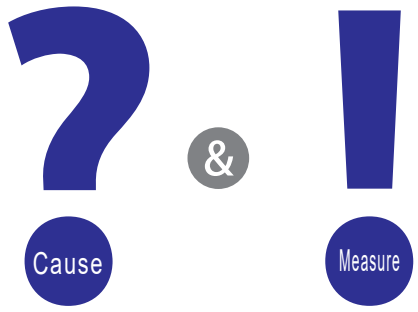
OMRON

The SOLUTIONS

[Industrial Micro 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

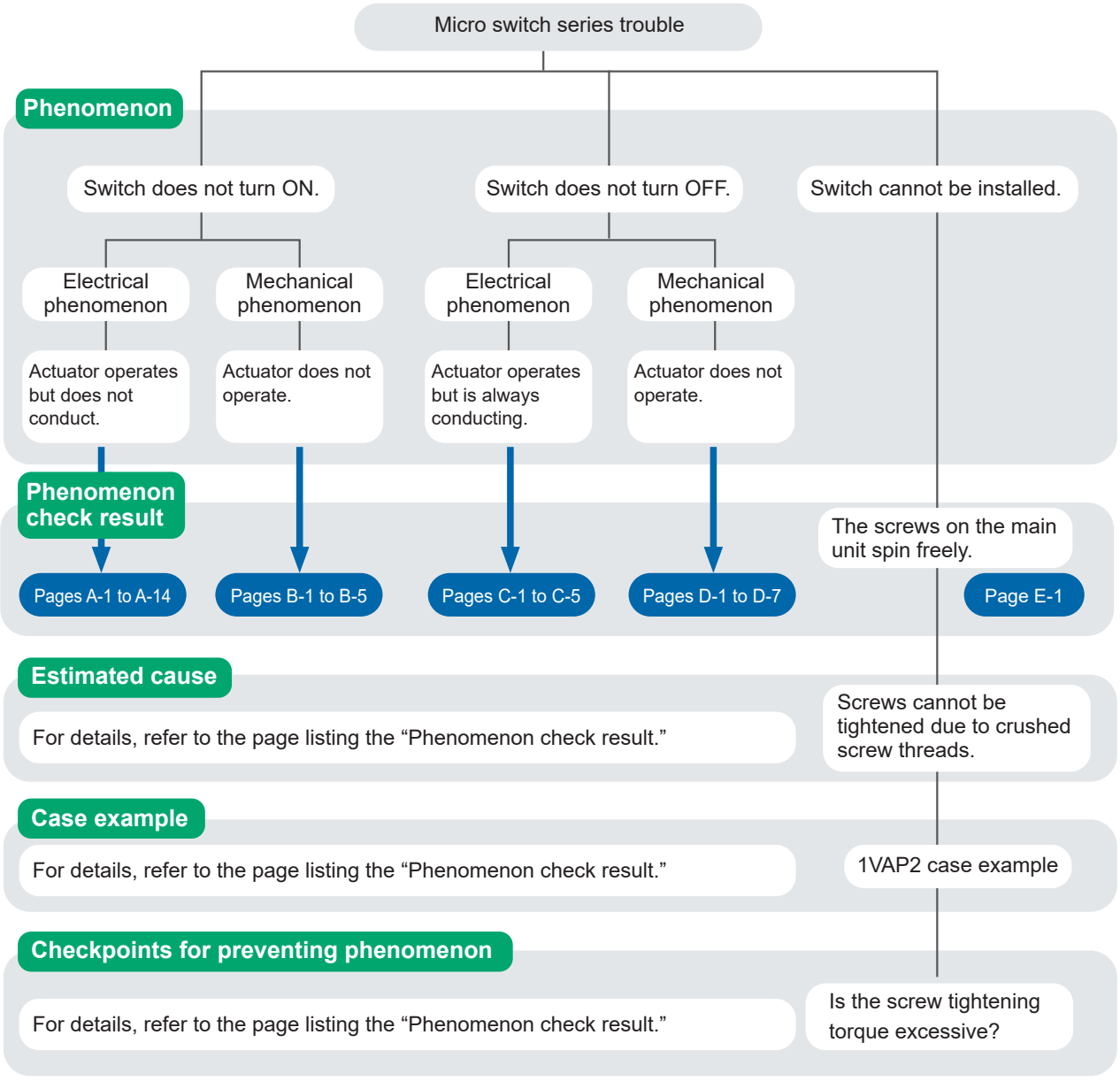
- "The Solution" introduces some typical examples of failures found by our customers.
  Please understand some cases may not apply to "The Solution."
- Please do not unseal, disassemble, etc. samples of switches sent out for detailed analysis as doing so may adversely affect analysis.
  Please note that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

Table of Contents

Table of Contents

List of Market Trouble FTA Related to Micro Switches

We are developing FTA by trouble phenomenon of **micro 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 Micro Switch series models

Z

X

TZ

1ZAP2, 1VAP2

DZ

A

[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.

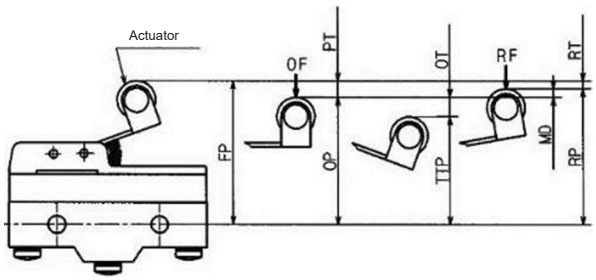
■ Details of resolution, checkpoints for preventing phenomenon before use

Check!

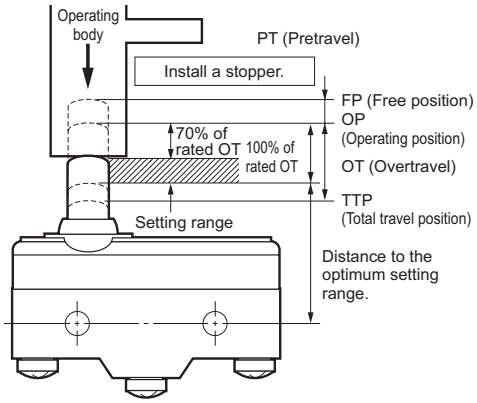
(1) Is the actuator ON/OFF operation set near the contact switching position?

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.

[Lever specification]



[Plunger specification]



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

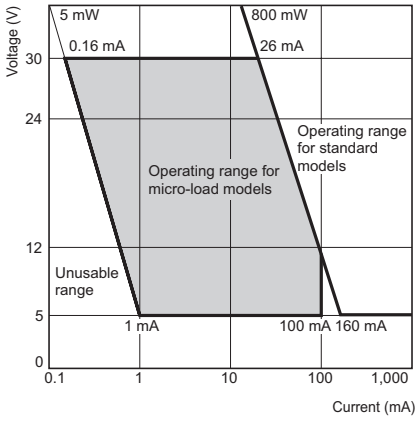
<Phenomenon check result>
• Contact resistance is high.
<Cause>
A general load specification switch is used in the micro load range, and insulating mterial accumulates due to repeated operation.

■ 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]

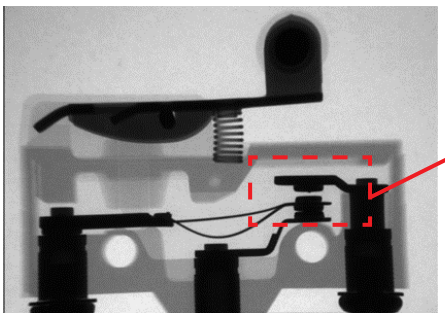
■ Phenomenon check result and cause

<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.

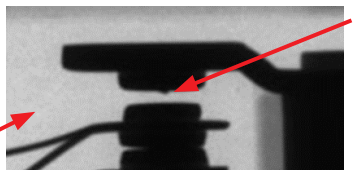
■ The malfunction case

● **Contact is welded.**
Example) Z-15GM22-B

X-ray image

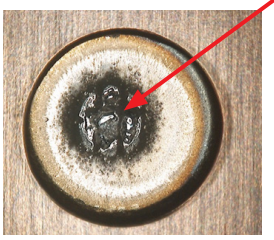


Enlarged view of NO contact

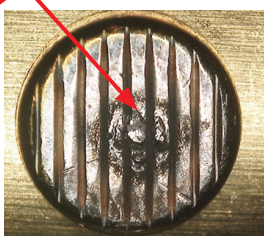


The contact is welded and detached protrusions are visible.

Contact image

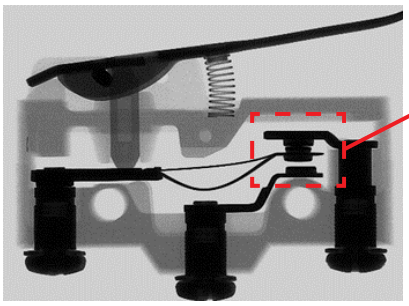


Internal parts have melted.

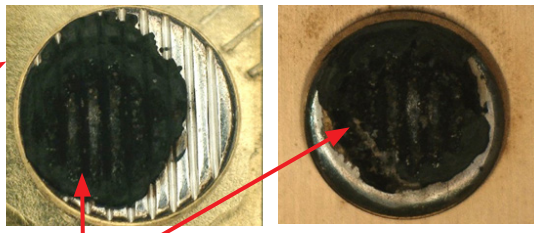


● **Carbides have formed.**
Example) Z-15GW-B

X-ray image



Contact image



Carbides have formed and the contact does not turn ON.

[Phenomenon: Actuator operates but does not conduct]

■ Details of resolution, checkpoints for preventing phenomenon before use

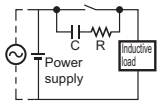
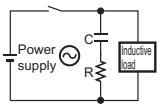
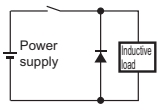
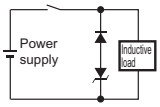
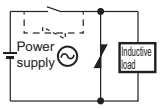
Check!

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]

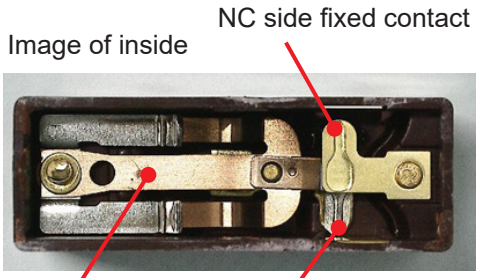
■ Phenomenon check result and cause

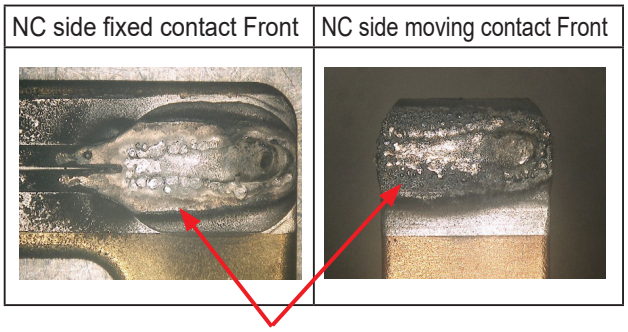
<Phenomenon check result>
• Contact resistance is infinite.
<Cause>
Contacts melt due to overcurrent.

■ The malfunction case

● **Contact is welded.**
Example) X-10GQ22-B

Image of inside





■ Details of resolution, checkpoints for preventing phenomenon before use

Are the positive and negative wires reversed?

X is a direct current exclusive switch. When the polarity is reversed, magnetic blowout no longer functions, the arc that is generated when the load is switched remains due to the load, melting and welding occur early, resulting in contact failure and faulty operation.
Check the polarity when wiring.

[Phenomenon: Actuator operates but does not conduct]

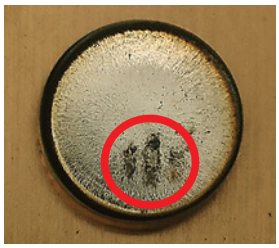
■ Phenomenon check result and cause

<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

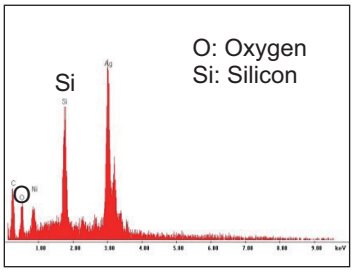
● **Silicon oxide is formed on the contact surface which results in contact failure.**
Example) Z-15GW-B

Contact image



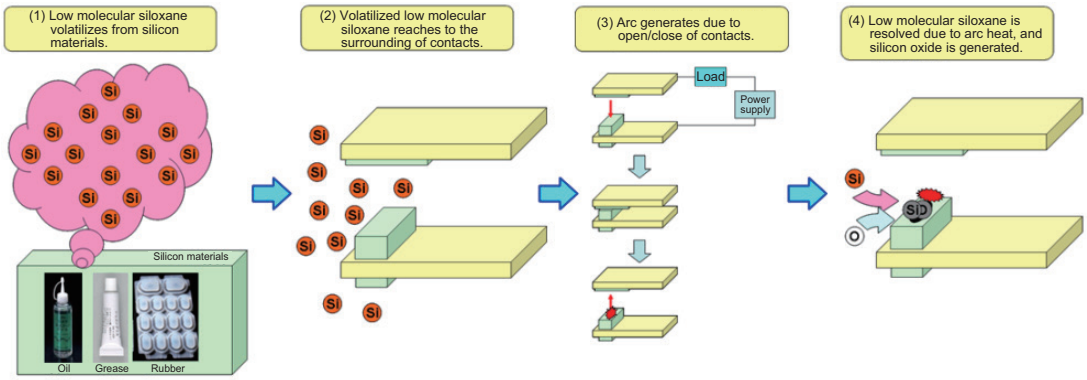
Black foreign objects have formed.

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

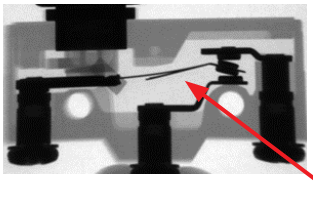
<Phenomenon check result>
• Contact resistance is infinite.
<Cause>
There is a sulfide gas generating source in the area around the switch and sulfur is formed on the contact surface as insulation material.

■ The malfunction case

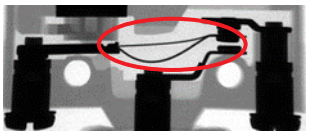
● **Sulfurization causes the movable piece to become damaged, resulting in faulty operation.**
Example) Z-15GQ22-B

X-ray image

Faulty switch



Normal switch

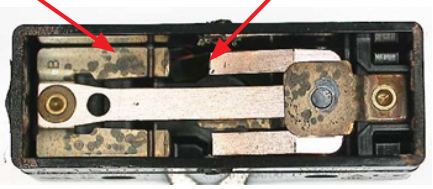


Movable piece damage

Image of the inside faulty switch

Discoloration

Movable piece damage



Discoloration is visible.

● **The contact surface is sulfurized which results in contact failure.**

Contact image

Contact has sulfurized.

■ Details of resolution, checkpoints for preventing phenomenon before use

Check!

Are the switch storage environment and storage state appropriate?

● **Storage environment**
To prevent deterioration such as discoloration of terminals during storage of this product, avoid storing under the following conditions.
(1) Under high temperature, high humidity environments
(2) In corrosive gas atmospheres
(3) In the direct sunlight

● **Storage state**
Store products in a packaged state.
Use products as soon as possible after opening the package, and store remaining products after taking appropriate measures to prevent humidity and generation of gas.

Check!

Is sulfide gas or hydrogen sulfide gas present in the environment in which the switch is used?

When there is sulfide gas or hydrogen sulfide gas present, functional failure, such as damages due to contact failure or corrosion may occur. For this reason, use the product in a location where there are no gas generating sources.

- **The following are examples of sources that generate sulfide gas.**

[Generating sources]
Vehicle gas emissions, gypsum plaster board, wood, paper such as cardboard boxes, fiber scraps, seawater, filth, sludge, volcanic gas, hot springs, etc.
[Generating locations]
Gypsum storage warehouses, sewage and wastewater treatment plants, waste treatment plants, abandoned mine sites, oil refineries, etc.

In addition, hydrogen sulfide gas is considered to be generated whenever the air is thin or anoxic and the environment is humid.
Oxygenation is the most effective way to suppress the formation of hydrogen sulfide gas, but dry conditions and the removal of nutrient pollutants can also hold back its formation.

[Phenomenon: Actuator operates but does not conduct]

■ Phenomenon check result and cause

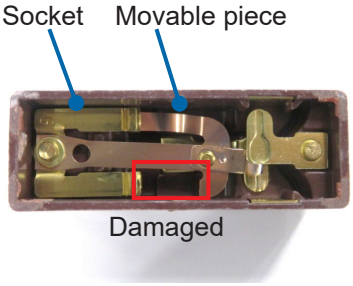
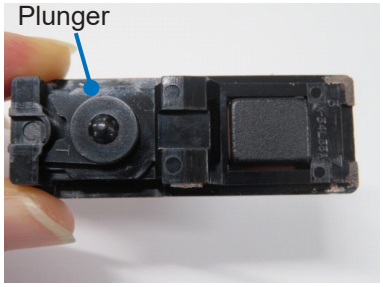
<Phenomenon check result>
• Contact resistance is infinite.
<Cause>
The inside of the switch is disassembling.

■ The malfunction case

● **Setting an excessive stroke causes operation and conductivity trouble.**
Example) X-10GD-B

If the stroke setting is excessive, the amount that the movable piece is pushed increases and stress is applied to the movable piece, causing it to become damaged.
If a movable piece is damaged, operation and continuity will no longer be possible.

[Image of appearance]

Case	Cover
	

■ Details of resolution, checkpoints for preventing phenomenon before use

Check!

Take care to prevent excessive shock and vibration from being continuously applied to the switch.

Use under environments where shock or vibration is applied continuously to the actuator
Continuous application of shock or vibration to the actuator is considered to cause mechanical stress to be applied to the movable piece and may result in damage.

Check!

Do not use the actuator while it is pushed in at all times.

When the actuator is set to turn OFF during operation while it is pushed into the dog at all times when the switch is not operated, mechanical stress is continuously applied to the movable piece and this may result in damage.

Check!

Is the stroke setting after the switch turns ON excessive?

The operating stroke after actuator operation must be set to 70% to 100% of the rated OT.

[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.

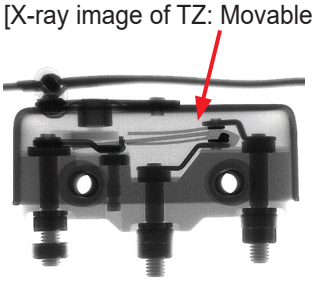
■ The malfunction case

● Setting an excessive stroke causes trouble in actuator return.

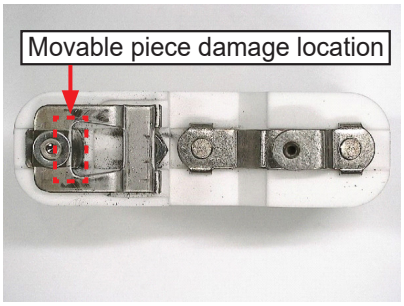
Example) TZ-1GV

If the stroke setting is excessive, the push button will further contact the socket after the movable piece is reversed, and if the push button becomes worn, stress is applied to the movable piece, causing it to become damaged.
If a movable piece becomes damaged, the operation is no longer possible.

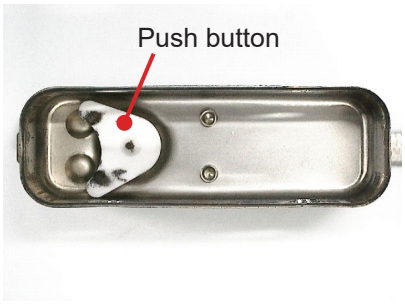
[X-ray image of TZ: Movable piece damaged]



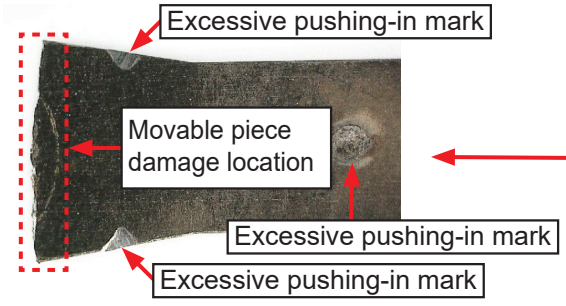
Case side



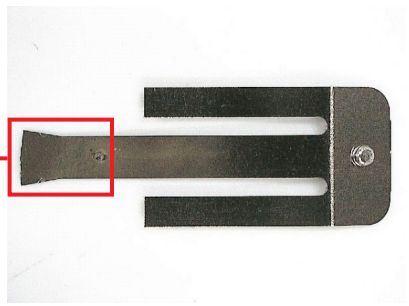
Cover inner side



Enlarged view of damaged movable piece



Overall view of the damaged movable piece



[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

● **Lever contacts cover and does not operate.**
Example) TZ-1G

Damage to cylindrical section of push button

Image of appearance

■ Details of resolution, checkpoints for preventing phenomenon before use

Check!

Take care to prevent falling or excessive shock from being applied.

Ceramic is used as the material for the push button of this switch.
Although ceramic has outstanding heat resistance, dropping or subjecting parts to excessive shock may damage the parts.

[Phenomenon: Actuator operates but does not conduct]

■ Phenomenon check result and cause

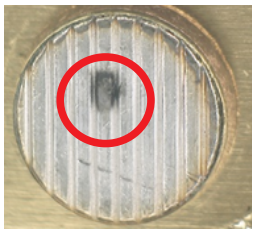
<Phenomenon check result>
• Contact resistance is infinite.
<Cause>
There is an ammonium dihydrogen phosphate-based gas generating source in the area around the switch and the ammonium dihydrogen phosphate-based gas is formed on the contact surface as an insulating material of the contact.

■ The malfunction case

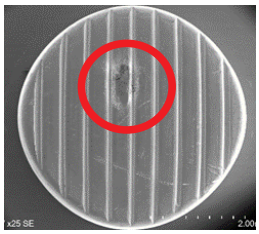
● **Foreign matter is generated by the ammonium dihydrogen phosphate-based gas on the contact surface, causing a contact failure.**

Example) Z-15GDA55-B5V

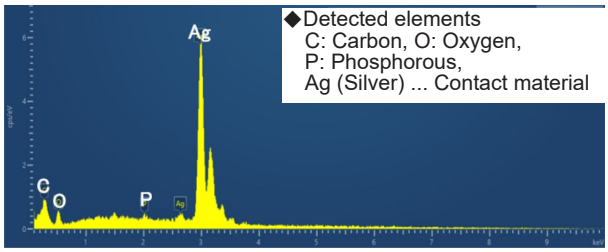
Contact image



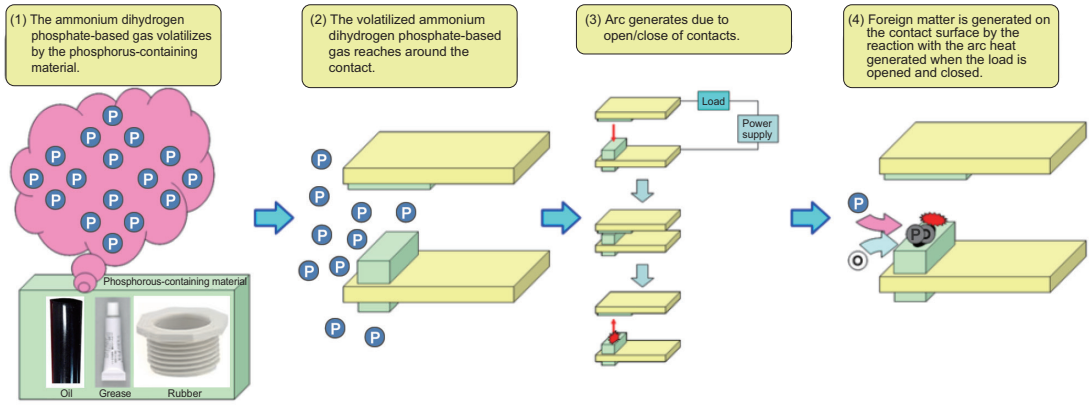
Contact SEM image



Result of element analysis at ○ section



The ammonium dihydrogen phosphate-based gas is formed on the contact surface by the reaction of the gas emitted from the phosphorus-containing material around the switch with the arc heat generated when the load is opened and closed.



■ Details of resolution, checkpoints for preventing phenomenon before use

Are there any materials that contain phosphorus (ammonium dihydrogen phosphate) components in the area around where the switch is used?

The following are examples of sources that generate ammonium dihydrogen phosphate-based gas.

[Generating sources]
Heat-shrinkable tubes, lead wires, connectors, resin materials containing red phosphorus, oils, industrial waste water, corroded food (waste, garbage), seawater, pesticides, smoking materials, chemicals, etc.

If there is a material containing a phosphorus (ammonium dihydrogen phosphate) component in the area around where the switch is used, remove it from around the switch or change it to another material.
The followings are the examples. However, this does not guarantee the performance of the switch. When using the switch, evaluate it on the actual device and take action at your own discretion.

- For a heat-shrinkable tube
  (1) Heat-shrinkable tubes with surface (water-resistant) treatment make it difficult for phosphate reactions to progress, and generation of gas can be suppressed.
  There are the following two types of water-resistant red phosphorus tubes:
  - SUMITUBE NHR2
  - SUMITUBE NHR4

  (2) Do not use a heat-shrinkable tube, but use a round terminal with nylon insulation coating for M3.5 for wiring.
  Example) N1.25-M3 (RAC1.25-3.5) (manufactured by J.S.T. Mfg. Co., Ltd.)
- Connector
  OMRON SC series

If it is unavoidable to use the switch in an environment where materials containing phosphorus (ammonium dihydrogen phosphate) components are present, perform periodic inspections and periodic replacement.

[Phenomenon: Actuator does not operate]

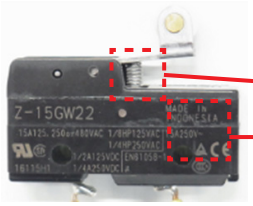
■ Phenomenon check result and cause

<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.

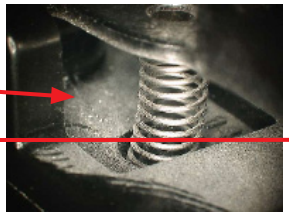
■ The malfunction case

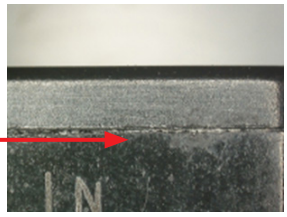
● Foreign objects entering from the periphery of the switch adhere to the contacts which results in contact failure.

Image of appearance



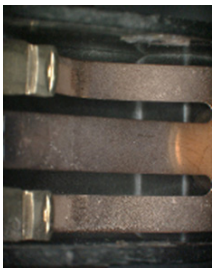
Foreign objects adhere to the periphery





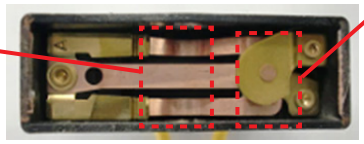
Adhesion of foreign objects is visible.

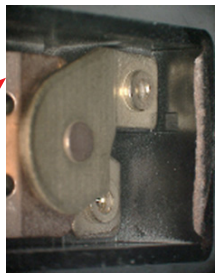
Adhesion of foreign objects is visible.



Entry of foreign objects from the push button sliding part is visible.

Image of inside





Adhesion of foreign objects is visible on contacts or areas around contact.

■ Details of resolution, checkpoints for preventing phenomenon before use

Check!

Is there dust, PCB powder, or other foreign objects in the area around the switch?

As general-purpose basic switches are not sealed type switches, the entry of foreign objects, liquids, etc. cannot be completely prevented.
Take care to prevent the adhesion of foreign objects when the switch is stored, installed, or used.

Check!

Consider the use of a sealed type switch. (Z-□55 series)

Consider the use of a sealed type switch as the entry of foreign objects into the inside of the switch can be prevented.

[Phenomenon: Actuator does not operate]

■ Phenomenon check result and cause

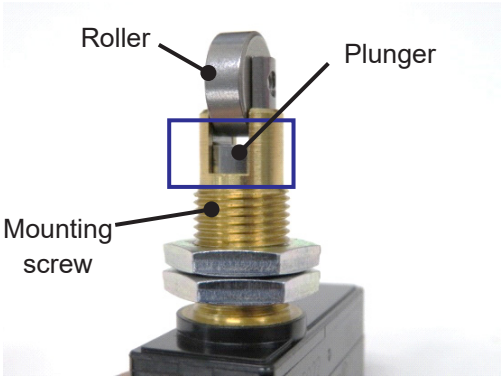
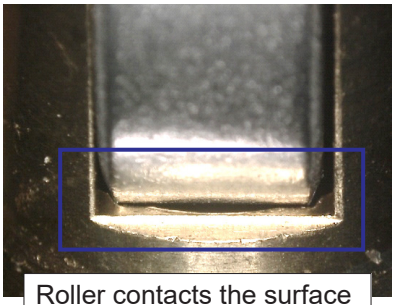
<Phenomenon check result>
• Operating force is variable (snagging).
<Cause>
Switch is pushed in by a distance more than the total travel position, causing damage.

■ The malfunction case

● Setting an excessive stroke causes trouble in actuator return.

Example) Z-15GQ22-B

If the roller is at its stopping position or beyond, the mounting screw contacts the roller and causes a dent. The plunger snags on that dent and can no longer return.

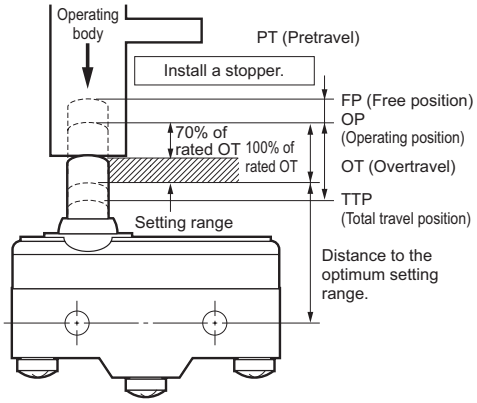
Enlarged view of the actuator	Roller contacting state
	 Roller contacts the surface of the mounting screw.

■ Details of resolution, checkpoints for preventing phenomenon before use

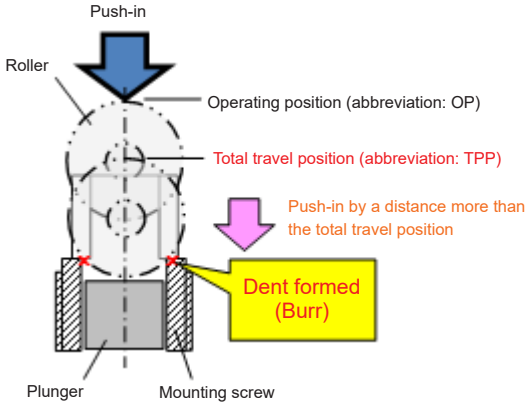
Check!

Is the stroke setting after the switch turns ON excessive?

The operating stroke after actuator operation must be set to 70% to 100% of the rated OT.



Dent forming mechanism



[Phenomenon: Actuator does not operate]

■ Phenomenon check result and cause

<Phenomenon check result>
• Cannot push the distance up to where the switch turns ON.
<Cause>
Deformation caused by excessive external force being applied to the switch actuator.

■ The malfunction case

● **Lever is deformed.**
Example) Z-15GW-B

Faulty switch

■ Details of resolution, checkpoints for preventing phenomenon before use

Check!

Is a load being applied on the lever other than in the operating direction?

Handle the switch so that unbalanced force and a load other than in the operating direction are not applied to the lever.
Otherwise, this results in malfunction, lever and switch damage, reduced durability, or other abnormalities.

[Phenomenon: Actuator does not operate]

■ Phenomenon check result and cause

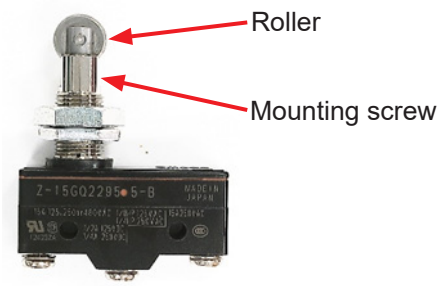
<Phenomenon check result>
• Cannot push the distance up to where the switch turns ON.
<Cause>
Significant abrasion of the switch actuator is occurring which causes sliding resistance.

■ The malfunction case

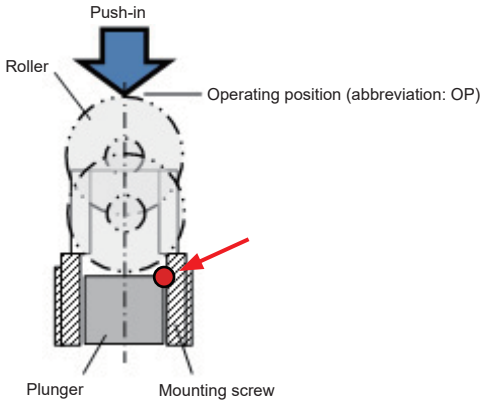
● Roller is pushed in and contacts the mounting screw.

Example) Z-15GQ2255-B

Image of overall view



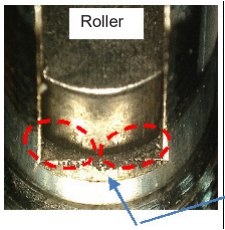
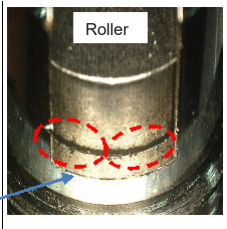
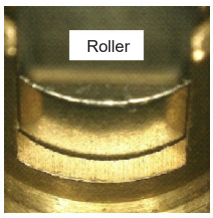
● Grinding powder (→●) obstructs operation.



● Mounting screw becomes scraped.

Example) Z-15GQ2255-B

Black foreign objects are formed on the mounting screw.

Roller contact dent		Normal product (for comparison)
Left side	Right side	
		
Black foreign objects adhere to the mounting screw.		Initial state

■ Details of resolution, checkpoints for preventing phenomenon before use

Check!

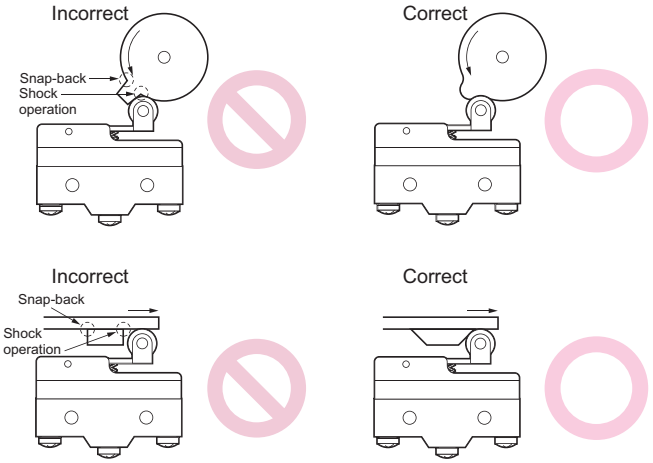
Is the operation frequency exceeding the specified value of the Z model?

An extremely high operation frequency will result in shock action, which may cause early breakage.
The operation frequency of the Z-15 is 240 mechanical operations/minute and 20 electrical switching operations/minute.
Permissible operating frequency indicates the reliability of switching.
The durability of a switch is determined at the specified operation speed. As durability varies with the operation speed even when it is within the permissible frequency, always conduct appropriate durability tests under actual conditions before using a switch.

Check!

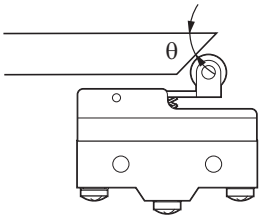
● **Is the shape of the operating body (cam, dog, etc.) of the switch smooth?**

Make sure that the shape of the operating body (cam, dog, etc.) of the switch is smooth.
If the actuator snaps backward quickly or receives shock due to the shape of the operating body even only a few times, its durability may deteriorate.



● **Set the angle θ of the cam or dog to within the range 30 to 45°.**

When the angle increases, abnormal stress will be applied to the lever in the lateral direction.



[Phenomenon: Actuator operates but is always conducting]

■ Phenomenon check result and cause

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

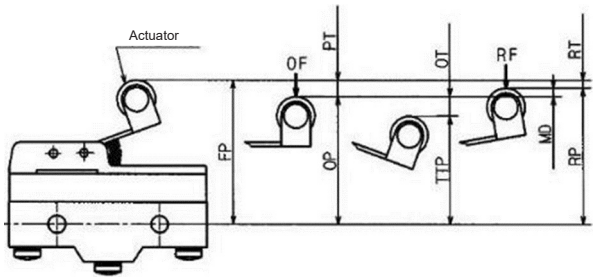
■ Details of resolution, checkpoints for preventing phenomenon before use

Check!

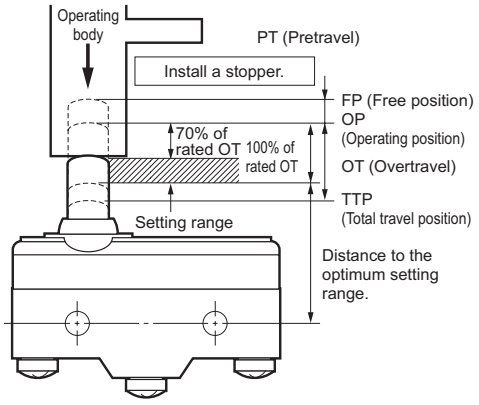
(1) Is the actuator ON/OFF operation set near the contact switching position?

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 stroke so that the operating body is completely away from the actuator and the switch returns to the FP (free position).

[Lever specification]



[Plunger specification]



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>
• Contact is welded.
<Cause>
Arc generation increases and causes the contact to weld when a current exceeding the allowable inrush current (NO side: 15 A, NC side: 30 A) of the switch flows momentarily to the contact or the current value exceeds the inductive load condition (time constant 7 msec).

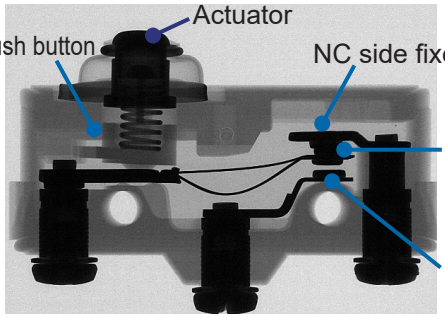
■ The malfunction case

● **Contact is welded.**

Example) Z-15GDA55-B5V

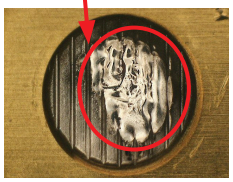
X-ray image

TTP (Total travel position)



The contact is welded and detached protrusions are visible.

Enlarged view of NC contact

NC side moving contact	NC side fixed contact
	
Melting is visible.	Melting is visible.

■ Checkpoints for preventing phenomenon

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.

[Phenomenon: Actuator operates but is always conducting]

■ Details of resolution, checkpoints for preventing phenomenon before use

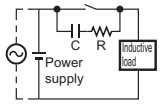
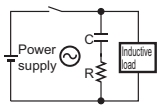
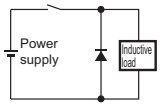
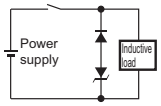
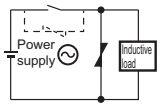
Check!

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>
Contact is welded.
<Cause>
When a current of the rated current or higher is applied to the contact, the contact melts due to the effect of arc heat, the temperature of the contact drops, and the contact becomes stuck.

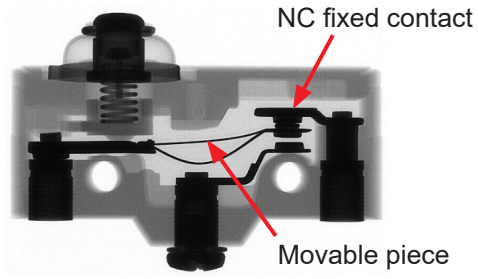
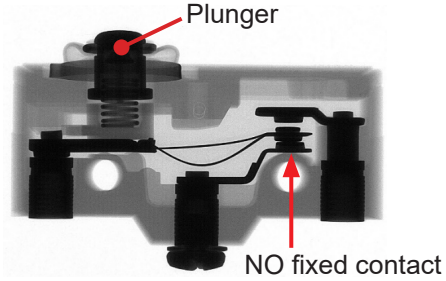
■ The malfunction case

● **When the stroke setting is insufficient, the contact does not turn ON.**

Example) Z-15GD55-B

By pressing the plunger, the movable piece of a switch is reversed, the NC side is switched to the NO side, and the contact turns ON at the NO side.
When the stroke setting is insufficient, the force pressing against the movable piece decreases, and contact with the NO side becomes unstable.

X-ray image

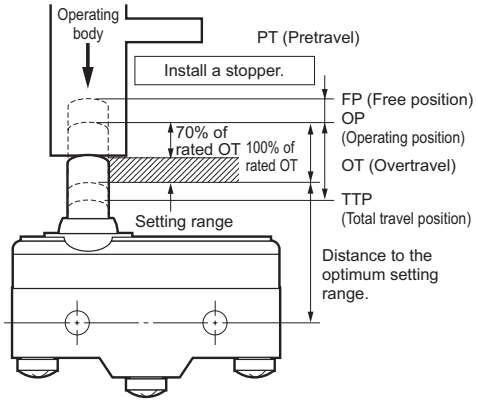
Free position	Total travel position
	

■ Checkpoints for preventing phenomenon

Check!

Is the stroke setting after the switch turns ON insufficient?

The operating stroke after actuator operation must be set to 70% to 100% of the rated OT.



[Phenomenon: Actuator operates but is always conducting]

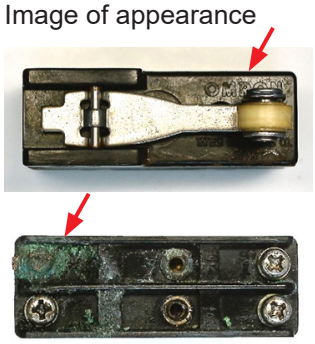
■ Phenomenon check result and cause

<Phenomenon check result>
• NO contact is in a conducting state.
<Cause>
When liquid enters inside the switch, a short circuit is formed between the contacts and the contact remains in a conducting state.

■ The malfunction case

• Foreign objects entering from the periphery of the switch adhere to the contacts.

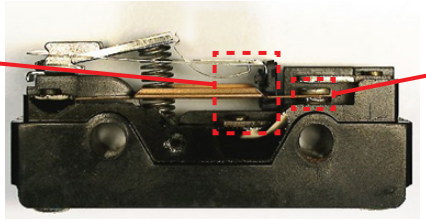
Image of appearance

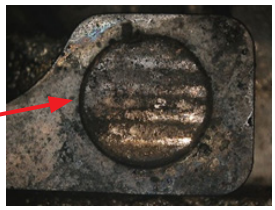


Foreign objects adhere to the periphery

Adhesion of foreign objects is visible.

Image of inside





Adhesion of foreign objects to the contact is visible.

■ Checkpoints for preventing phenomenon

Check!

Is there dust, liquid, or other foreign objects in the area around the switch?

The general series of basic switches do not have a degree of protection.
They also do not have a degree of protection against liquids.
Either prevent the entry of dust and liquids by modifying the installation position or take measures on the device side such as the installation of protective covers.

Check!

Consider the use of a sealed type switch. (□-□55 series)

Consider the use of a sealed type switch as the entry of foreign objects into the inside of the switch can be prevented.
Contact your OMRON representative for details.

[Phenomenon: Actuator does not operate]

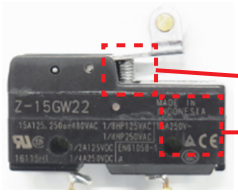
■ Phenomenon check result and cause

<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

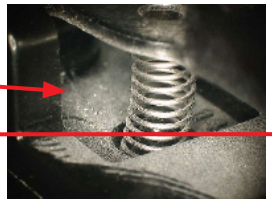
● Foreign objects entering from the periphery of the switch adhere to sliding parts and obstruct operation. They also adhere to the contacts which results in contact failure.

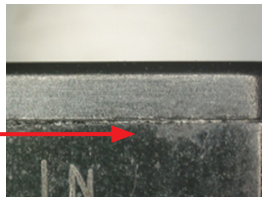
Image of appearance



Adhesion of foreign objects is visible.

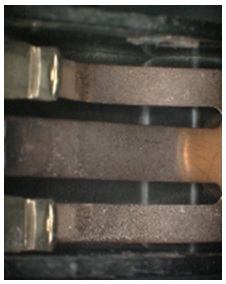
Foreign objects adhere to the periphery



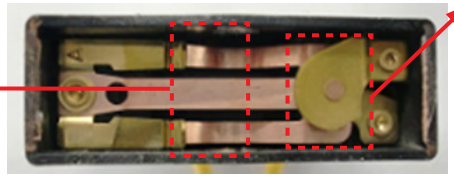


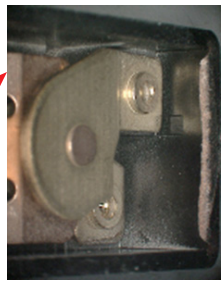
Adhesion of foreign objects is visible.

Image of inside



Entry of foreign objects from the push button sliding part is visible.





Adhesion of foreign objects is visible on contacts or areas around contact.

■ Checkpoints for preventing phenomenon

Check!

Is there dust, PCB powder, or other foreign objects in the area around the switch?

As general-purpose basic switches are not sealed type switches, the entry of foreign objects, liquids, etc. cannot be completely prevented.
Take care to prevent the adhesion of foreign objects when the switch is stored, installed, or used.

[Phenomenon: Actuator does not operate (In case of X model)]

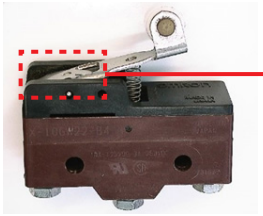
■ Phenomenon check result and cause

<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.

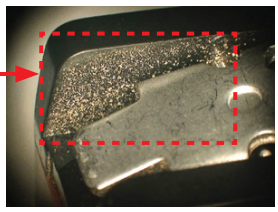
■ The malfunction case

● **Foreign objects entering from the periphery of the switch adhere to the contacts which results in contact failure.**

Image of appearance



Foreign objects adhere to the periphery



Adhesion of foreign objects is visible.

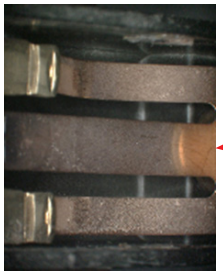
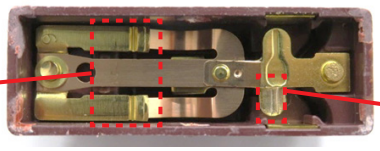
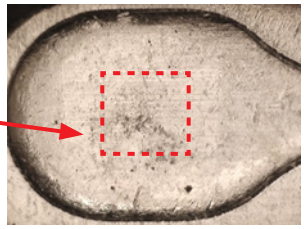


Image of inside





Entry of foreign objects from the push button sliding part is visible.

Adhesion of foreign objects to the contact is visible.

■ Checkpoints for preventing phenomenon

Check!

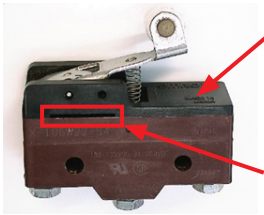
Is there dust or other foreign objects at the area around the switch?

The Magnet Blowout Basic Switch X is a direct current switch with built-in magnetic blowout mechanism.
As its magnetic blowout mechanism, this model has a ventilation port (hole) on the cover side. If peripheral dust accumulates over time, and dust (foreign objects) enters and adheres to the contacts, it will induce contact failure.
Take care to prevent the adhesion of foreign objects when the switch is stored, installed, or used.

Check!

Consider using a General-purpose Basic Switch (Z).

Check the load conditions in use, and consider changing over to a Z model.
The installation method of the Z model is the same but it does not have a ventilation port (hole).



[Phenomenon: Actuator does not operate]

■ Phenomenon check result and cause

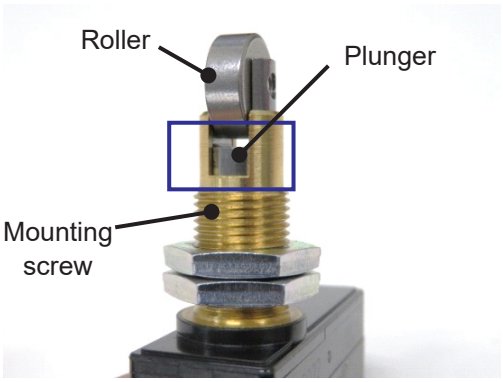
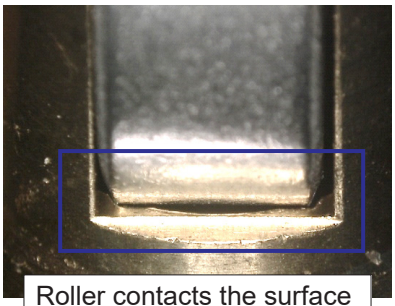
<Phenomenon check result>
• Operating force is variable (snagging).
<Cause>
Switch is pushed in by a distance more than the total travel position, causing damage.

■ The malfunction case

● **Setting an excessive stroke causes trouble in actuator return.**

Example) Z-15GQ22-B

If the roller is at its stopping position or beyond, the mounting screw contacts the roller and causes a dent. The plunger snags on that dent and can no longer return.

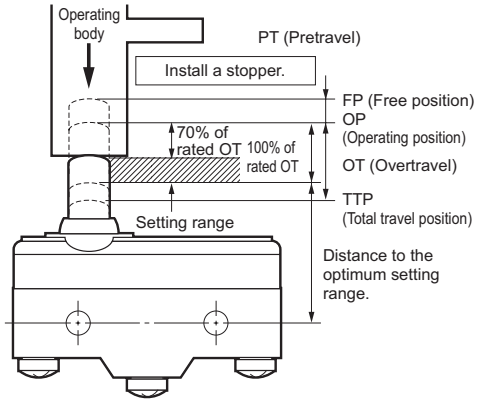
Enlarged view of the actuator	Roller contacting state
	 Roller contacts the surface of the mounting screw.

■ Details of resolution, checkpoints for preventing phenomenon before use

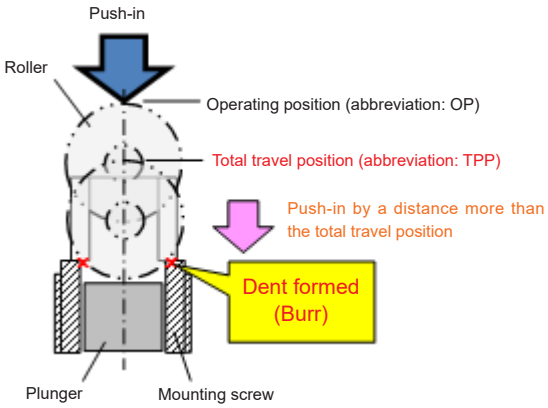
Check!

Is the stroke setting after the switch turns ON excessive?

The operating stroke after actuator operation must be set to 70% to 100% of the rated OT.



Dent forming mechanism



[Phenomenon: Actuator does not operate]

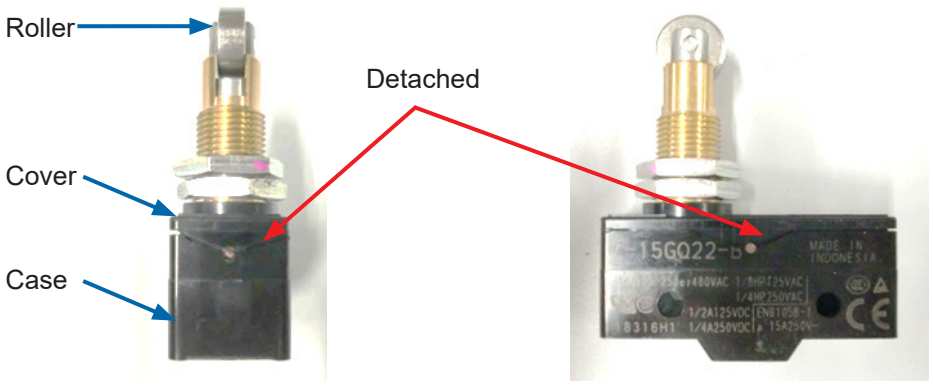
■ Phenomenon check result and cause

<Phenomenon check result>
• Cannot push the distance up to where the switch turns ON.
<Cause>
The switch does not turn ON or OFF as it is pushed in by a distance more than the total travel position and has become damaged.

■ The malfunction case

● **Setting an excessive stroke causes operation trouble.**
Example) Z-15GQ22-B

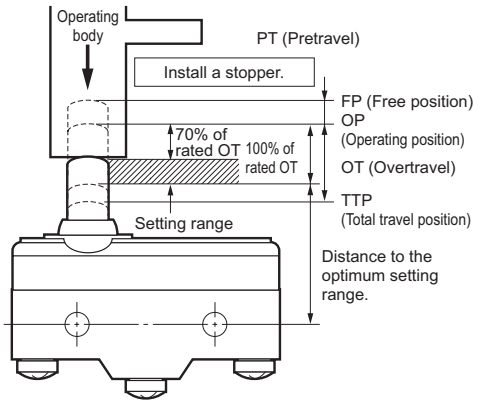
When the roller is pushed in beyond the total travel position (TTP) as a result of an excessive stroke setting, the case becomes detached from the cover and the roller can no longer operate.



■ Checkpoints for preventing phenomenon

Is the stroke setting after the switch turns ON excessive?

The operating stroke after actuator operation must be set to 70% to 100% of the rated OT.



[Phenomenon: Actuator does not operate]

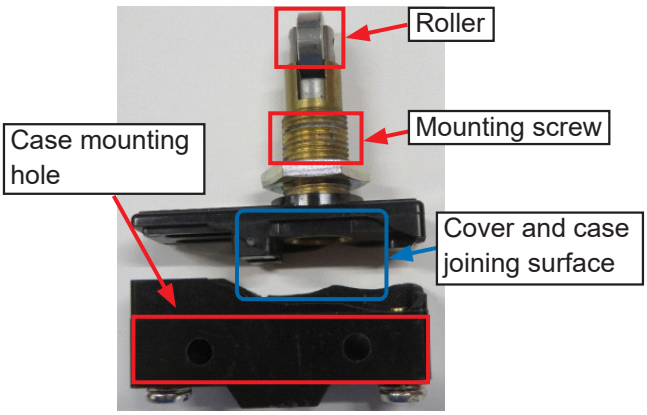
■ Phenomenon check result and cause

<Phenomenon check result>
• The actuator does not return up to where the switch turns OFF.
<Cause>
The switch does not turn ON or OFF as it is pushed in by a distance more than the total travel position and has become damaged.

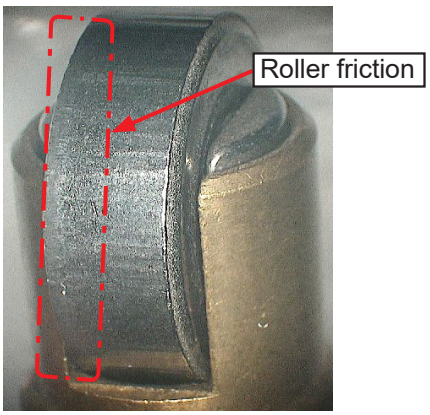
■ The malfunction case

● **Roller is pushed in and contacts the mounting screw.**
Example) A-20GQ21-B

Overall view



Enlarged view of roller

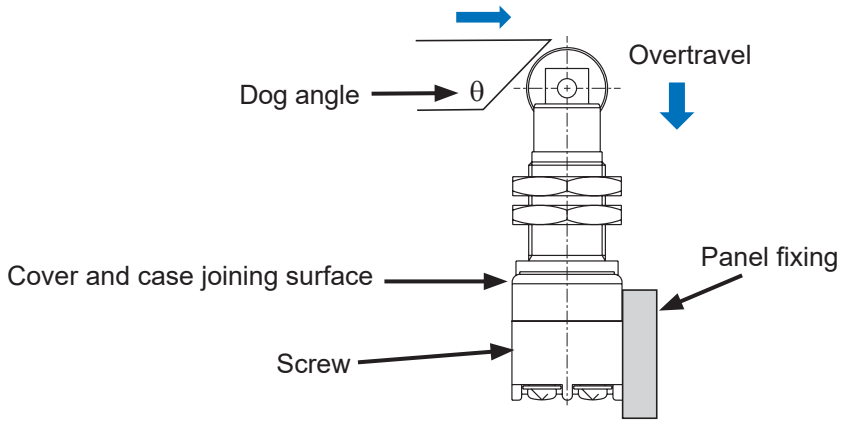


■ Checkpoints for preventing phenomenon

Check!

● **Are the dog angle, operating speed, and overtravel (OT) within specified limits?**
If the dog angle, operating speed, and overtravel (OT) are large, excessive stress is applied to the cover and case joining surface and the switch is damaged as shown in the figure.
Set within the condition range below.

1) Dog angle: Set the angle θ to within the range 30 to 45°.
2) Operating speed: 0.01 mm to 1 m/s
3) Overtravel (OT): 70% to 100% (2.5 to 3.58 mm) of the rated value.

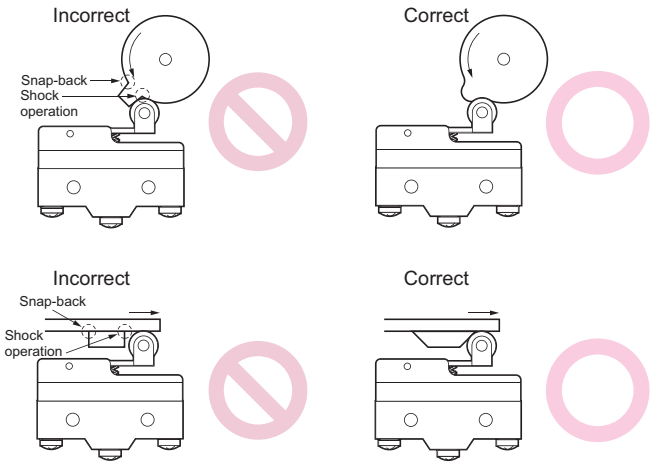


■ Checkpoints for preventing phenomenon

Check!

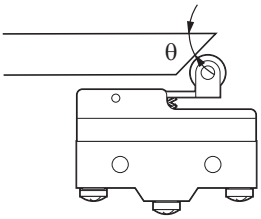
● Is the shape of the operating body (cam, dog, etc.) of the switch smooth?

Make sure that the shape of the operating body (cam, dog, etc.) of the switch is smooth.
If the actuator snaps backward quickly or receives shock due to the shape of the operating body even only a few times, its durability may deteriorate.



● Set the angle θ of the cam or dog to within the range 30 to 45°.

When the angle increases, abnormal stress will be applied to the lever in the lateral direction.



Check!

Is a load being applied on the lever other than in the operating direction?

Handle the switch so that unbalanced force and a load other than in the operating direction are not applied to the lever.
Otherwise, this results in malfunction, lever and switch damage, reduced durability, or other abnormalities.
The TZ model uses ceramic for the push button and case. Although ceramic has outstanding heat resistance, dropping or subjecting parts to excessive shock may damage the parts.

[Phenomenon: Actuator does not operate]

■ Phenomenon check result and cause

<Phenomenon check result>
• Cannot push the distance up to where the switch turns ON.
<Cause>
When installing a switch on the panel, excessive stress is applied, the cover is deformed, and this obstructs lever operation.

■ The malfunction case

● **Lever contacts cover and does not operate.**
Example) X-10GW-BO-105

Image of appearance

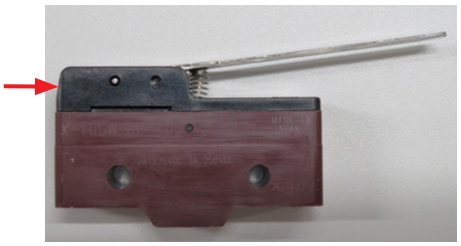
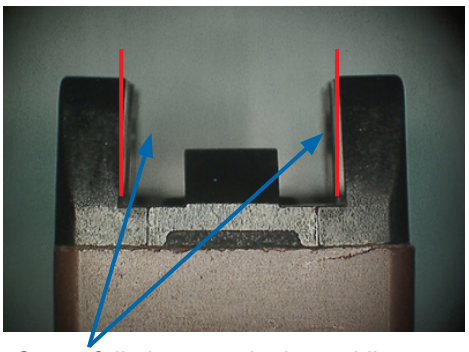


Image of cover viewed from → direction



Cover falls in towards the red lines.

■ Checkpoints for preventing phenomenon

When installing a switch on the panel, take care to prevent excessive stress from being applied.

When installing a switch on the panel, use M4 mounting screws with plane washers or spring washers to securely install the switch. Tighten the screws to a torque of 1.18 to 1.47 N·m.

[Phenomenon: Switch cannot be installed]

■ Phenomenon check result and cause

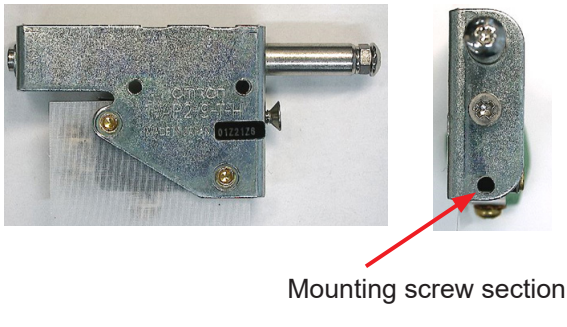
<Phenomenon check result>
• The screws on the main unit spin freely.
<Cause>
When installing a switch on the panel, excessive torque is applied, and screw threads are crushed preventing screws from being tightened.

■ The malfunction case

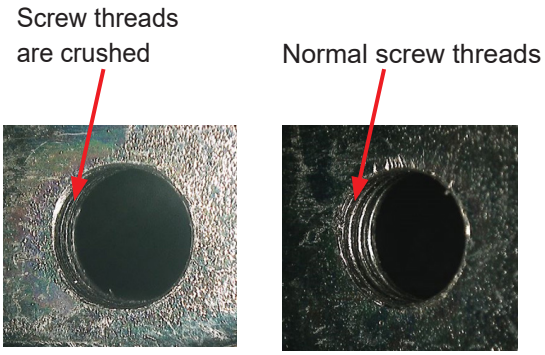
● **The screw threads on the mounting screw section are crushed and the screws spin freely.**
Example) 1VAP2-9

At the general tightening torque (0.68 N·m) of M3 screws, the screws do not spin freely.
When the screws are tightened at an excessive torque (1.5 N·m or more), the tapped section is crushed and the screws spin freely.

Image of appearance



Side view of the mounting screw section



■ Checkpoints for preventing phenomenon

Is the screw tightening torque excessive?

Check that the screws are tightened at the recommended tightening torque (0.58 to 0.68 N·m).

memo

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OMRON Corporation **Industrial Automation Company**

Kyoto, JAPAN **Contact : www.ia.omron.com**

Regional Headquarters

OMRON EUROPE B.V.
Wegalaan 67-69, 2132 JD Hoofddorp
The Netherlands
Tel: (31) 2356-81-300 Fax: (31) 2356-81-388

OMRON ELECTRONICS LLC
2895 Greenspoint Parkway, Suite 200
Hoffman Estates, IL 60169 U.S.A.
Tel: (1) 847-843-7900 Fax: (1) 847-843-7787

OMRON ASIA PACIFIC PTE. LTD.
438B Alexandra Road, #08-01/02 Alexandra
Technopark, Singapore 119968
Tel: (65) 6835-3011 Fax: (65) 6835-3011

OMRON (CHINA) CO., LTD.
Room 2211, Bank of China Tower,
200 Yin Cheng Zhong Road,
PuDong New Area, Shanghai, 200120, China
Tel: (86) 21-6023-0333 Fax: (86) 21-5037-2388

Authorized Distributor:

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