malfunction.

■ Pay attention to magnetic environments.

- If surroundings contain a strong magnetic field or large current (large magnet, spot welding machine, etc.), use a strong magnetic field proof switch. (HO, HOY, T2YD)
  If a magnetic object is very close to the cylinder, mutual interference may occur and adversely affect detection accuracy.

■ In the mid-stroke position, pay attention to the ON time of the cylinder switch.

- When setting the cylinder switch at mid-stroke and driving a load with the piston movement, 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 max. detectable piston speed is:

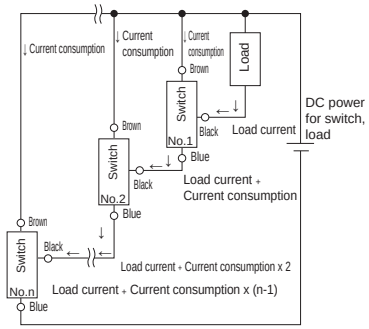
$$V(mm/s) = \frac{\text{Cylinder switch operating range (mm)}}{\text{Load operation time (s)}}$$

If the piston speed is too fast, use an off-delay output cylinder switch T2JH/V (models limited).

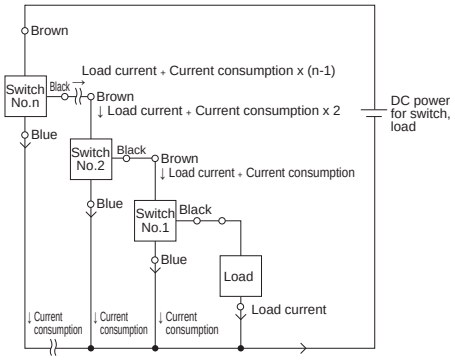
■ Pay attention to the serial connection usage method.

- When serially connecting several 2-wire switches, the switch voltage drop is the total voltage drop of all connected switches. The voltage applied to the load is the voltage obtained by subtracting the voltage drop at switches from the power supply voltage. Check load specifications and determine the number of switches.
- Connecting several 2-wire proximity switches in series may result in a malfunction. Contact CKD in advance. It is recommended to use reed switches.
- When connecting several 3-wire serial proximity switches, the switch voltage drop is the total voltage drop of all connected switches, as with the 2-wire switch. In addition, the current flowing to the switch is the sum of current consumption and load current of the switches connected as in the upper right figure. Check load specifications and determine the number of connections so as not to exceed the maximum load current of the switch.
- The indicator lamp turns ON only when all switches are ON.

Fig. 1: For R3 (Y)/M3 (W)/T3 (Y)/K3 (Y)/F3 (Y)



For T3P/K3P/M3P



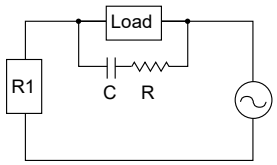
■ Pay attention to the parallel connection usage method.

- When connecting several 2-wire switches in parallel, note that leakage current increases in proportion to the number of connected units. Check load specifications and determine the number of connections.
- With the 2-wire proximity switch, when 1 switch changes from ON to OFF status, voltage at both ends of the switch connected in parallel drops to the internal voltage drop value when the switch is ON and goes below the load voltage range, so other switches will not turn ON. Therefore, check the input specifications of the programmable controller that is the connected load before use.
- Since the leakage current value of the 3-wire proximity switch is very small (10 μA or less), it should not be a problem for normal use.
- Note that switch's indicator lamp could dim or may not turn ON.

■ Output circuit protection (proximity switch)

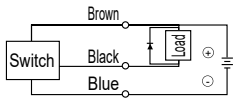
● When an inductive load (relay or solenoid valve) is connected, surge voltage is generated when the switch is turned OFF. Provide the following protection circuit.

R1



● Capacitor
C=0.03 to 0.1 μF
● Resistance
R = 1 to 3 kΩ
Okaya Electric
XEB1K1 or equivalent product

R3(Y), M3(W), T3(Y), K3(Y), F3(Y)

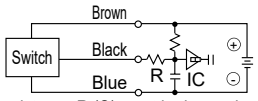


● Diode
D = HITACHI Ltd.
V06C or equivalent product

An example of using a surge absorbing element with inductive load.

● When a capacitive load is connected, starting current is generated when the switch is turned ON. Provide the following protection circuit.

R3(Y), M3(W), T3(Y), K3(Y), F3(Y)



Resistance R (Ω) must be larger than the following equation in this case.

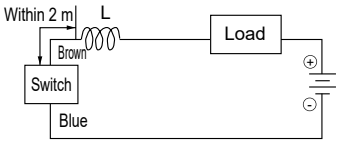
$\frac{V}{0.15}$ = R (Ω) (R3 (Y), M3 (W))

$\frac{V}{0.05}$ = R (Ω) (T3 (Y), K3 (Y), F3 (Y))

● Provide the following protective circuit if the lead wire length exceeds 10 m.

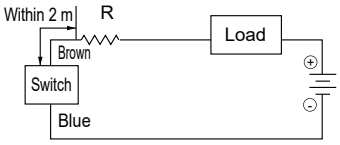
R1, R2(Y), M2(W), T2(Y/J), K2(Y), F2

● Choke coil used



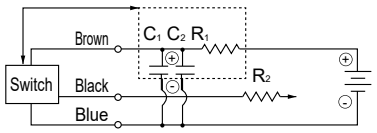
● Choke coil
L = Several hundred μH to several mH
Item with outstanding high frequency characteristics

● Resistance used



● Rush current limiting resistor
R = Largest resistor tolerated by load circuit side

● Resistance used
Within 2 m



Power supply noise absorptive circuit
C_1 = 20 to 50 μF
Electrolytic capacitor (Voltage resistance 50 V or more)
C_2 = 0.01 to 0.1 μF
Ceramic capacitor
Rush current limiting resistor
R_1 = 20 to 30 Ω
R_2 = Largest resistance tolerated by load circuit side used.

■ Pay attention to the service life of the reed switch.

● Although the service life of the reed switch differs depending on usage conditions, it is generally approx. several million cycles. The contact service life is reached sooner if the device is used continuously or operated at a high frequency. In this case, use a proximity switch with no contact.

■ If special quality and reliability are required, such as when using with a customer-dedicated circuit board, a proximity switch is recommended. In addition, please be sure to thoroughly check the compatibility judgment by yourself.

Mounting, installation and adjustment

⚠CAUTION

■Do not drop or apply impact.

Do not drop, bump, or apply excessive impact (294 m/s^2 or more for reed switches, 980 m/s^2 or more for proximity switches). Even if the switch case is not damaged, switch components could break or malfunction.

■Do not carry the cylinder by the switch's lead wire.

Never do this: it not only causes disconnection of lead wires, but since stress is applied to the internal switch, it may also damage the switch internal element.

■Do not wire together with power lines or high voltage lines.

Avoid the use of parallel wiring or wiring in the same conduit as that of power lines or high voltage lines. Wire separately. The control circuit containing the cylinder switch could malfunction due to noise.

■Do not short-circuit the load.

If turned ON in a state of load short-circuit, excess current will flow and the switch will be instantly damaged.

■Pay attention to the lead wire connection.

Turn OFF power to the device in the electric circuit to be connected before starting wiring. If operated while the power is turned ON, it may cause accidents due to electric shock or unpredicted operation.

● Reed switch

Do not connect the switch lead wire directly to the power supply. Connect the load serially. Pay attention to the following (1), (2) for RO, MO, TO, KO, EO, FO, ETO.

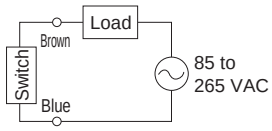
(1) When used for DC, connect the brown wire on the positive (+) side and the blue wire on the negative (-) side. The switch will function when connected in reverse, but the indicator lamp will not turn ON. (There is no polarity for HO.)

(2) When connected to an AC relay or programmable controller input, conducting half wave rectification with that circuit may prevent the indicator lamp from turning ON. The indicator lamp will come ON when the switch lead's polarity is reversed.

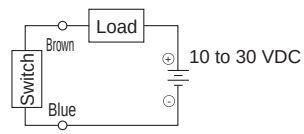
● Proximity switch

Correctly connect the lead wires based on the color coding in the figure on the right.
Incorrect wiring could result in damage.

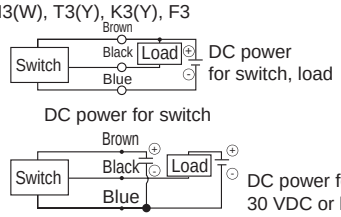
● R1



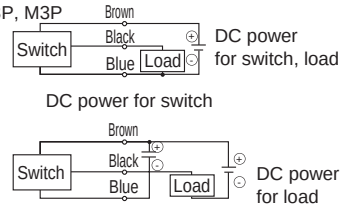
● R2 (Y), M2 (W), T2 (Y), T2J, K2 (Y), F2 (T2YD has no polarity)



● R3(Y), M3(W), T3(Y), K3(Y), F3



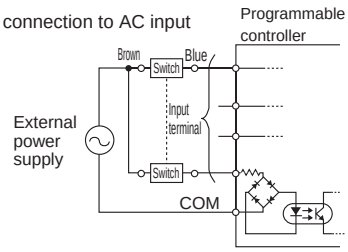
● T3P, K3P, M3P



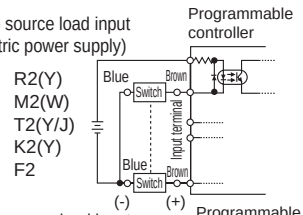
(Connection to programmable controller (PLC))

● Connection direction differs depending on the type of programmable controller. Connect based on input specifications.

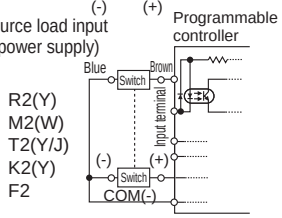
● R1 connection to AC input



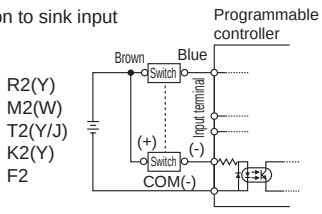
● Connection to source load input (external electric power supply)



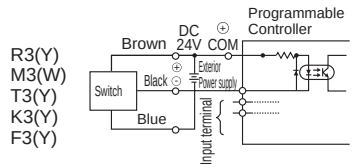
● Connection to source load input (internal electric power supply)



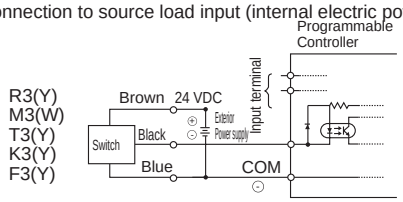
● Connection to sink input



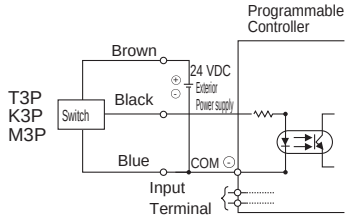
● Connection to source load input (external electric power supply)



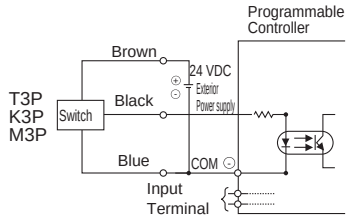
● Connection to source load input (internal electric power supply)



● Sink input (External power supply) Example of connection to type



● Sink input (Built-in power supply) Example of connection to type



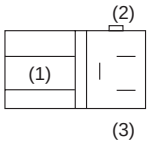
■ Set the switch to the center of the operation range.

Adjust the mounting position of the cylinder switch so that the piston stops at the center of the operating range (ON range). (Mounting position in the catalog shows the optimal position at stroke end.) If set at the end of the operating range (near the boundary line of ON, OFF), operation may become unstable.

■ Observe tightening torque when installing the switch.

If the tightening torque range is exceeded, the set screw, mounting bracket, switch, etc., could be damaged. In addition, if tightening the set screw with a torque less than the min. tightening torque, the switch mounting position could be displaced. (Refer to Ending Pages 42 and 43 for details on switch mounting, movement, tightening torque, etc.)

■ Pay attention to the terminal box wiring.



Model \ Terminal	(1)	(2)	(3)
R0(DC), R2, R2Y, R6		+	-
R 0(AC),R1,R 4,R 5		±	±
R 3,R3Y	OUT	+	-

■ Lead wire protection

The lead wire's min. bending radius is 9 mm or more (when fixed). Pay attention to wiring so repeated bending and tensile strain are not applied to the lead wire. Connect T2H/VR3 cylinder switch (models limited) with more flexible bend-resistant lead wire specifications to the moving parts for use.

■ Relay

Use the following or equivalent relays.

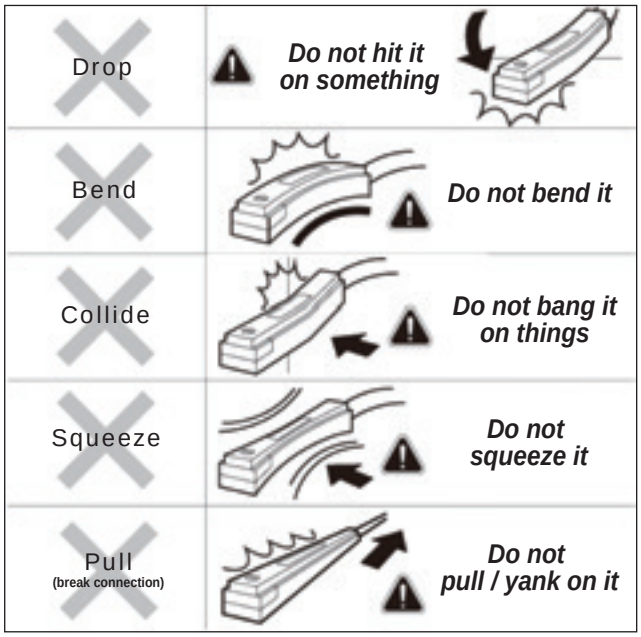
◯OMRON Corporation ——— MY type
◯Fuji Electric Co., Ltd. ——— HH5 type
◯Tokyo Denki ——— MPM type
◯Panasonic Co., Ltd. ——— HC type

1 . Precautions for "external force"

⚠CAUTION

■ When using the reed type in particular, the reed switch (glass tube) could be damaged or the sensitivity could be reduced.

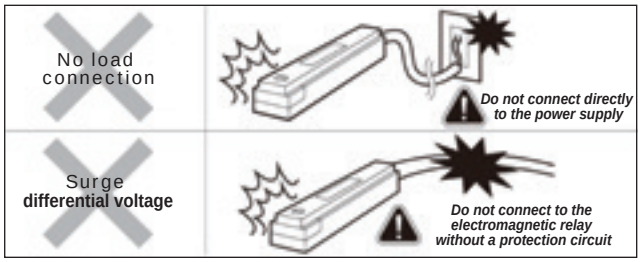
Example: T0□ T5□ T8□Model



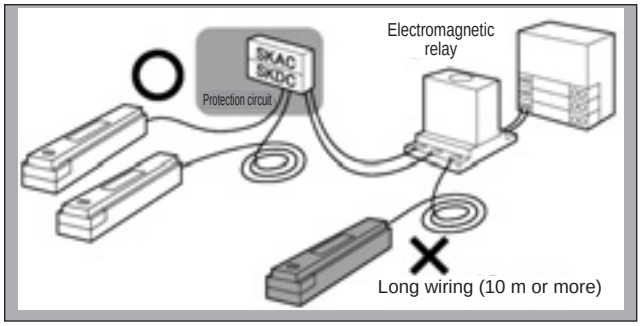
2 . Precautions regarding "overcurrent/overvoltage"

■ Do not connect directly to power supply.

■ Do not connect to the electromagnetic relay without a protection circuit.



■ For electromagnetic relay and long wiring, install a "protection circuit".



⚠WARNING

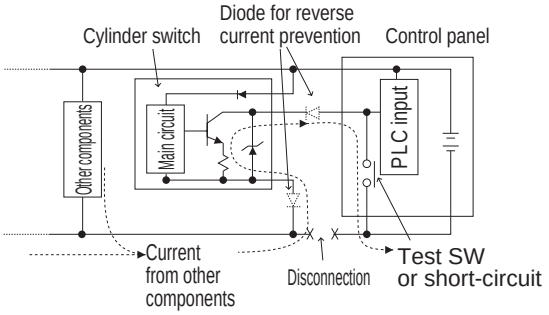
■Do not apply overcurrent.

If overcurrent flows to the cylinder switch because of a load short-circuit, etc., the cylinder switch will be damaged with a risk of ignition.
Provide an overcurrent protection circuit, such as a fuse, for the output wire and power cable as needed.

⚠CAUTION

■Pay attention to the reverse current caused by disconnected wires/wiring resistance.

● When other devices, including cylinder switches, are connected to the same power supply as the cylinder switch and the output cable and power cable are short-circuited or the power supply is disconnected to check operation of the input unit in the control panel, reverse current could flow to the cylinder switch's output circuit and cause damage.

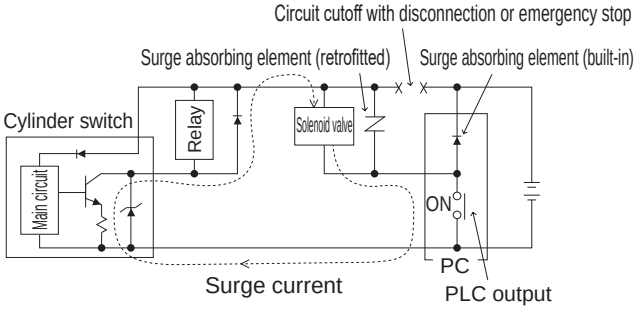


● Take the following measures to prevent damage caused by reverse current.

(1) Avoid centralizing current at the power cable, especially a negative power cable, and use as thick a cable as possible.
(2) Limit the number of devices connected to the same power supply as the cylinder switch.
(3) Insert a diode in serial with the cylinder switch's output cable to prevent reversal of current.
(4) Insert a diode in serial with the cylinder switch's power cable negative side to prevent reversal of current.

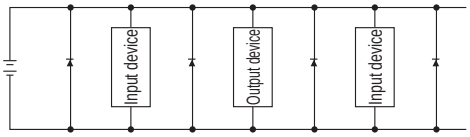
■Pay attention to surge current leading.

● When cylinder switch power is shared with an inductive load that generates surges, such as a solenoid valve or relay, if the circuit is cut off while the inductive load is functioning, surge current could enter the output circuit and cause damage depending on where the surge absorbing element is installed.



● Take the measures below to prevent damage from sneak surge current.

(1) Separate the power supply for the output system comprising the inductive load, such as the solenoid valve and relay, and the input system, such as the cylinder switch.
(2) If a separate power supply cannot be used, directly install a surge absorption element for all inductive loads. Consider that the surge absorption element connected to the PLC, etc., protects only the individual device.
(3) Connect a surge absorption element to places on the power wiring shown in the figure below, as a measure against disconnections in unspecified areas.



When devices are connected to a connector, the output circuit could be damaged by the above if the connector is disconnected while power is ON. Turn power OFF before connecting or disconnecting the connector.