



# Operation Manual

High Vacuum Solenoid Valve

PRODUCT NAME

XSA Series

MODEL/ Series

Thank you for purchasing this SMC product.

Be sure to read this Operation Manual carefully and understand its contents before operating this product to ensure the safety of the operator and the product.

Please refer to the drawing and other informative documents for the construction and specifications of the product.

Further, ensure your operating environment satisfies the requirements specified for the product.

Keep this Operation Manual available for reference, when necessary.

**SMC Corporation**

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# Safety Instructions

These safety instructions are intended to prevent hazardous situations and/or equipment damage. These instructions indicate the level of potential hazard with the labels of “Caution,” “Warning” or “Danger.”

They are all important notes for safety and must be followed in addition to International Standards (ISO/IEC)\*1), and other safety regulations.

\*1) ISO 4414: Pneumatic fluid power – General rules relating to systems

ISO 4413: Hydraulic fluid power -- General rules relating to systems

IEC 60204-1: Safety of machinery -- Electrical equipment of machines (Part 1: General requirements) General requirements) General requirements)

ISO 10218-1992: Manipulating industrial robots -- Safety



## Caution

**Caution** indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.



## Warning

**Warning** indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.



## Danger

**Danger** indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.

## Warning

### 1. The compatibility of the product is the responsibility of the person who designs the equipment or decides its specifications.

Since the product specified here is used under various operating conditions, its compatibility with specific equipment must be decided by the person who designs the equipment or decides its specifications based on necessary analysis and test results.

The expected performance and safety assurance of the equipment will be the responsibility of the person who has determined its compatibility with the product.

This person should also continuously review all specifications of the product referring to its latest catalog information, with a view to giving due consideration to any possibility of equipment failure when configuring the equipment.

### 2. Only personnel with appropriate training should operate machinery and equipment.

The product specified here may become unsafe if handled incorrectly.

The assembly, operation and maintenance of machines or equipment including our products must be performed by an operator who is appropriately trained and experienced.

### 3. Do not service or attempt to remove product and machinery/equipment until safety is confirmed.

1. The inspection and maintenance of machinery/equipment should only be performed after measures to prevent falling or runaway of the driven objects have been confirmed.

2. When the product is to be removed, confirm that the safety measures as mentioned above are implemented and the power from any appropriate source is cut, and read and understand the specific product precautions of all relevant products carefully.

3. Before machinery/equipment is restarted, take measures to prevent unexpected operation and malfunction.

### 4. Contact SMC beforehand and take special consideration of safety measures if the product is to be used in any of the following conditions.

1. Conditions and environments outside of the given specifications, or use outdoors or in a place exposed to direct sunlight.

2. Installation on equipment in conjunction with atomic energy, railways, air navigation, space, shipping, vehicles, military, medical treatment, combustion and recreation, or equipment in contact with food and beverages, emergency stop circuits, clutch and brake circuits in press applications, safety equipment or other applications unsuitable for the standard specifications described in the product catalog.

3. An application which could have negative effects on people, property, or animals requiring special safety analysis.

4. Use in an interlock circuit, which requires the provision of double interlock for possible failure by using a mechanical protective function, and periodical checks to confirm proper operation.



# Safety Instructions

## Caution

### **1. The product is provided for use in manufacturing industries.**

The product herein described is basically provided for peaceful use in manufacturing industries. If considering using the product in other industries, consult SMC beforehand and exchange specifications or a contract if necessary.  
If anything is unclear, contact your nearest sales branch.

## **Limited warranty and Disclaimer/Compliance Requirements**

The product used is subject to the following “Limited Warranty and Disclaimer” and “Compliance Requirements”.

Read and accept them before using the product.

### **Limited warranty and Disclaimer**

- 1. The warranty period of the product is 1 year in service or 1.5 years after the product is delivered, whichever is first.\*2)**  
Also, the product may have specified durability, running distance or replacement parts. Please consult your nearest sales branch.
- 2. For any failure or damage reported within the warranty period which is clearly our responsibility, a replacement product or necessary parts will be provided.**  
This limited warranty applies only to our product independently, and not to any other damage incurred due to the failure of the product.
- 3. Prior to using SMC products, please read and understand the warranty terms and disclaimers noted in the specified catalog for the particular products.**

\*2) Vacuum pads are excluded from this 1 year warranty.

A vacuum pad is a consumable part, so it is warranted for a year after it is delivered.

Also, even within the warranty period, the wear of a product due to the use of the vacuum pad or failure due to the deterioration of rubber material are not covered by the limited warranty.

### **Compliance Requirements**

- 1. The use of SMC products with production equipment for the manufacture of weapons of mass destruction (WMD) or any other weapon is strictly prohibited.**
- 2. The exports of SMC products or technology from one country to another are governed by the relevant security laws and regulation of the countries involved in the transaction. Prior to the shipment of a SMC product to another country, assure that all local rules governing that export are known and followed.**

# 1. Product Specific Precautions 1



## Common Precautions 1

Be sure to read before handling.

### Design

- Not suitable for use as an emergency shutoff valve, etc.  
The valves listed in this catalog are not designed for safety applications such as an emergency shutoff valve. If the valves are used in this type of system, other reliable safety assurance measures should also be adopted.
- Extended periods of continuous energization  
The solenoid coil generates heat if continuously energized. Do not use the product in sealed containers. Install the product in a ventilated location. Do not touch the valves with bare hands during or after energization.

### Selection



## Caution

### (1) Applicable fluids

Verify the applicability of all fluids by referring to the materials on page 11, "Construction and Components"

### (2) Fluid quality

#### < Air >

Use clean air.

- Do not use compressed air that contains chemicals, synthetic oils including organic solvents, salt or corrosive gases, etc., as it can cause damage or malfunction.
- Install an air filter, if necessary.  
Install air filters close to valves on the upstream side.
- Install an aftercooler or air dryer, if necessary.  
Compressed air that contains excessive drainage may cause malfunction of valves and other pneumatic equipment. To prevent this, install an aftercooler or air dryer, etc.
- If excessive carbon powder is generated, eliminate it by installing mist separators on the upstream side of valves.  
If excessive carbon powder is generated by the compressor, it may adhere to the inside of the valves and cause malfunction.  
Refer to SMC's Best Pneumatics catalog for further details on compressed air quality.

#### < Vacuum >

Vacuum piping direction: Connect the piping so that the pressure in the secondary side is lower.

Avoid entry of foreign matter.

### (3) Ambient environment

Use within the operable ambient temperature range. After confirming the compatibility of the product's component materials with the ambient environment, operate so that fluid does not adhere to the product's exterior surfaces.

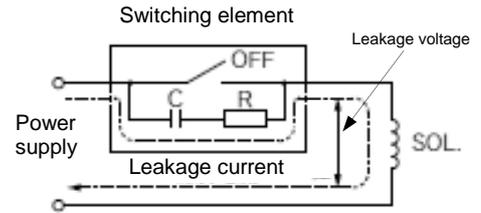
### (4) Countermeasures against static electricity

Take measures to prevent static electricity since some fluids can cause static electricity.

## ⚠ Caution

### (5) Leakage voltage

When a C-R device (surge suppressor) is used for the protection of a switching device, note the valve may not be turned off when voltage leakage passes through the C-R device.



AC coil: 5% or less of the rated voltage  
DC coil: 2% or less of the rated voltage

## Mounting

## ⚠ Warning

- (1) If air leakage increases or the equipment does not operate properly, stop operation.  
After mounting is completed, perform a suitable function test to confirm correct mounting.
- (2) Do not apply external force to the coil section.  
When tightening the product, apply a wrench or other tool to the outside of the piping connection parts.
- (3) The solenoid valve can be mounted to any direction, but recommended mounting direction of the coil is upward.  
When mounting a valve with its coil positioned downwards, foreign objects in the fluid will adhere to the iron core leading to malfunction. The coil must be positioned upwards especially for strict leakage control.
- (4) Do not warm the coil assembly with a heat insulator, etc.  
Use tape, heaters, etc., for freeze prevention on the piping and body only. Heating the coil may burn it out.
- (5) Avoid sources of vibration, or adjust the arm from the body to the minimum length so that resonance will not occur.
- (6) Painting and coating  
Warnings or specifications printed or labeled on the product should not be erased, removed or covered up.

## Piping

## ⚠ Caution

- (1) Preparation before piping  
Before piping, clean the seal surface with ethanol, etc.
- (2) Avoid connecting ground lines to piping, as this may cause electric corrosion of the system.
- (3) Mounting of fitting  
Tighten the fitting as follows:  
After tightening, confirm there is no leakage from the fitting.

### Tightening of fitting

Compression fitting	1 and 1/4 turns after manual tightening
Face seal fitting	1/8 turn after manual tightening

### (4) Piping to products

When connecting piping to a product, refer to its operation manual to avoid mistakes involving the supply port, etc.

## Wiring

### **Caution**

- (1) Use wiring cable with a cross section of 0.5 to 1.25mm<sup>2</sup>. Make sure that no excessive force is applied to the wires.
- (2) Use electrical circuits which do not generate chattering within their contacts.
- (3) Use voltages which are within +/-10% of the rated voltage. If a direct current power supply is used and the response is important, the voltage should be within +/-5% of the rated value. Voltage drop is the value at the lead wire when the coil is connected.
- (4) If no solenoid surge is allowed in the electrical circuit system, mount a voltage suppressor in parallel to the solenoid or, use the option with a surge voltage suppressor circuit.  
(Surge voltage is generated even when the surge voltage suppressor circuit is used.)  
Please consult with SMC for details.

## Operating

### **Warning**

- (1) Do not use in an environment where corrosive gases, chemicals, sea water, water or steam are present.
- (2) Do not use in explosive atmospheres.
- (3) Do not use in locations subject to vibration or impact.
- (4) Do not use in areas where product is exposed to heat sources or in areas where the product is exposed to radiant heat.
- (5) Employ suitable protective measures in locations where there is contact with water droplets, oil or welding spatter, etc.

## Maintenance

### **Warning**

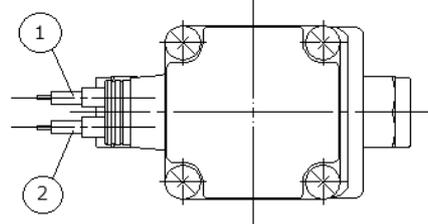
- (1) Removal of product  
Confirm that the valve temperature has dropped sufficiently before removing the product.  
If touched inadvertently, there is a danger of being burnt.
  - a) Shut off the fluid supply and release the fluid pressure in the system.
  - b) Shut off the power supply.
  - c) Remove the product.
- (2) Low frequency operation  
Switch valves at least once every 30 days to prevent malfunction. The product requires periodic inspection every 6 months for optimum operating conditions.

Electrical wiring

**CAUTION**

■ Grommet

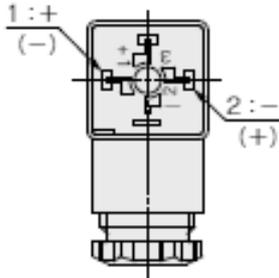
Rated voltage	Lead wire color	
	(1)	(2)
DC polar indication	Black	Red
100VAC	Blue	Blue
200VAC	Red	Red
Other AC	Grey	Grey



※Polarity (positive and negative) does not matter.

■ DIN terminal

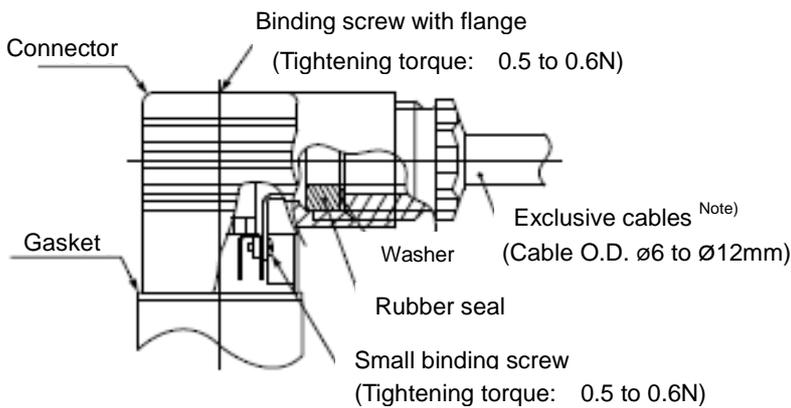
The DIN terminal is wired internally as shown below. Connect each of them to the corresponding wire of the power supply.



Terminal No	1	2
DIN terminal	+(-)	-(+)

※Polarity (positive and negative) does not matter.

- The applicable heavy-duty cord with an outside diameter (O.D.) of  $\phi 6$  to 12mm can be used.
- Tighten parts to the torque values specified below:

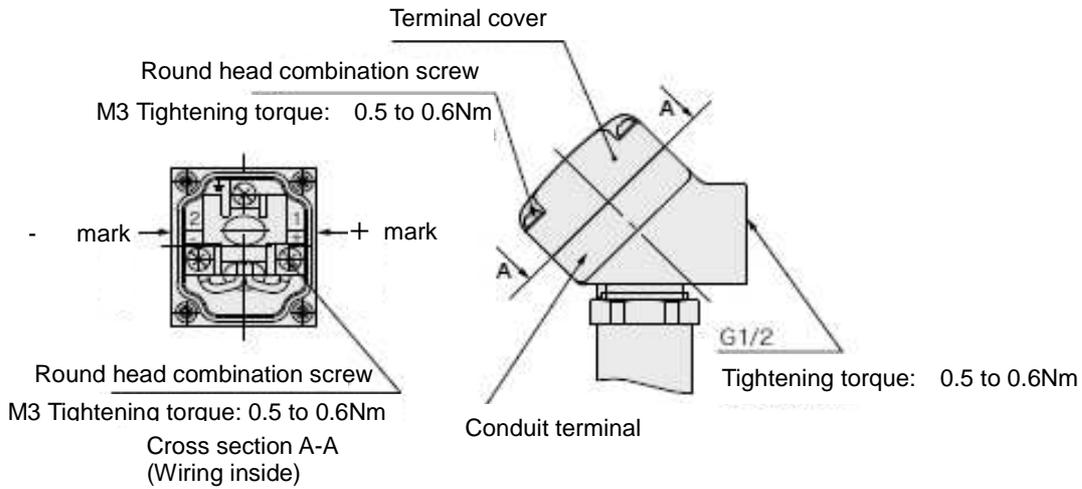


Note) If using a cable with outside diameter of  $\phi 9$  to 12mm, use it from the inner part of the rubber seal.

■ Conduit terminal

Wire the conduit terminal as illustrated below:

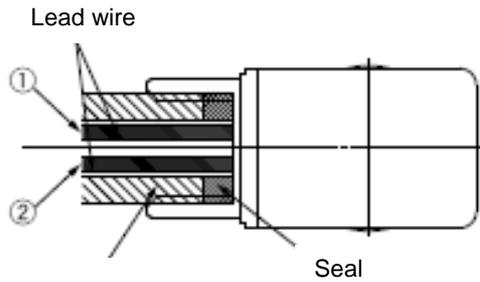
- Tighten parts to the torque values specified below.
- Seal the piping (G1/2) properly with the specified conduit.



■ Conduit

Tighten the piping referring to the tightening torque specified below.

B side coil: AWG20 Outside diameter of the insulator is 2.5mm



Conduit piping  
(Port size G1/2 Tightening torque 0.5 to 0.6Nm)

Rated voltage	Lead wire color	
	(1)	(2)
DC polar indication	Black	Red
100VAC	Blue	Blue
200VAC	Red	Red
Other AC	Grey	Grey

※Polarity (positive and negative) does not matter.

Part name	Part No.
Seal	VCW20-15-6

Note) Order separately.

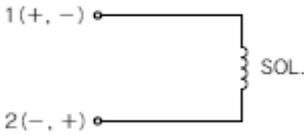
Electrical circuit



**CAUTION**

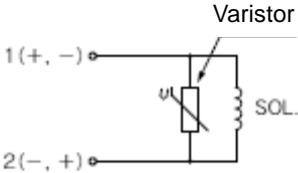
[DC Circuit]

Grommet, fastened on terminal



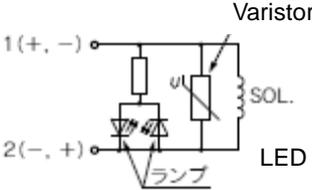
No electrical options

Grommet, DIN terminal, conduit terminal, conduit



With surge voltage suppressor

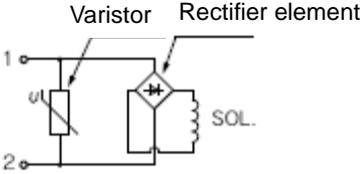
DIN terminal, conduit terminal



With surge voltage suppressor and LED

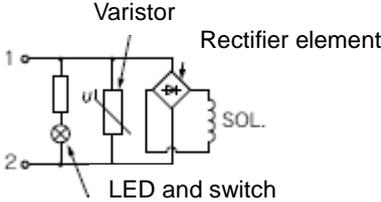
**【AC circuit】**

Grommet, DIN terminal, conduit terminal, conduit



No electrical options

DIN terminal, conduit terminal



With surge voltage suppressor and LED

## 2. Specifications

Model	XSA1-12	XSA1-22	XSA2-22	XSA2-32	XSA2-43	XSA3-32	XSA3-43	
Operation	Normally close							
Fluid	Air, Inert gas							
Orifice diameter mm $\varnothing$	2	3	4.5	6	4.5	6		
Max. working pressure MPa (G)	1.5							
Max. operating pressure MPa(G)	1.0							
Max. operating pressure difference MPa	0.8	0.3	1.0	0.3	0.1	0.8	0.3	
Differential pressure MPa (G) Note <sup>2)</sup>	0.5	0.25	0.4	0.2	0.05	0.2	0.15	
Max. operating pressure Pa(abs)	1 $\times$ 10 <sup>-6</sup>							
Leakage Pa $\cdot$ m <sup>3</sup> /s Note <sup>3)</sup>	Internal	1.3 $\times$ 10 <sup>-9</sup>						
	External	1.3 $\times$ 10 <sup>-11</sup>						
Piping method	Face seal fitting and compression fitting							
Port size Inch	1/4			3/8	1/4	3/8		
Ambient and fluid temperature $^{\circ}$ C	5to60							
Rated voltage Note 4)	100/110/200/220/230/240/24/48VAC 12/24VDC							
Power consumption [W] Note 5)	DC polar indication	4.5	7	10.5				
Apparent power value [VA] Note 5)	AC	7	9.5	12				
Temperature increase of the coil [ $^{\circ}$ C] Note 6)	DC polar indication	50	55	65				
	AC	60	70	70				
Allowable voltage fluctuation	10% of the rated voltage or less							
Allowable leakage voltage	DC polar indication	5% of the rated voltage or less						
	AC	2% of the rated voltage or less						
Type of coil insulation	Class B							
Weight (kg) Note 7)	Face seal fitting	0.28	0.28	0.41	0.41	0.42	0.53	0.62
	Compression fitting	0.28	0.28	0.41	0.41	0.42	0.53	0.55

Note 1) Operating pressure difference indicates the pressure difference between Port 1 (high pressure) and Port 2 (low pressure). (Construction)  
Ex.) When the operating pressure difference is 0.3MPa and Port 2 is applied with a vacuum pressure (1Torr or lower), Port 1 can be applied up to 0.2MPa.

Note 2) Differential pressure is the pressure which can be applied from Port 2 when the pressure at Port 1 is atmospheric pressure.

Note 3) Leakage at 20 $^{\circ}$ C of ambient temperature, 0.1MPa of differential pressure. Gas permeation is not included.

Note 4) AC type is equipped with full-wave rectifier.

Note 5) Power consumption and apparent power values are obtained when the ambient temperature is 20 $^{\circ}$ C at rated voltage. (Dispersion: +/-10%)

Note 6) Value when the ambient temperature is 20 $^{\circ}$ C at rated voltage. The value depends on the ambient environment. This is for reference.

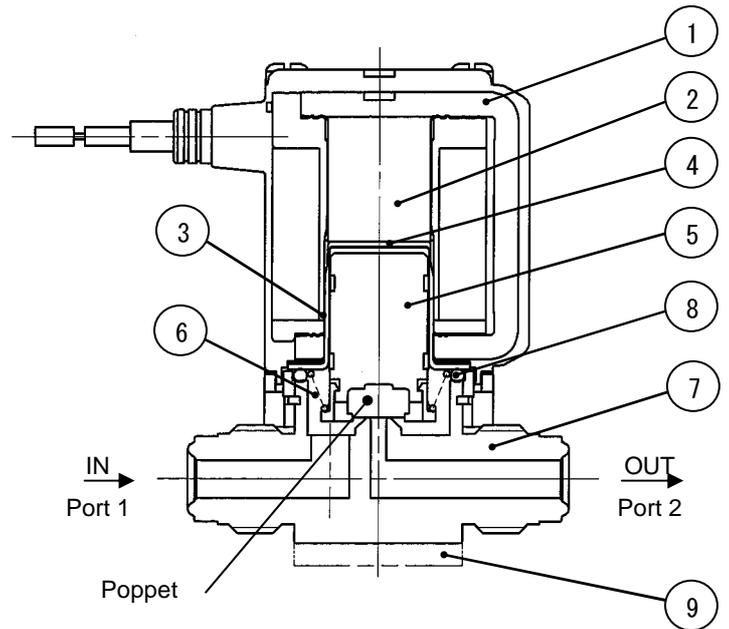
Note 7) Grommet value.

### 3. Construction and Outer dimensions

#### 3-1. Construction/Operation

##### Components

No.	Description	Material
1	Solenoid coil	Cu+Fe+Resin
2	Core	Fe
3	Tubing	SUS
4	Seat (PET seat to shut the residual magnetism)	PET
5	Armature assembly	FKM, SUS, Resin(PPS)
6	Spring	SUS
7	Body	SUS
8	O-ring	FKM
9	Spacer	Al



##### <Operation>

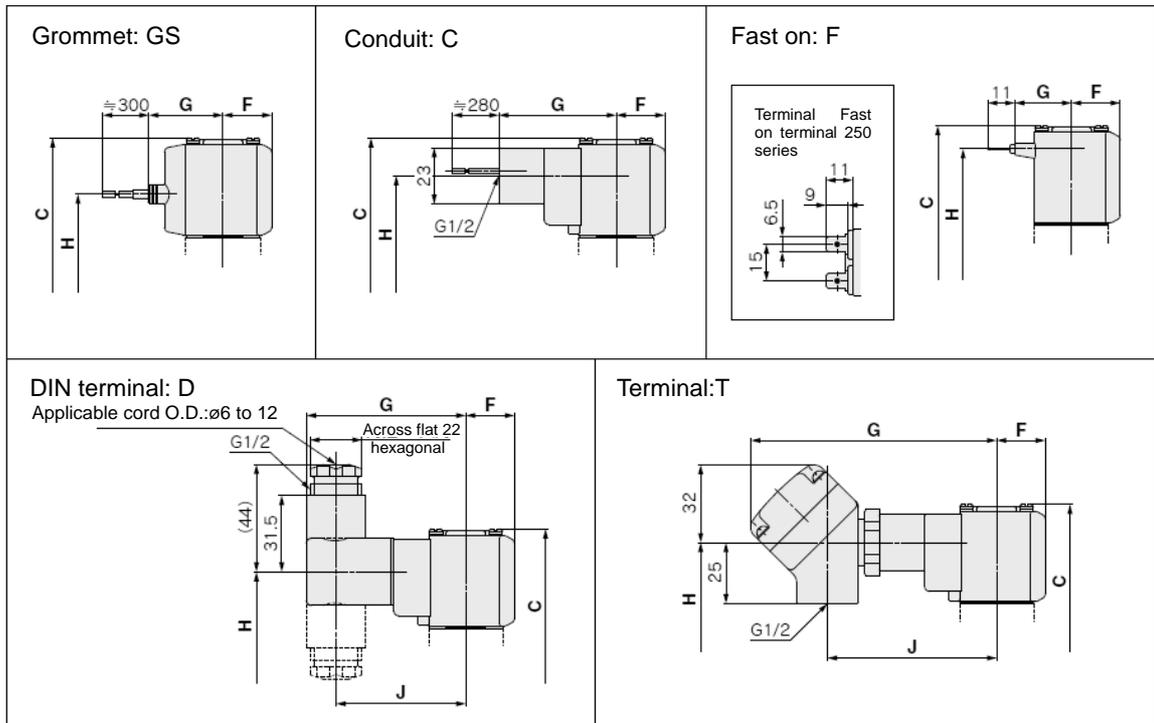
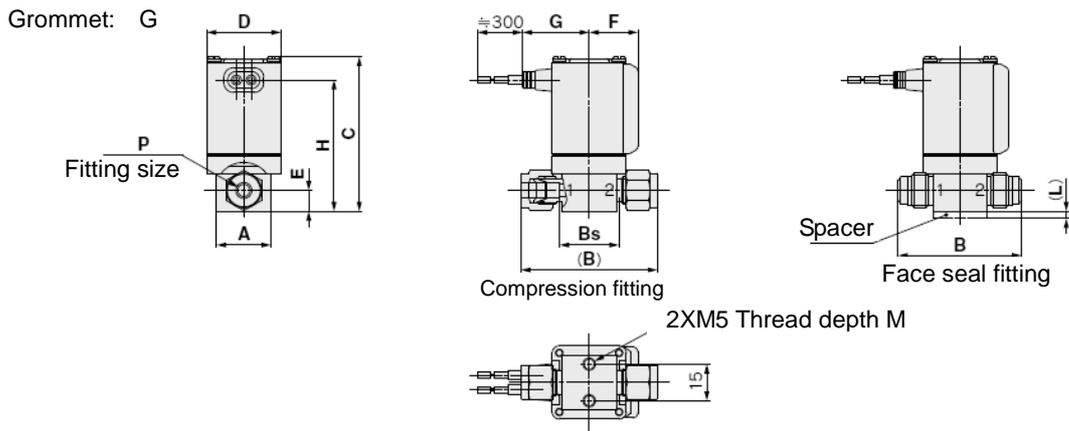
When the solenoid coil(1) is energized, the suction force of the solenoid coil becomes larger than the accumulated force of the action force. This is due to the differential pressure between the inlet and output working on the poppet and the reaction force of the spring(6), opening the poppet by attracting the armature assembly(5) to the armature (2).

When the power supply to the solenoid coil(1) is stopped, the armature assembly(5) is separated from the armature(2) by the reaction force of the spring(6), closing the poppet.

##### << Optional specifications >>

(9) Spacer: Increase the height of the body when tightening the body to the flat surface.

### 3-2. Exterior dimensions



Model	A	B	Bs	C	D	E	F	L	M	P [inch]	Grommet: G		Grommet: GS		Conduit: C		Fast on: F		DIN terminal: D			Terminal: T		
											G	H	G	H	G	H	G	H	G	H	J	G	H	J
XSA1-□2S	22	55	24	63	30	8.5	20	3	8	1/4	27	54	30	40	47.5	47.5	23	53.5	64.5	45.5	52.5	99.5	47.5	68.5
-□2V		50	-								30	40	47.5	47.5	23	53.5	64.5	45.5	52.5	99.5	47.5	68.5		
XSA2-□2S	25	63	31.5	73.5	35	11.5	22	5	10	3/8	30	63	33	50	50	57	25.5	63	67	55	55	102	57	71
-□2V		56	-								30	50	50	57	25.5	63	67	55	55	102	57	71		
-43S		64.5	31	78	40	25	1/4	32	68	35	54	52.5	61.5	28	67.5	59.5	57.5	105	61.5	73.5				
-43V		67	-	82.5	3/8	72	59	66	72	64	66	72	64	66	72	64	66	66	66	66				
XSA3-32S	25	63	31.5	78	40	11.5	25	5	10	3/8	32	68	35	54	52.5	61.5	28	67.5	59.5	57.5	105	61.5	73.5	
-32V		56	-								30	50	50	57	25.5	63	67	55	55	102	57	71		
-43S		64.5	31	82.5	3/8	72	59	66	72	64	66	72	64	66	72	64	66	66	66					
-43V	67	-	82.5	3/8	72	59	66	72	64	66	72	64	66	72	64	66	66	66	66					

## 4. Period and scope of warranty

The warranty period is 2,000,000 cycles (under SMC endurance test conditions), 18 months after delivery or 12 months in service, whichever comes first.

If the valve has been used outside of the specifications, or if a failure occurs as a result of mounting onto a machine or reassembling by the user, the guarantee is void.

For any failure reported within the warranty period which is clearly our responsibility, the entire valve will be replaced. This guarantee does not apply to any damage incurred due to the failure of the valve.

### SMC endurance test conditions

- Normal temperature (Room temperature)
- 5Hz
- Rated voltage
- Max. operating pressure

The valve was opened and closed, checked for internal and external leakage and proper operation.

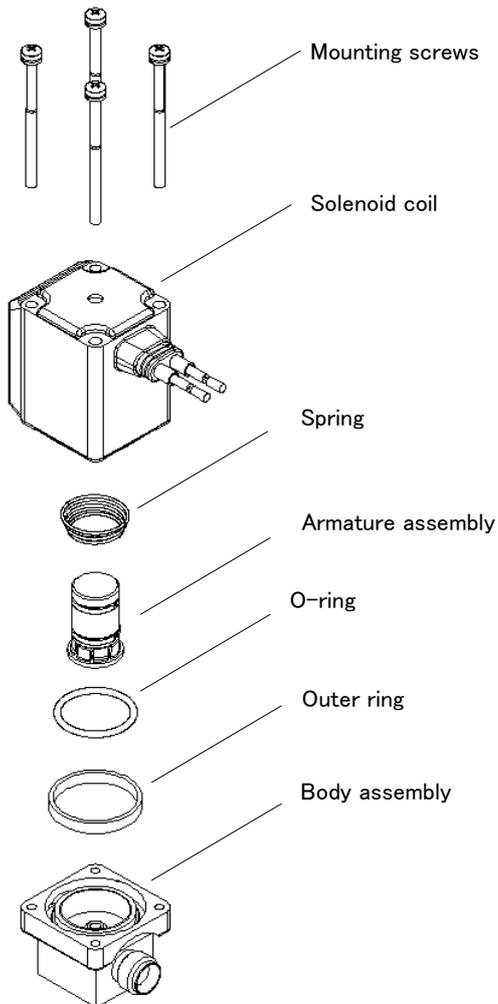
We confirmed that the product satisfies the product specifications up to 2,000,000 cycles.

## 5. Troubleshooting

This section summarizes troubleshooting the product. Refer to the table on the next page for troubleshooting measures.

For disassembly and re-assembly, refer to the drawing below.

If the problem is not resolved, please contact SMC.



### **Disassembly**

- ① Before disassembling, shut off the power supply and air supply source to discharge the residual pressure.
- ② Loosen the mounting screws.
- ③ Solenoid coil, spring, armature assembly, O-ring, outer ring, and body assembly can be removed.

### **Assembly**

- ① Assemble the parts to the body in reverse order of the disassembly.
- ② To change the direction of the electrical entry, rotate the solenoid coil to desired direction, then mount the solenoid coil.
- ③ Hold the solenoid coil on the body assembly in order to avoid creating gap between them, and tighten screws diagonally more than 2 turns.

Appropriate tightening torque (Nm)

XSA1	0.5
XSA2	0.7
XSA3	

- \* Before use, make sure there is no leakage from parts.

Troubleshooting

Fault		Possible causes	*Confirmation method	Countermeasures
Leakage	Piping	Adherence of foreign matter to the seal	Check that there is no foreign matter stuck to the seal.	Solid matter has entered from outside and is stuck to the seal. Take measures to prevent adherence of foreign matter.
		Scratches on the seal	Check that there are no scratches on the seals.	
		Inadequate tightening	Check tightening conditions/torque.	Tighten properly.
	External seal O-ring	Loose bolt due to vibration or impact	Check if vibration or impact to the product is present.	Sealing failure by loose bolt due to vibration or impact. - Do not use the product where exposed to vibration or impact.
		Deterioration of the O-ring	Check that there is no deterioration of the O-ring.	O-ring deterioration due to the fluid or fluid temperature. Select fluid and fluid temperature which does not deteriorate O-ring.
	Poppet	Adherence of foreign matter to the seal	Check that there is no foreign matter stuck to the seal.	Foreign matter has entered from outside and is stuck to the seal. Take measures to prevent adherence of foreign matter.
		Scratches on the seal	Check that there are no scratches on the seals.	
		Poppet is deteriorated	Check that there is no deterioration of the poppet.	Sealing failure due to poppet deterioration because of the fluid or fluid temperature. Select fluid and fluid temperature which does not deteriorate poppet.
		Residual magnetic force	Check if the leakage voltage of the power supply exceeds the allowable value.	Armature does not return due to the leakage voltage, causing leakage level non-conformance. Keep the leakage voltage lower than the allowable value.
		Excessive differential pressure.	Check if the differential pressure exceeds the allowable value.	Sealing force does not return due to the excessive differential pressure, causing leakage level non-conformance. Keep the differential pressure lower than the allowable value.
Did Not Operate	Not ON	Broken or blown solenoid coil	Check if applied voltage exceeds the upper limit of the allowable voltage range.	Coil was burnt or blown by over voltage. Apply voltage lower than the upper limit of the allowable voltage range.
			Check if surge voltage is present.	
			Check if surge voltage is present.	Coil was burnt or blown by moisture. Take measures to prevent moisture.
	Supply voltage is not applied	Please check if there are any abnormalities with the power supply and/or control circuit.	Replace or repair the power supply and/or control circuit.	
	Excessive fluid pressure	Check if fluid pressure exceeds the maximum pressure difference.	Operation failure due to excessive fluid pressure. Operate within the specified pressure range.	
	Error caused by vibration or impact	Check if vibration or impact to the product is present.	Operation failure due to vibration or impact. Do not use the product where exposed to vibration or impact.	
	Foreign matter stuck	Check that there is no foreign matter stuck inside the sliding part of the armature.	Foreign matter has entered from outside and is stuck to the seal. Take measures to prevent entrapment of foreign matter.	
	Attraction force shortage of the solenoid coil	Check if applied voltage exceeds the lower limit of the allowable voltage range.	Operation failure due to the attraction force shortage because of insufficient supply voltage. Supply voltage higher than the lower limit of the allowable voltage range.	
		Check if the ambient temperature exceeds the upper limit of the specification.	Operation failure due to the decrease of attraction force because of temperature. Operate within the specified temperature range.	
	Not OFF	Error caused by vibration or impact	Check if vibration or impact to the product is present.	Operation failure due to vibration or impact. Do not use the product where exposed to vibration or impact.
		Foreign matter stuck	Check that there is no foreign matter stuck inside the sliding part of the armature.	Foreign matter has entered from outside and is stuck to the seal. Take measures to prevent entrapment of foreign matter.
		Residual magnetic force	Check if the leakage voltage of the power supply exceeds the allowable value.	Armature does not return due to the leakage voltage, causing operation failure. Keep the leakage voltage lower than the allowable value.
		Excessive differential pressure	Check if the differential pressure exceeds the allowable value.	Armature does not return due to the excessive differential pressure. Keep the differential pressure lower than the allowable value.
Small flow	Foreign matter stuck	Check that there is no foreign matter stuck inside the parts.	Solid matter has entered from outside and is stuck in the fluid path. Take measures to prevent entrapment of foreign matter.	

Noise	Foreign matter stuck	Check that there is no foreign matter stuck inside the valve.	Solid matter has entered from outside and is stuck to the moving parts. Take measures to prevent entrapment of foreign matter.
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Revision history

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1st printing:SS

# SMC Corporation

4-14-1, Sotokanda, Chiyoda-ku, Tokyo 101-0021 JAPAN  
Tel: + 81 3 5207 8249 Fax: +81 3 5298 5362  
URL <http://www.smcworld.com>

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Note: Specifications are subject to change without prior notice and any obligation on the part of the manufacturer.  
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