

Zero Differential Pressure Type Pilot Operated 2 Port Solenoid Valve

For Steam



New

RoHS

Long service life

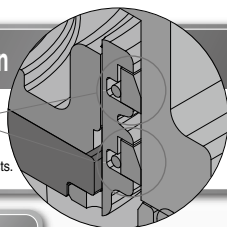
3 million cycles*1

*1 Based on SMC's test condition

Improved air filtration

Double guide rings

- Stable sliding performance
- Improved scraper performance reduces the entry of foreign objects.



Enclosure IP65



Steam

* Can be used with heated water.

Reduced apparent power

12 VA*2 ← 18 VA

15 VA*3 ← 20 VA

*2 VXS23/24 ← Existing model VXS22

*3 VXS25/26 ← Existing model VXS23

Reduced coil temperature rise

100°C*4 ← 120°C

*4 VXS23 to 26 ← Existing model VXS22/23

Electrical entry

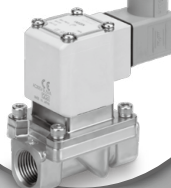
Grommet/DIN terminal
Conduit terminal/Conduit



24 VDC added



DIN terminal added



Body material

C37, Stainless steel



C37 body

Stainless steel body

High sealing performance

Internal leakage (Air)

1.0 cm³/min or less

Full-wave rectifier standardized

- Improved durability
- Reduced buzz noise
- Low-noise construction

Process Valves

VX2

VXD

VXZ

VXS

VXF2

SX10

Series VXS



Zero Differential Pressure Type Pilot Operated 2 Port Solenoid Valve *Series VXS*



Steam

Enclosure
IP65

Flame resistance
UL94V-0 conformed

Flame resistant mold coil material

24 VDC,
DIN terminal
standardized

Rubber seal
(special FKM) with high
sealing performance

Internal leakage (Air)
1.0 cm³/min or less

Reliability is improved due to a piston main valve and a rubber seal made of special FKM.

Double guide rings

- Stable sliding performance
- Improved scraper performance reduces the entry of foreign objects.

Clearance

Reduced power consumption

12 VA^{*1} ← 18 VA

15 VA^{*2} ← 20 VA

^{*1} VXS23/24 ← Existing model VXS22

^{*2} VXS25/26 ← Existing model VXS23

Reduced coil temperature rise

100°C^{*3} ← 120°C

^{*3} VXS23 to 26 ← Existing model VXS22/23

Improved armature durability

Low-noise construction

Noise reduction and low impact due to bumper

By providing a bumper and clearance, we reduced the collision sound of the core when ON (when the valve is open).

Body material
C37, Stainless steel

Built-in full-wave rectifier type (AC specification)

Improved durability

Service life is extended by the special construction. (compared with current shading coil)

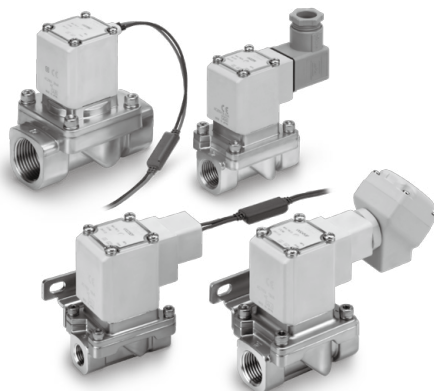
Reduced buzz noise

Rectified to DC by the full-wave rectifier, resulting in a buzz noise reduction.

Low-noise construction

Specially constructed to reduce the metal noise during operation.

Model	Size	Orifice diameter (mm)	Port size	Body material	Fluid
VXS23	10A	10	1/4, 3/8	C37	<p>Steam</p>
				Stainless steel	
VXS24	15A	15	1/2	C37	
				Stainless steel	
VXS25	20A	20	3/4	C37	
				Stainless steel	
VXS26	25A	25	1	C37	
				Stainless steel	

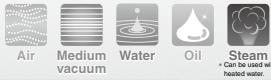


Variations

Series

Direct Operated

Series VX

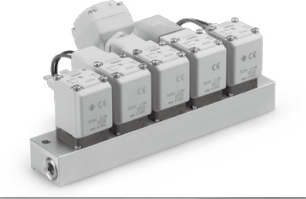


Single Unit



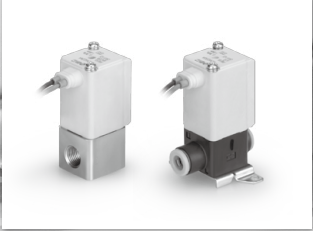
Valve type	Port size	Orifice diameter (mmø)
N.C./N.O.	1/8, 1/4, 3/8, 1/2, ø6, ø8, ø10, ø12	2, 3, 4, 5, 7, 8, 10

Manifold



Valve type	Port size				Orifice diameter (mmø)
N.C./ N.O.	Common SUP type		Individual SUP type		
	IN	OUT	IN	OUT	
	3/8	1/8 1/4	1/8 1/4	3/8	
					2, 3, 4, 5, 7

Compact Series VDW



Valve type	Port size	Orifice diameter (mmø)
N.C.	M5, 1/8, ø3.2, ø4, ø6	1, 1.6, 2.3, 3.2

Process Valves

VX2

VXD

VXZ

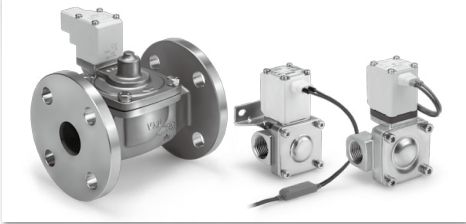
VXS

VXF2

SX10

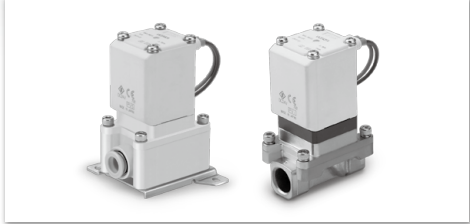
Pilot Operated

Series VXD



Valve type	Port size	Orifice diameter (mmø)
N.C./N.O.	1/4, 3/8, 1/2, 1, 32A, 40A, 50A, ø10, ø3/8", ø12	10, 15, 20, 25, 35, 40, 50

Zero differential pressure Series VXZ



Valve type	Port size	Orifice diameter (mmø)
N.C./N.O.	1/4, 3/8, 1/2, 3/4, 1, ø10, ø12, ø3/8"	10, 15, 20, 25

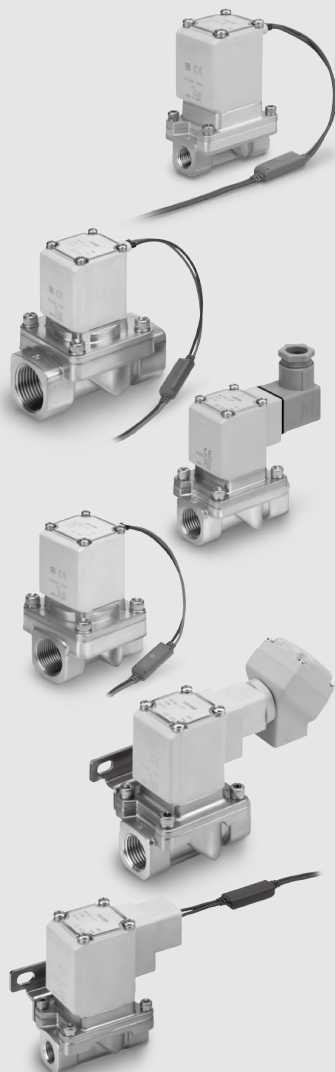
Fluid/Orifice Diameter

Series		Applicable fluid	Orifice diameter (mmø)				
			1	5	10	20	50
Direct Operated	Series VX*						
	* For single unit						
Pilot Operated	Series VDW						
	Series VXD						
	Series VXZ						

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Zero Differential Pressure Type Pilot Operated 2 Port Solenoid Valve

Series VXS



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For Steam

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Common Specifications/Selection Steps

Standard Specifications

Valve specifications	Valve construction		Zero differential pressure type pilot operated piston type
	Withstand pressure (with water pressure)		2.0 MPa
	Body material		C37 (Brass), Stainless steel
	Seal material		FKM
	Enclosure		Dust-tight, Water-jet-proof type (IP65)
Coil specifications	Environment		Location without corrosive or explosive gases
	Rated voltage	AC	100 VAC, 200 VAC, 110 VAC, 230 VAC, (220 VAC, 240 VAC, 48 VAC, 24 VAC) ^{Note)}
		DC	24 VDC
	Allowable voltage fluctuation		±10% of rated voltage
	Allowable leakage voltage	AC (Built-in full-wave rectifier type)	5% or less of rated voltage
	leakage voltage	DC	2% or less of rated voltage
		Coil insulation type	Class H

Note) Voltage in () indicates special voltage. (Refer to page 754.)

⚠ Be sure to read “Specific Product Precautions” before handling.

⚠ When pressure differential is less than 0.01 MPa, operation may become unstable. Please contact SMC in case of low flow operation. (Refer to page 756.)

Solenoid Coil Specifications

Normally Closed (N.C.)

DC Specification

Model	Power consumption (W) ^{Note 1)}	Temperature rise (°C) ^{Note 2)}
VXS23/24	12	100
VXS25/26	15	100

Note 1) The value at ambient temperature of 20°C and when the rated voltage is applied. (Variation: ±10%)

Note 2) The value at ambient temperature of 20°C and when the rated voltage is applied. The value depends on the ambient environment. This is for reference.

AC Specification (Built-in Full-wave Rectifier Type)

Model	Apparent power (VA) ^{Note 1) 2)}	Temperature rise (°C) ^{Note 3)}
VXS23/24	12	100
VXS25/26	15	100


Note 1) The value at ambient temperature of 20°C and when the rated voltage is applied. (Variation: ±10%)

Note 2) There is no difference in the frequency and the inrush and energized apparent power, since a rectifying circuit is used in the AC (Built-in full-wave rectifier type).

Note 3) The value at ambient temperature of 20°C and when the rated voltage is applied. The value depends on the ambient environment. This is for reference.

Selection Steps

Step 1 Select the fluid.

Item	Selection item	Page	Symbol	
Select the fluid.	Steam 	752	5	①

VXS2 3 ⑤ A B

Step 2 Select “Body material”, “Port size” and “Orifice diameter” from “Flow rate — Pressure” of each fluid.

Item	Selection item	Symbol	
Select from “Flow rate — Pressure.” • Body material • Port size • Orifice diameter	Size, Valve	Size 3	②
	Body material	C37	
	Port size	1/4	A
	Orifice diameter	10	

VXS2 ③ ⑤ ② A B

Step 3 Select electrical specification.

Item	Selection item	Symbol	
Select electrical specification.	Voltage	100 VAC	
	Electrical entry	Grommet	A

VXS2 3 5 A ④ B

Step 4 For other special options, refer to page 754.



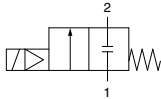
For Steam

* Can be used with heated water.

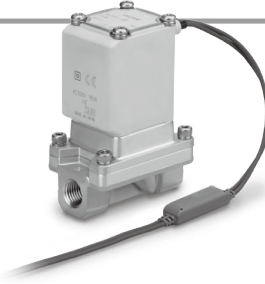
Model/Valve Specifications

N.C.

Symbol



When the valve is closed, flow is blocked from port 1 to port 2. However, if the pressure in port 2 is higher than port 1, the valve will not be able to block the fluid and it will flow from port 2 to port 1.



Normally Closed (N.C.)

Body material	Size	Port size (Nominal diameter)	Orifice diameter (mmø)	Model	Min. operating pressure differential Note 1) (MPa)	Max. operating pressure differential (MPa)		Flow-rate characteristics		Max. system pressure (MPa)	Weight Note 2) (g)
						AC	DC	Av x 10 ⁻⁶ m ²	Cv		
C37, Stainless steel	3	1/4 (8A)	10	VXS235	0	1.0		58	2.4	1.0	600
		3/8 (10A)		VXS245				67	2.8		
	4	1/2 (15A)	15	VXS245				130	5.3		720
	5	3/4 (20A)	20	VXS255				220	9.2		1100
	6	1 (25A)	25	VXS265				290	12.0		1300

Note 1) The operation of the valve may be unstable due to the capacity of the pressure supply source such as pumps and boilers or the pressure loss by the orifice of piping. Please contact SMC to check if the required valve size can be used in the application. Please contact SMC for the compatibility of the circuit flow and valve size. (Refer to page 756.)

Note 2) Weight of grommet type. Add 10 g for conduit, 30 g for DIN terminal, and 60 g for conduit terminal type respectively.

● Refer to "Glossary of Terms" on page 759 for details on the maximum operating pressure differential.

Fluid and Ambient Temperature

Fluid	Temperature (°C)	Ambient temperature (°C)
Steam	183 or less	-20 to 60
Heated water	99 or less	

Note) With no freezing

Valve Leakage Rate

Internal Leakage

Fluid	Seal material	Leakage rate
Steam	FKM	1 cm ³ /min or less
Heated water		0.1 cm ³ /min or less

External Leakage

Fluid	Seal material	Leakage rate
Steam	FKM	1 cm ³ /min or less
Heated water		0.1 cm ³ /min or less

Note) Leakage is the value at ambient temperature 20°C.

Process Valves

VX2

VXD

VXZ

VXS

VXF2

SX10

How to Order



VXS2 **3** **5** **A** **B**

Fluid

5 For Steam

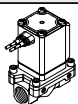
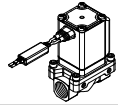
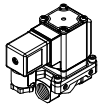
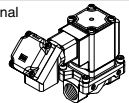
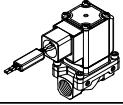
Size/Valve type

Symbol	Size	Valve type
3	10A	N.C.
4	15A	N.C.
5	20A	N.C.
6	25A	N.C.

Body material/Port size/Orifice diameter

Symbol	Body material	Port size	Orifice diameter
A	C37	1/4	10
B		3/8	
C	Stainless steel	1/4	
D		3/8	
F	C37	1/2	15
G	Stainless steel		
H	C37	3/4	20
J	Stainless steel		
K	C37	1	25
L	Stainless steel		

Voltage/Electrical entry

Symbol	Voltage	Electrical entry
A	24 VDC	Grommet 
B	100 VAC	Grommet (With surge voltage suppressor) 
C	110 VAC	
D	200 VAC	
E	230 VAC	DIN terminal (With surge voltage suppressor Note 1) 2) 
G	24 VDC	
H	100 VAC	
J	110 VAC	
K	200 VAC	Conduit terminal (With surge voltage suppressor) 
L	230 VAC	
N	100 VAC	
P	110 VAC	Conduit (With surge voltage suppressor) 
Q	200 VAC	
R	230 VAC	
T	100 VAC	
U	110 VAC	
V	200 VAC	
W	230 VAC	
Z	Other voltages	

Note 1) Coil for DIN terminal H type with AC voltage does not have full-wave rectifier. Full-wave rectifier is built in the DIN connector. Refer to page 758 to order it as an accessory.

Note 2) DIN connector insulation class is Class "B".

Note 3) Flat terminal is not available.

For other special options, refer to page 754.

Special voltage	24 VAC
	48 VAC
	220 VAC
	240 VAC
DIN terminal with light	
Conduit terminal with light	
Without DIN connector	
Oil-free	
G thread	
NPT thread	
With bracket	
Special electrical entry direction	

Series VXS

Other Special Options

Electrical options (Special voltage, With light)

VXS2 **3** **5** **A** **Z** **1A**

Enter standard product number.

Electrical option

Special voltage/Electrical entry/Electrical option

Specification	Symbol	Voltage	Electrical entry
Special voltage	1A	48 VAC	Grommet (With surge voltage suppressor)
	1B	220 VAC	
	1C	240 VAC	
	1U	24 VAC	
	1F	48 VAC	DIN terminal (With surge voltage suppressor)
	1G	220 VAC	
	1H	240 VAC	
	1V	24 VAC	
	1K	48 VAC	Conduit terminal (With surge voltage suppressor)
	1L	220 VAC	
	1M	240 VAC	
	1W	24 VAC	
With light	1P	48 VAC	Conduit (With surge voltage suppressor)
	1Q	220 VAC	
	1R	240 VAC	
	1Y	24 VAC	
	2A	24 VDC	DIN terminal (With surge voltage suppressor)
	2B	100 VAC	
	2C	110 VAC	
	2D	200 VAC	
	2E	230 VAC	
	2F	48 VAC	
	2G	220 VAC	Conduit terminal (With surge voltage suppressor)
	2H	240 VAC	
	2V	24 VAC	
	2L	100 VAC	
	2M	110 VAC	
	2N	200 VAC	
	2P	230 VAC	Conduit terminal (With surge voltage suppressor)
	2Q	48 VAC	
	2R	220 VAC	
	2S	240 VAC	
	2W	24 VAC	

Other options (Oil-free, Port thread)

VXS2 **3** **5** **A** **A** **Z**

Enter standard product number.

Other option

Oil-free/Port thread

Symbol	Oil-free	Port thread
Nil	—	Rc
A	—	G
B	—	NPT
D	○	G
E	—	NPT
Z	○	Rc

Process Valves

VX2

VXD

VXZ

VXS

VXF2

SX10

* Enter symbols in the order below when ordering a combination of electrical option, other option, etc.

Example VXS2 **3** **5** **A** **Z** **1A** **Z** **XB** **A**

Electrical option

Other option

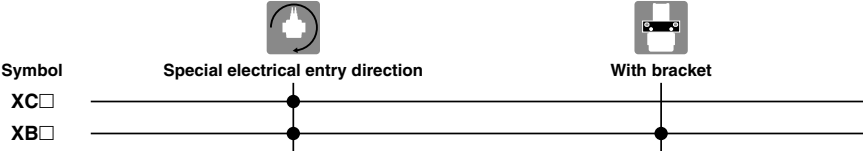
Special electrical entry direction

With bracket

Installation options
(Mounting option/Special electrical entry direction)

The following shows combinations that can be selected using installation options.

Combinations



Special Electrical Entry Direction

VXS2 XC **A**

Enter standard product number.

Symbol	Rotation angle
A	90°
B	180°
C	270°

*1 Available for the VXS23 to 26.
*2 Bracket is packed in the same container as the main body.

**With Bracket/
Special Electrical Entry Direction**

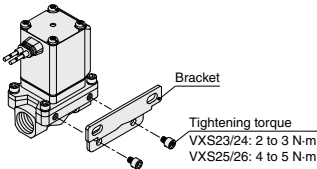
VXS2 XB **A**

Enter standard product number.

Symbol	Rotation angle
Nil	Standard
A	90°
B	180°
C	270°

*1 Available for the VXS23 to 26.
*2 Bracket is packed in the same container as the main body.

How to mount a bracket



* Enter symbols in the order below when ordering a combination of electrical option, other option, etc.

Example) VXS2 **3** **5** **A** **Z** **1A** **Z** **XB** **A**

Electrical option

Other option

Special electrical entry direction

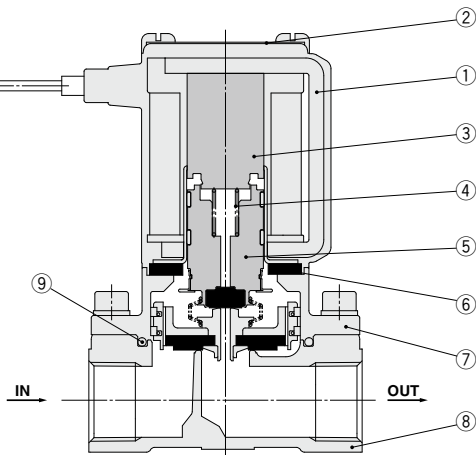
With bracket

Construction/Normally Closed (N.C.)

Body material: C37, Stainless steel

Component Parts

No.	Description	Material
1	Solenoid coil	Cu + Fe + Resin
2	Coil cover	Stainless steel
3	Tube assembly	Stainless steel
4	Return spring	Stainless steel
5	Armature/Piston assembly	Stainless steel, FKM
6	Stopper	FKM
7	Bonnet	C37, Stainless steel
8	Body	C37, Stainless steel
9	O-ring	FKM



Process Valves

VX2

VXD

VXZ

VXS

VXF2

SX10

Working Principle

De-energized

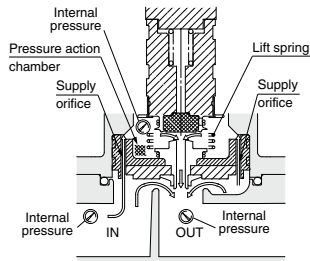
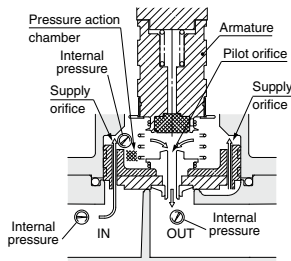
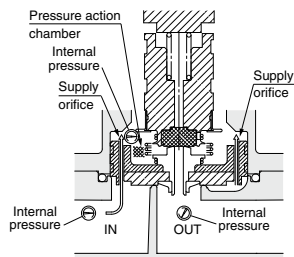
The fluid enters from the IN goes through the supply orifice to fill the pressure action chamber. Main valve is closed by the pressure in the pressure action chamber and the reaction force of the return spring.

Right after energized (Pilot valve open)

When the coil is energized, the armature is attracted causing the pilot orifice to opening. The fluid filling the pressure action chamber flows to the OUT side through the pilot orifice.

Energized (Main valve side)

The pressure in the pressure action chamber decreases by discharging fluid through the pilot orifice. Because the force which pushes down the valve is reduced by the discharge of the fluid, the force that pushes up the main valve overcomes the push down force and opens the main valve. The main valve opens by the lift spring reaction force even if pressure on the IN side is 0 MPa or very low pressure.

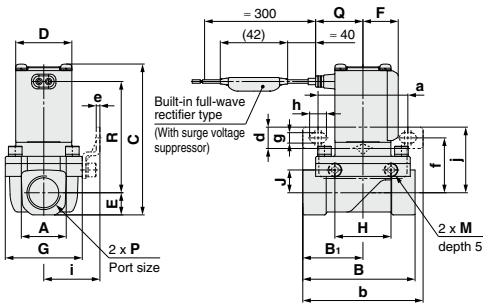


Warning

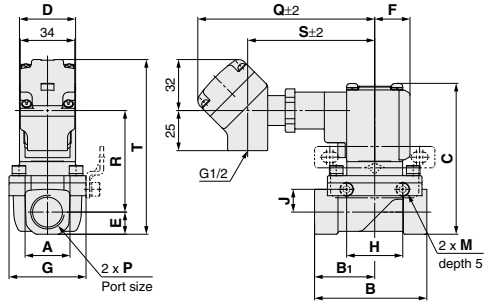
Unstable flow may occur with the product under the following conditions: • low flow from the pump or boiler, etc. • use of several elbows or tees in the circuit, or • thin nozzles installed at the end of the piping etc. This can cause valve opening/closing failure, or oscillation, and cause a valve malfunction. If products are used with vacuum, then the vacuum level can be unstable due to these conditions. Please contact SMC to check if the valve can be used in the application by providing the relevant fluid circuit.

Dimensions/Body Material: C37, Stainless Steel

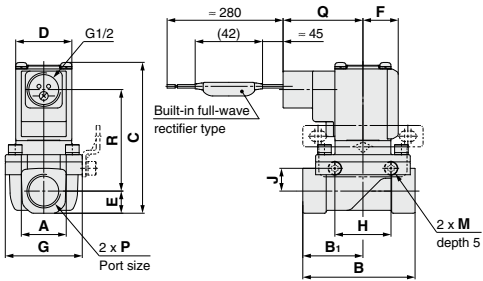
Grommet



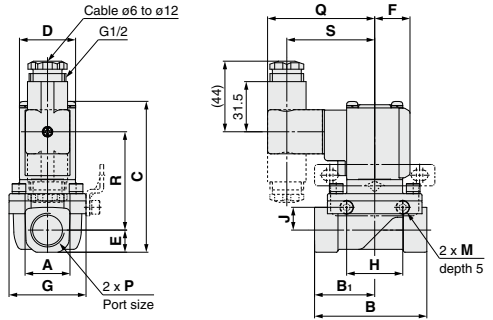
Conduit terminal



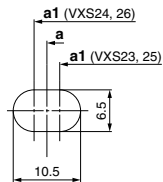
Conduit



DIN terminal



Bracket mounting hole



Dimensions

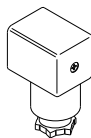
(mm)

Model	Port size P	A	B	B ₁	C	D	E	F	G	H	J	M	Bracket mounting								
													a	b	d	e	f	g	h	i	j
VXS23	1/4, 3/8	21	57	28.5	87.5	35	10.5	22	40	35	10	M5	56	75		2.3	30	6.5	10.5	31	37
VXS24	1/2	28	70	37.5	94	35	14	22	48	35	14	M5	56	75		2.3	34	6.5	10.5	35	41
VXS25	3/4	33.5	71	38.5	105.5	40	17	24.5	62	33	15.2	M6	70.5	92		2.3	39	6.5	10.5	43	46
VXS26	1	42	95	49.5	111.5	40	20	24.5	66	37	17.2	M6	70.5	92	2.3	41	6.5	10.5	45	48	

Model	Port size P	Electrical entry										
		Grommet		DIN terminal			Conduit terminal			Conduit		
		Q	R	Q	R	S	Q	R	S	T	Q	R
VXS23	1/4, 3/8	29.5	66	67	58	55	110.5	60	79.5	102.5	50	60
VXS24	1/2	29.5	69.5	67	61.5	55	110.5	63.5	79.5	109	50	63.5
VXS25	3/4	32	78	69.5	70	57.5	113	72	82	120.5	52.5	72
VXS26	1	32	81	69.5	72.5	57.5	113	74.5	82	126.5	52.5	74.5

Replacement Parts

• DIN Connector Part No.



<Coil Insulation Type/Class H>

Electrical option	Rated voltage	Connector part no.
None	24 VDC	GDM2A-G-S5
	100 VAC	GDM2A-R
	110 VAC	
	200 VAC	
	220 VAC	
	230 VAC	
	240 VAC	
	24 VAC	
	48 VAC	
With light	24 VDC	GDM2A-G-Z5
	100 VAC	GDM2A-R-L1
	110 VAC	GDM2A-R-L1
	200 VAC	GDM2A-R-L2
	220 VAC	GDM2A-R-L2
	230 VAC	GDM2A-R-L2
	240 VAC	GDM2A-R-L2
	24 VAC	GDM2A-R-L5
	48 VAC	GDM2A-R-L5

• Gasket Part No. for DIN Connector

VCW20-1-29-1-F

• Bracket Assembly Part No.

VXZ 3 0S-14A-1

3	VXS2 $\frac{3}{8}$ 5□
5	VXS2 $\frac{5}{8}$ 5□

* 2 mounting screws are shipped together with the bracket assembly.

Process Valves

VX2

VXD

VXZ

VXS

VXF2

SX10

Glossary of Terms

Pressure Terminology

1. Maximum operating pressure differential

The maximum pressure differential (the difference between the inlet and outlet pressure) which is allowed for operation. When the outlet pressure is 0 MPa, this becomes the maximum operating pressure.

2. Minimum operating pressure differential

The minimum pressure differential (the difference between the inlet pressure and outlet pressure) required to keep the main valve fully open.

3. Maximum system pressure

The maximum pressure that can be applied inside the pipelines (line pressure).

[The pressure differential of the solenoid valve portion must be less than the maximum operating pressure differential.]

4. Withstand pressure

The pressure in which the valve must be withstood without a drop in performance after holding for one minute under prescribed pressure (static pressure) and returning to the operating pressure range. [value under the prescribed conditions]

Electrical Terminology

1. Apparent power (VA)

Volt-ampere is the product of voltage (V) and current (A).

Power consumption (W): For AC, $W = V \cdot A \cdot \cos\theta$. For DC, $W = V \cdot A$.

Note) $\cos\theta$ shows power factor. $\cos\theta = 0.9$

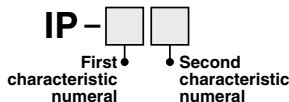
2. Surge voltage

A high voltage which is momentarily generated by shutting off the power in the shut-off area.

3. Degree of protection

A degree defined in the "JIS C 0920: Waterproof test of electric machinery/appliance and the degree of protection against the intrusion of solid foreign objects."

Verify the degree of protection for each product.



● First Characteristics:

Degrees of protection against solid foreign objects

0	Non-protected
1	Protected against solid foreign objects of 50 mmφ and greater
2	Protected against solid foreign objects of 12 mmφ and greater
3	Protected against solid foreign objects of 2.5 mmφ and greater
4	Protected against solid foreign objects of 1.0 mmφ and greater
5	Dust-protected
6	Dust-tight

Electrical Terminology

● Second Characteristics:

Degrees of protection against water

0	Non-protected	—
1	Protected against vertically falling water drops	Dripproof type 1
2	Protected against vertically falling water drops when enclosure tilted up to 15°	Dripproof type 2
3	Protected against rainfall when enclosure tilted up to 60°	Rainproof type
4	Protected against splashing water	Splashproof type
5	Protected against water jets	Water-jet-proof type
6	Protected against powerful water jets	Powerful water-jet-proof type
7	Protected against the effects of temporary immersion in water	Immersible type
8	Protected against the effects of continuous immersion in water	Submersible type

Example) IP65: Dust-tight, Water-jet-proof type

"Water-jet-proof type" means that no water intrudes inside an equipment that could hinder from operating normally by means of applying water for 3 minutes in the prescribed manner. Take appropriate protection measures, since a device is not usable in an environment where a droplet of water is splashed constantly.

Others

1. Material

FKM: Fluororubber

2. Oil-free treatment

The degreasing and washing of wetted parts

3. Symbol

When the valve is closed, flow is blocked from port 1 to port 2.

However, if the pressure in port 2 is higher than port 1, the valve will not be able to block the fluid and it will flow from port 2 to port 1.

Solenoid Valve Flow-rate Characteristics

(How to indicate flow-rate characteristics)

1. Indication of flow-rate characteristics

The flow-rate characteristics in equipment such as a solenoid valve etc., are indicated in their specifications as shown in Table (1).

Table (1) Indication of Flow-rate Characteristics

Corresponding equipment	Indication by international standard	Other indications	Conformed standard
Process fluid control equipment	Av	—	IEC60534-2-3: 1997 JIS B 2005: 1995 Equipment: JIS B 8471, 8472, 8473
	—	Cv	
Pneumatic equipment	C, b	—	ISO 6358: 1989 JIS B 8390: 2000
	—	S	JIS B 8390: 2000 Equipment: JIS B 8373, 8374, 8375, 8379, 8381
		Cv	ANSI/(NFPA) T3.21.3: 1990

2. Process fluid control equipment

(1) Conformed standard

IEC60534-2-3: 1997: Industrial-process control valves. Part 2: Flow capacity, Section Three-
Test procedures

JIS B 2005: 1995: Test method for the flow coefficient of a valve

Equipment standards: JIS B 8471: Solenoid valve for water

JIS B 8472: Solenoid valve for steam

JIS B 8473: Solenoid valve for fuel oil

(2) Definition of flow-rate characteristics

Av factor: Value of the clean water flow rate represented by m^3/s which runs through a valve (equipment for test) when the pressure differential is 1 Pa. It is calculated using the following formula.

$$Av = Q \sqrt{\frac{\rho}{\Delta P}} \quad \dots \dots \dots (1)$$

Av : Flow coefficient [m^2]

Q : Flow rate [m^3/s]

ΔP : Pressure differential [Pa]

ρ : Fluid density [kg/m^3]

(3) Formula of flow rate

It is described by the practical units. Also, the flow-rate characteristics are shown in Graph (1).

In the case of liquid:

$$Q = 1.9 \times 10^6 Av \sqrt{\frac{\Delta P}{G}} \quad \dots \dots \dots (2)$$

Q : Flow rate [L/min]

Av : Flow coefficient [m^2]

ΔP : Pressure differential [MPa]

G : Relative density [water = 1]

In the case of saturated steam:

$$Q = 8.3 \times 10^6 Av \sqrt{\Delta P (P_2 + 0.1)} \quad \dots \dots \dots (3)$$

Q : Flow rate [kg/h]

Av : Flow coefficient [m^2]

ΔP : Pressure differential [MPa]

P_1 : Upstream pressure [MPa] : $\Delta P = P_1 - P_2$

P_2 : Downstream pressure [MPa]

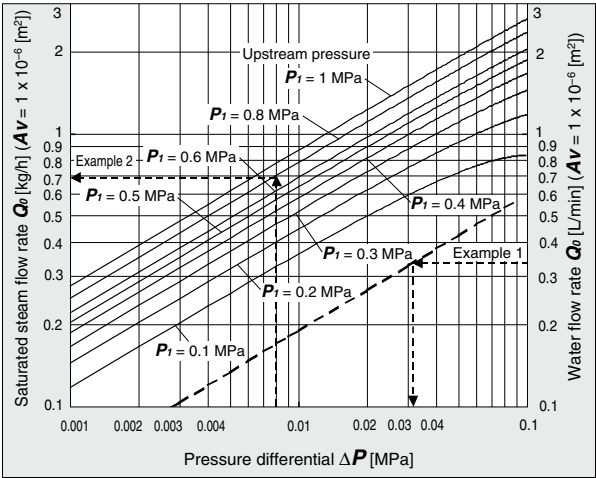
Conversion of flow coefficient:

$Av = 28 \times 10^{-6} Kv = 24 \times 10^{-6} Cv$ (4)

Here, **Kv** factor : Value of the clean water flow rate represented by m³/h which runs through a valve at 5 to 40°C, when the pressure differential is 1 bar.

Cv factor (Reference values): Figures representing the flow rate of clean water by US gal/min which runs through a valve at 60°F, when the pressure differential is 1 lbf/in² (psi).

Value is different from **Kv** and **Cv** factors for pneumatic purpose due to different test method.



Graph (1) Flow-rate characteristics

Example 1)

Obtain the pressure differential when water 15 [L/min] runs through a solenoid valve with an $Av = 45 \times 10^{-6} [m^2]$. Since $Q_0 = 15/45 = 0.33 [L/min]$, according to Graph (1), if reading ΔP when Q_0 is 0.33, it will be 0.031 [MPa].

Example 2)

Obtain the saturated steam flow rate when $P_t = 0.8 [MPa]$, $\Delta P = 0.008 [MPa]$ with a solenoid valve with an $Av = 1.5 \times 10^{-6} [m^2]$. According to Graph (1), if reading Q_0 when P_t is 0.8 and ΔP is 0.008, it is 0.7 [kg/h]. Therefore, the flow rate $Q = 0.7 \times 1.5 = 1.05 [kg/h]$.

(4) Test method

Attach a test equipment with the test circuit shown in Fig. (2). Next, pour water at 5 to 40°C, then measure the flow rate with a pressure differential of 0.075 MPa. However, the pressure differential needs to be set with a large enough difference so that the Reynolds number does not go below a range of 4×10^4 .

By substituting the measurement results for formula (1) to figure out **Av**.

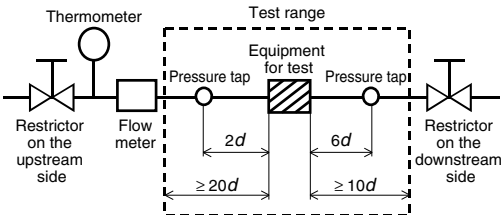
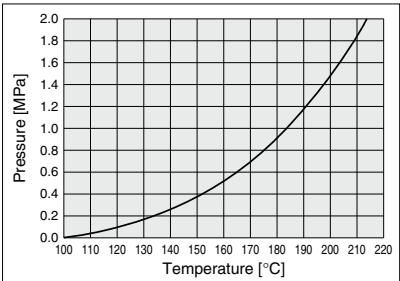


Fig. (2) Test circuit based on IEC60534-2-3, JIS B 2005

Vapor Dome (Water)

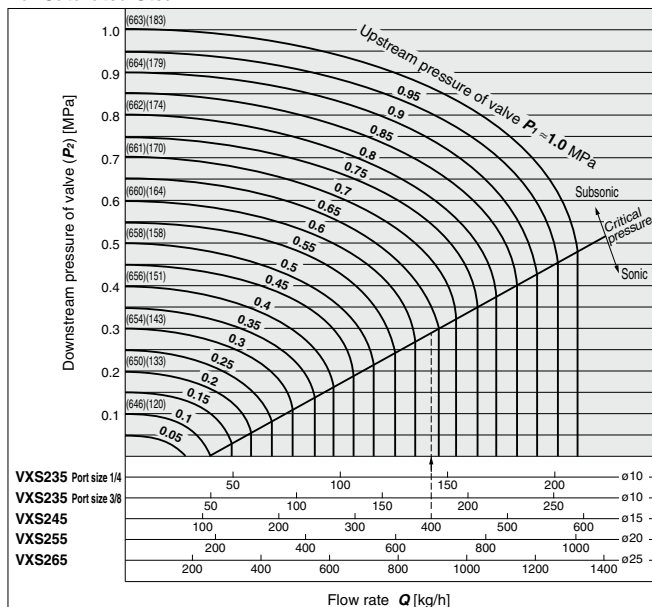


The above chart is calculated using the Antoine equation.

Flow-rate Characteristics

Note) Use this graph as a guide. In the case of obtaining an accurate flow rate, refer to pages 760 and 761.

For Saturated Steam



(): Saturated steam holding heat (kcal/kg) (): Saturation temperature (°C)

How to read the graph

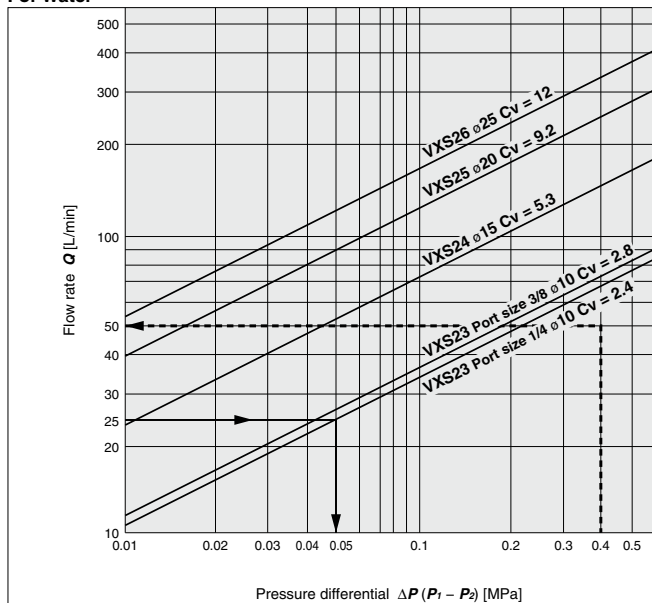
The sonic range pressure to generate a flow rate of 400 kg/h is as follows.

For a $\phi 15$ orifice (VXS224□-04),

$P_1 \approx 0.64$ MPa

The holding heat slightly differs depending on the pressure P_1 , but at 400 kg/h it is approx. 25900 kcal/h.

For Water



How to read the graph

The pressure differential to generate a flow rate of 25 L/min water is as follows.

For a $\phi 10$ orifice (VXS23/Port size 1/4),

$\Delta P \approx 0.05$ MPa

The optimum size for a pressure differential of $\Delta P \approx 0.2$ MPa and a flow of 50 L/min will be the VXS23 ($\phi 10$ orifice, port size 3/8).



Series VXS

Specific Product Precautions 1

Be sure to read before handling. Refer to page 1154 for Safety Instructions, "Handling Precautions for SMC Products" (M-E03-3) and the Operation Manual for 2 Port Solenoid Valves for Fluid Control Precautions. Please download it via our website, <http://www.smcworld.com>

Design

Warning

1. Cannot be used as an emergency shutoff valve etc.

The valves presented 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.

2. Extended periods of continuous energization

The solenoid coil will generate heat when continuously energized. Avoid using in a tightly shut container. Install it in a well ventilated area. Furthermore, do not touch it while it is being energized or right after it is energized.

3. Liquid rings

In cases with a flowing liquid, provide a bypass valve in the system to prevent the liquid from entering the liquid seal circuit.

4. Pressure holding

It is not usable for an application such as holding the pressure inside of a pressure vessel because air leakage is entailed in a valve.

5. When the conduit type is used as equivalent to an IP65 enclosure, install a wiring conduit etc.

6. When an impact, such as steam hammer etc., caused by the rapid pressure fluctuation is applied, the solenoid valve may be damaged. Give an attention to it.

Selection

Warning

1. Usage with low flow

Unstable flow may occur with the product under the following conditions: • low flow from the pump or boiler, etc. • use of several elbows or tees in the circuit, or • thin nozzles installed at the end of the piping etc. This can cause valve opening/closing failure, or oscillation, and cause a valve malfunction.

Check the pressure differential and flow to select the appropriate size of the valve referring to the Flow-rate Characteristics on page 762. Ensure that pressure differential does not become lower than 0.01 MPa during ON (N.C.: Valve open).

2. Fluid

1) Corrosive gas

Cannot be used since it will lead to cracks by stress corrosion or result in other incidents.

2) When a brass body is used, then depending on water quality, corrosion and internal leakage may occur. If such abnormalities occur, exchange the product for a stainless steel body.

3) Use an oil-free specification when any oily particle must not enter the passage.

Selection

Warning

3. Air quality

<Steam, Water>

The use of a fluid that contains foreign objects can cause problems such as malfunction and seal failure by promoting wear of the valve seat and armature, and by sticking to the sliding parts of the armature etc. Install a suitable filter (strainer) immediately upstream from the valve. As a general rule, use 100 mesh.

As a standard, the mesh count for the strainer is 100 mesh. However, the size and shape of foreign objects that occur depends on the operating environment. Check the fluid status and choose an appropriate mesh count.

The supply water to a boiler includes materials that create a hard sediment or sludge such as calcium and magnesium.

Sediment and sludge from steam can cause the valve to not operate properly. Install a water softening device, which removes these materials. Do not use operation steam which contains chemicals, synthetic oils containing organic solvents, salts or corrosive gases, etc., as these can cause damage or deterioration.

Since the special FKM used for this product improves the alkali-resistance when compared to the general FKM, it can be used for the steam, into which the boiler compound is charged.

However, the resistance to other chemicals, such as organic solvent is the same as the general FKM. So, use this product after checking the resistance to the components included in the boiler compound.

4. Ambient environment

Use within the operable ambient temperature range. Check the compatibility between the product's composition materials and the ambient atmosphere. Be certain that the fluid used does not touch the external surface of the product.

5. Low temperature operation

1) The valve can be used in an ambient temperature of between -20 to -10°C. However, take measures to prevent freezing or solidification of impurities, etc.

2) When using valves for water application in cold climates, take appropriate countermeasures to prevent the water from freezing in tubing after cutting the water supply from the pump, by draining the water etc. When warming by a heater etc., be careful not to expose the coil portion to a heater. Installation of a dryer, heat retaining of the body is recommended to prevent a freezing condition in which the dew point temperature is high and the ambient temperature is low, and the high flow runs.



Series VXS

Specific Product Precautions 2

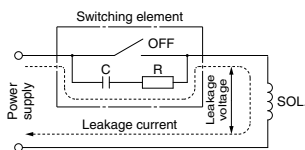
Be sure to read before handling. Refer to page 1154 for Safety Instructions, "Handling Precautions for SMC Products" (M-E03-3) and the Operation Manual for 2 Port Solenoid Valves for Fluid Control Precautions. Please download it via our website, <http://www.smcworld.com>

Selection

⚠ Caution

1. Leakage voltage

Particularly when using a resistor in parallel with a switching element and using a C-R element (surge voltage suppressor) to protect the switching element, take note that leakage current will flow through the resistor, C-R element, etc., creating a possible danger that the valve may not turn off.



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

Mounting

⚠ Warning

1. If air leakage increases or equipment does not operate properly, stop operation.

After mounting is completed, confirm that it has been done correctly by performing a suitable function test.

2. Do not apply external force to the coil section.

When tightening is performed, apply a wrench or other tool to the outside of the piping connection parts.

3. Mount a valve with its coil position upward, not downward.

When mounting a valve with its coil positioned downward, foreign objects in the fluid will adhere to the iron core leading to a malfunction. Especially for strict leakage control, the coil must be positioned upward.

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. They can cause the coil to burn out.

5. Secure with brackets, except in the case of steel piping and copper fittings.

6. Avoid sources of vibration, or adjust the arm from the body to the minimum length so that resonance will not occur.

7. 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 is connected, it should be thoroughly blown out with air (flushing) or washed to remove chips, cutting oil and other debris from inside the pipe. Avoid pulling, compressing, or bending the valve body when piping.

2. Avoid connecting ground lines to piping, as this may cause electric corrosion of the system.

3. Always tighten threads with the proper tightening torque.

Refer to the tightening torque in the table below for connecting steel piping. Lower tightening torque will lead into fluid leakage. For mounting the fittings, refer to the specified torque.

Tightening Torque for Piping

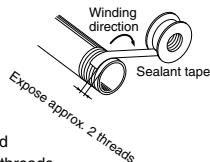
Connection thread	Proper tightening torque (N·m)
Rc1/8	3 to 5
Rc1/4	8 to 12
Rc3/8	15 to 20
Rc1/2	20 to 25
Rc3/4	20 to 25
Rc1	36 to 38

4. Connection of piping to products

When connecting piping to a product, avoid mistakes regarding the supply port etc.

5. Wrapping of sealant tape

When connecting pipes, fittings, etc., be sure that chips from the pipe threads and sealing material do not enter the valve. Furthermore, when sealant tape is used, leave 1.5 to 2 thread ridges exposed at the end of the threads.



6. If an excessive amount of thread sealant such as sealant tape or liquid thread sealant is used during piping, it will get inside the product and lead to malfunction.

7. Steam generated in a boiler contains a large amount of drainage. Be sure to operate it with a drain trap installed.

8. Arrange piping so that condensate will not accumulate in the solenoid valve.

Install the piping to the solenoid valve higher than peripheral piping. Be sure to avoid installing the piping to the solenoid valve at the lowest part of the piping layout. If condensate accumulates in the solenoid valve or peripheral piping, the steam entering the piping will cause steam hammer. This will lead to destruction and malfunction of the solenoid valve and piping. If steam hammer causes problems, install bypass piping to thoroughly discharge condensate from the piping. Apply steam to the device afterward to start operation.



Series VXS

Specific Product Precautions 3

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Piping

Caution

9. If the effective area of piping on the fluid supply side is restricted, the operating time may become unstable due to differential pressure fluctuation when the valve is closed.
10. For the convenience of maintenance and repair, install a bypass circuit and use a union for piping.
11. To control the fluid in the tank, connect the piping a little higher than the bottom of the tank.

Wiring

Caution

1. As a rule, use electrical wire with a cross sectional area of 0.5 to 1.25 mm² for wiring. Furthermore, do not allow excessive force to be applied to the lines.
2. Use electrical circuits which do not generate chattering in their contacts.
3. Use voltage which is within $\pm 10\%$ of the rated voltage. In cases with a DC power supply where importance is placed on responsiveness, stay within $\pm 5\%$ of the rated value. The voltage drop is the value in the lead wire section connecting the coil.
4. When a surge from the solenoid affects the electrical circuitry, install a surge voltage suppressor etc., in parallel with the solenoid. Or, adopt an option that comes with the surge voltage protection circuit. (However, a surge voltage occurs even if the surge voltage protection circuit is used. For details, please consult with SMC.)
5. Do not apply AC voltage to AC type unless it is built in full-wave rectifier, or the coil will be damaged.

Operating Environment

Warning

1. Do not use in an atmosphere having corrosive gases, chemicals, sea water, water, water vapor, or where there is direct contact with any of these.
2. Do not use in explosive atmospheres.
3. Do not use in locations subject to vibration or impact.
4. Do not use in locations where radiated heat will be received from nearby heat sources.
5. Employ suitable protective measures in locations where there is contact with water droplets, oil or welding spatter, etc.

Maintenance

Warning

1. Removing the product

The valve will reach a high temperature when used with high temperature fluids. Confirm that the valve temperature has dropped sufficiently before performing work. If touched inadvertently, there is a danger of being burned.

- 1) Shut off the fluid supply and release the fluid pressure in the system.
- 2) Shut off the power supply.
- 3) Dismount the product.

2. Low frequency operation

Switch valves at least once every 30 days to prevent a malfunction. Also, in order to use it under the optimum state, conduct a regular inspection once a half year.

Caution

1. Strainers

- 1) Be careful regarding clogging of strainers.
- 2) Clean strainers when the pressure drop reaches 0.1 MPa.

2. Lubrication

When using after lubricating, never forget to lubricate continuously.

3. Storage

In case of long term storage after use, thoroughly remove all moisture to prevent rust and deterioration of rubber materials etc.

4. Exhaust the drainage from the piping periodically.

Operating Precautions

Warning

1. The valve will reach a high temperature when used with high temperature fluids. Use caution, as there is a danger of being burned if a valve is touched directly.
2. The valve may become hot if energized continuously. Use caution, as there is a danger of being burned if a valve is touched directly.
3. If there is a possibility of reverse pressure being applied to the valve, take countermeasures such as mounting a check valve on the downstream side of the valve.
4. When problems are caused by a steam hammer, install a steam hammer relief device such as an accumulator.
5. When the pilot type 2 port solenoid valve is closed, and pressure is applied suddenly due to the starting of fluid supply source such as a boiler, the valve may open momentarily and fluid may leak.
6. If the product is used in the conditions in which rapid decrease in the inlet pressure of the valve and rapid increase in the outlet pressure of the valve are repeated, excessive stress will be applied to the piston, which causes the piston to be damaged and dropped, leading to the operation failure of the valve. Check the operating conditions before use.



Series VXS

Specific Product Precautions 4

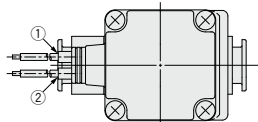
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Electrical Connections

⚠ Caution

■ Grommet

Class H coil: AWG18 Insulator O.D. 2.1 mm

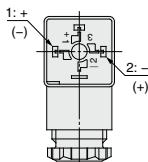


Rated voltage	Lead wire color	
	①	②
DC	Black	Red
100 VAC	Blue	Blue
200 VAC	Red	Red
Other AC	Gray	Gray

* There is no polarity.

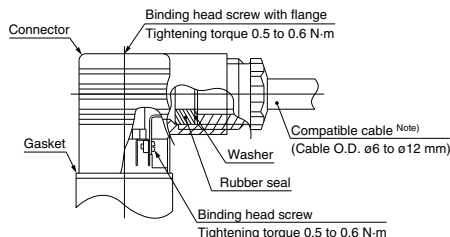
■ DIN terminal

Since internal connections are as shown below for the DIN terminal, make connections to the power supply accordingly.



Terminal no.	1	2
DIN terminal	+ (-)	- (+)

- * There is no polarity.
- Use a heavy-duty cord with cable O.D. of $\phi 6$ to $\phi 12$ mm.
- Use the tightening torques below for each section.



Note) For cable O.D. of $\phi 9$ to $\phi 12$ mm, remove the internal parts of the rubber seal before using.

[Change of electrical entry]

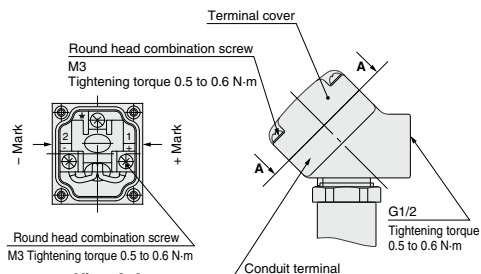
Wire entry can be changed by mounting the housing in either direction (four directions at every 90°) after dividing the terminal block and the housing.

- * For the indicator lighted style, be careful not to damage the light with the lead wire of the cable.

■ Conduit terminal

In the case of the conduit terminal, make connections according to the marks shown below.

- Use the tightening torques below for each section.
- Properly seal the terminal connection (G1/2) with the special wiring conduit etc.



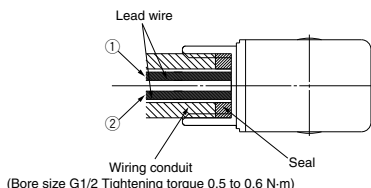
View A-A

(Internal connection diagram)

■ Conduit

When used as an IP65 equivalent, use seal to install the wiring conduit. Also, use the tightening torque below for the conduit.

Class H coil: AWG18 Insulator O.D. 2.1 mm



Rated voltage	Lead wire color	
	①	②
DC	Black	Red
100 VAC	Blue	Blue
200 VAC	Red	Red
Other AC	Gray	Gray

- * There is no polarity.
- (For the power saving type, there is polarity.)

Description	Part no.
Seal	VCW20-15-6

Note) Please order separately.

Process Valves

VX2

VXD

VXZ

VXS

VXF2

SX10



Series VXS

Specific Product Precautions 5

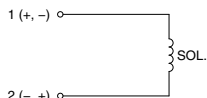
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Electrical Circuits

⚠ Caution

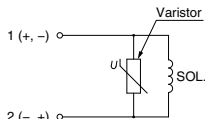
[DC circuit]

Grommet



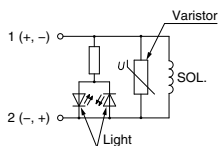
Without electrical option

DIN terminal



With surge voltage suppressor

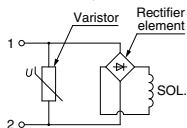
DIN terminal, Conduit terminal



With light/surge voltage suppressor

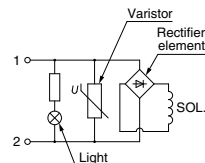
[AC circuit]

Grommet, DIN terminal,
Conduit terminal, Conduit



With surge voltage suppressor

DIN terminal, Conduit terminal



With light/surge voltage suppressor

DIN terminal H type with AC voltage has full-wave rectifier built in the DIN connector. Coil does not have full-wave rectifier.