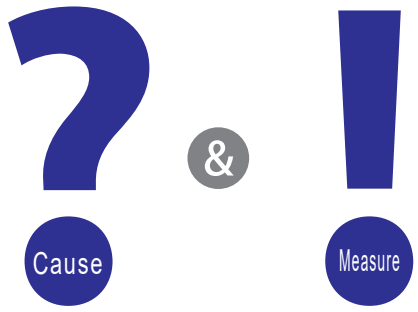
OMRON

The SOLUTIONS

[Rigid Vertical Limit Switch]

Must-read Details of switch failure and preventive measures



Let's Prolong Switch Life by Preventing Failures!

Introduction

We would like to thank you for using our switches.

We started to develop switches over half a century ago. In order to do everything possible to meet the needs of our customers, we have been committed to various types of switch development and quality improvement.
We are pleased to inform you that our switches have been used for equipment/devices in various applications, and we shipped about a billion switches in one year (actual figure in FY2022 by our research). We appreciate selecting and continuing to use our products.
We summarized preventive measures against failures in this guide so that customers will use our switches more safely.
We appreciate if The Solution would be helpful in preventive/corrective actions when malfunction occurs.
We are going to meet our customers' needs by focusing on core technologies, and appreciate your continued business.

OMRON Corporation

Notes

- "The Solution" introduces some typical examples of failures found by our customers.
  Please understand some cases may not apply to "The Solution."
- Please do not unseal, disassemble, etc. samples of switches sent out for detailed analysis as doing so may adversely affect analysis.
  Please note that if you disassemble a switch (ex, open the cover), we may not be able to investigate the true cause.

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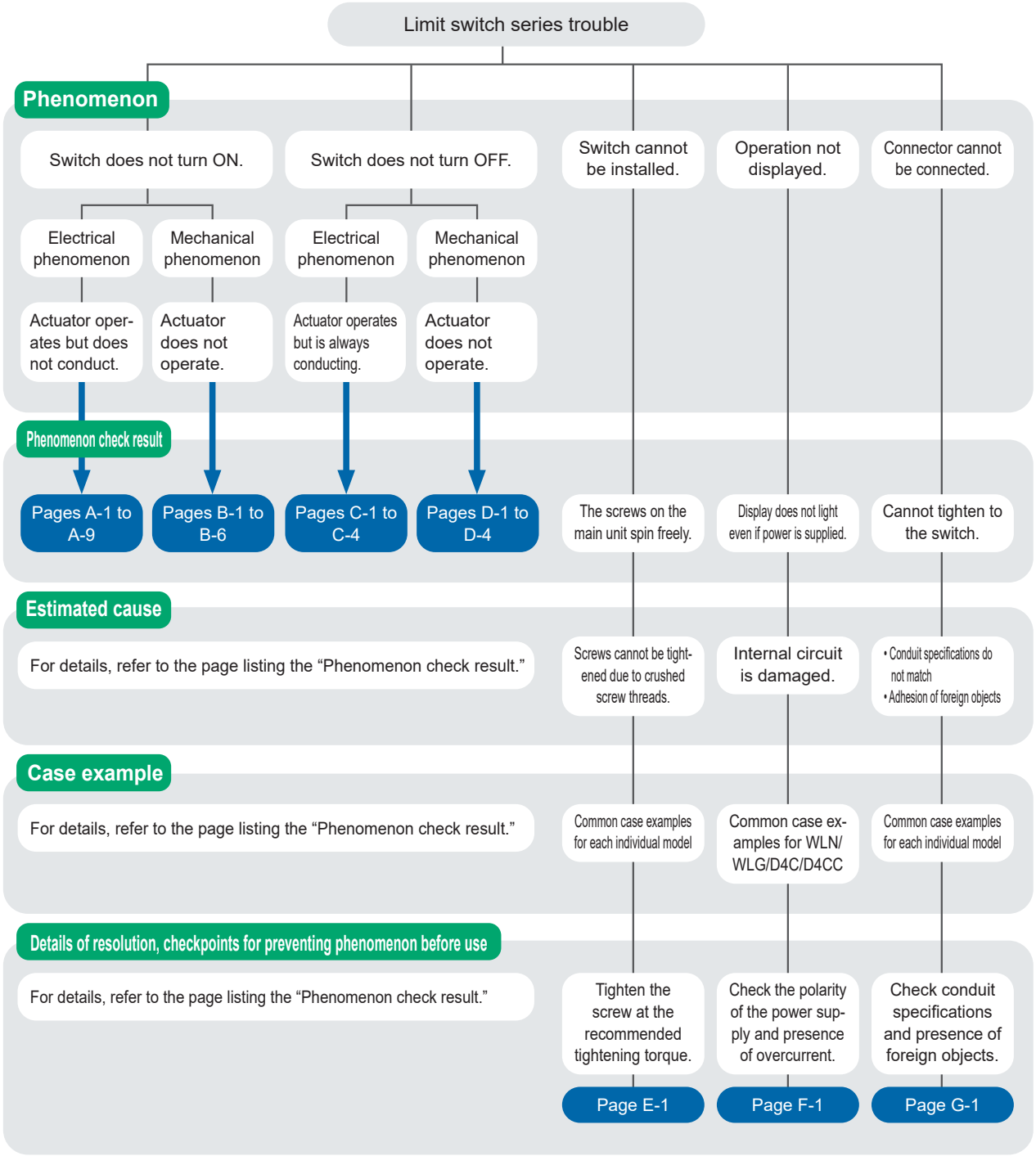
List of Market Trouble FTA Related to Rigid Vertical Limit Switches

We are developing FTA by trouble phenomenon of limit switch series. The following lists the estimated causes by each individual result confirmed by the customer. Refer to each case example, and use it to solve and prevent trouble.



List of OMRON rigid vertical Limit Switch series models

WLN/WLG

D4C/D4CC

HL

D4A

[Phenomenon: Actuator operates but does not conduct]

■ Phenomenon check result and cause

<Phenomenon check result>
• Contact resistance is high.
<Cause>
During normally open (NO) use, it does not conduct if the operating stroke is insufficient, or conduction becomes unstable.

■ Details of resolution, checkpoints for preventing phenomenon before use

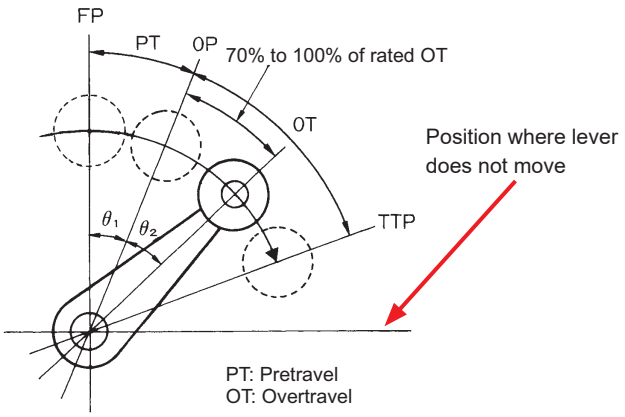
Check!

(1) Is the actuator ON/OFF operation set near the contact switching position?

The range near the contact switching position (OP: operating position, RP: return position) is an unstable contact range where conductivity trouble may occur.
In this case, resistance to vibration and shock weakens.
During normally open (NO) use, ensure an operating stroke of 70% to 100% of the rated OT.
Set the operating angle to within the maximum value of PT + OT = TTP (see lever operation diagram) including movement by inertia.

[Lever specification]

[Lever operation diagram]



Check!

(2) Are the switch mounting screws loose or is the operating body deformed?

If the switch mounting screws are loose or there is deformation or distortion on the operating body side, there is the possibility that normal operation cannot be performed even if a correct stroke is set.
Also, even though there may not be a problem at the early stages, the above trouble may occur over the course of time. So, pay attention when installing the switch and also perform periodic inspections.

[Phenomenon: Actuator operates but does not conduct]

■ Phenomenon check result and cause

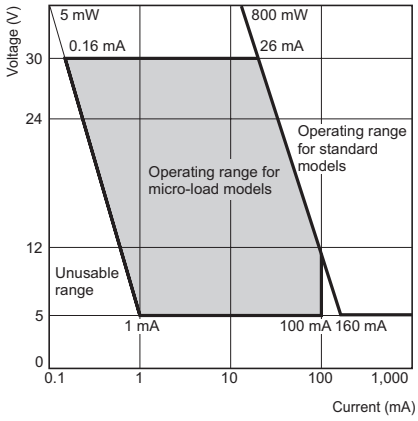
<Phenomenon check result>
• Contact resistance is high.
<Cause>
A general load specification switch is used in the micro load range, and insulating material accumulates due to repeated operation.

■ Details of resolution, checkpoints for preventing phenomenon before use

Are the load conditions used compatible with the specifications of the switch?

Using a model for ordinary loads to open or close the contact of a micro load circuit may result in faulty contact.
Use switches in the ranges shown in the diagram below.
However, even when using micro load models within the operating range shown here, if an inrush current occurs when the contact is opened or closed, it may increase contact wear and so decrease durability. Therefore, insert a contact protection circuit where necessary.
The minimum applicable load is the N-level reference value. This value indicates the malfunction reference level for the reliability level of 60% (λ60). (JIS C5003)

* λ60 = 0.5 × 10^{-6}/operation indicates that the estimated malfunction rate is less than 1/2,000,000 operations with a reliability level of 60%.



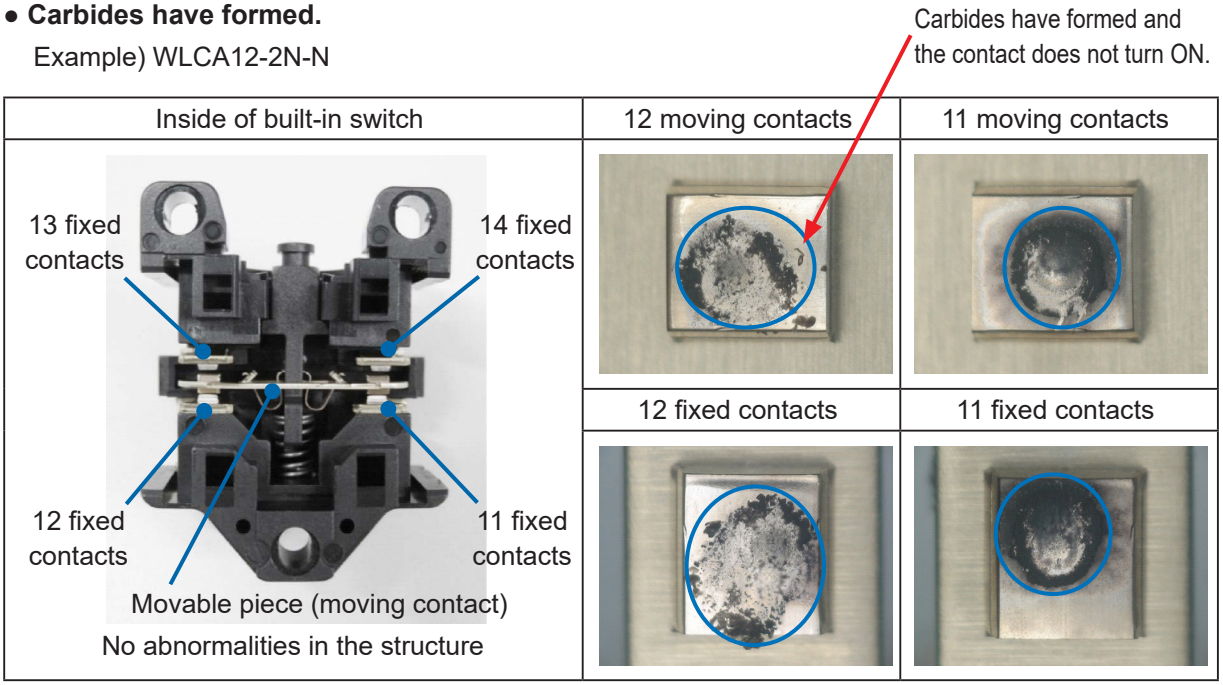
[Phenomenon: Actuator operates but does not conduct]

■ Phenomenon check result and cause

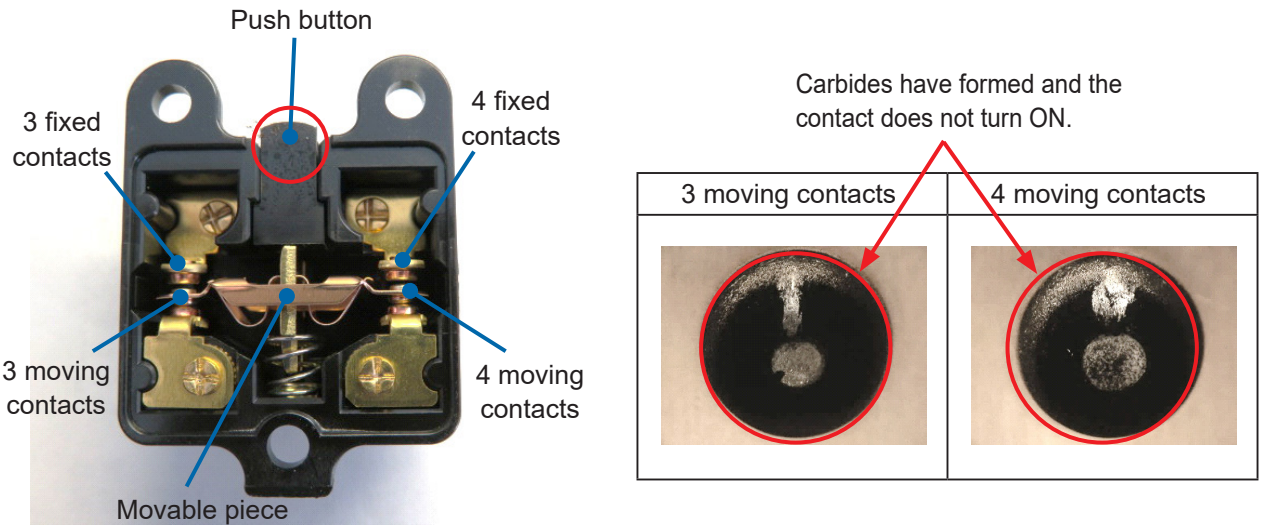
<Phenomenon check result>
• Contact resistance is high.
<Cause>
Carbides have formed on the contact surface due to the influence of the switching load and have turned into insulation material.

■ The malfunction case

● **Carbides have formed.**
Example) WLCA12-2N-N



● **Carbides have formed.**
Example) WLG12



[Phenomenon: Actuator operates but does not conduct]

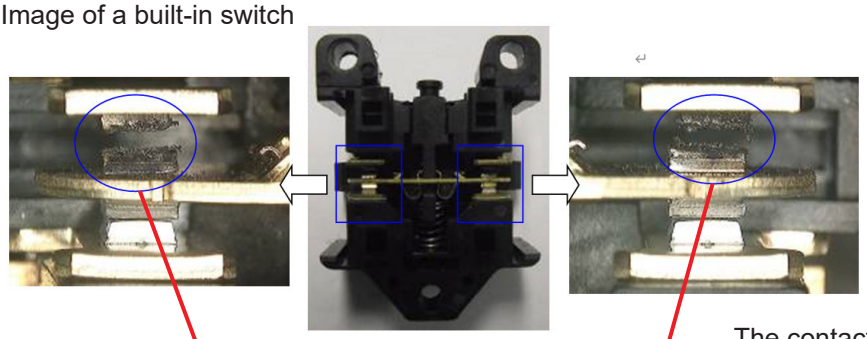
■ Phenomenon check result and cause

<Phenomenon check result>
• Contact resistance is infinite.
<Cause>
Contacts melt due to overcurrent.

■ The malfunction case

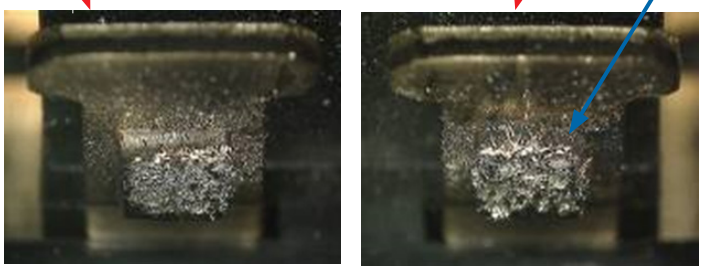
● **Contact is welded.**
Example) WLCA2-8-N

Image of a built-in switch

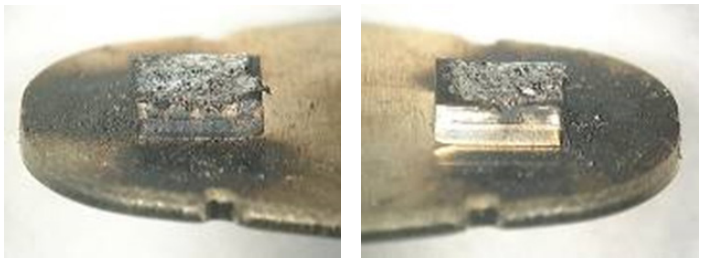


The contact is welded and detached protrusions are visible.

NO side fixed contact



NO side moving contact



[Phenomenon: Actuator operates but does not conduct]

■ Details of resolution, checkpoints for preventing phenomenon before use

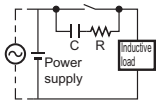
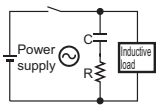
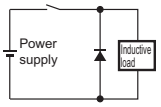
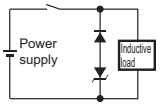
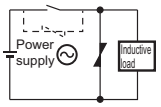
Check!

Is the circuit configured to allow a current exceeding the rating to flow to the switch?

Take care to prevent an overcurrent from flowing to the switch. (Including short-circuit current)
Also, depending on the type of load, there is a large difference between the inrush current and the steady-stage current or the steady-state current and the reverse voltage, and there is a possibility that a current at the rating or above will flow. So, also check these.

*** Refer to the case example of a general contact protection circuit provided for reference.**

Case example of a general contact protection circuit

Circuit example		Applicable current		Feature	Element selection
		AC	DC		
CR circuit		See note.	Yes	**Note:** When AC is switched, the load impedance must be lower than the C and R impedance.	C: 0.5 to 1 μF per switching current (1 A) R: 0.5 to 1 Ω per switching voltage (1 V) The values may change according to the characteristics of the load. The capacitor suppresses the spark discharge of current when the contacts are open. The resistor limits the inrush current when the contacts are closed again. Consider these roles of the capacitor and resistor and determine the ideal capacitance and resistance values from experimentation. Use a capacitor with a dielectric strength between 200 and 300 V. When AC is switched, make sure that the capacitor has no polarity. If, however, the ability to control arcs between contacts is a problem for high DC voltage, it may be more effective to connect a capacitor and resistor between the contacts across the load. Check the results by testing in the actual application.
		Yes	Yes	The operating time will increase if the load is a relay or solenoid. It is effective to connect the CR circuit in parallel to the load when the power supply voltage is 24 or 48 V and in parallel to the contacts when the power supply voltage is 100 to 200 V.	
Diode method		No	Yes	Energy stored in the coil is changed into current by the diode connected in parallel to the load. Then the current flowing to the coil is consumed and Joule heat is generated by the resistance of the inductive load. The reset time delay in this method is longer than that of the CR method.	The diode must withstand a peak inverse voltage 10 times higher than the circuit voltage and a forward current as high as or higher than the load current.
Diode and Zener diode method		No	Yes	This method will be effective if the reset time delay caused by the diode method is too long.	Zener voltage for a Zener diode must be about 1.2 times higher than the power source since the load may not work under some circumstances.
Varistor method		Yes	Yes	This method makes use of constant-voltage characteristic of the varistor so that no high-voltage is imposed on the contacts. This method causes a reset time delay more or less. It is effective to connect varistor in parallel to the load when the supply voltage is 24 to 48 V and in parallel to the contacts when the supply voltage is 100 to 200 V.	Select the varistor so that the following condition is met for the cut voltage Vc. For AC currents, the value must be multiplied by $\sqrt{2}$. Vc > (Current Voltage × 1.5) If Vc is set too high, however, the voltage cut for high voltages will no longer be effective, diminishing the effect.

[Phenomenon: Actuator operates but does not conduct]

■ Phenomenon check result and cause

<Phenomenon check result>
• Contact resistance is infinite.
<Cause>
There is a silicon gas generating source in the area around the switch and silicon is formed on the contact surface as insulation material.

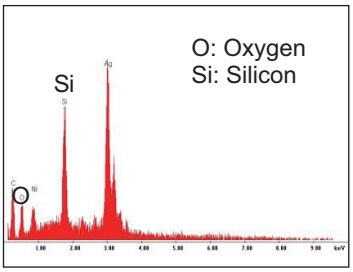
■ The malfunction case

● **Silicon oxide is formed on the contact surface which results in contact failure.**
Example) D4C-4229-P

Contact image

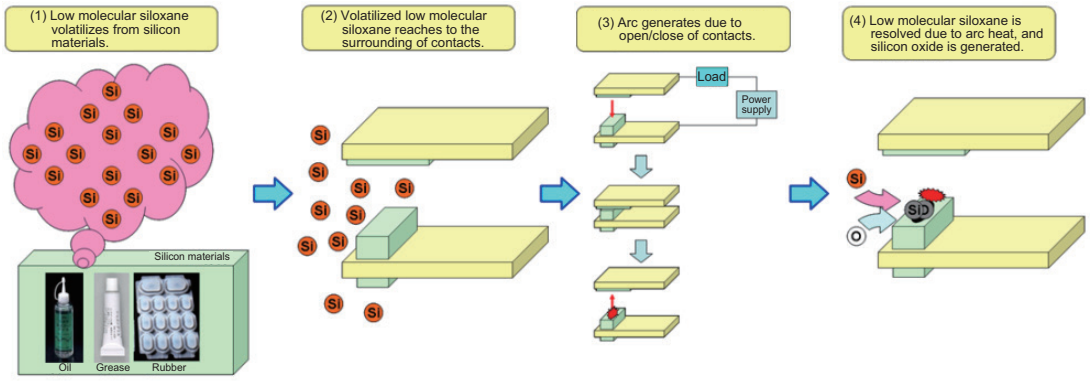
Black foreign objects have formed.

Result of element analysis at ○ section



Silicon oxide detected

Silicon oxide is formed on the contact surface as a result of the reaction between gas that is discharged from silicon-based materials present in the area around the switch and arc heat that is generated when the load is switched.



■ Details of resolution, checkpoints for preventing phenomenon before use

Are there any materials that contain silicon (low molecular siloxane) components in the area around where the switch is used?

The following are examples of sources that generate silicon gas.

[Generating sources]
Silicon-based coating agents, silicon-based adhesive, silicon rubber, silicon oil/grease, silicone-based mold release agent, silicon filler, silicon wiring, etc.

When a silicon gas generating source is present, suppress the generation of arcs by a contact protection circuit, remove the silicon gas generating source from the area around the switch, or change to a different material.
One example would be a silicon-based mold release agent used for a mold when making molded products. Check that there are no such items in the surrounding area.
(The molded parts of OMRON switches use fluorine-based mold release agents.)

Also, when using switches unavoidably in environments where a silicon gas generating source is present, perform periodic inspections or periodic replacements.

[Phenomenon: Actuator operates but does not conduct]

■ Phenomenon check result and cause

<Phenomenon check result>
• Contact resistance is infinite.
<Cause>
The inside of the switch is disassembling.

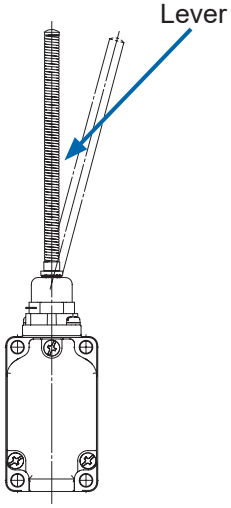
■ The malfunction case

● Disassembly of switch inside due to pushing in of a flexible rod type from the tip

Example) WLNJ-N

(1) Sudden snap back due to impactful operation on the lever, operation at the bottom of the lever (position close to the base of the spring), or other operations that apply excessive stress will result in the lever breaking.

Overall view

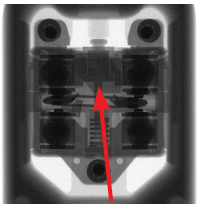


Damaged state

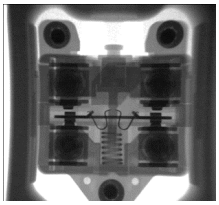
(2) The built-in switch will be damaged if a force of 2,200 to 2,800 N is applied perpendicularly to the lever.

Front	Enlarged view of the actuator tip	Cover inside
Perpendicular load 	Perpendicular load application mark  ○ : Dent present	Perpendicular load application  No abnormalities in an assembled state

X-ray image of a built-in switch: Abnormal



X-ray image of a built-in aswitch: Normal



Movable piece comes loose and causes damage to the inside.

■ Details of resolution, checkpoints for preventing phenomenon before use

Check! The WLNJ-N model may be damaged during shock operation or when a perpendicular load is applied.

1. During operation, set under the following conditions.
   (1) Set the operating distance at PT = 20 ± 10 mm.
   (2) Set the permissible operating speed to 1 mm/sec to 0.5 m/sec.
   (3) Set the permissible frequency to 30 operations or less/minute.
2. Take consideration not to apply external force from the direction perpendicular to the actuator due to operation in the vertical direction, dropping, etc.
   Check the operation and make sure it works properly if it falls and falls from the tip.

[Phenomenon: Actuator operates but does not conduct]

■ Phenomenon check result and cause

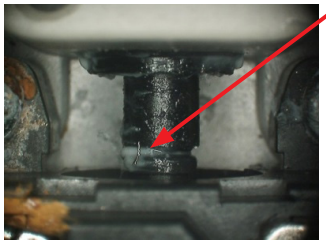
<Phenomenon check result>
• Contact resistance is infinite.
<Cause>
Dust and other foreign objects stick to the switch and obstruct operation.

■ The malfunction case

● **Foreign objects entering from the periphery of the switch adhere to the contacts which results in contact failure.**
Example) WLCA2-N

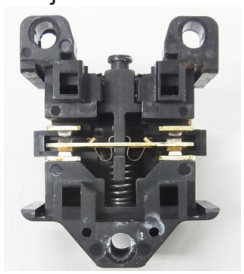
Image of appearance

Cover removed state

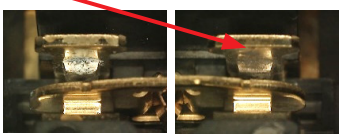


Adhesion of foreign objects is visible.

Adhesion of foreign objects is visible.



View of contact



* In the case example this time, as a result of analyzing the components, carbon and oxygen have been detected, and there is the possibility that oil liquid has entered inside the switch.

■ Details of resolution, checkpoints for preventing phenomenon before use

Check!

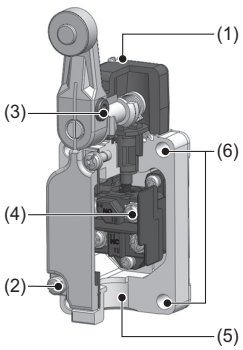
Are there foreign objects, liquids, etc. in the area around the switch?

Although limit switches are to IP67 specification, the entry of foreign objects, liquids, etc. cannot be completely prevented when they are constantly present in the area around switches. As a preventive measure, either cover switches with a cover or take other measures, or the use of a molded type switch is recommended. When using at places, for example, where the switch is subjected to foreign objects and liquid, evaluate the switch under actual operating conditions beforehand and use the switch under adequate conditions.

Check!

When screws at various locations are tightened with little force, foreign objects, liquids, etc. get inside switches.

Appropriate tightening torques are listed on the right.
Tighten at the recommended torque.



No.	Item	Torque	Screw type
(1)	Head mounting screw	0.78 to 0.88 N·m	M3.5 screw
(2)	Cover mounting screw	1.18 to 1.37 N·m	M4 screw
(3)	Allen-head bolt (for securing the roller lever)	4.90 to 5.88 N·m	M5 Allen-head bolt
(3)	Allen-head bolt (for securing the roller lever)	0.88 to 1.08 N·m	M8 hexagon socket set screw
(4)	Terminal screw	0.59 to 0.78 N·m	M3.5 screw
(5)	Connectors	1.77 to 2.16 N·m	G1/2 or Pg13.5 or M20 or 1/2-14NPT
(6)	Unit mounting screw	4.90 to 5.88 N·m	M5 screw

[Phenomenon: Actuator does not operate]

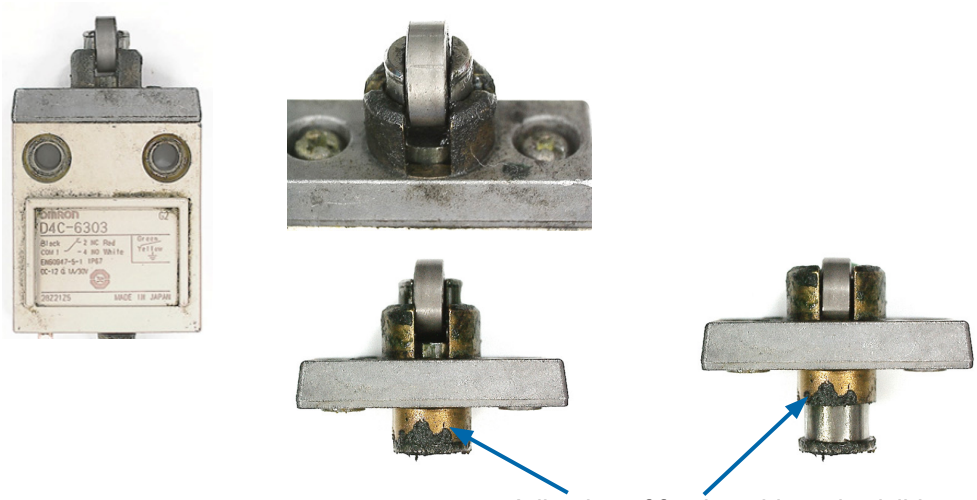
■ Phenomenon check result and cause

<Phenomenon check result>
• Both the operating distance and operating force cannot be measured.
<Cause>
Dust and other foreign objects stick to the switch and obstruct operation.

■ The malfunction case

● **Oil entering from the periphery of the switch adheres to the contacts which results in contact failure.**
Case example: D4C-6303

Image of appearance　　Head periphery

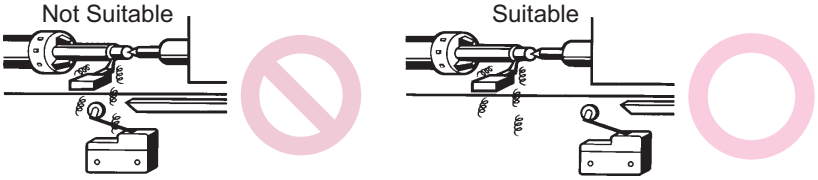


■ Details of resolution, checkpoints for preventing phenomenon before use

Check!

Are there foreign objects, liquids, etc. directly adhering to the switch?

Although limit switches are to IP67 specification, the entry of foreign objects, liquids, etc. to sliding parts cannot be completely prevented.
Install the switch in a location that is not directly subject to foreign objects, liquids, etc.
The actuator and switch must also be protected from the accumulation of foreign objects and liquids.



[Phenomenon: Actuator does not operate]

■ Phenomenon check result and cause

<Phenomenon check result>
• Operating force is variable (snagging).
<Cause>
Setting an excessive stroke causes the shaft to deform and not operate.

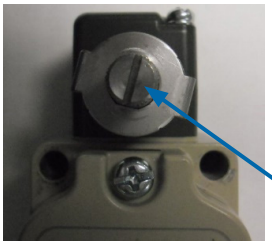
■ The malfunction case

● **Setting an excessive stroke causes trouble in actuator return.**
Example) WLCA12-2NTH-N

Setting an excessive stroke causes the shaft to deform, and the plunger snags and can no longer return.

Image of appearance

Lever removed state: Deformed

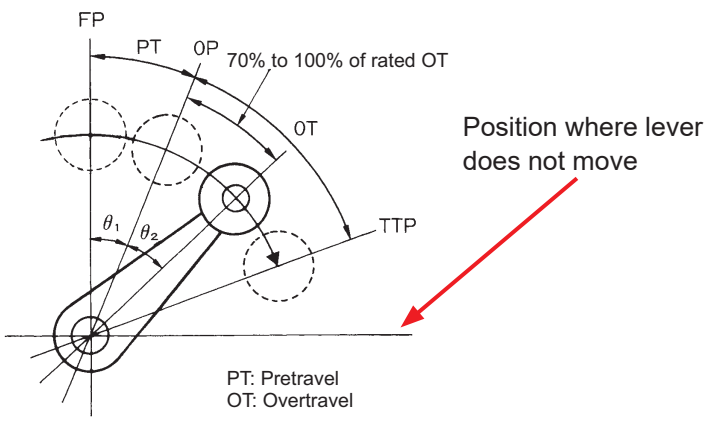


Lever removed state: Normal

■ Details of resolution, checkpoints for preventing phenomenon before use

Check!

If the lever is pushed in beyond the position where it does not move, the shaft that interlocks with the lever is deformed and may cause faulty operation.
Set the operating angle to within the maximum value of PT + OT = TTP (see lever operation diagram) including movement by inertia.



[Phenomenon: Actuator does not operate]

■ Phenomenon check result and cause

<Phenomenon check result>
• Switch does not turn ON or OFF.
<Cause>
The installation direction of the plunger when the operating direction is changed is different.

■ The malfunction case

With the WL-N model, the operating direction of the head can be changed.
By removing the head and then changing the direction of the operational plunger, one of three operating directions can be selected.
However, the switch does not turn ON or OFF unless it is installed in the designated direction.

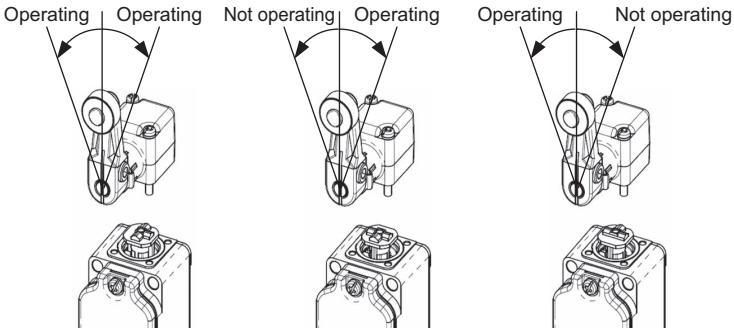
■ Details of resolution, checkpoints for preventing phenomenon before use

Note that the setting method differs according to the WL-N specifications.

Setting One-side Operation for Basic Models

The output of the Switch will be changed, regardless of which direction the lever is pushed.

The output of the Switch will only be changed when the lever is pushed in one direction.

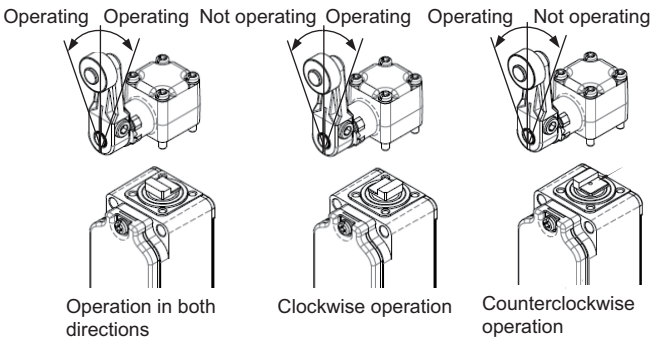


Operation in both directions | Clockwise operation | Counterclockwise operation

Setting One-side Operation for High-precision Models

The output of the Switch will be changed, regardless of which direction the lever is pushed.

The output of the Switch will only be changed when the lever is pushed in one direction.



Operation in both directions | Clockwise operation | Counterclockwise operation

[Phenomenon: Actuator does not operate]

■ Phenomenon check result and cause

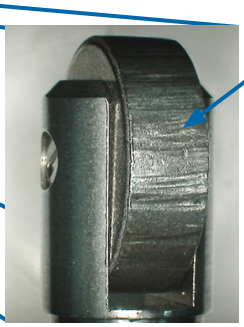
<Phenomenon check result>
• The actuator cannot be pressed up to where the switch turns ON.
<Cause>
A heavy load is applied from the side which deforms and damages the actuator and prevents the switch from turning ON.

■ The malfunction case

● **Cracking has occurred in the head, which causes the plunger to tilt and prevent it from operating.**
Example) WLD28-RP-N

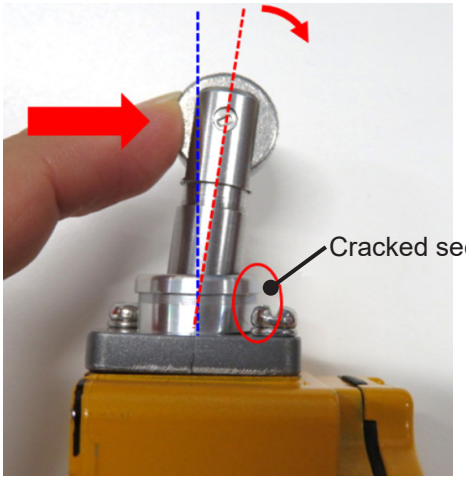
Overall view

Enlarged view of roller

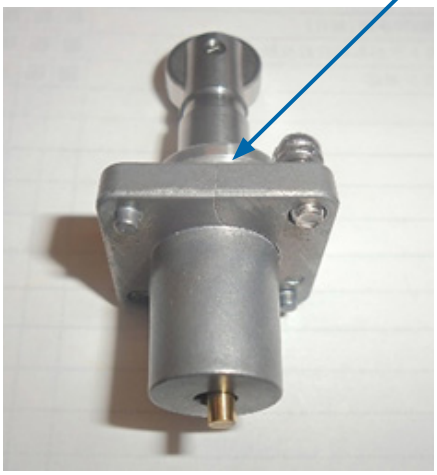


There are many pronounced dents around the entire circumference of the roller.
These dents are the result of contact with the operating body under a heavy load.

Cracks have occurred which causes the actuator to tilt towards the front, preventing force from being transmitted to the built-in switch.



Cracks occur by being repeatedly subjected to excessive force.



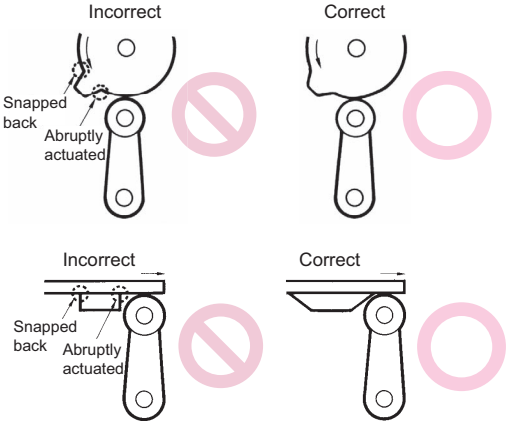
■ Details of resolution, checkpoints for preventing phenomenon before use

Check!

Is the operation of the head roller accompanied by shock?

• If the dog moves at a high speed and the slope of impact is steep, the actuator may be deformed and damaged. Also, if the operation of the head roller is accompanied by shock, the stress limits of the mounting may be exceeded and cracks may occur.
Check the following precautions, and design the dog to have a shape that is suitable for the operation speed and that reduces the shock on the switch.

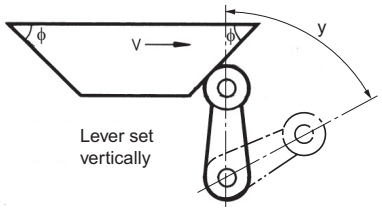
● When the operating body has snap back



● Dog angle and speed

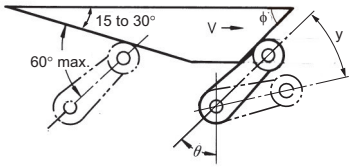
Dog speed: 0.5 m/s max.

V max. (m/s)	ϕ	y*
0.4 0.25 0.1	30° 45° 60°	0.8 (TT) Can be taken to 80% of total travel.



Dog speed: 0.5 m/s min.

If the speed of the overtravel dog is comparatively high, make the rear edge of the dog smooth at an angle of 15° to 30° or make it in the shape of a quadratic curve. Then lever shaking will be reduced.



V max. (m/s)	θ	ϕ	y*
0.5	45°	45°	0.5 to 0.8 (TT)
0.6	50°	40°	0.5 to 0.8 (TT)
1.3	55° to 60°	30° to 35°	0.5 to 0.7 (TT)
2	65° to 75°	15° to 25°	0.5 to 0.7 (TT)

* The above y values indicate the ratio ranges based on TT (total travel). Therefore, the optimum pressing distance of the dog is between 50% and 80% (or 50% and 70%).

[Phenomenon: Actuator does not operate]

■ Phenomenon check result and cause

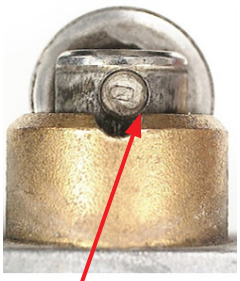
<Phenomenon check result>
• The actuator cannot be pressed up to where the switch turns ON.
<Cause>
A heavy load is applied from the side which wears the actuator and prevents the switch from turning ON.

■ The malfunction case

● **When the set dog angle is large, the bearing becomes abnormally worn which causes faulty operation.**
Example) D4C-9001

Image of appearance

Image of roller



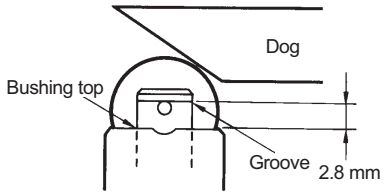
The plunger is tilting to the right.

■ Details of resolution, checkpoints for preventing phenomenon before use

Check!

Are the dog angle and surface roughness appropriate?

• Operation error preventive measures, shape of cam and dog, operating frequency, overtravel, etc. have a significant effect on the durability and precision.
For this reason, the dog angle must be 30° max., the surface roughness of the dog must be ▽▽▽ (6.3 S) min., and hardness must be Hv 400 to 500.
• To set the plunger stroke without excess or deficiency, set the dog, cam, etc. by aligning them with the grooves that are the appropriate setting positions. The appropriate setting position is where the plunger groove fits the bushing top.



[Phenomenon: Actuator operates but is always conducting]

■ Phenomenon check result and cause

<Phenomenon check result>
• NO contact is in a conducting state.
<Cause>
During normally open (NO) use, the contact remains in a conducting state when the operating body is not completely away from the actuator.

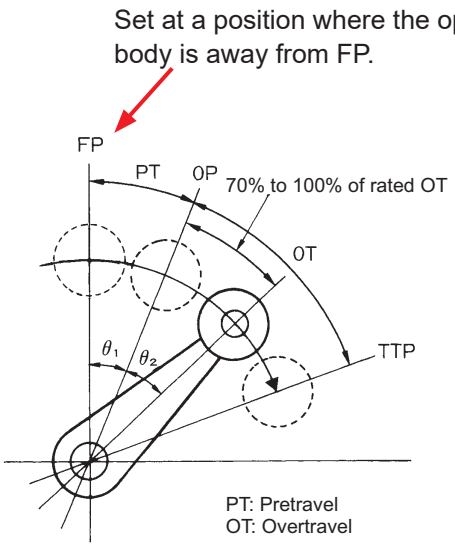
■ Details of resolution, checkpoints for preventing phenomenon before use

Check!

(1) Set the stroke so that the operating body is completely away from the actuator, the switch returns to the FP (free position), and slight deviation or error is absorbed.

[Lever specification]

[Lever operation diagram]



Check!

(2) Are the switch mounting screws loose or is the operating body deformed?

If the switch mounting screws are loose or there is deformation or distortion on the operating body side, there is the possibility that normal operation cannot be performed even if a correct stroke is set.
Also, even though there may not be a problem at the early stages, the above trouble may occur over the course of time. So, pay attention when installing the switch and also perform periodic inspections.

[Phenomenon: Actuator operates but is always conducting]

■ Phenomenon check result and cause

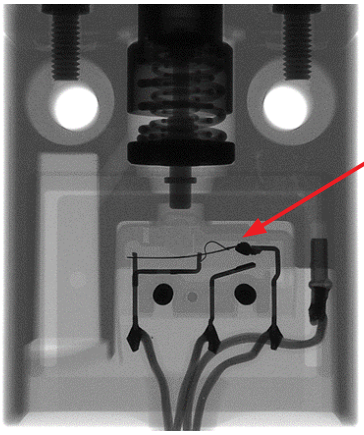
<Phenomenon check result>
• NO contact is in a conducting state.
<Cause>
Contact is welded due to overcurrent.

■ The malfunction case

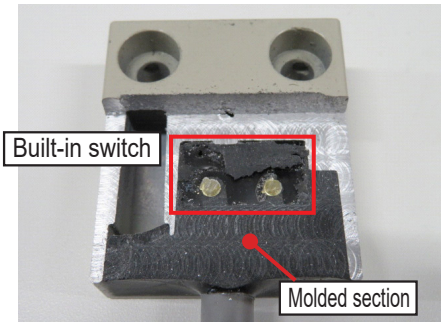
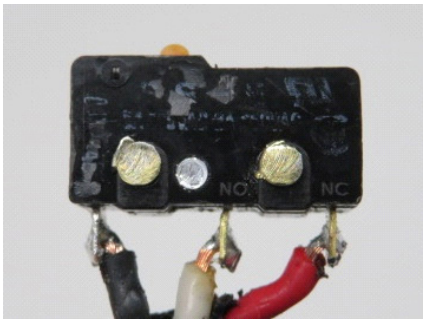
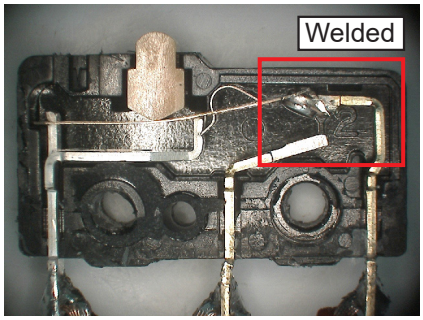
● **Contact is welded.**
Example) D4C-1220-P

Image of the entire switch

X-ray image of a built-in switch



The contact is welded and detached protrusions are visible.

Cutaway view of switch body	Built-in switch after removal from switch body
	
Inside of built-in switch	Enlarged view of contact of NC side (welded)
	

[Phenomenon: Actuator operates but is always conducting]

■ Details of resolution, checkpoints for preventing phenomenon before use

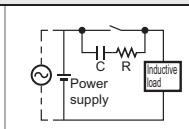
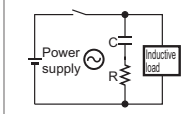
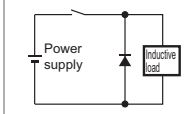
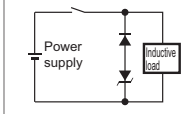
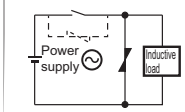
Check!

Is the circuit configured to allow a current exceeding the rating to flow to the switch?

Take care to prevent an overcurrent from flowing to the switch. (Including short-circuit current)
Also, depending on the type of load, there is a large difference between the inrush current and the steady-stage current or the steady-state current and the reverse voltage, and there is a possibility that a current at the rating or above will flow. So, also check these.

*** Refer to the case example of a general contact protection circuit provided for reference.**

Case example of a general contact protection circuit

Circuit example		Applicable current		Feature	Element selection
		AC	DC		
CR circuit		See note.	Yes	**Note:** When AC is switched, the load impedance must be lower than the C and R impedance.	C: 0.5 to 1 μF per switching current (1 A) R: 0.5 to 1 Ω per switching voltage (1 V) The values may change according to the characteristics of the load. The capacitor suppresses the spark discharge of current when the contacts are open. The resistor limits the inrush current when the contacts are closed again. Consider these roles of the capacitor and resistor and determine the ideal capacitance and resistance values from experimentation. Use a capacitor with a dielectric strength between 200 and 300 V. When AC is switched, make sure that the capacitor has no polarity. If, however, the ability to control arcs between contacts is a problem for high DC voltage, it may be more effective to connect a capacitor and resistor between the contacts across the load. Check the results by testing in the actual application.
		Yes	Yes	The operating time will increase if the load is a relay or solenoid. It is effective to connect the CR circuit in parallel to the load when the power supply voltage is 24 or 48 V and in parallel to the contacts when the power supply voltage is 100 to 200 V.	
Diode method		No	Yes	Energy stored in the coil is changed into current by the diode connected in parallel to the load. Then the current flowing to the coil is consumed and Joule heat is generated by the resistance of the inductive load. The reset time delay in this method is longer than that of the CR method.	The diode must withstand a peak inverse voltage 10 times higher than the circuit voltage and a forward current as high as or higher than the load current.
Diode and Zener diode method		No	Yes	This method will be effective if the reset time delay caused by the diode method is too long.	Zener voltage for a Zener diode must be about 1.2 times higher than the power source since the load may not work under some circumstances.
Varistor method		Yes	Yes	This method makes use of constant-voltage characteristic of the varistor so that no high-voltage is imposed on the contacts. This method causes a reset time delay more or less. It is effective to connect varistor in parallel to the load when the supply voltage is 24 to 48 V and in parallel to the contacts when the supply voltage is 100 to 200 V.	Select the varistor so that the following condition is met for the cut voltage Vc. For AC currents, the value must be multiplied by $\sqrt{2}$. Vc > (Current Voltage × 1.5) If Vc is set too high, however, the voltage cut for high voltages will no longer be effective, diminishing the effect.

[Phenomenon: Actuator operates but is always conducting]

■ Phenomenon check result and cause

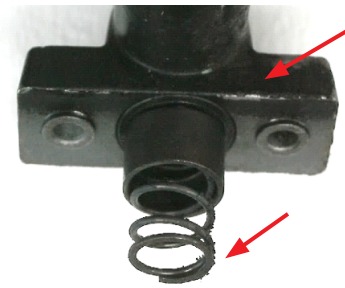
<Phenomenon check result>
• NO contact is in a conducting state.
<Cause>
Liquid enters, which causes insulation resistance to drop and a short-circuit.

■ The malfunction case

● **Liquid entering from the periphery of the switch adheres to the contacts which causes a short-circuit.**
Example) D4C-1220

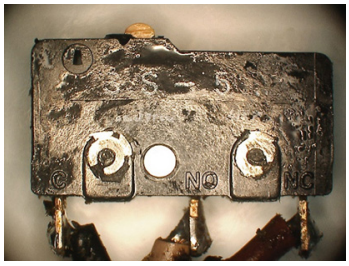
Adhesion of foreign objects is visible.

Image of appearance

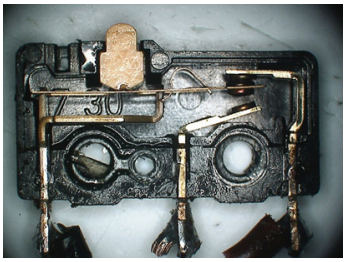
Head side	Main unit side
	

In the case example this time, as a result of analyzing the components, carbon and oxygen have been detected, and there is the possibility that oil liquid has entered inside the switch.

Appearance of built-in switch



Inside of built-in switch



■ Details of resolution, checkpoints for preventing phenomenon before use

Check!

Are there foreign objects, liquids, etc. in the area around the switch?

Although limit switches are to IP67 specification, the entry of foreign objects, liquids, etc. cannot be completely prevented when they are constantly present in the area around switches. As a preventive measure, either cover switches with a cover or take other measures, or the use of a molded type switch is recommended.
When using at places, for example, where the switch is subjected to foreign objects and liquid, evaluate the switch under actual operating conditions beforehand and use the switch under adequate conditions.

[Phenomenon: Actuator does not operate]

■ Phenomenon check result and cause

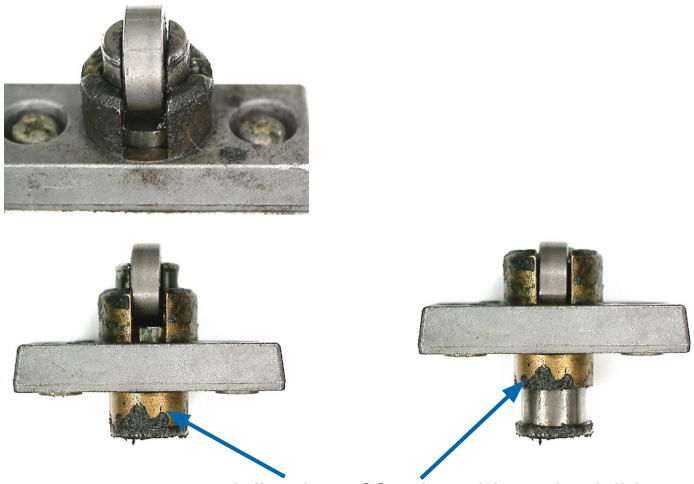
<Phenomenon check result>
• Both the operating distance and operating force cannot be measured.
<Cause>
Dust and other foreign objects stick to the switch and obstruct operation.

■ The malfunction case

● **Oil entering from the periphery of the switch adheres to the contacts which results in contact failure.**
Case example: D4C-6303

Image of appearance

Head periphery

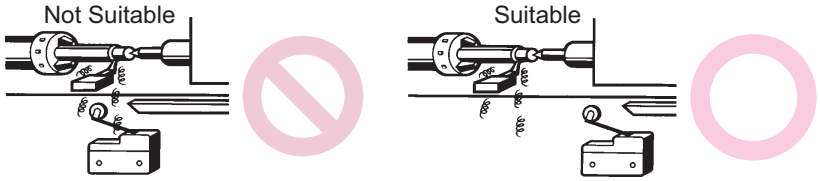


Adhesion of foreign objects is visible.

■ Details of resolution, checkpoints for preventing phenomenon before use

Are there foreign objects, liquids, etc. directly adhering to the switch?

Although limit switches are to IP67 specification, the entry of foreign objects, liquids, etc. to sliding parts cannot be completely prevented.
Install the switch in a location that is not directly subject to foreign objects, liquids, etc.
The actuator and switch must also be protected from the accumulation of foreign objects and liquids.



[Phenomenon: Actuator does not operate]

■ Phenomenon check result and cause

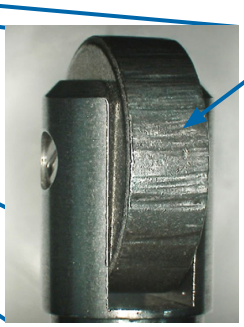
<Phenomenon check result>
• The actuator cannot be pressed up to where the switch turns ON.
<Cause>
A heavy load is applied from the side which deforms and damages the actuator and prevents the switch from turning ON.

■ The malfunction case

● **Cracking has occurred in the head, which causes the plunger to tilt and prevent it from operating.**
Example) WLD28-RP-N

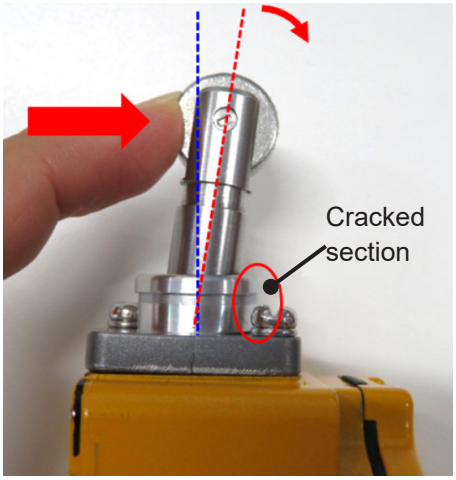
Overall view

Enlarged view of roller

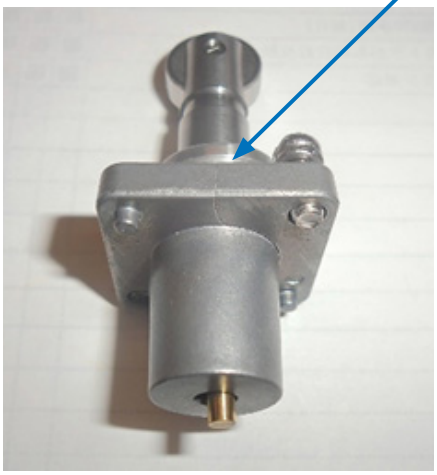


There are many pronounced dents around the entire circumference of the roller.
These dents are the result of contact with the operating body under a heavy load.

Cracks have occurred which causes the actuator to tilt towards the front, preventing force from being transmitted to the built-in switch.



Cracks occur by being repeatedly subjected to excessive force.



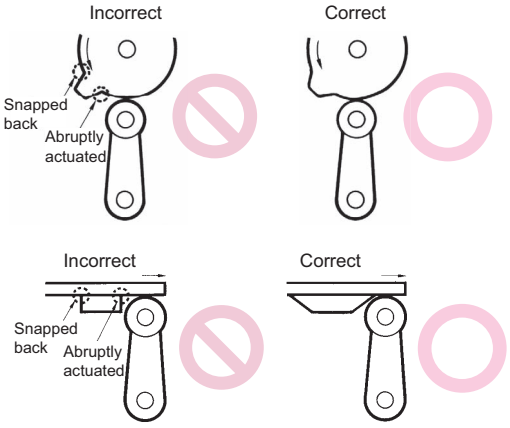
■ Details of resolution, checkpoints for preventing phenomenon before use

Check!

Is the operation of the head roller accompanied by shock?

• If the dog moves at a high speed and the slope of impact is steep, the actuator may be deformed and damaged.
Also, if the operation of the head roller is accompanied by shock, the stress limits of the mounting may be exceeded and cracks may occur.
Check the following precautions, and design the dog to have a shape that is suitable for the operation speed and that reduces the shock on the switch.

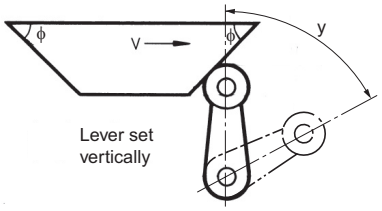
● When the operating body has snap back



● Dog angle and speed

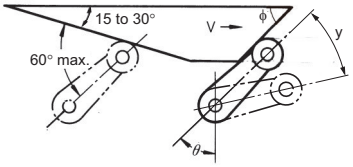
Dog speed: 0.5 m/s max.

V max. (m/s)	ϕ	y*
0.4 0.25 0.1	30° 45° 60°	0.8 (TT) Can be taken to 80% of total travel.



Dog speed: 0.5 m/s min.

If the speed of the overtravel dog is comparatively high, make the rear edge of the dog smooth at an angle of 15° to 30° or make it in the shape of a quadratic curve. Then lever shaking will be reduced.



V max. (m/s)	θ	ϕ	y*
0.5	45°	45°	0.5 to 0.8 (TT)
0.6	50°	40°	0.5 to 0.8 (TT)
1.3	55° to 60°	30° to 35°	0.5 to 0.7 (TT)
2	65° to 75°	15° to 25°	0.5 to 0.7 (TT)

* The above y values indicate the ratio ranges based on TT (total travel). Therefore, the optimum pressing distance of the dog is between 50% and 80% (or 50% and 70%).

[Phenomenon: Actuator does not operate]

■ Phenomenon check result and cause

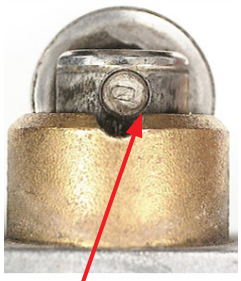
<Phenomenon check result>
• The actuator cannot be pressed up to where the switch turns ON.
<Cause>
A heavy load is applied from the side which wears the actuator and prevents the switch from turning ON.

■ The malfunction case

● **When the set dog angle is large, the bearing becomes abnormally worn which causes faulty operation.**
Example) D4C-9001

Image of appearance

Image of roller



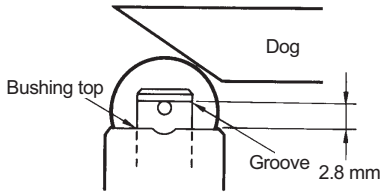
The plunger is tilting to the right.

■ Details of resolution, checkpoints for preventing phenomenon before use

Check!

Are the dog angle and surface roughness appropriate?

• Operation error preventive measures, shape of cam and dog, operating frequency, overtravel, etc. have a significant effect on the durability and precision.
For this reason, the dog angle must be 30° max., the surface roughness of the dog must be ▽▽▽ (6.3 S) min., and hardness must be Hv 400 to 500.
• To set the plunger stroke without excess or deficiency, set the dog, cam, etc. by aligning them with the grooves that are the appropriate setting positions. The appropriate setting position is where the plunger groove fits the bushing top.



[Phenomenon: Switch cannot be installed]

■ Phenomenon check result and cause

<Phenomenon check result>
- The switch cannot be secured to the panel.

<Cause>
- Panel holes are out of position.
- Screws cannot be tightened due to crushed screw threads.

■ Details of resolution, checkpoints for preventing phenomenon before use

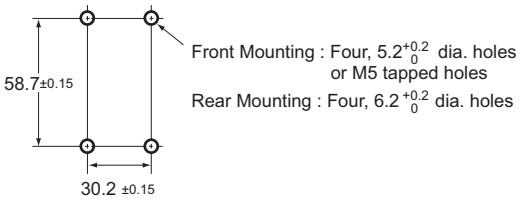
Check!

Are the panel hole machining dimensions for installing the switch in accordance with the specified values?

• To install the switch, make an installation panel to the following mounting dimensions. Tighten the screws to the appropriate tightening torque.

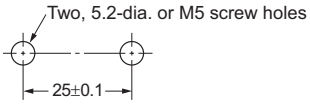
WLN/WLG

Appropriate tightening torque: 4.90 to 5.88 N·m M5 screw



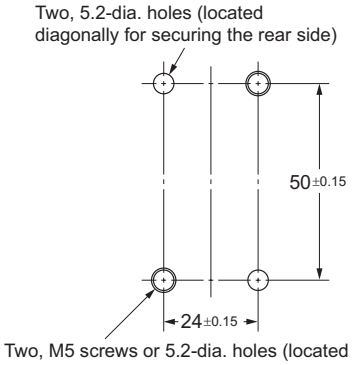
D4C/D4CC

Appropriate tightening torque: 4.90 to 5.88 N·m M5 screw



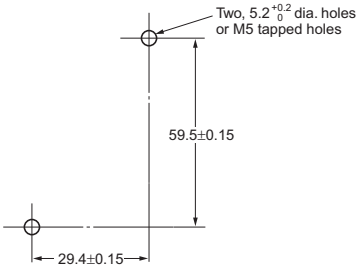
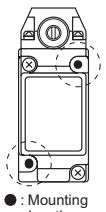
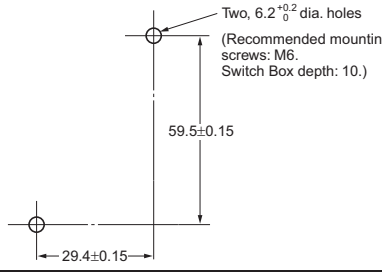
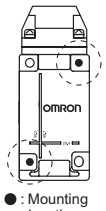
HL

Appropriate tightening torque: 4.90 to 5.88 N·m M5 screw



D4A

Appropriate tightening torque: 4.90 to 5.88 N·m M5 screw

Model	G1/2 Conduit D4A-3□□□N D4A-4□□□N	Mounting locations
Front Mounting		
Rear Mounting		

Note: For 1/2-14NPT conduits, use Two, No.10-32UNF (depth: 10) back-mounting screws.

[Phenomenon: Operation not displayed]

■ Phenomenon check result and cause

<Phenomenon check result>
• Display does not light even if power is supplied.
<Cause>
The internal circuit is damaged due to the effect of overvoltage, overcurrent, and noise.

■ The malfunction case

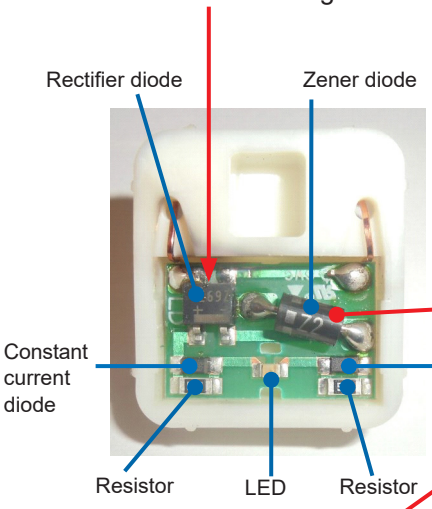
● **The built-in rectifier diode is damaged and the circuit is interrupted, which results in the display not lighting.**
Example) WLCA2-LD-N

Image of appearance

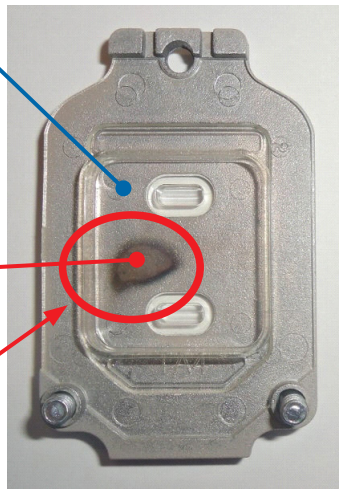
Cover opened state

Internal PCB

State of internal PCB



Main unit cover



○ Heat discoloration is visible at the section that contacts the Zener diode at the main unit cover lens.

■ Details of resolution, checkpoints for preventing phenomenon before use

Check!

Are there any factors that may cause abnormal voltage exceeding the rated voltage to enter?

- The rectifier diode serves as a cutoff to prevent damage to internal circuits if noise, surges, or other voltage abnormalities exceeding the rated voltage enter the circuits.
  The damage was caused by a short-circuit state and short-circuit current flow.
- If there is a possibility of abnormal voltage such as noise or surge entering, consider noise countermeasures such as inserting protective elements (varistor, etc.) between switch terminals or separating parallel wiring if present.

* Case example of noise
Terminal-to-terminal noise from peer devices / Inductive noise from cables wired in parallel

[Phenomenon: Connector cannot be connected]

■ Phenomenon check result and cause

<Phenomenon check result>
• Cannot tighten the connector to the switch body.
<Cause>
The connector cannot be tightened as the currently used conduits do not match the main unit specifications.
Or, the connector cannot be tightened due to foreign objects adhering to the screw threads.

■ The malfunction case

● **The connector cannot be tightened due to crushed screw threads at the conduit opening.**
The screw threads were crushed as the screw was tightened into a conduit having a different specification.
Example) D4A-4918N

Image of appearance

Conduit opening

Screw threads at conduit opening

Screw threads crushed

Conduit installed state

Cannot tighten (there is a space)

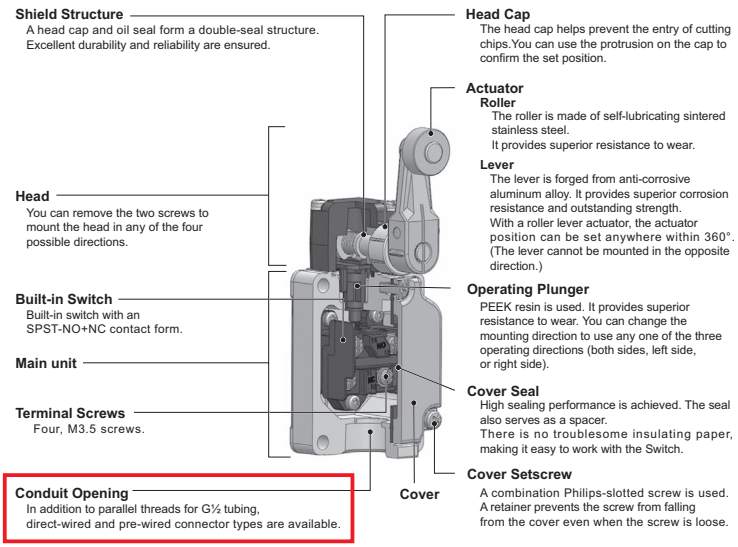
■ Details of resolution, checkpoints for preventing phenomenon before use

Check!

Do the conduit specifications of the switch and connector match?

• On a switch, the conduit specifications are determined by model.
Select and use a connector that is compatible with the specifications.
• Compatible screw types are G1/2, Pg13.5, M20, and 1/2-14NPT. The recommended tightening torque is 1.77 to 2.16 N·m.

[Structure of switch]



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