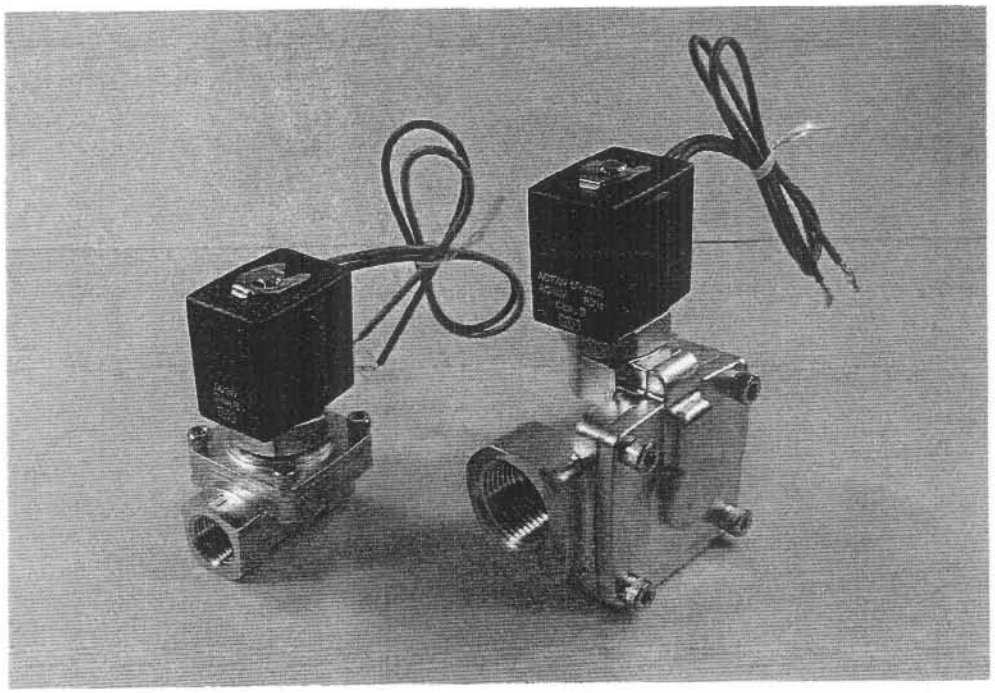
SMC

Pilot 2-port Solenoid Valve

Series VXD21/22/23

Operation Manual



Registration No.	VXDN＊＊＊－OMJ0002

Symb	Part	Revision	Date	YMO

SMC Corporation

Contents

Series VXD21/22/23
Safety Instructions

These safety instructions are intended to prevent a hazardous situation and/or equipment damage. These instructions indicate the level of potential hazard by labels of **"Caution", "Warning"** or **"Danger"**. To ensure safety, be sure to observe ISO 4414 Note 1), JIS B 8370 Note 2) and other safety practices.

⚠ **Caution :** Operator error could result in injury or equipment damage.

⚠ **Warning :** Operator error could result in serious injury or loss of life.

⚠ **Danger :** In extreme conditions, there is a possible result of serious injury or loss of life.

Note 1) ISO 4414: Pneumatic fluid power--General rules relating to systems.
Note 2) JIS B 8370: General Rules for Pneumatic Equipment

⚠ Warning

1. **The compatibility of the pneumatic equipment is the responsibility of the person who designs the pneumatic system or decides its specifications.**
   Since the products specified here are used in various operating conditions, their compatibility for the specific pneumatic system must be based on specifications or post analysis and/or tests to meet your specific requirements. The expected performance and safety assurance are the responsibility of the person who has determined the compatibility of the system. This person should continuously review the suitability of all items specified, referring to the latest catalog information with a view to giving due consideration to any possibility of equipment failure when configuring a system.
2. **Only trained personnel should operate pneumatically operated machinery and equipment.**
   Compressed air can be dangerous if handled incorrrectly. Assembly, handling or repair of pneumatic systems should be performed by trained and experienced operators.
3. **Do not service machinery/equipment or attempt to remove components until safety is confirmed.**
   1. Inspection and maintenance of machinery/equipment should only be performed once measures to prevent falling or runaway of the driven objects have been confirmed.
   2. When equipment is removed, confirm that safety process as mentioned above. Turn off the supply pressure for this equipment and exhaust all residual compressed air in the system.
   3. Before machinery/equipment is restarted, take measures to prevent quick extension of a cylinder piston rod, etc.
4. **Contact SMC if the product will be used in any of the following conditions:**
   1. Conditions and environments beyond the given specifications, or if product is used outdoors.
   2. Installation on equipment in conjunction with atomic energy, railway, air navigation, vehicles, medical equipment, food and beverages, recreation equipment, emergency stop circuits, clutch and brake circuits in press applications, or safety equipment.
   3. An application which has the possibility of having negative effects on people, property, or animals, requiring special safety analysis.

2 Port Solenoid Valve for Fluid Control/Precautions 1

Be sure to read this before handling.
For detailed precautions on each series, refer to the main text.

Caution on 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. This solenoid valve cannot be used for explosion proof applications.

4. Maintenance space

The installation should allow sufficient space for maintenance activities (removal of valve, etc.).

5. 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.

6. Actuator drive

When an actuator, such as a cylinder, is to be driven using a valve, take appropriate measures to prevent potential danger caused by actuator operation.

7. Pressure (including vacuum) holding

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

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

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

Selection

⚠ Warning

1. Confirm the specifications.

Give careful consideration to the operating conditions such as the application, fluid and environment, and use within the operating ranges specified in this catalog.

2. Fluid

1) Type of fluid

Before using a fluid, confirm whether it is compatible with the materials from each model by referring to the fluids listed in this catalog. Use a fluid with a dynamic viscosity of 50 mm^2/s or less. If there is something you do not know, please contact us.

2) Inflammable oil, Gas

Confirm the specification for leakage in the interior and/or exterior area.

Selection

⚠ Warning

3) Corrosive gas

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

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

5) Applicable fluid on the list may not be used depending on the operating condition. Give adequate confirmation, and then determine a model, just because the compatibility list shows the general case.

3. Fluid quality

The use of a fluid which contains foreign matter 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 80 to 100 mesh. When used to supply water to boilers, substances such as calcium and magnesium which generate hard scale and sludge are included. Since this scale and sludge can cause the valve to malfunction, install water softening equipment, and a filter (strainer) directly upstream from the valve to remove these substances.

4. Air quality

1) Use clean air.

Do not use compressed air which includes chemicals, synthetic oils containing organic solvents, salt or corrosive gases, etc., as it can cause damage or malfunction.

2) Install air filters.

Install air filters close to valves at their upstream side. A filtration degree of 5μm or less should be selected.

3) Install an air dryer or after cooler, etc.

Compressed air that includes excessive drainage may cause malfunction of valves and other pneumatic equipment. To prevent this, install an air dryer or after cooler, etc.

4) If excessive carbon powder is generated, eliminate it by installing mist separators at 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 a malfunction.

Refer to SMC's Best Pneumatics catalog vol. 14 for further details on compressed air quality.

5. Ambient environment

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

6. Countermeasures against static electricity

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

7. For the low particle generation specification, confirm us separately.

2 Port Solenoid Valve for Fluid Control/Precautions 2

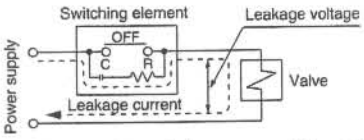
Be sure to read this before handling.
For detailed precautions on each series, refer to the main text.

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/Class B coil with a full-wave rectifier: 10% or less of rated voltage
AC/Class B, H coil: 20% or less of rated voltage
DC coil: 2% or less of rated voltage

2. Low temperature operation

1. The valve can be used in an ambient temperature of between −10 to −20°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 heating by steam, be careful not to expose the coil portion to steam. Installation of 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.

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. Be sure not to position the coil downwards.

When mounting a valve with its coil positioned downwards, foreign objects in the fluid will adhere to the iron core leading to a malfunction.

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

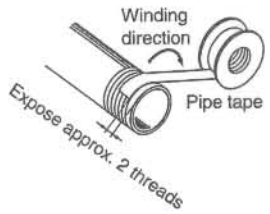
1. Preparation before piping

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. Wrapping of pipe tape

When connecting pipes, fittings, etc., be sure that chips from the pipe threads and sealing material do not enter the valve.

Furthermore, when pipe tape is used, leave 1.5 to 2 thread ridges exposed at the end of the threads.



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

4. Always tighten threads with the proper tightening torque.

When attaching fittings to valves, tighten with the proper tightening torque shown below.

Tightening Torque for Piping

Connection threads	Proper tightening torque N·m
Rc 1/8	7 to 9
Rc 1/4	12 to 14
Rc 3/8	22 to 24
Rc 1/2	28 to 30
Rc 3/4	
Rc 1	36 to 38

5. Connection of piping to products

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

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

7. In applications such as vacuum and non-leak specifications, use caution specifically against the contamination of foreign matters or airtightness of the fittings.

2 Port Solenoid Valve for Fluid Control/Precautions 3

Be sure to read this before handling.
For detailed precautions on each series, refer to the main text.

Wiring

⚠ Caution

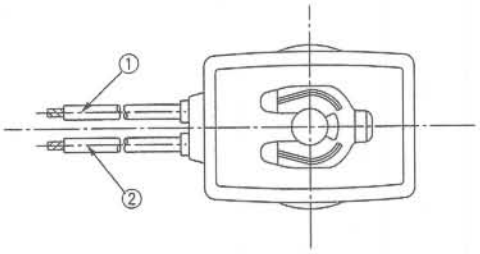
1. **As a rule, use electrical wire with a cross sectional area of 0.5 to 1.25 mm² for wiring. Furthermore, do not allow excessive force to be applied to the lines.**
2. **Use electrical circuits which do not generate chattering in their contacts.**
3. **Use voltage which is within ±10% of the rated voltage. In cases with a DC power supply where importance is placed on responsiveness, stay within ±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 absorber, 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 us.)

Electrical Connection

⚠ Caution

Grommet

Class H coil: AWG18 Insulator O.D. 2.2 mm
Class B coil: AWG20 Insulator O.D. 2.5 mm

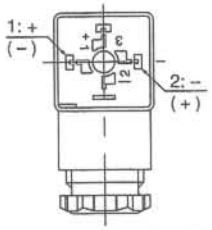


Rated voltage	Lead wire color	
	①	②
DC (Class B only)	Black	Red
100 VAC	Blue	Blue
200 VAC	Red	Red
Other AC	Gray	Gray

* There is no polarity.

DIN connector (Class B only)

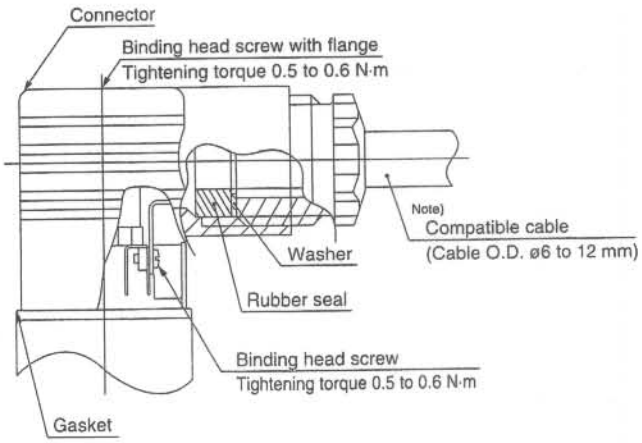
Since internal connections are as shown below for the DIN connector, make connections to the power supply accordingly.



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

* There is no polarity.

- Use compatible heavy duty cords with cable O.D. of ø6 to 12.
- Use the tightening torques below for each section.



Note) For an outside cable diameter of ø9 to 12 mm, remove the internal parts of the rubber seal before using.

2 Port Solenoid Valve for Fluid Control/Precautions 4

Be sure to read this before handling.
For detailed precautions on each series, refer to the main text.

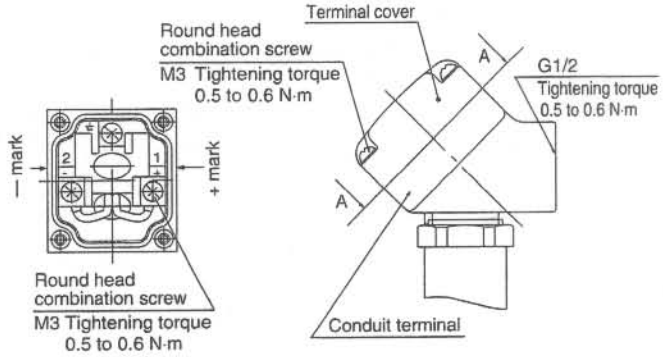
Electrical Connection

⚠ Caution

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.

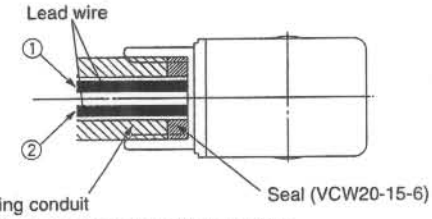


View A-A
(Internal connection diagram)

Conduit

When used as an IP65 equivalent, use seal (part no. VCW20-15-6) to install the wiring conduit. Also, use the tightening torque below for the conduit.

Class H coil: AWG18 Insulator O.D. 2.2 mm
Class B coil: AWG20 Insulator O.D. 2.5 mm



Bore size G1/2 Tightening torque 0.5 to 0.6 N·m

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 DC.

Description	Part no.
Seal	VCW20-15-6

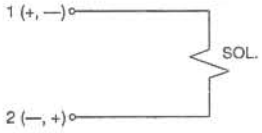
Note) Please order separately.

Electrical Circuit

⚠ Caution

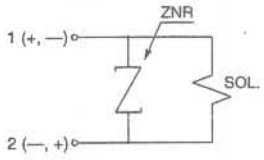
DC circuit

Grommet, Conduit, Conduit terminal, DIN connector



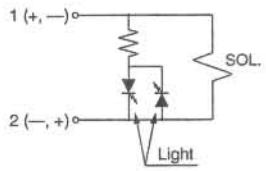
Without electrical option

Grommet, Conduit terminal, DIN connector



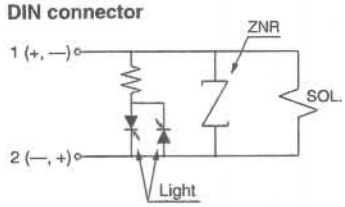
With surge voltage suppressor

Conduit terminal, DIN connector



With light

Conduit terminal, DIN connector

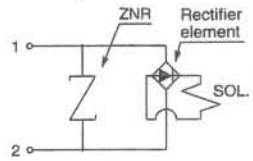


With light/surge voltage suppressor

AC/Class B (with a full-wave rectifier) coil circuit

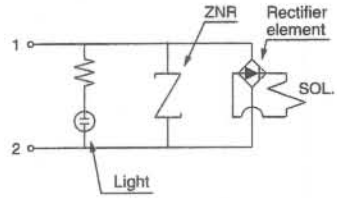
* Surge voltage suppressor is attached to the AC/Class B coil, as a standard.

Grommet, Conduit, Conduit terminal, DIN connector



Without electrical option

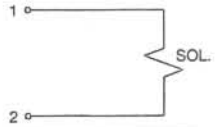
Conduit terminal, DIN connector



With light

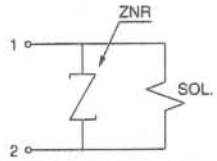
AC/Class B, H coil circuit

Grommet, Conduit, Conduit terminal



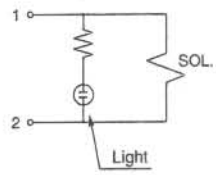
Without electrical option

Grommet, Conduit terminal



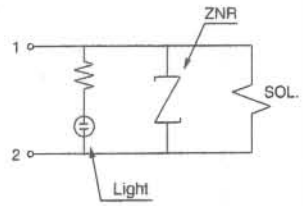
With surge voltage suppressor

Conduit terminal



With light

Conduit terminal



With light/surge voltage suppressor

2 Port Solenoid Valve for Fluid Control/Precautions 5

Be sure to read this before handling.
For detailed precautions on each series, refer to the main text.

Operating Environment

⚠ Warning

1. **Do not use the valves in an atmosphere having corrosive gases, chemicals, salt water, water, steam, 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.**

Lubrication

⚠ Caution

1. **This solenoid valve can be operated without lubrication.**
   If a lubricant is used in the system, use turbine oil Class 1, ISO VG32 (with no additive). But do not lubricate a valve with EPDM seal.
   Refer to the table of brand name of lubricants compliant with Class 1 turbine oil (with no additive), ISO VG32.

Class 1 Turbine Oil (with no additive), ISO VG32

Classification of viscosity (cst) (40°C) / Viscosity according to ISO Grade	32
Idemitsu Kosan Co.,Ltd.	Turbine oil P-32
Nippon Oil Corp.	Turbine oil 32
Cosmo Oil Co.,Ltd.	Cosmo turbine 32
Japan Energy Corp.	Kyodo turbine 32
Kygnus Oil Co.	Turbine oil 32
Kyushu Oil Co.	Stork turbine 32
Nippon Oil Corp.	Mitsubishi turbine 32
Showa Shell Sekiyu K.K.	Turbine 32
Tonen General Sekiyu K.K.	General R turbine 32
Fuji Kosan Co.,Ltd.	Fucoal turbine 32

Please contact SMC regarding Class 2 turbine oil (with additives), ISO VG32.

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. Demount the product.

2. Low frequency operation

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

⚠ Caution

1. Filters and strainers

1. Be careful regarding clogging of filters and strainers.
2. Replace filter elements after one year of use, or earlier if the pressure drop reaches 0.1 MPa.
3. 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 with heated water, thoroughly remove all moisture to prevent rust and deterioration of rubber materials, etc.

4. **Exhaust the drain from an air filter periodically.**

Operating Precautions

⚠ Warning

1. **Valves will reach high temperatures from high temperature fluids. Use caution, as there is a danger of being burned if a valve is touched directly.**
2. **The pilot operated 2-port solenoid valve in closed condition might open instantaneously and allow fluid to come out when a fluid supply source (pump and compressor) is started and pressure changes suddenly.**
3. **If water hammer causes some problem, a water hammer reduction device (accumulator) should be installed on a line or SMC's water hammer reduction valve VXR series should be reviewed.**
   Detail information is available from SMC.

Solenoid Valves Flow Characteristics
(How to indicate flow characteristics)

1. Indication of flow characteristics

Indication of the flow characteristics in specifications for equipment such as solenoid valve, etc. is depending on "Table (1)".

Table (1) Indication of Flow Characteristics

Corresponding equipment	Indication by international standard	Other indications	Standards conforming to
Equipment for pneumatics	*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
Equipment for controlling process fluids	*Av*	—	IEC60534-2-3: 1997 JIS B 2005: 1995 Equipment: JIS B 8471, 8472, 8473
	—	*Cv*	

2. Equipment for pneumatics

2.1 Indication according to the international standards

(1) Standards conforming to

ISO 6358: 1989 : Pneumatic fluid power—Components using compressible fluids—Determination of flow-rate characteristics

JIS B 8390: 2000 : Pneumatic fluid power—Components using compressible fluids—How to test flow rate characteristics

(2) Definition of flow characteristics

Flow rate characteristics are indicated as a result of a comparison between sonic conductance *C* and critical pressure ratio *b*.

Sonic conductance *C* : Values which divide the passing mass flow rate of an equipment in a choked flow condition by the product of the upstream absolute pressure and the density in the standard condition.

Critical pressure ratio *b* : It is the pressure ratio which will turn to the choke flow (downstream pressure/upstream pressure) when it is smaller than this values. (critical pressure ratio)

Choked flow : It is the flow in which the upstream pressure is higher than the downstream pressure and where sonic speed in a certain part of an equipment is reached.
Gaseous mass flow rate is in proportion to the upstream pressure and not dependent on the downstream pressure. (choked flow)

Subsonic flow : Flow greater than the critical pressure ratio

Standard condition : Air in a temperature state of 20°C, absolute pressure 0.1 MPa (= 100 kPa = 1 bar), relative humidity 65%.
It is stipulated by adding the abbreviation (ANR) after the unit depicting air volume.
(standard reference atmosphere)
Standard conforming to: ISO 8778: 1990 Pneumatic fluid power—Standard reference atmosphere, JIS B 8393: 2000: Pneumatic fluid power—Standard reference atmosphere

(3) Formula of flow rate

It can be indicated by the practical unit as following.

When

$\frac{P_2 + 0.1}{P_1 + 0.1} \leq b$, **choked flow**

$$Q = 600 \times C\,(P_1 + 0.1)\sqrt{\frac{293}{273 + t}} \quad \cdots\cdots (1)$$

When

$\frac{P_2 + 0.1}{P_1 + 0.1} > b$, **subsonic flow**

$$Q = 600 \times C\,(P_1 + 0.1)\sqrt{1 - \left[\frac{\frac{P_2 + 0.1}{P_1 + 0.1} - b}{1 - b}\right]^2}\sqrt{\frac{293}{273 + t}} \quad \cdots\cdots (2)$$

Q : Air flow rate [dm³/min (ANR)], dm³ (Cubic decimeter) of SI unit are also allowed to described by ℓ (liter). 1 dm³ = 1 ℓ.

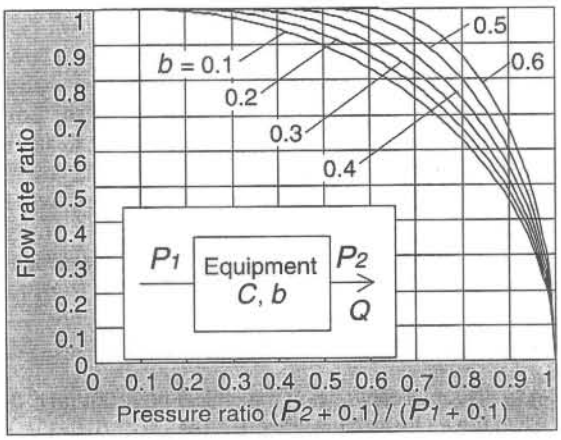
C : Sonic conductance [dm³/(s·bar)]
b : Critical pressure ratio [—]
P_1 : Upstream pressure [MPa]
P_2 : Downstream pressure [MPa]
t : Temperature [°C]
Note) Formula of subsonic flow is the elliptic analogous curve.
Flow characteristics curve is indicated in the Graph (1) For details, please use SMC's "Energy Saving Program".

Example)
Obtain the air flow rate for $P_1 = 0.4$ [MPa], $P_2 = 0.3$ [MPa], $t = 20$ [°C] when a solenoid valve is performed in $C = 2$ [dm³/(s·bar)] and $b = 0.3$.

According to formula 1, the maximum flow rate = $600 \times 2 \times (0.4 + 0.1) \times \sqrt{\dfrac{293}{273 + 20}} = 600$ [dm³/min (ANR)]

Pressure ratio = $\dfrac{0.3 + 0.1}{0.4 + 0.1} = 0.8$

Based on the Graph (1), it is going to be 0.7 if it is read by the pressure ratio as 0.8 and the flow ratio to be $b = 0.3$.
Hence, flow rate = Max. flow x flow ratio = 600 x 0.7 = 420 [dm³/min (ANR)]



Graph (1) Flow characteristics line

(4) Test method
By attaching a test equipment with the test circuit indicated in Fig. (1) while maintaining to a certain amount which does not let the upstream pressure go down below 0.3 MPa, measure the maximum flow to be saturated in the first place. Next, measure this flow rate at 80%, 60%, 40%, 20% and the upstream and downstream pressure. And then, obtain the sonic conductance C from this maximum flow rate. Besides that, substitute each data of others for the formula of subsonic flow in order to find b, then obtain the critical pressure ratio b from that average.

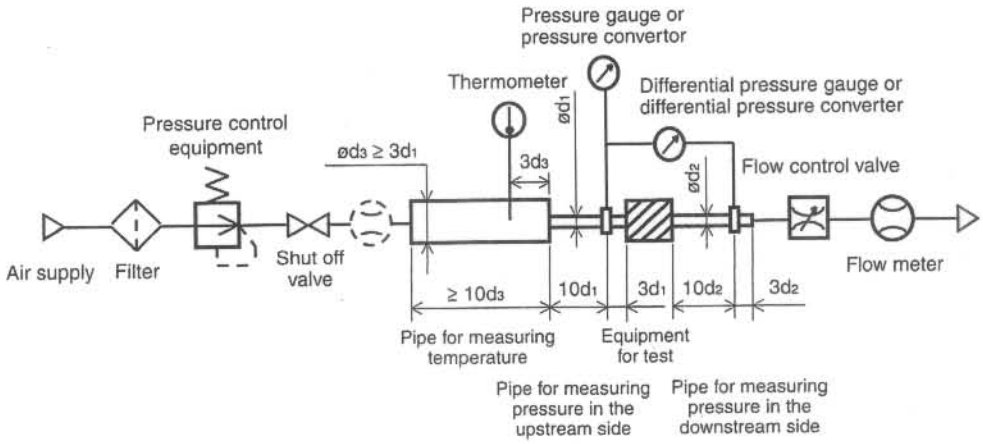


Fig. (1) Test circuit based on ISO 6358, JIS B 8390

2.2 Effective area *S*

(1) Standards conforming to

JIS B 8390: 2000: Pneumatic fluid power—Components using compressible fluids—Determination of flow rate characteristics

Equipment standards: JIS B 8373: 2 port solenoid valve for pneumatics
JIS B 8374: 3 port solenoid valve for pneumatics
JIS B 8375: 4 port, 5 port solenoid valve for pneumatics
JIS B 8379: Silencer for pneumatics
JIS B 8381: Fittings of flexible joint for pneumatics

(2) Definition of flow characteristics

Effective area *S*: is the cross-sectional area having an ideal throttle without friction deduced from the calculation of the pressure changes inside an air tank or without reduced flow when discharging the compressed air in a choked flow, from an equipment attached to the air tank. This is the same concept representing the "easy to run through" as sonic conductance *C* (effective area).

(3) Formula of flow rate

When

$\frac{P_2 + 0.1}{P_1 + 0.1} \leq 0.5$, **choked flow**

$$Q = 120 \times S\,(P_1 + 0.1)\sqrt{\frac{293}{273 + t}} \quad \cdots\cdots (3)$$

When

$\frac{P_2 + 0.1}{P_1 + 0.1} > 0.5$, **subsonic flow**

$$Q = 240 \times S\sqrt{(P_2 + 0.1)(P_1 - P_2)}\sqrt{\frac{293}{273 + t}} \quad \cdots\cdots (4)$$

Conversion with sonic conductance *C*:

$$S = 5.0 \times C \quad \cdots\cdots (5)$$

Q :Air flow rate[dm³/min(ANR)], dm³ (cubic decimeter) of SI unit is good to be described by ℓ (liter), too. 1 dm³ = 1 ℓ
S : Effective area [mm²]
P_1 : Upstream pressure [MPa]
P_2 : Downstream pressure [MPa]
t : Temperature [°C]

Note) Formula for subsonic flow (4) is only applicable when the critical pressure ratio *b* is the unknown equipment. In the formula by sonic conductance *C* (2), it is the same formula when *b* = 0.5.

(4) Test method

By attaching the equipment for testing with the test circuit shown in Fig. (2), discharge air into the atmosphere until the pressure inside the air tank goes down to 0.25 MPa (0.2 MPa) from an air tank filled with compressed air of a certain pressure (0.5 MPa) which does not go down below 0.6 MPa. At this time, measure the discharging time and the residual pressure inside the air tank which had been left until it turned to be the normal values, and then determine the effective area *S* by using the following formula. The volume of air tank should be selected within the specified range by corresponding to the effective area of the equipment being tested. In the case of JIS B 8373, 8374, 8375, 8379, 8381, the pressure values are in parentheses and the coefficient of formula is 12.9.

$$S = 12.1\,\frac{V}{t}\log_{10}\left(\frac{P_s + 0.1}{P + 0.1}\right)\sqrt{\frac{293}{T}} \quad \cdots\cdots (6)$$

S : Effective area [mm²]
V : Air tank capacity [dm³]
t : Discharging time [s]
Ps : Pressure inside air tank before discharging [MPa]
P : Residual pressure inside air tank after discharging [MPa]
T : Temperature inside air tank before discharging [K]

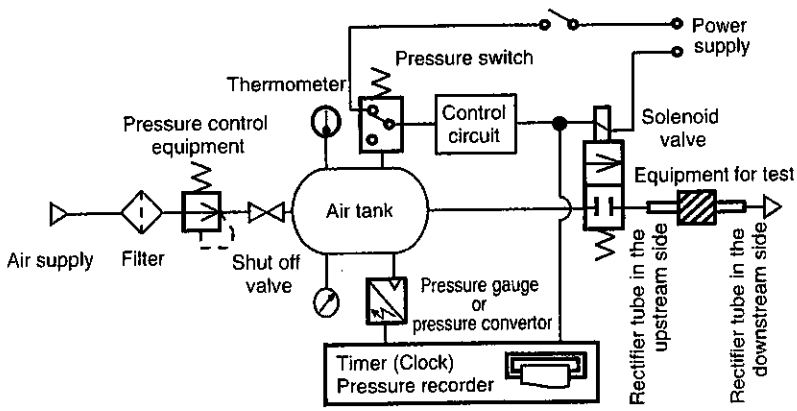


Fig. (2) Test circuit based on JIS B 8390

2.3 Flow coefficient *Cv* factor

The United States Standard ANSI/(NFPA)T3.21.3:1990: Pneumatic fluid power—Flow rating test procedure and reporting method for fixed orifice components

defines the Cv factor of flow coefficient by the following formula which is based on the test conducted by the test circuit analogous to ISO 6358.

$$Cv = \frac{Q}{114.5\sqrt{\frac{\Delta P\,(P_2 + P_a)}{T_1}}} \quad \cdots\cdots (7)$$

ΔP : Pressure drop between the static pressure tapping ports [bar]
P_1 : Pressure of the upstream tapping port [bar gauge]
P_2 : Pressure of the downstream tapping port [bar gauge]: $P_2 = P_1 - \Delta P$
Q : Flow rate [dm^3/s standard condition]
Pa : Atmospheric pressure [bar absolute]
T_1 : Test conditions of the upstream absolute temperature [K]
is < $P_1 + P_a = 6.5 \pm 0.2$ bar absolute, $T_1 = 297 \pm 5$K, 0.07 bar $\leq \Delta P \leq$ 0.14 bar.
This is the same concept as effective area A which ISO6358 stipulates as being applicable only when the pressure drop is smaller than the upstream pressure and the compression of air does not become a problem.

3. Equipment for process fluids

(1) Standards conforming to

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: Regulator for water
JIS B 8472: Solenoid valve for steam
JIS B 8473: Solenoid valve for fuel oil

(2) Definition of flow 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 difference is 1 Pa. It is calculated using the following formula.

$$Av = Q\sqrt{\frac{\rho}{\Delta P}} \quad \cdots\cdots (8)$$

Av : Flow coefficient [m^2]
Q : Flow rate [m^3/s]
ΔP : Pressure difference [Pa]
ρ : Density of fluid [kg/m^3]

(3) Formula of flow rate

It is described by the known unit. Also, the flow characteristics line shown in the Graph (2).
In the case of liquid:

$$Q = 1.9 \times 10^6 Av\sqrt{\frac{\Delta P}{G}} \quad \cdots\cdots (9)$$

Q : Flow rate [ℓ/min]
Av : Flow coefficient [m^2]
ΔP : Pressure difference [MPa]
G : Relative density [water = 1]
In the case of saturated aqueous vapor:

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

Q : Flow rate [m^3/s]
Av : Flow coefficient [m^2]
ΔP : Pressure difference [Pa]
P_1 : Relative density [MPa]: $\Delta P = P_1 - P_2$
P_2 : Relative density [MPa]

Conversion of flow coefficient:

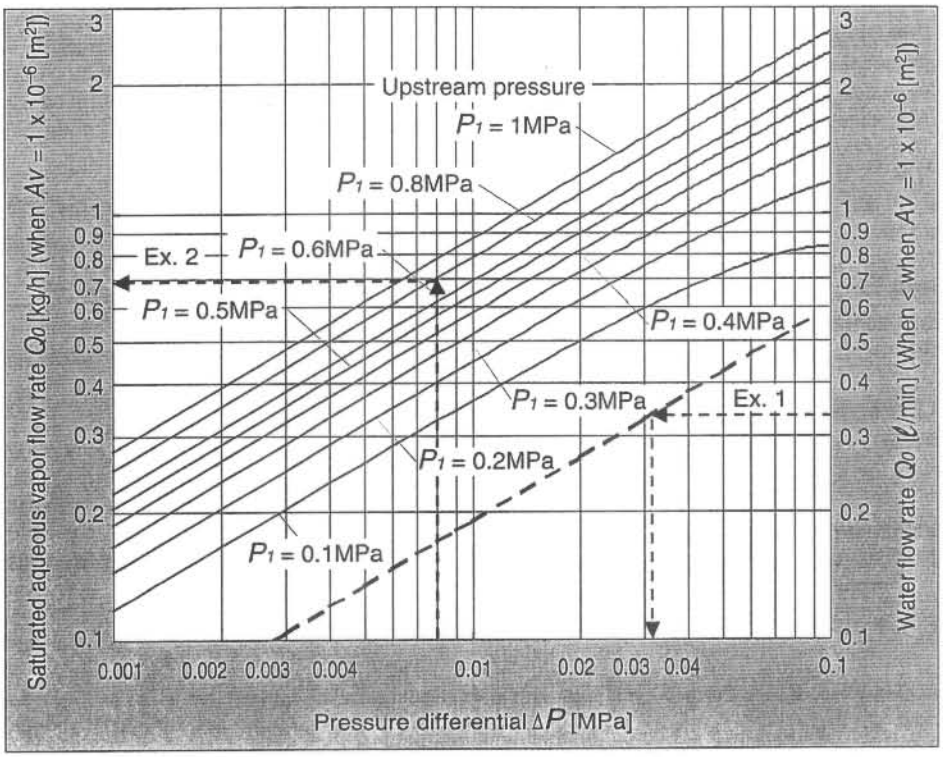
$Av = 28 \times 10^{-6}\ Kv = 24 \times 10^{-6} Cv$ .....(11)

Here,

Kv factor: Value of the clean water flow rate represented by the m^3/h which runs through the valve at 5 to 40°C, when the pressure difference is 1 bar.

Cv factor (Reference values): It is the figures representing the flow rate of clean water by US gal/min which runs through the valve at 60°F, when the pressure difference is 1 lbf/in^2 (psi).

Values of pneumatic Kv are different from Cv because the testing method is different from each other.



Graph (2) Flow characteristics line

Example 1)

Obtain the pressure difference when water 15 [ℓ/min] runs through the solenoid valve with an $Av = 45 \times 10^{-6}$ [m^2].

Since $Qo = 15/45 = 0.33$ [/min], according to the Graph (2), if reading ΔP when Qo is 0.33, it will be 0.031 [MPa].

Example 2)

Obtain the flow rate of saturated aqueous vapor when $P_1 = 0.8$ [MPa], $\Delta P = 0.008$ [MPa] with a solenoid valve with an $Av = 1.5 \times 10^{-6}$ [m^2].

According to the Graph (2), if reading Qo when P_1 is 0.8 and ΔP is 0.008, it is 0.7 [kg/h]. Hence, the flow rate $Q = 0.7 \times 1.5 = 1.05$ [kg/h].

(4) Test method

By attaching the equipment for testing with the test circuit shown in Fig. (3) and running water at 5 to 40°C, measure the flow rate with a pressure difference of 0.075 MPa. However, the pressure difference 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 (8) to figure out *Av*.

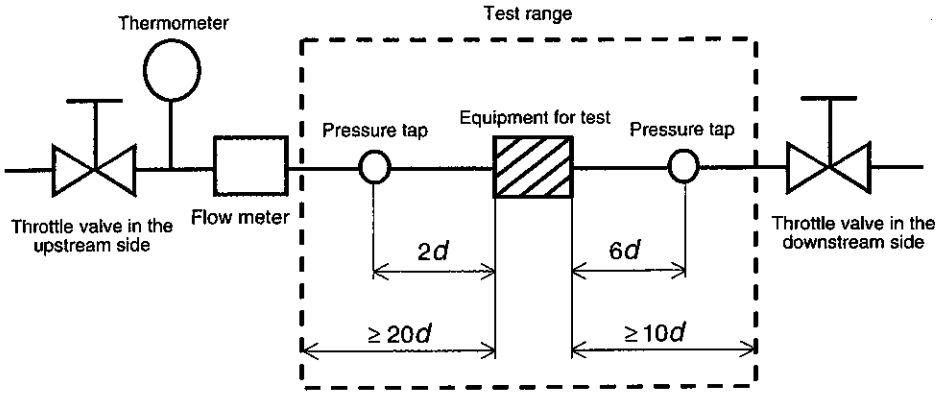
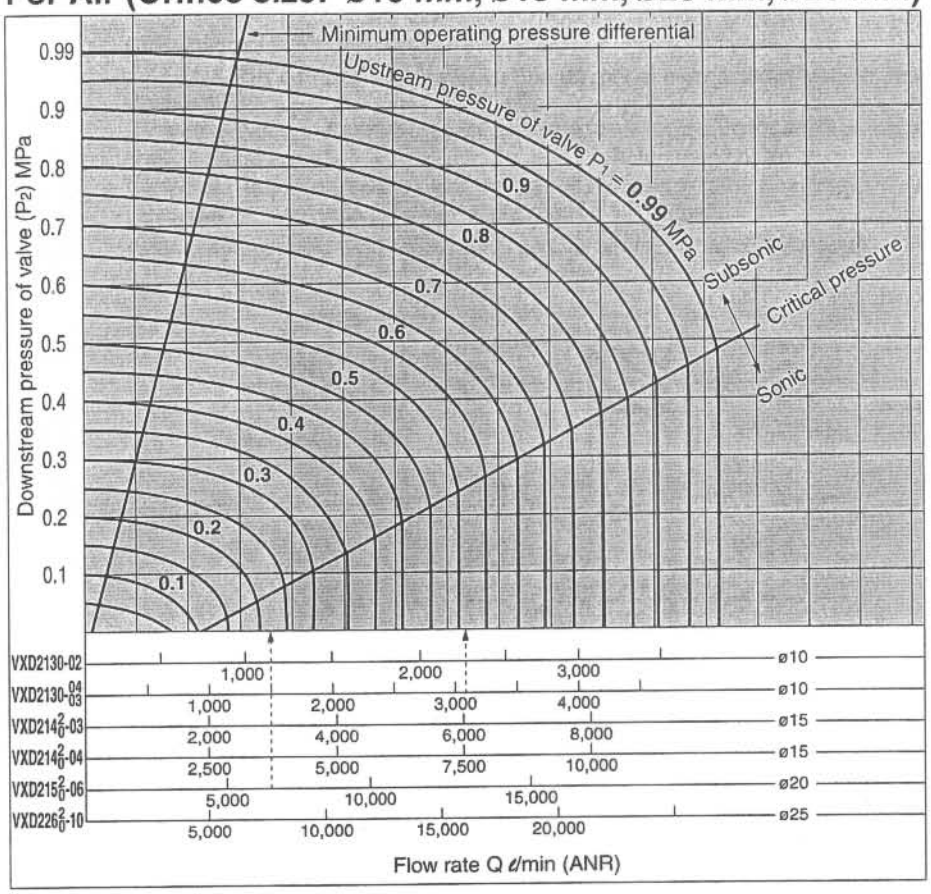


Fig. (3) Test circuit based on IEC60534-2-3, JIS B 2005

Flow Characteristics

Note) Use this graph as a guide. In the case of obtaining an accurate flow rate, refer to front matter pages 1 to 6.

For Air (Orifice size: ø10 mm, ø15 mm, ø20 mm, ø25 mm)



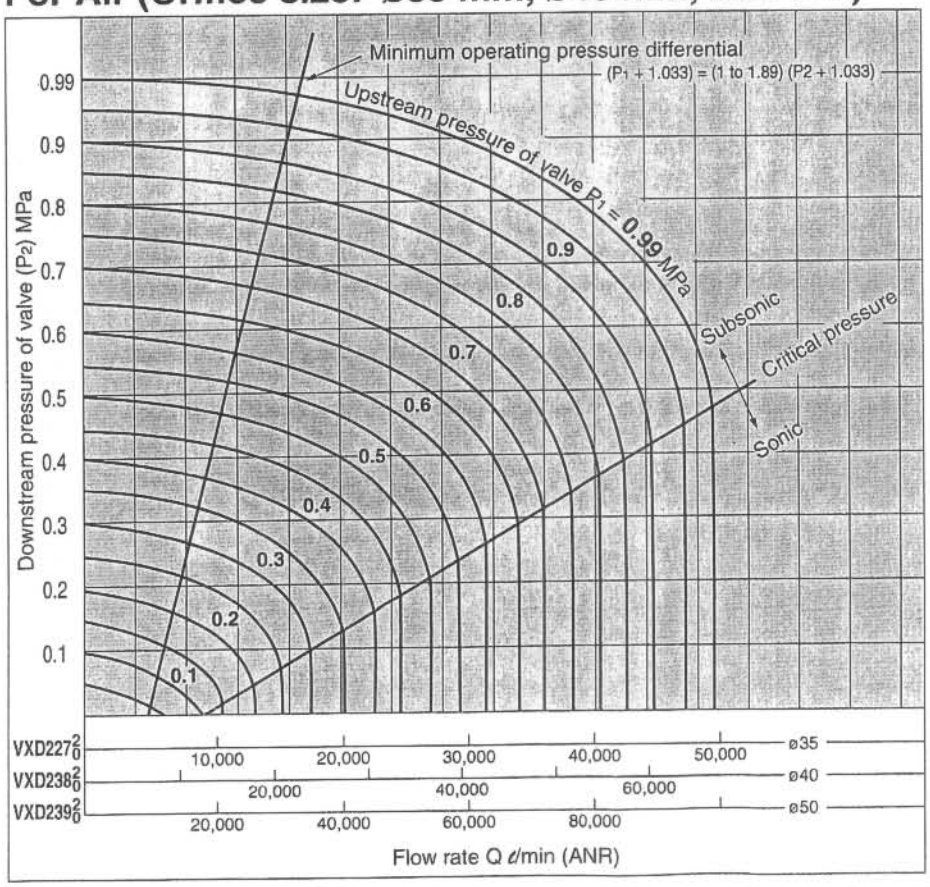
How to read the graph

The sonic range pressure to generate a flow rate of 6000 ℓ/min (ANR) is

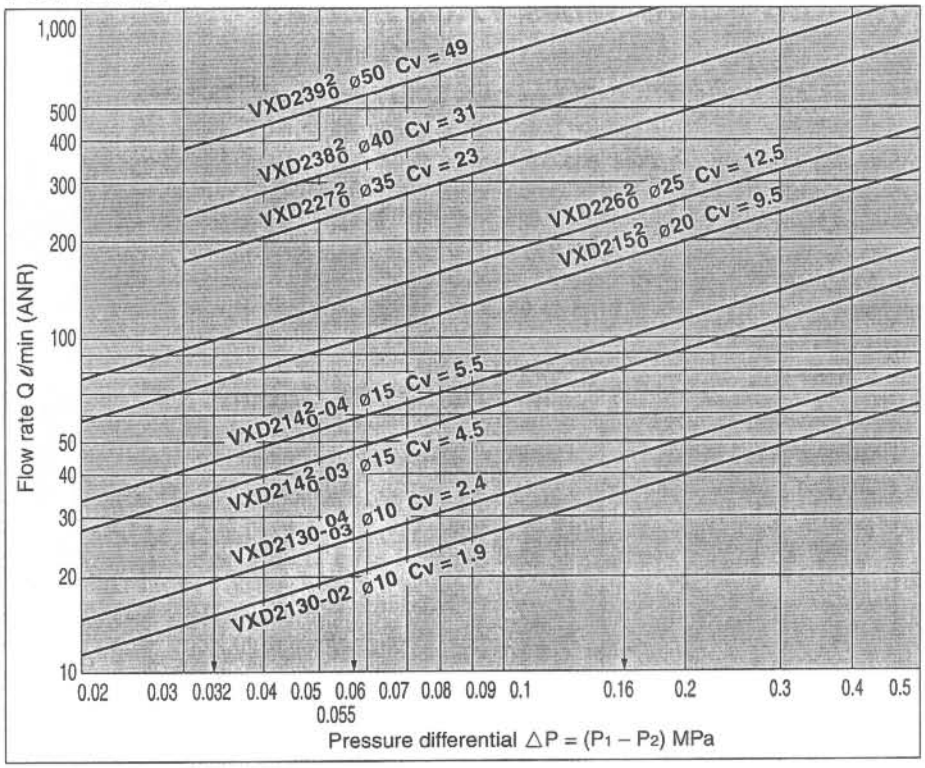
P_1 ≈ 0.57 MPa for a ø15 orifice (VXD214□2-03) and

P_1 ≈ 0.22 MPa for a ø20 orifice (VXD215□2-06).

For Air (Orifice size: ø35 mm, ø40 mm, ø50 mm)



For Water



How to read the graph

When a water flow of 100 ℓ/min is generated,
△P ≈ 0.16 MPa for a ø15 orifice (VXD214$^{2}_{0}$-04),
△P ≈ 0.055 MPa for a ø20 orifice (VXD215$^{2}_{0}$), and
△P ≈ 0.032 MPa for a ø25 orifice (VXD226$^{2}_{0}$).

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, with the valve closed. When the downstream pressure is 0 MPa, this becomes the maximum operating pressure.

2. Minimum operating pressure differential

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

Note1) If the pressure differential is the minimum operating pressure differential when the valve is closed, it may be below the minimum operating pressure differential when the valve is open.

Note2) If a fluid supply source such as pump and compressor doesn't have enough capacity or sectional area of fluid supply port is narrowed, proper differential pressure can't be obtained and valve might operate unstably.

3. Maximum system pressure

The maximum pressure that can be applied inside the pipelines (line pressure).
(The pressure differential of the solenoid valve unit must be less than the maximum operating pressure differential.)

4. Proof pressure

The pressure which must be withstood without a drop in performance after 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 dissipation (W): For AC, $W = V \cdot A \cdot \cos\theta$. For DC, $W = V \cdot A$.
(Note) $\cos\theta$ shows power factor. $\cos\theta = 0.6$

2. Surge voltage

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

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".

IP65: Dusttight, Low jetproof type

"Low jetproof type" means that no water intrudes inside an equipment that could hinder from operating normally by means of discharging water for 3 minutes in the prescribed manner. Take appropriate protection measures, since a device is not usable in an environment where a water drop is splashed.

Others

1. Material

NBR: Nitrile rubber
FKM: Fluoro rubber – Trade names: Viton®, Dai-el®, etc.
EPDM: Ethylene propylene rubber
PTFE: Polytetrafluoroethylene resin – Trade names: Teflon®, Polyflon®, etc.
FFKM: Perfluoroelastomer
Trade names: Kalrez®, Chemraz®

2. Oil-free treatment

The degreasing and washing of wetted parts.

3. Passage symbol

In the JIS symbol ( ) IN and OUT are in a blocked condition ( ), but actually in the case of reverse pressure (OUT>IN), there is a limit to the blocking.
( ) is used to indicate that blocking of reverse pressure is not possible.

Pilot Operated 2 Port Solenoid Valve

Series VXD21/22/23

For Water, Oil, Air

Single Unit

■ Valve

Normally closed (N.C.)
Normally open (N.O.)

■ Electrical Entry

- Grommet
- DIN terminal
- Conduit
- Conduit terminal

■ Solenoid Coil

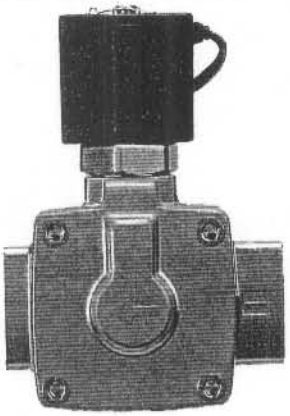
Coil: Class B, Class H

■ Rated Voltage

100 VAC, 200 VAC, 110 VAC, 220 VAC, 240 VAC, 230 VAC, 48 VAC, 24 VDC, 12 VDC

■ Material

Body	Brass (C37)/CAC407, Stainless steel
Seal	NBR, FKM, EPDM



Model		VXD2130	VXD214⁰₂	VXD215⁰₂	VXD226⁰₂
Body size	10A	●	—	—	—
	15A	—	●	—	—
	20A	—	—	●	—
	25A	—	—	—	●
Port size (Thread)		1/4, 3/8, 1/2	3/8, 1/2	3/4	1

Model		VXD227⁰₂	VXD238⁰₂	VXD239⁰₂
Body size	32A	●	—	—
	40A	—	●	—
	50A	—	—	●
Port size (Flange)		32A	40A	50A

Standard Specifications

Valve specifications	Valve construction		Pilot operated 2 port diaphragm type
	Withstand pressure (MPa)		5.0
	Body material		Brass (C37), Stainless steel, CAC407
	Seal material		NBR, FKM, EPDM
	Enclosure		Dusttight, Low jetproof (equivalent to IP65) Note 1)
	Environment		Location without corrosive or explosive gases
Coil specifications	Rated voltage	AC (Class B coil, with a full-wave rectifier)	100 VAC, 200 VAC, 110 VAC, 220 VAC, 230 VAC, 240 VAC, 48 VAC
		AC (Class B coil/H coil) Note 2)	
		DC (Class B coil only)	24 VDC, 12 VDC
	Allowable voltage fluctuation		±10% of rated voltage
	Allowable leakage voltage	AC (Class B coil, with a full-wave rectifier)	±10% or less of rated voltage
		AC (Class B coil/H coil) Note 2)	±20% or less of rated voltage
		DC (Class B coil only)	±2% or less of rated voltage
	Coil insulation type		Class B, Class H

Note 1) Electrical entry, Grommet with surge voltage suppressor (GS) has a rating of IP40.
Note 2) The AC (Class B) coil for the VXD2130 comes with a full-wave rectifier.

Solenoid Coil Specifications

Note) The values are for an ambient temperature of 20°C and at the rated voltage.

DC Specification

Model	Power consumption (W)	Temperature rise (C°) Note)
VXD2130	5.5	50
VXD214⁰₂/215⁰₂	4.5	45
VXD226⁰₂/227⁰₂	7	45
VXD238⁰₂/239⁰₂	10.5	60

AC Specification (Class B coil, with a full-wave rectifier)

Model	Apparent power (VA)*	Temperature rise (C°) Note)
VXD21	7	55
VXD22	9.5	60
VXD23	12	65

* There is no difference in apparent power due to the inrush, energization, or frequency of the power, since the AC coil uses a rectifying circuit.

AC Specification (Class B coil)

Model	Frequency (Hz)	Apparent power (VA) Inrush	Apparent power (VA) Energized	Temperature rise (C°) Note)
VXD21	50	19	9	45
	60	16	7	40
VXD22	50	43	19	55
	60	35	16	50
VXD23	50	62	30	65
	60	52	25	60

* The AC (Class B) coil for the VXD2130 comes with a full-wave rectifier.

AC Specification (Class H coil)

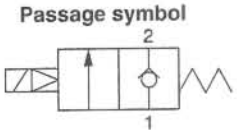
Model	Frequency (Hz)	Apparent power (VA) Inrush	Apparent power (VA) Energized	Temperature rise (C°) Note)
VXD21	50	19	9	45
	60	16	7	40
VXD22	50	43	19	55
	60	35	16	50
VXD23	50	62	30	65
	60	52	25	60

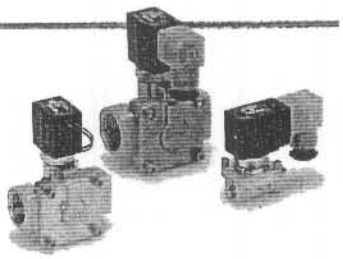
For Water

Model/Valve Specifications

Normally closed (N.C.)

Passage symbol



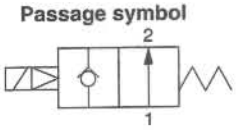


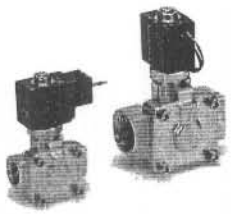
Port size		Orifice size (mmø)	Model	Min. operating pressure differential (MPa)	Max. operating pressure differential (MPa) AC	Max. operating pressure differential (MPa) DC	Flow characteristics Av x $10^{-6}m^2$	Flow characteristics Cv converted	Max. system pressure (MPa)	Weight Note) (g)
Thread	1/4 (8A)	10	VXD2130-02	0.02	0.7	0.5	46	1.9	1.5	420
	3/8 (10A)	10	VXD2130-03				58	2.4		
		15	VXD2140-03		1.0	1.0	110	4.5		670
	1/2 (15A)	10	VXD2130-04		0.7	0.5	58	2.4		500
		15	VXD2140-04		1.0	1.0	130	5.5		670
	3/4 (20A)	20	VXD2150-06				230	9.5		1150
	1 (25A)	25	VXD2260-10				310	13		1650
Flange	32A	35	VXD2270-32	0.03			550	23		5400
	40A	40	VXD2380-40				740	31		6800
	50A	50	VXD2390-50				1200	49		8400

Note) Weight of grommet type. Add 10 g for conduit, 30 g for DIN terminal, and 60 g for terminal type respectively.
• Refer to "Glossary of Terms" on front matter 10, for details on the max. operating pressure differential and the max. system pressure.

Normally open (N.O.)

Passage symbol





Port size		Orifice size (mmø)	Model	Min. operating pressure differential (MPa)	Max. operating pressure differential (MPa) AC, DC	Flow characteristics Av x $10^{-6}m^2$	Flow characteristics Cv converted	Max. system pressure (MPa)	Weight Note) (g)
Thread	3/8 (10A)	15	VXD2142-03	0.02	0.7	110	4.5	1.5	690
	1/2 (15A)		VXD2142-04			130	5.5		
	3/4 (20A)	20	VXD2152-06			230	9.5		1170
	1 (25A)	25	VXD2262-10			310	13		1690
Flange	32A	35	VXD2272-32	0.03		550	23		5400
	40A	40	VXD2382-40			740	31		6800
	50A	50	VXD2392-50			1200	49		8400

Note) Weight of grommet type. Add 10 g for conduit, 30 g for DIN terminal, and 60 g for terminal type respectively.
• Refer to "Glossary of Terms" on front matter 10, for details on the max. operating pressure differential and the max. system pressure.

Operating Fluid and Ambient Temperature

Power source	Operating fluid temperature (°C) Solenoid valve option Nil, G, H	Operating fluid temperature (°C) Solenoid valve option E, P	Ambient temperature (°C)
AC	1 to 60	1 to 99	−10 to 60
DC	1 to 60	—	−10 to 60

Note 1) With no freezing

Tightness of Valve (Leakage Rate)

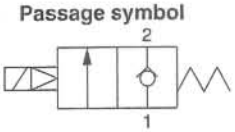
Seal material	Leakage rate (With water pressure) 1/4 to 1	Leakage rate (With water pressure) 32A to 50A
NBR, FKM, EPDM	0.2 cm³/min or less	1 cm³/min or less

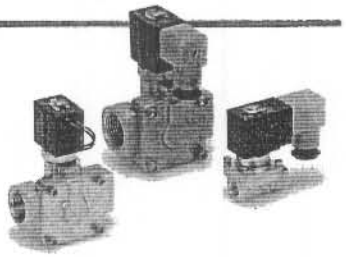
For Oil

Model/Valve Specifications

Normally closed (N.C.)

Passage symbol



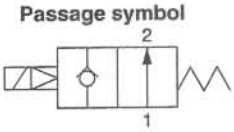


Port size		Orifice size (mmø)	Model	Min. operating pressure differential (MPa)	Max. operating pressure differential (MPa) AC	Max. operating pressure differential (MPa) DC	Flow characteristics Av x $10^{-6}m^2$	Flow characteristics Cv converted	Max. system pressure (MPa)	Note) Weight (g)
Thread	1/4 (8A)	10	VXD2130-02	0.02	0.5	0.4	46	1.9	1.5	420
	3/8 (10A)	10	VXD2130-03				58	2.4		
		15	VXD2140-03		0.7	0.7	110	4.5		670
	1/2 (15A)	10	VXD2130-04		0.5	0.4	58	2.4		500
		15	VXD2140-04		0.7	0.7	130	5.5		670
	3/4 (20A)	20	VXD2150-06				230	9.5		1150
	1 (25A)	25	VXD2260-10				310	13		1650
Flange	32A	35	VXD2270-32	0.03			550	23		5400
	40A	40	VXD2380-40				740	31		6800
	50A	50	VXD2390-50				1200	49		8400

Note) Weight of grommet type. Add 10 g for conduit, 30 g for DIN terminal, and 60 g for terminal type respectively.
• Refer to "Glossary of Terms" on front matter 10, for details on the max. operating pressure differential and the max. system pressure.

Normally open (N.O.)

Passage symbol



Port size		Orifice size (mmø)	Model	Min. operating pressure differential (MPa)	Max. operating pressure differential (MPa) AC, DC	Flow characteristics Av x $10^{-6}m^2$	Flow characteristics Cv converted	Max. system pressure (MPa)	Note) Weight (g)
Thread	3/8 (10A)	15	VXD2142-03	0.02	0.6	110	4.5	1.5	690
	1/2 (15A)		VXD2142-04			130	5.5		
	3/4 (20A)	20	VXD2152-06			230	9.5		1170
	1 (25A)	25	VXD2262-10			310	13		1690
Flange	32A	35	VXD2272-32	0.03		550	23		5400
	40A	40	VXD2382-40			740	31		6800
	50A	50	VXD2392-50			1200	49		8400

Note) Weight of grommet type. Add 10 g for conduit, 30 g for DIN terminal, and 60 g for terminal type respectively.
• Refer to "Glossary of Terms" on front matter 10, for details on the max. operating pressure differential and the max. system pressure.

Operating Fluid and Ambient Temperature

Power source	Operating fluid temperature (°C) Solenoid valve option A, H	Operating fluid temperature (°C) Solenoid valve option D, N	Ambient temperature (°C)
AC	−5 to 60	−5 to 100	−10 to 60
DC	−5 to 60	—	−10 to 60

Note 1) Dynamic viscosity: 50 mm^2/s or less

Tightness of Valve (Leakage Rate)

Seal material	Leakage rate (With oil pressure) 1/4 to 1	Leakage rate (With oil pressure) 32A to 50A
FKM	0.2 cm^3/min or less	1 cm^3/min or less

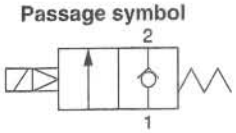
For Air

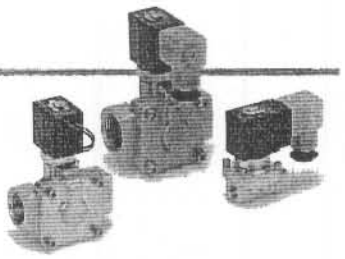
(Inert gas)

Model/Valve Specifications

Normally closed (N.C.)

Passage symbol





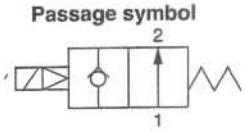
Port size		Orifice size (mmø)	Model	Min. operating pressure differential (MPa)	Max. operating pressure differential (MPa)		Flow characteristics			Max. system pressure (MPa)	Note) Weight (g)
					AC	DC	C	b	Cv		
Thread	1/4 (8A)	10	VXD2130-02	0.02	0.9	0.7	8.5	0.35	2.0	1.5	420
	3/8 (10A)	10	VXD2130-03				9.2		2.4		
		15	VXD2140-03		1.0	1.0	18.0		5.0		670
	1/2 (15A)	10	VXD2130-04		0.9	0.7	9.2		2.4		500
		15	VXD2140-04		1.0	1.0	20.0		5.5		670
	3/4 (20A)	20	VXD2150-06				38.0	0.30	9.5		1150

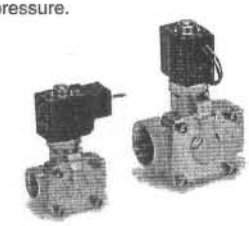
Port size		Orifice size (mmø)	Model	Min. operating pressure differential (MPa)	Max. operating pressure differential (MPa)	Flow characteristics	Max. system pressure (MPa)	Note) Weight (g)
					AC, DC	Effective area (mm²)		
Thread	1 (25A)	25	VXD2260-10	0.02	1.0	225	1.5	1650
Flange	32A	35	VXD2270-32	0.03		415		5400
	40A	40	VXD2380-40			560		6800
	50A	50	VXD2390-50			880		8400

Note) Weight of grommet type. Add 10 g for conduit, 30 g for DIN terminal, and 60 g for terminal type respectively.
• Refer to "Glossary of Terms" on front matter 10, for details on the max. operating pressure differential and the max. system pressure.

Normally open (N.O.)

Passage symbol





Port size		Orifice size (mmø)	Model	Min. operating pressure differential (MPa)	Max. operating pressure differential (MPa)	Flow characteristics			Max. system pressure (MPa)	Note) Weight (g)
					AC, DC	C	b	Cv		
Thread	3/8 (10A)	15	VXD2142-03	0.02	0.7	18.0	0.35	5.0	1.5	690
	1/2 (15A)		VXD2142-04			20.0		5.5		
	3/4 (20A)	20	VXD2152-06			38.0	0.30	9.5		1170

Port size		Orifice size (mmø)	Model	Min. operating pressure differential (MPa)	Max. operating pressure differential (MPa)	Flow characteristics	Max. system pressure (MPa)	Note) Weight (g)
					AC, DC	Effective area (mm²)		
Thread	1 (25A)	25	VXD2262-10	0.02	0.7	225	1.5	1690
Flange	32A	35	VXD2272-32	0.03		415		5400
	40A	40	VXD2382-40			560		6800
	50A	50	VXD2392-50			880		8400

Note) Weight of grommet type. Add 10 g for conduit, 30 g for DIN terminal, and 60 g for terminal type respectively.
• Refer to "Glossary of Terms" on front matter 10, for details on the max. operating pressure differential and the max. system pressure.

Operating Fluid and Ambient Temperature

Power source	Operating fluid temperature (°C) Solenoid valve option Nil, G	Ambient temperature (°C)
AC	−10 Note) to 60	−10 to 60
DC	−10 to 60	−10 to 60

Note) Dew point temperature: −10°C or less

Tightness of Valve (Leakage Rate)

Seal material	Leakage rate (Air)	
	1/4 to 1	32A to 50A
NBR, FKM	2 cm³/min or less	10 cm³/min or less

How to Order

DC/AC (except VXD2130 AC/Class B) VXD 21 3 0 □ □ – 02 □ – 5 G 1 – □

AC/Class B coil (with a full-wave rectifier) VXD 21 3 0 □ □ – 02 □ – 1 G R1 – □

* The AC (Class B) coil for VXD2130 comes with a full-wave rectifier.

Model
Refer to "Table (1)" shown below for availability.

Orifice size
Refer to "Table (1)" shown below for availability.

Valve/Body configuration

0	N.C. / Single unit
2	N.O. / Single unit

Solenoid valve option
Refer to "Table (2)" shown below for availability.

Suffix

Nil	—
Z	Oil-free

Thread type

Nil	Rc
T	NPTF
F	G
N	NPT

Port size
Refer to "Table (1)" shown below for availability.

Rated voltage

1	100 VAC 50/60 Hz	6	12 VDC
2	200 VAC 50/60 Hz	7	240 VAC 50/60 Hz
3	110 VAC 50/60 Hz	8	48 VAC 50/60 Hz
4	220 VAC 50/60 Hz	J	230 VAC 50/60 Hz
5	24 VDC		

* Refer to "Table (3)" shown below for availability.

Refer to page 1 for ordering coil only.

With a full-wave rectifier, surge voltage suppressor

Electrical entry

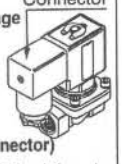
G - Grommet
GS - With grommet surge voltage suppressor

C - Conduit

T - With conduit terminal
TS - With conduit terminal and surge voltage suppressor
TL - With conduit terminal and light
TZ - With conduit terminal, surge voltage suppressor and light

D - DIN
DS - DIN with surge voltage suppressor
DL - DIN with light
DZ - DIN with surge voltage suppressor and light
DO - For DIN (without connector)

Connector



* DIN type is available with class B insulation only.

* Refer to "Table (3)" for the available combinations between each electrical option (S, L, Z) and rated voltage.
* Option S, Z are not available since a surge voltage suppressor is integrated into the AC/Class B coil, as a standard.

Table (1) Port/Orifice Size

Normally closed (N.C.)

Solenoid valve (Port size)					Orifice symbol							Material	
Model		VXD21	VXD22	VXD23	3 (10 mmø)	4 (15 mmø)	5 (20 mmø)	6 (25 mmø)	7 (35 mmø)	8 (40 mmø)	9 (50 mmø)	Body	Seal
Port no. (Port size)	Thread	02 (1/4)	—	—	●	—	—	—	—	—	—	Brass (C37), Stainless steel	NBR FKM EPDM
		03 (3/8)	—	—	●	●	—	—	—	—	—		
		04 (1/2)	—	—	●	●	—	—	—	—	—		
		06 (3/4)	—	—	—	—	●	—	—	—	—		
		—	10 (1)	—	—	—	—	●	—	—	—		
	Flange	—	32 (32A)	—	—	—	—	—	●	—	—	CAC407	
		—	—	40 (40A)	—	—	—	—	—	●	—		
		—	—	50 (50A)	—	—	—	—	—	—	●		

Normally open (N.O.)

Solenoid valve (Port size)					Orifice symbol						Material	
Model		VXD21	VXD22	VXD23	4 (15 mmø)	5 (20 mmø)	6 (25 mmø)	7 (35 mmø)	8 (40 mmø)	9 (50 mmø)	Body	Seal
Port no. (Port size)	Thread	03 (3/8)	—	—	●	—	—	—	—	—	Brass (C37), Stainless steel	NBR FKM EPDM
		04 (1/2)	—	—	●	—	—	—	—	—		
		06 (3/4)	—	—	—	●	—	—	—	—		
		—	10 (1)	—	—	—	●	—	—	—		
	Flange	—	32 (32A)	—	—	—	—	●	—	—	CAC407	
		—	—	40 (40A)	—	—	—	—	●	—		
		—	—	50 (50A)	—	—	—	—	—	●		

Table (2) Solenoid Valve Option

Option symbol	Seal material	Body material/ Shading coil material	Coil insulation type	Note
Nil	NBR	Brass (C37), Cu	B	—
G		Stainless steel, Ag		
E	EPDM	Brass (C37), Cu	H	Heated water (AC only)
P		Stainless steel, Ag		
L	FKM	Stainless steel, Ag	B	High corrosion resistance specification, Oil-free

Table (3) Rated Voltage – Electrical Option

Rated voltage			Class B			Class H		
AC/DC	Voltage symbol	Voltage	S With surge voltage suppressor	L With light	Z With light and surge voltage suppressor	S With surge voltage suppressor	L With light	Z With light and surge voltage suppressor
AC	1	100 V	●	●	●	●	●	●
	2	200 V	●	●	●	●	●	●
	3	110 V	●	●	●	●	●	●
	4	220 V	●	●	●	●	●	●
	7	240 V	●	—	—	●	—	—
	8	48 V	●	—	—	●	—	—
	J	230 V	●	—	—	●	—	—
DC	5	24 V	●	●	●	DC specification is not available.		
	6	12 V	●	—	—			

Note) Option S, Z are not available as surge voltage suppressor is integrated into the AC/Class B coil, as a standard.

How to Order

DC/AC (except VXD2130 AC/Class B) VXD 21 3 0 ☐ ☐ – 02 ☐ – 5 G 1 – ☐

AC/Class B coil (with a full-wave rectifier) VXD 21 3 0 ☐ ☐ – 02 ☐ – 1 G R1 – ☐

* The AC (Class B) coil for VXD2130 comes with a full-wave rectifier.

Model
Refer to "Table (1)" shown below for availability.

Orifice size
Refer to "Table (1)" shown below for availability.

Valve/Body configuration

0	N.C. / Single unit
2	N.O. / Single unit

Solenoid valve option
Refer to "Table (2)" shown below for availability.

Suffix

Nil	—
Z	Oil-free

Port size
Refer to "Table (1)" shown below for availability.

Thread type

Nil	Rc
T	NPTF
F	G
N	NPT

Rated voltage

1	100 VAC 50/60 Hz	6	12 VDC
2	200 VAC 50/60 Hz	7	240 VAC 50/60 Hz
3	110 VAC 50/60 Hz	8	48 VAC 50/60 Hz
4	220 VAC 50/60 Hz	J	230 VAC 50/60 Hz
5	24 VDC		

* Refer to "Table (3)" shown below for availability.

Refer to page 1 for ordering coil only.

With a full-wave rectifier, surge voltage suppressor

Bracket

Nil	None
B	With bracket

* Bracket is not removable.

Electrical entry

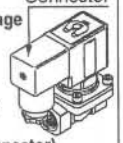
G - Grommet
GS - With grommet surge voltage suppressor

C - Conduit

T - With conduit terminal
TS - With conduit terminal and surge voltage suppressor
TL - With conduit terminal and light
TZ - With conduit terminal, surge voltage suppressor and light

D - DIN
DS - DIN with surge voltage suppressor
DL - DIN with light
DZ - DIN with surge voltage suppressor and light
DO - For DIN (without connector)

Connector



* DIN type is available with class B insulation only.

* Refer to "Table (3)" for the available combinations between each electrical option (S, L, Z) and rated voltage.
* Option S, Z are not available since a surge voltage suppressor is integrated into the AC/Class B coil, as a standard.

Table (1) Port/Orifice Size

Normally closed (N.C.)

Solenoid valve (Port size)					Orifice symbol							Material	
Model		VXD21	VXD22	VXD23	3 (10 mmø)	4 (15 mmø)	5 (20 mmø)	6 (25 mmø)	7 (35 mmø)	8 (40 mmø)	9 (50 mmø)	Body	Seal
Port no. (Port size)	Thread	02 (1/4)	—	—	●	—	—	—	—	—	—	Brass (C37), Stainless steel	NBR FKM EPDM
		03 (3/8)	—	—	●	●	—	—	—	—	—		
		04 (1/2)	—	—	●	●	—	—	—	—	—		
		06 (3/4)	—	—	—	—	●	—	—	—	—		
		—	10 (1)	—	—	—	—	●	—	—	—		
	Flange	—	32 (32A)	—	—	—	—	—	●	—	—	CAC407	
		—	—	40 (40A)	—	—	—	—	—	●	—		
		—	—	50 (50A)	—	—	—	—	—	—	●		

Normally open (N.O.)

Solenoid valve (Port size)					Orifice symbol						Material	
Model		VXD21	VXD22	VXD23	4 (15 mmø)	5 (20 mmø)	6 (25 mmø)	7 (35 mmø)	8 (40 mmø)	9 (50 mmø)	Body	Seal
Port no. (Port size)	Thread	03 (3/8)	—	—	●	—	—	—	—	—	Brass (C37), Stainless steel	NBR FKM EPDM
		04 (1/2)	—	—	●	—	—	—	—	—		
		06 (3/4)	—	—	—	●	—	—	—	—		
		—	10 (1)	—	—	—	●	—	—	—		
	Flange	—	32 (32A)	—	—	—	—	●	—	—	CAC407	
		—	—	40 (40A)	—	—	—	—	●	—		
		—	—	50 (50A)	—	—	—	—	—	●		

Table (2) Solenoid Valve Option

Option symbol	Seal material	Body material/ Shading coil material	Coil insulation type
A	FKM	Brass (C37), Cu	B
H		Stainless steel, Ag	
D		Brass (C37), Cu	H
N		Stainless steel, Ag	

Table (3) Rated Voltage – Electrical Option

Rated voltage			Class B			Class H		
			S	L	Z	S	L	Z
AC/DC	Voltage symbol	Voltage	With surge voltage suppressor	With light	With light and surge voltage suppressor	With surge voltage suppressor	With light	With light and surge voltage suppressor
AC	1	100 V	●	●	●	●	●	●
	2	200 V	●	●	●	●	●	●
	3	110 V	●	●	●	●	●	●
	4	220 V	●	●	●	●	●	●
	7	240 V	●	—	—	●	—	—
	8	48 V	●	—	—	●	—	—
	J	230 V	●	—	—	●	—	—
DC	5	24 V	●	●	●	DC specification is not available.		
	6	12 V	●	—	—			

Note) Option S, Z are not available as surge voltage suppressor is integrated into the AC/Class B coil, as a standard.

How to Order

DC/AC VXD 21 3 0 □ □ – 02 □ – 5 G 1 – □

AC/Class B coil (with a full-wave rectifier) VXD 21 3 0 □ □ – 02 □ – 1 G R1 – □

* The AC (Class B) coil for VXD2130 comes with a full-wave rectifier.

Model
Refer to "Table (1)" shown below for availability.

Orifice size
Refer to "Table (1)" shown below for availability.

Valve/Body configuration

0	N.C. / Single unit
2	N.O. / Single unit

Solenoid valve option
Refer to "Table (2)" shown below for availability.

Suffix

Nil	—
Z	Oil-free

Port size
Refer to "Table (1)" shown below for availability.

Thread type

Nil	Rc
T	NPTF
F	G
N	NPT

Rated voltage

1	100 VAC 50/60 Hz	6	12 VDC
2	200 VAC 50/60 Hz	7	240 VAC 50/60 Hz
3	110 VAC 50/60 Hz	8	48 VAC 50/60 Hz
4	220 VAC 50/60 Hz	J	230 VAC 50/60 Hz
5	24 VDC		

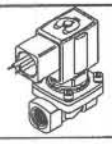
* Refer to "Table (3)" shown below for availability.

Refer to page 1 for ordering coil only.

Electrical entry

G - Grommet
GS - With grommet surge voltage suppressor

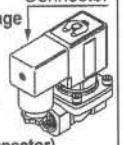
C - Conduit



T - With conduit terminal
TS - With conduit terminal and surge voltage suppressor
TL - With conduit terminal and light
TZ - With conduit terminal, surge voltage suppressor and light

D - DIN
DS - DIN with surge voltage suppressor
DL - DIN with light
DZ - DIN with surge voltage suppressor and light
DO - For DIN (without connector)

Connector



* DIN type is available with class B insulation only.

Bracket

Nil	None
B	With bracket

* Bracket is not removable.

With a full-wave rectifier, surge voltage suppressor

* Refer to "Table (3)" for the available combinations between each electrical option (S, L, Z) and rated voltage.
* Option S, Z are not available since a surge voltage suppressor is integrated into the AC/Class B coil, as a standard.

Table (1) Port/Orifice Size

Normally closed (N.C.)

Solenoid valve (Port size)					Orifice symbol							Material	
Model		VXD21	VXD22	VXD23	3 (10 mmø)	4 (15 mmø)	5 (20 mmø)	6 (25 mmø)	7 (35 mmø)	8 (40 mmø)	9 (50 mmø)	Body	Seal
Port no. (Port size)	Thread	02 (1/4)	—	—	●	–	–	–	–	–	–	Brass (C37), Stainless steel	NBR
		03 (3/8)	—	—	●	●	–	–	–	–	–		
		04 (1/2)	—	—	●	●	–	–	–	–	–		
		06 (3/4)	—	—	–	–	●	–	–	–	–		
		—	10 (1)	—	–	–	–	●	–	–	–		
	Flange	—	32 (32A)	—	–	–	–	–	●	–	–	CAC407	
		—	—	40 (40A)	–	–	–	–	–	●	–		
		—	—	50 (50A)	–	–	–	–	–	–	●		

Normally open (N.O.)

Solenoid valve (Port size)					Orifice symbol						Material	
Model		VXD21	VXD22	VXD23	4 (15 mmø)	5 (20 mmø)	6 (25 mmø)	7 (35 mmø)	8 (40 mmø)	9 (50 mmø)	Body	Seal
Port no. (Port size)	Thread	03 (3/8)	—	—	●	–	–	–	–	–	Brass (C37), Stainless steel	NBR
		04 (1/2)	—	—	●	–	–	–	–	–		
		06 (3/4)	—	—	–	●	–	–	–	–		
		—	10 (1)	—	–	–	●	–	–	–		
	Flange	—	32 (32A)	—	–	–	–	●	–	–	CAC407	
		—	—	40 (40A)	–	–	–	–	●	–		
		—	—	50 (50A)	–	–	–	–	–	●		

Table (2) Solenoid Valve Option

Option symbol	Seal material	Body material/ Shading coil material	Coil insulation type	Note
Nil	NBR	Brass (C37), Cu	B	—
G		Stainless steel, Ag		

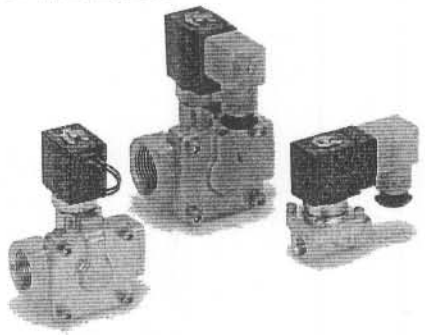
Table (3) Rated Voltage – Electrical Option

Rated voltage			Class B			Class H		
			S	L	Z	S	L	Z
AC/DC	Voltage symbol	Voltage	With surge voltage suppressor	With light	With light and surge voltage suppressor	With surge voltage suppressor	With light	With light and surge voltage suppressor
AC	1	100 V	●	●	●	●	●	●
	2	200 V	●	●	●	●	●	●
	3	110 V	●	●	●	●	●	●
	4	220 V	●	●	●	●	●	●
	7	240 V	●	–	–	●	–	–
	8	48 V	●	–	–	●	–	–
	J	230 V	●	–	–	●	–	–
DC	5	24 V	●	●	●	DC specification is not available.		
	6	12 V	●	–	–			

Note) Option S, Z are not available as surge voltage suppressor is integrated into the AC/Class B coil, as a standard.

Applicable Fluid Check List

Pilot Operated 2 Port Solenoid Valve *Series VXD21/22/23*



Normally closed (N.C.)

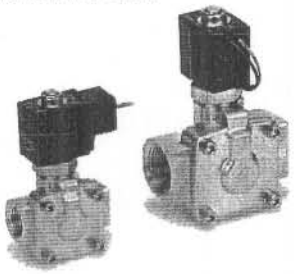
Option Symbol and Components

Option symbol	Seal material	Material Body: Shading coil	Coil insulation type	Note
Standard type	NBR	Brass (C37) or CAC407/Cu Note 1)	B	—
A	FKM			
B	EPDM			
D	FKM		H	
E	EPDM			
G	NBR	Stainless steel/Ag Note 3)	B	—
H	FKM			
J	EPDM			
L	FKM			High corrosion resistance, Oil-free
N	FKM		H	—
P	EPDM			

Fluid Name and Option

Fluid (Application)	Option symbol and body material	
	Note 1) Brass (C37) or CAC407	Note 3) Stainless steel
Applicable valve	10A to 50A	10A to 25A
Caustic soda (25% ≥)	—	J
Gas oil	A	H
Silicon oil	A	H
Steam system (Water for boiler)	—	G, J
Steam system (Condensation)	E	P
Perchloroethylene	A	H
Water (Max. 99°C)	D, E	N, P

Note 1) 10A to 25A are C37 and 32A to 50A are CAC407.
Note 2) The highest operating temperature of 32A to 50A is 80°C.
Note 3) Stainless steel/Ag is not available for valve sizes from 32A to 50A.
Note 4) Consult with SMC for other than above fluids.



Normally open (N.O.)

Option Symbol and Components

Option symbol	Seal material	Material: Body, Shading coil	Material: Inside bushing rod assembly	Coil insulation type	Note
Standard type	NBR	Brass (C37) or CAC407/Cu Note 1)	PPS	B	—
A	FKM				
B	EPDM				
D	FKM			H	
E	EPDM				
G	NBR	Stainless steel/Ag Note 3)		B	
H	FKM				
J	EPDM				
L	FKM				High corrosion resistance, Oil-free
N	FKM			H	—
P	EPDM				

Fluid Name and Option

Fluid (Application)	Option symbol and body material	
	Note 1) Brass (C37) or CAC407	Note 3) Stainless steel
Applicable valve	15A to 50A	15A to 25A
Caustic soda (25% ≥)	—	J
Gas oil	A	H
Silicon oil	A	H
Steam system (Water for boiler)	—	G, J
Steam system (Condensation)	E	P
Perchloroethylene	A	H
Water (Max. 99°C)	E	N, P

Note 1) 10A to 25A are C37 and 32A to 50A are CAC407.
Note 2) The highest operating temperature of 32A to 50A is 80°C.
Note 3) Stainless steel/Ag is not available for valve sizes from 32A to 50A.
Note 4) Consult with SMC for other than above fluids.

How to Order Solenoid Coil Assembly

Table (1) Model and Solenoid Coil Type

Select the coil type from A to C, and refer to "How to Order" below.

Voltage type		AC		AC (with a full-wave rectifier)	DC
Coil insulation type		Class B	Class H	Class B	Class H
(Solenoid valve option)		(Nil, A, B, G, H, J, L)	(D, E, N, P)	(Nil, A, B, G, H, J, L)	(Nil, A, B, G, H, J, L)
Model	VXD2130	— Note)	Ⓐ	Ⓒ	Ⓑ
	VXD21 4/5 □	Ⓐ	Ⓐ	Ⓒ	Ⓐ
	VXD22 6/7 □	Ⓐ	Ⓐ	Ⓒ	Ⓐ
	VXD23 8/9 □	Ⓐ	Ⓐ	Ⓒ	Ⓐ

Table (2) Rated Voltage – Electrical Option

Rated voltage			Class B			Class H		
			S	L	Z	S	L	Z
AC/DC	Voltage symbol	Voltage	With surge voltage suppressor	With light	With light and surge voltage suppressor	With surge voltage suppressor	With light	With light and surge voltage suppressor
AC	1	100 V	●	●	●	●	●	●
	2	200 V	●	●	●	●	●	●
	3	110 V	●	●	●	●	●	●
	4	220 V	●	●	●	●	●	●
	7	240 V	●	–	–	●	–	–
	8	48 V	●	–	–	●	–	–
	J	230 V	●	–	–	●	–	–
DC	5	24 V	●	●	●	DC specification is not available.		
	6	12 V	●	–	–			

* Option S, Z are not available since a surge voltage suppressor is integrated into the AC/Class B coil, as a standard.
* When changing coils, AC/DC are not interchangeable with each other, and Class B and H coils are also not interchangeable with each other.
AC (with a full-wave rectifier)/DC are interchangeable with each other.

DC, AC (Except VXD2130 AC/Class B) Note 1)

ⒶVX02 1 N – 5 G – □ – □

Series

1	VXD21□□
2	VXD22□□
3	VXD23□□

Rated voltage Note 2)

1	100 VAC 50/60 Hz
2	200 VAC 50/60 Hz
3	110 VAC 50/60 Hz
4	220 VAC 50/60 Hz
5	24 VDC
6	12 VDC
7	240 VAC 50/60 Hz
8	48 VAC 50/60 Hz
J	230 VAC 50/60 Hz

Note 1) The AC (Class B) coil for VXD2130 comes with a full-wave rectifier.
Note 2) Refer to "Table (2)" for the available combinations.

Coil insulation type

Nil	Class B
H	Class H Note)

Note) DIN terminal and DC are not available.

Valve

Symbol	Valve
Nil	N.C.
2	N.O.

Electrical entry

G - Grommet GS - With grommet surge voltage suppressor	C - Conduit
T - With conduit terminal TS - With conduit terminal and surge voltage suppressor TL - With conduit terminal and light TZ - With conduit terminal, surge voltage suppressor and light	D - DIN DS - DIN with surge voltage suppressor DL - DIN with light DZ - DIN with surge voltage suppressor and light DO - For DIN (without connector) Connector

* Refer to "Table (2)" for the available combinations between each electrical option and rated voltage.

VXD2130 DC

ⒷVX021N – 5 G – Z

Rated voltage

5	24 VDC
6	12 VDC

AC/Class B (with a full-wave rectifier)

ⒸVX02 1 N – 1 G R – □

Series

1	VXD21□□
2	VXD22□□
3	VXD23□□

Rated voltage Note 1)

1	100 VAC 50/60 Hz
2	200 VAC 50/60 Hz
3	110 VAC 50/60 Hz
4	220 VAC 50/60 Hz
7	240 VAC 50/60 Hz
8	48 VAC 50/60 Hz
J	230 VAC 50/60 Hz

Note 1) Refer to "Table (2)" for the available combinations.

Valve

Symbol	Valve
Nil	N.C.
2	N.O.

Electrical entry

G - Grommet	C - Conduit
T - With conduit terminal TL - With conduit terminal and light	D - DIN DL - DIN with light DO - For DIN (without connector) Connector

* Refer to "Table (2)" for the available combinations between each electrical option and rated voltage.
* A surge voltage suppressor is inegrated into the AC/Class B coil, as a standard.

• Name plate part no.

AZ-T-VX [Valve model]

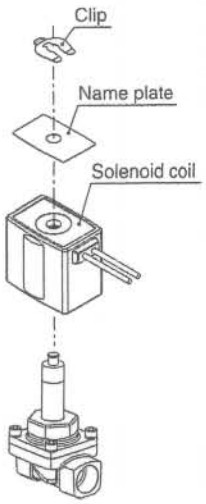
↑ Enter by referring to "How to Order".

• Clip part no. (For N.C.)

For VXD21: VX021N-10
For VXD22: VX022N-10
For VXD23: VX023N-10

• Clip part no. (For N.O.)

For VXD21: ETW-7
For VXD22: ETW-8
For VXD23: ETW-9



Troubleshooting

If an abnormality is detected while using the valve, perform the following checks and take necessary countermeasures.

NC Type

Misoperation	Cause	Countermeasure
Fluid does not stop	Power is ON	Switch power OFF and check circuit
	Large vibration and shock	Prevent vibration or change installation position
	Breakdown in wiring system, or incorrect wiring	Correct wiring
	Ingress of foreign matter	Remove foreign matter and install filter
	Viscosity is high	Keep viscosity below 50 cSt
	Reverse connection	Connect IN port to high pressure side
	Damaged, worn, deformed or degraded part	Replace part
Fluid does not flow	Power is OFF	Switch power ON and check circuit
	Voltage is low	Adjust voltage
	Frequency is different	Select correct coil
	Pressure is high	Select valve which can be set to correct pressure
	Fluid temperature or ambient temperature is high	Select correct type of valve
	Open circuit coil - surge, careless handling	Replace coil ass'y

Misoperation	Cause		Countermeasure
Burnt out coil	Voltage is high, low	→	Adjust voltage
	Frequency is different	→	Select correct coil
	Pressure is high	→	Select valve which can be set to correct pressure
	Ingress of foreign matter	→ Remove foreign matter and install filter	→ Replace coil ass'y
	Viscosity is high	→	Keep viscosity below 50 cSt
	Careless handling (coil energized when removed from valve ass'y)	→	Replace coil ass'y
	Fluid temperature or ambient temperature is high	→	Select correct type of valve
	Large vibration and shock	→	Prevent vibration or change installation position
	Valve exposed to water for long period	→	Take steps to make valve waterproof

NO Type

Misoperation	Cause	Countermeasure
Fluid does not stop	Power is OFF	Switch power ON and check circuit
	Large vibration and shock	Prevent vibration or change installation position
	Breakdown in wiring system, or incorrect wiring	Correct wiring
	Open circuit coil - surge, careless handling	Replace coil ass'y
	Voltage is low	Adjust voltage
	Frequency is different	Select correct coil
	Ingress of foreign matter	Remove foreign matter and install filter
	Reverse connection	Connect IN port to high pressure side
	Fluid temperature or ambient temperature is high	Select correct type of valve
	Damaged, worn, deformed or degraded part	Replace part (core ass'y)
Fluid does not flow	Power is ON	Switch power OFF and check circuit
	Viscosity is high	Keep viscosity below 50 cSt
	Leakage voltage is high	20% (AC) and 2% (DC) of rated voltage
	Pressure is high	Select valve which can be set to correct pressure
Burnt out oil	Voltage is high, low	Adjust voltage
	Frequency is different	Select correct coil
	Ingress of foreign matter	Remove foreign matter and install filter → Replace coil ass'y
	Careless handling (coil energized when removed from valve ass'y)	Replace coil ass'y
	Fluid temperature or ambient temperature is high	Select correct type of valve
	Large vibration and shock	Prevent vibration or change installation position
	Valve exposed to water for long period	Take steps to make valve waterproof

Poor air-tightness	Cause	Countermeasure
Internal leakage	Ingress of foreign matter	Remove foreign matter and install filter
	Damaged, worn, deformed or scratched part	Replace part
	Large vibration and shock	Prevent vibration or change installation position
	Swelling or deterioration due to working fluid	Select correct type of valve
	Freezing	Take steps to prevent freezing
	Piping condition	Check piping
External leakage	Improper clamping	Tighten core ass'y
	Defective packing ("O" ring)	Replace part
	Swelling or deterioration due to working fluid	Select correct type of valve
	Damaged part	Replace part
	Freezing	Take steps to prevent freezing
Growling noise	Voltage is low	Adjust voltage
	Ingress of foreign matter	Remove foreign matter, install filter, and change mesh (replace part)
	Damaged, deformed or worn part	Replace part
	Valve resonates with equipment	Take steps to prevent vibration