Angle Seat Valve Air Operated Type

Low pressure loss due to angle seat structure!
Reduced leakage with rubber seal!

Long service life

3 million cycles* (Steam)

5 million cycles* (Air)

* Based on SMC's test condition

Low leakage

10 cm³/min* or less

* With air

Space saving

Height
100 mm*

* Port size: 3/8

Body material
Bronze (CAC)

Body material
Stainless steel 316L equivalent

Series *VXB*

SMC®

CAT.ES70-54A

Angle Seat Valve
Air Operated Type *Series VXB*

Long service life

Steam **3** million cycles*

Air **5** million cycles*

* Based on SMC's test condition

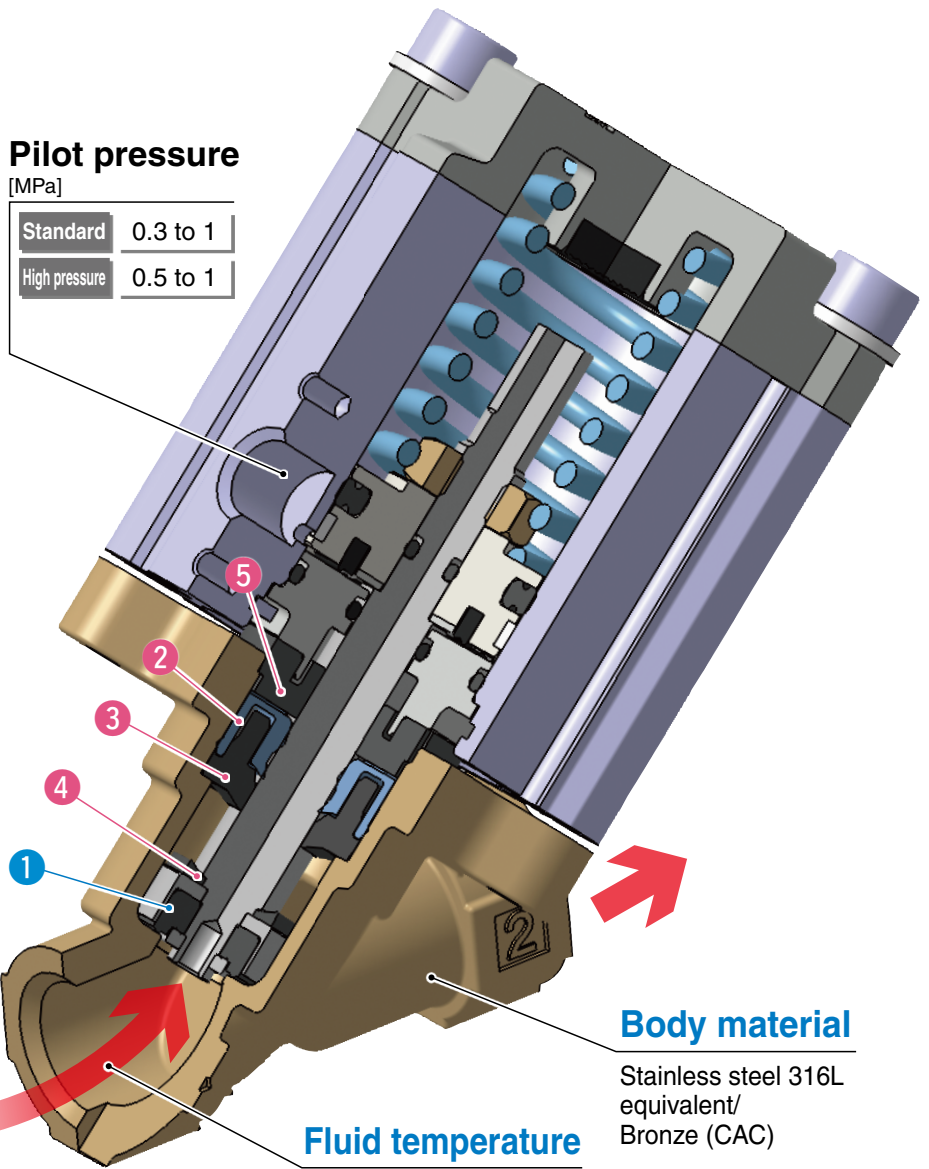**②Squeeze seal with scraper function**
Scraper function added to the seal to shut off fluid leakage

③Resin scraper
Scraper function during the main valve stroke

④Protective seal
Prevents foreign matter from entering the squeeze seal when the valve is open.

⑤Guide bushing
Prevents misalignment and lengthens the squeeze seal life.

Low leakage

Internal leakage **10** cm³/min* or less
* With air

①Rubber seal
Special FKM with high sealing performance

Pilot pressure
[MPa]

Standard	0.3 to 1
High pressure	0.5 to 1

Body material
Stainless steel 316L equivalent/ Bronze (CAC)
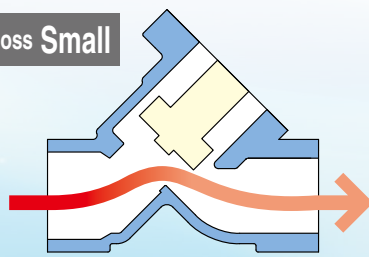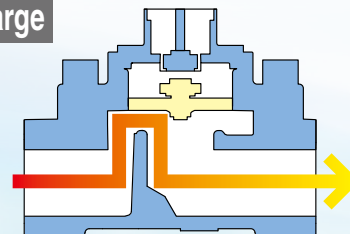
Fluid temperature
183°C (steam) or less

Low pressure loss

Pressure loss Small

Angle seat structure

Pressure loss Large

Current structure

Variations

Model	Orifice diameter [mmø]	Cv	Port size	Max. operating pressure [MPa]		Body material	Fluid
				Standard	High pressure		
VXB215^A_D	11	3.5	3/8 (10A)	1	1.6	Stainless steel 316L equivalent, Bronze (CAC)	Steam * Can be used with air and water.
VXB215^B_E	14	5.4	1/2 (15A)	0.6	1.2		
VXB215^C_F	18	7.6	3/4 (20A)	0.4	0.6		

1

SMC

2 Port Solenoid Valve Variations

Series

Direct Operated

Series VX

Air | Medium vacuum | Water | Oil | Steam
* Can be used with heated water.

Compact
Series VDW

Air | Medium vacuum | Water

Single Unit
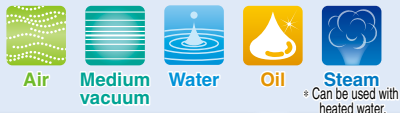
Valve type	Port size	Orifice diameter [mmø]
N.C./N.O.	1/8 to 1/2 ø6 to ø12	2, 3, 4, 5, 7, 8, 10

Manifold (Air)

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

Valve type	Port size	Orifice diameter [mmø]
N.C.	M5, 1/8, ø3.2 to ø6	1, 1.6, 2.3, 3.2

Pilot Operated

Series VXD

Air | Water | Oil | Heated water | High temperature oil

Zero Differential Pressure **Series VXZ**

Air | Water | Oil | Heated water | High temperature oil

Series VXS

Steam
* Can be used with heated water.
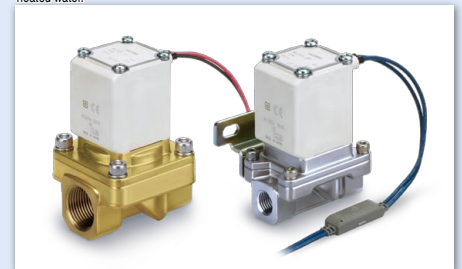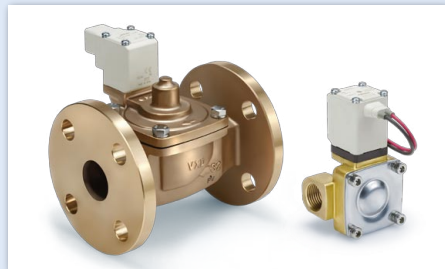
Valve type	Port size	Orifice diameter [mmø]
N.C./N.O.	1/4 to 50A ø10 to ø12	10, 15, 20, 25, 35, 40, 50

Valve type	Port size	Orifice diameter [mmø]
N.C./N.O.	1/4 to 1 ø10 to ø12	10, 15, 20, 25

Valve type	Port size	Orifice diameter [mmø]
N.C.	1/4 to 1	10, 15, 20, 25

Fluid/Orifice Diameter

Series	Applicable fluid						Orifice diameter [mmø]
	Air	Medium vacuum	Water	Oil	Heated water	High temperature oil	Steam * Can be used with heated water.
Direct Operated Series VX * * Single Unit	●	●	●	●			●	2–10
Series VDW	●	●	●					1–3.2
Pilot Operated Series VXD	●		●	●	●	●		10–50
Series VXZ	●		●	●	●	●		10–25
Series VXS							●	10–25

2
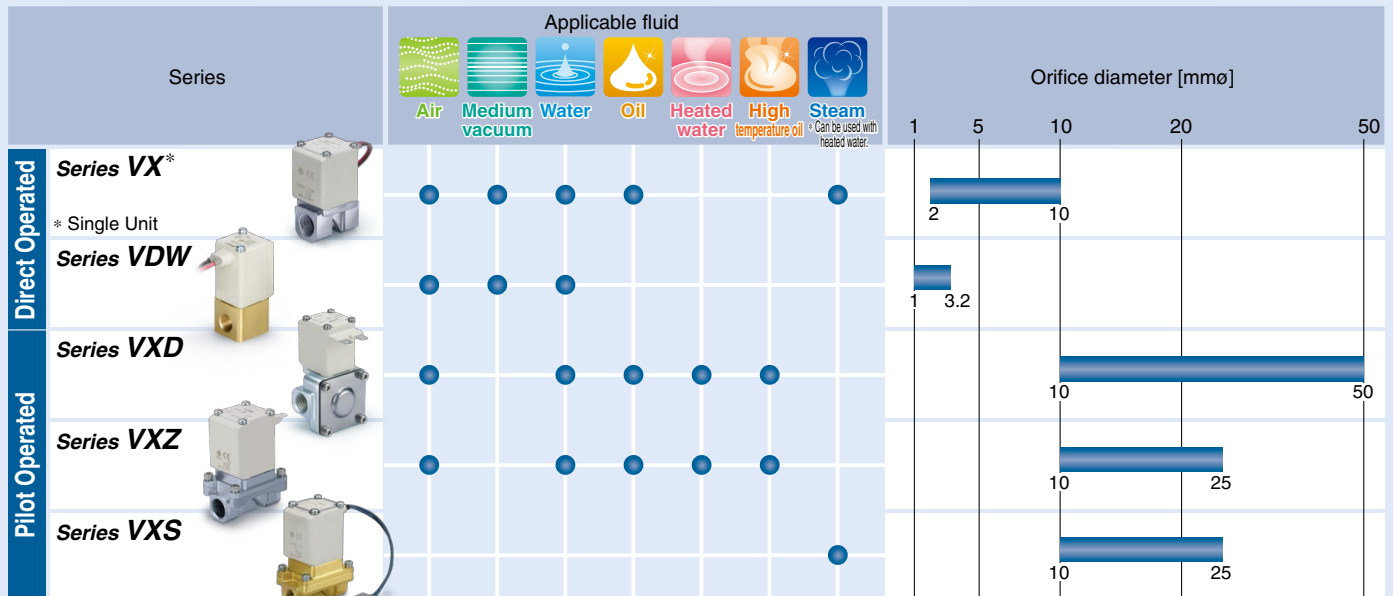
Standard Specifications

| Valve specifications	Valve construction	Air operated piston type
	Withstand pressure	2.4 MPa
	Body material	Stainless steel 316L equivalent, Bronze (CAC)
	Seal material	FKM
	Environment	Location without corrosive or explosive gases

Selection Steps

Step 1 **Select "Body material", "Port size" and "Orifice diameter".**

Item	Selection item		Symbol
● Body material ● Port size ● Orifice diameter	Body material	Bronze	A ❶
	Port size	3/8	
	Orifice diameter	12	

❶

VXB2 1 5 [A] H B

Step 2 **Select "Pressure type".**

Item	Selection item	Symbol
● Pressure type	High pressure	H ❷

❷

VXB2 1 5 A [H] B

Step 3 **Select "Thread type".**

Item	Selection item	Symbol
● Thread type	NPT	B ❸

❸

VXB2 1 5 A H [B]

Step 4 **For special options, refer to page 5.**

⊘SMC

For Steam

∗ Can be used with air and water.

Flow-rate Characteristics

| N.C. | **(Normally closed)** |

Symbol
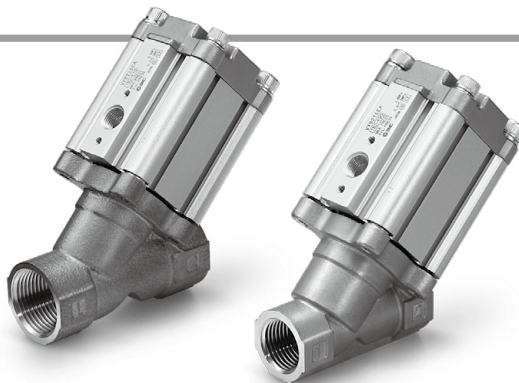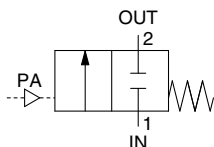
Size	Port size	Orifice diameter [mm]	Pressure type	Model	Air			Water		Max. operating pressure [MPa]	Pilot pressure [MPa]	Weight [g]
					Cv	C [dm³/(s·bar)]	b	Cv	Kv			
1	3/8	11	Standard	**VXB215_D^A**	3.5	14.1	0.29	3.5	3.0	1.0	0.3 to 1	570
			High pressure	**VXB215_D^AH**						1.6	0.5 to 1	
	1/2	14	Standard	**VXB215_E^B**	5.4	20.0	0.35	5.4	4.6	0.6	0.3 to 1	620
			High pressure	**VXB215_E^BH**						1.2	0.5 to 1	
	3/4	18	Standard	**VXB215_F^C**	7.6	23.9	0.45	7.6	6.5	0.4	0.3 to 1	680
			High pressure	**VXB215_F^CH**						0.6	0.5 to 1	

• The maximum operating pressure of steam is 1.0 MPa.
• **When the fluid is steam and a one-touch resin fitting is used for the pilot port, choose "Insulating Adapter Type" from page 5, Other Special Options.**

Fluid and Ambient Temperature

Fluid temperature [°C]	Ambient temperature [°C]
Steam: 183 or less Water, Air: 99 or less	−20 to 60

Note) No freezing

Valve Leakage Rate

Internal Leakage

Fluid	Seal material	Leakage rate [Note 1]
Steam, Air	FKM	10 cm³/min or less [Note 2]
Water		1 cm³/min or less

External Leakage

Fluid	Seal material	Leakage rate [Note 1]
Steam, Air	FKM	10 cm³/min or less [Note 2]
Water		1 cm³/min or less

Note 1) Leakage is the value at ambient temperature 20°C.
Note 2) With air

How to Order

VXB2 1 5 A ☐ ☐

Valve type

1	N.C.

Fluid

5	Steam

Body material/Port size/Orifice diameter

Symbol	Body material	Port size	Orifice diameter
A		3/8	11
B	Bronze (CAC)	1/2	14
C		3/4	18
D		3/8	11
E	Stainless steel 316L equivalent	1/2	14
F		3/4	18

Thread type∗

Nil	Rc
A	G
B	NPT

∗ The thread type for the main piping and pilot piping is the same.

Pressure type

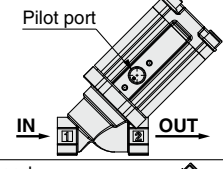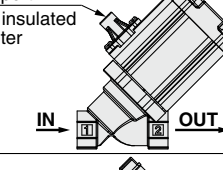| Nil	Standard
H	High pressure
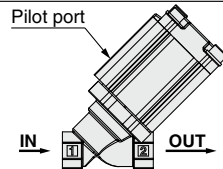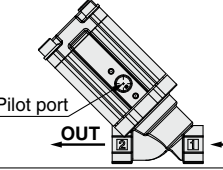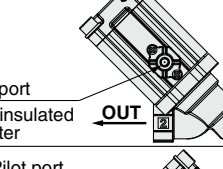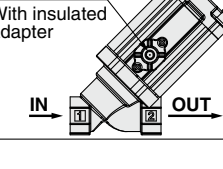
Other Special Options

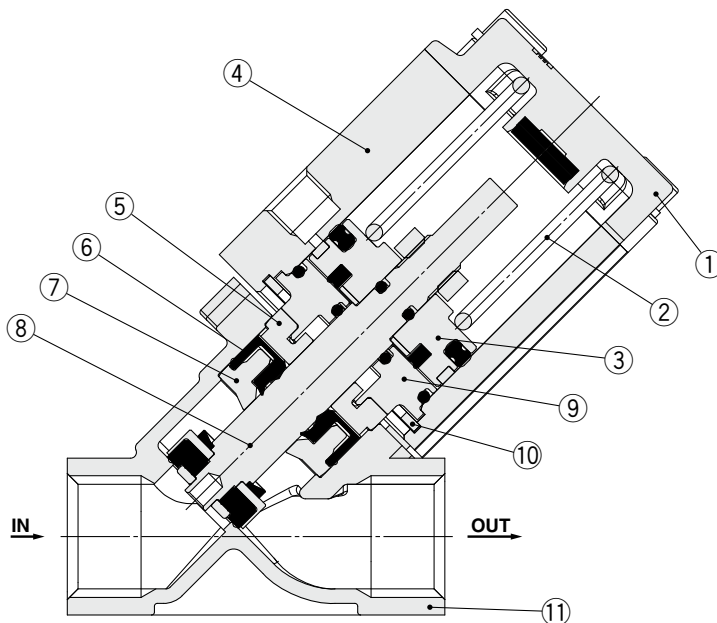### ● Special Entry for Pilot Port/ Insulating Adapter Type

VXB215 ☐ ☐ ☐ XCA

Enter standard product number.

Pilot port
90° **XCA**
270° **XCC**
2 (OUT)
1 (IN)

Insulated adapter
XA
90° **XAA**
270° **XAC**
2 (OUT)
1 (IN)
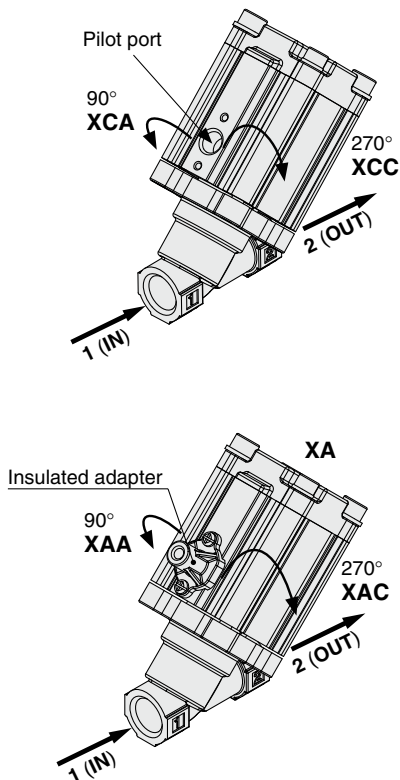
Symbol	Rotation angle		Insulated adapter
Nil	Pilot port / IN / OUT		No
XCA	**90°** Pilot port / OUT / IN		No
XCC	**270°** Pilot port / IN / OUT		No
XA	Pilot port With insulated adapter / IN / OUT		Yes
XAA	**90°** Pilot port With insulated adapter / OUT / IN		Yes
XAC	**270°** Pilot port With insulated adapter / IN / OUT		Yes

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Construction

Component Parts

No.	Description	Material
1	Cover assembly	Stainless steel 316L equivalent, FKM
2	Spring	Stainless steel 304
3	Piston assembly	Aluminum, FKM, PTFE, Stainless steel 304
4	Housing	Aluminum
5	Guide bushing	PPS
6	Squeeze seal with scraper function	FKM
7	Resin scraper	PEEK
8	Main valve assembly	FKM, Stainless steel 316L equivalent
9	Bushing assembly	Aluminum, FKM
10	Round type R retaining ring	Fe
11	Body	CAC or Stainless steel 316L equivalent

Dimensions

Insulated adapter (PPS, FKM, Fe)
(Other special options)

M5 (Tightening torque: 0.4 to 0.6 N·m)
10-32UNF can be connected.

1/8
Pilot port

2 x **P**
Port size
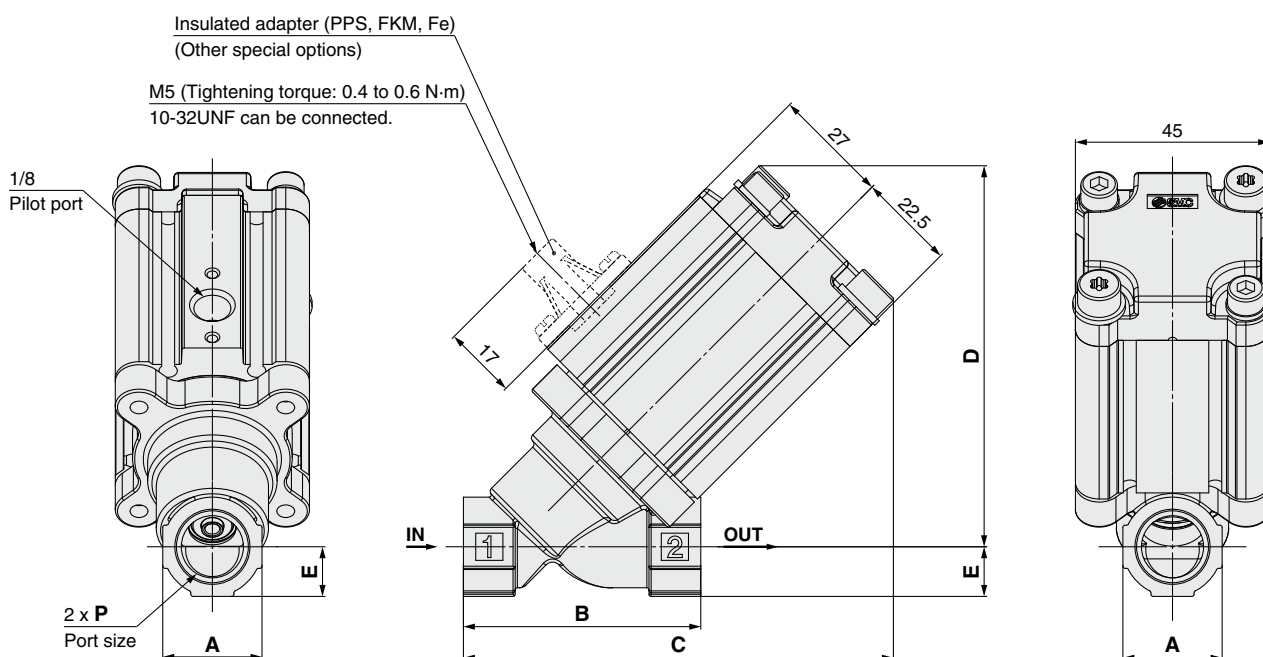
Dimensions   [mm]

Model	Port size **P**	**A**	**B**	**C**	**D**	**E**
VXB215^A_D	3/8	23	55	99.8	88.3	11.5
VXB215^B_E	1/2	27	65	106.8	90.8	13.5
VXB215^C_F	3/4	32	75	111.5	93.2	16

Replacement Parts

● Maintenance Kit

How to order maintenance kit

VXB215 – ☐☐☐ – KT

● Port size			● Pressure type			● Thread type	
Symbol	Port size		Symbol	Pressure type		Symbol	Thread type
03	3/8		**Nil**	Standard		**Nil**	Rc
04	1/2		**H**	High pressure		**A**	G
06	3/4					**B**	NPT

Component Parts

a	Housing assembly	1 pc.
b	Mounting screw: M5 hexagon socket head cap screw	2 pcs.
c	Spring washer	2 pcs.

● Disassembly/Assembly Procedures

Disassembly

1) Loosen the 2 M5 hexagon socket head cap screws.
2) Remove the housing assembly from the body. 2 spring washers are mounted between the housing assembly and body.

Assembly

1) Insert the housing assembly to the body. Assemble 2 spring washers between the housing assembly and body.
2) Tighten 2 M5 hexagon socket head cap screws
   Tighten the screws diagonally in order of ①→②→① (Fig.1).
   ∗ Tightening torque for M5 hexagon socket head cap screw: 3 N·m

b. Mounting screw
M5 hexagon socket head cap screw x 2 pcs.

a. Housing assembly

c. Spring washer (2 pcs.)

Body

⚠**Caution**
M6 special screw
(Do not disassemble.)

M5 hexagon socket head cap screw ①

⚠**Caution**
M6 special screw
(Do not disassemble.)

M5 hexagon socket head cap screw ②

Fig.1
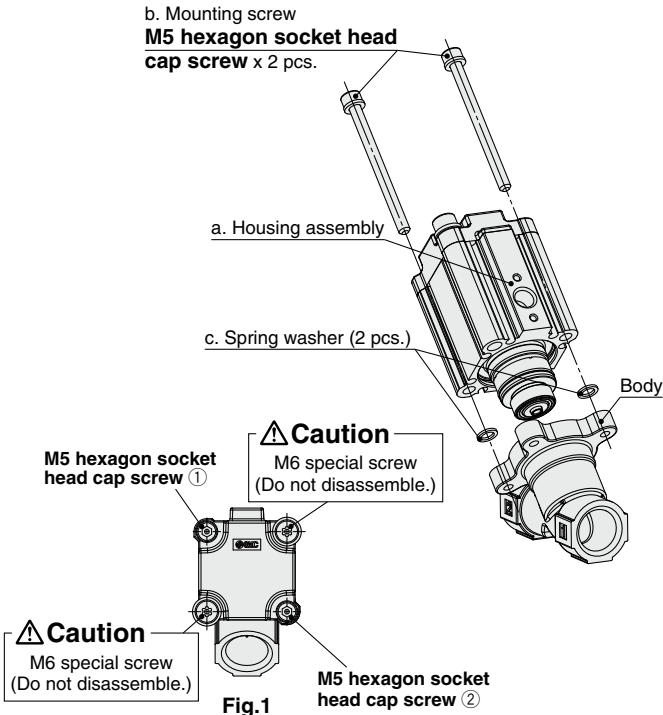
⚠Caution

1. Before disassembling, be sure to shut off the pressure supply, and then release the residual pressure.
2. After replacement, confirm that there is no fluid leakage.
   Additionally, when restarting the valve, make sure that the valve operates correctly after checking the safety.

● Insulated Adapter (for Individual Parts)

VXB021-20-1A (1 set)

∗ Valve body is not included.

M3 round head combination screw (Fe) 2 pcs.

Insulated adapter (PPS) — Set

O-ring (FKM)
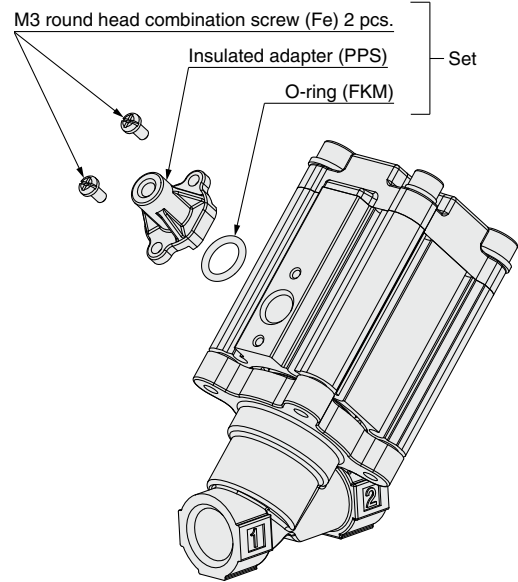
∗ All thread types (Rc, G, NPT) are common.
∗ Guideline for the tightening torque of the M3 round head combination screw is 0.5 N·m.

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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
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
Process fluid control equipment	*Av*	—	IEC60534-2-3: 1997 JIS B 2005: 1995 Equipment: JIS B 8471, 8472, 8473
	—	*Cv*	

2. Pneumatic equipment

2.1 Indication according to the international standards

(1) Conformed standard
    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-rate characteristics
    The flow-rate characteristics are indicated as a result of a comparison between sonic conductance *C* and critical pressure ratio *b*.

    Sonic conductance *C* : Value which divides 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 a standard condition.

    Critical pressure ratio *b* : Pressure ratio (downstream pressure/upstream pressure) which will turn to a choked flow when the value is smaller than this ratio.

    Choked flow : 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.

    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 "(ANR)" after the unit depicting air volume.
    (standard reference atmosphere)
    Conformed standard: ISO 8778: 1990 Pneumatic fluid power—Standard reference atmosphere, JIS B 8393: 2000: Pneumatic fluid power—Standard reference atmosphere

(3) Formula for flow rate
    Described by the practical units as following.

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

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

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

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

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

1 dm³ = 1 L

C : Sonic conductance [dm^3/(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-rate characteristics are shown in Graph (1). For details, please make use of 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 [dm^3/(s·bar)] and b = 0.3

According to formula (1), the maximum flow rate = 600 x 2 x (0.4 + 0.1) x $\sqrt{\dfrac{293}{273 + 20}}$ = 600 [dm^3/min (ANR)]

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

Based on Graph (1), the flow rate ratio will be 0.7 when the pressure ratio is 0.8 and b = 0.3
Therefore, flow rate = Maximum flow rate x flow rate ratio = 600 x 0.7 = 420 [dm^3/min (ANR)]
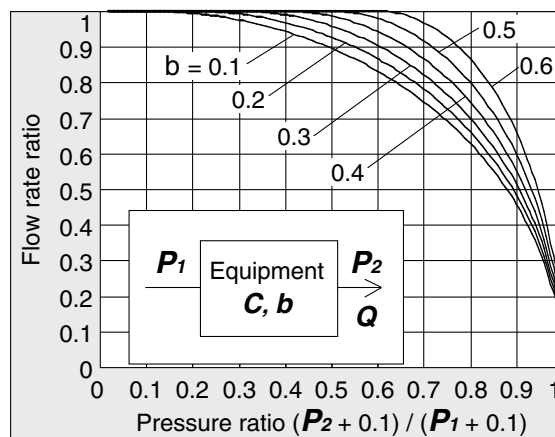
Graph (1) Flow-rate characteristics

(4) Test method

Attach a test equipment with the test circuit shown in Fig. (1) while maintaining the upstream pressure to a certain level which does not go below 0.3 MPa. Next, measure the maximum flow to be saturated in the first place, then 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 subsonic flow formula to find b, then obtain the critical pressure ratio b from that average.
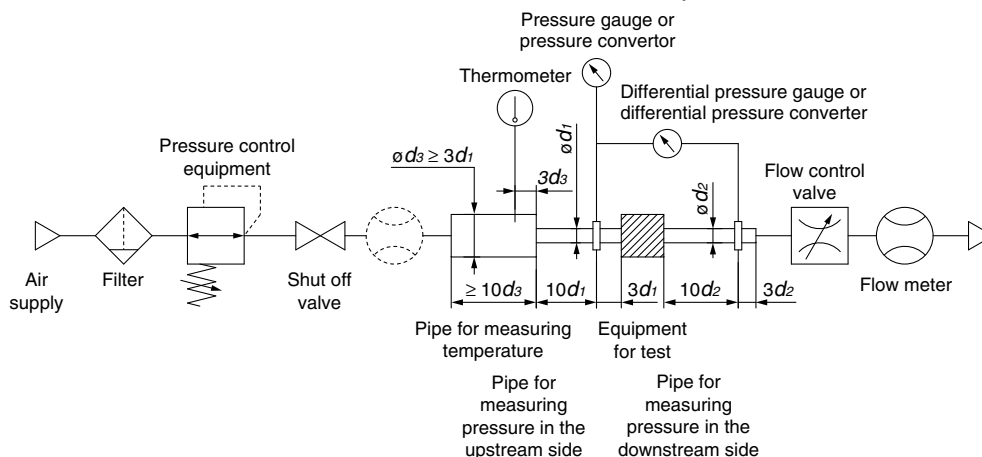

Fig. (1) Test circuit based on ISO 6358, JIS B 8390

2.2 Effective area S

(1) Conformed standard

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

Effective area S: The cross-sectional area having an ideal restrictor without friction or without reduced flow. It is deduced from the calculation of the pressure changes inside an air tank 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.

(3) Formula for flow rate

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

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

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

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

Conversion with sonic conductance C:

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

Q : Air flow rate [dm^3/min(ANR)], dm^3 (cubic decimeter) of SI unit are allowed to be described by L (liter).
　　1 dm^3 = 1 L
S : Effective area [mm^2]
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 unknown for equipment. In the formula (2) by the sonic conductance C, it is the same formula as when b = 0.5

(4) Test method

Attach a test equipment with the test circuit shown in Fig. (2) in order to 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 the compressed air at a certain pressure level (0.5 MPa) which does not go 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 to determine the effective area S, using the following formula. The volume of an air tank should be selected within the specified range by corresponding to the effective area of an equipment for test. In the case of JIS B 8373, 8374, 8375, 8379, 8381, the pressure values are in parentheses and the coefficient of the formula is 12.9

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

S : Effective area [mm^2]
V : Air tank capacity [dm^3]
t : Discharging time [s]
P_s: Pressure inside air tank before discharging [MPa]
P : Residual pressure inside air tank after discharging [MPa]
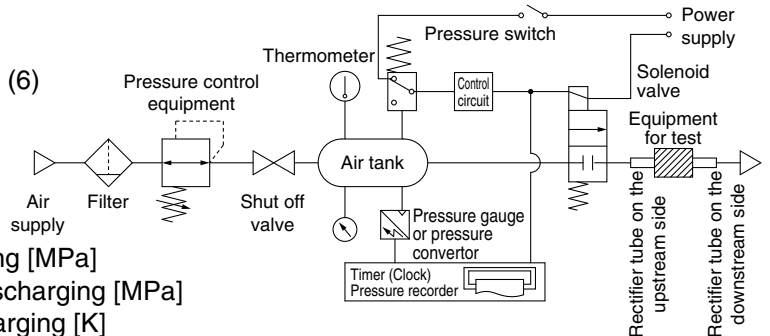T : Temperature inside air tank before discharging [K]

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

$$Cv = \frac{Q}{114.5 \sqrt{\dfrac{\Delta P\,(P_2 + Pa)}{T_1}}} \quad \text{..(7)}$$

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 [dm³/s standard condition]
Pa : Atmospheric pressure [bar absolute]
T_1 : Upstream absolute temperature [K]

Test conditions are $P_1 + Pa$ = 6.5 ±0.2 bar absolute, T_1 = 297 ±5 K, 0.07 bar ≤ ΔP ≤ 0.14 bar.

This is the same concept as effective area *A* which ISO 6358 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. 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: How to test 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 m³/s which runs through a valve (equipment for test) when the pressure differential is 1 Pa. It is calculated using the following formula.

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

   Av : Flow coefficient [m²]
   Q : Flow rate [m³/s]
   ΔP : Pressure differential [Pa]
   ρ : Fluid density [kg/m³]

(3) Formula for flow rate
   Described by the practical units. Also, the flow-rate characteristics are shown in Graph (2).
   In the case of liquid:

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

   Q : Flow rate [L/min]
   Av : Flow coefficient [m²]
   ΔP : Pressure differential [MPa]
   G : Specific gravity [water = 1]

   In the case of saturated steam:

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

   Q : Flow rate [kg/h]
   Av : Flow coefficient [m²]
   ΔP : Pressure differential [MPa]
   P_1 : Upstream pressure [MPa]: $\Delta P = P_1 - P_2$
   P_2 : Downstream pressure [MPa]

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Conversion of flow coefficient:

Av = 28 x 10⁻⁶ Kv = 24 x 10⁻⁶ Cv ···(11)

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): Value of the clean water flow rate represented 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.
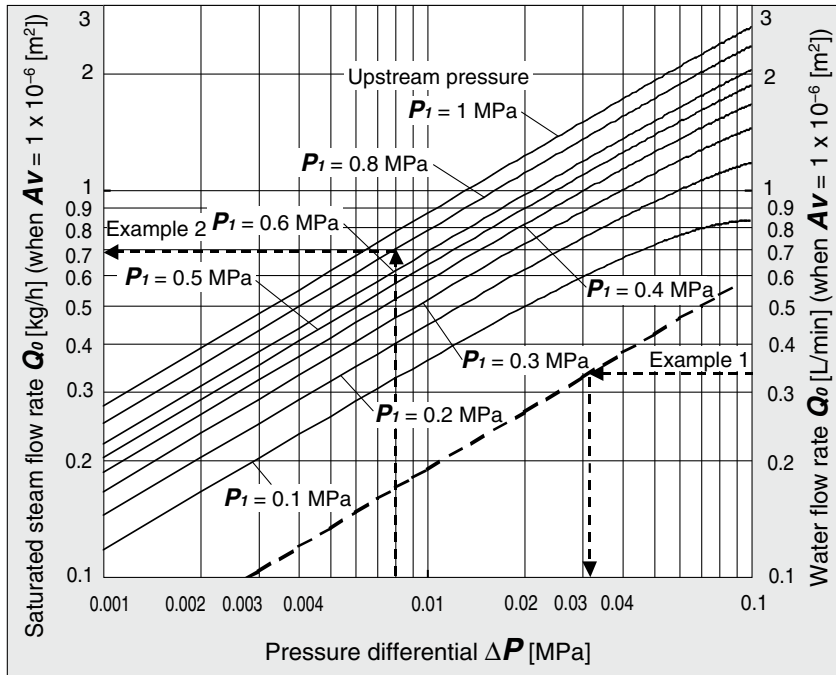
Graph (2) Flow-rate characteristics

Example 1)
Obtain the pressure differential when water 15 [L/min] runs through a solenoid valve with an Av = 45 x 10⁻⁶ [m²].
Since Q_0 = 15/45 = 0.33 [L/min], according to Graph (2), 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_1 = 0.8 [MPa], ΔP = 0.008 [MPa] with a solenoid valve with an Av = 1.5 x 10⁻⁶ [m²].
According to Graph (2), if reading Q_0 when P_1 is 0.8 and ΔP is 0.008, it is 0.7 [kg/h]. Therefore, the flow rate Q = 0.7 x 1.5 = 1.05 [kg/h].

(4) Test method
Attach a test equipment with the test circuit shown in Fig. (3). 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 x 10⁴.
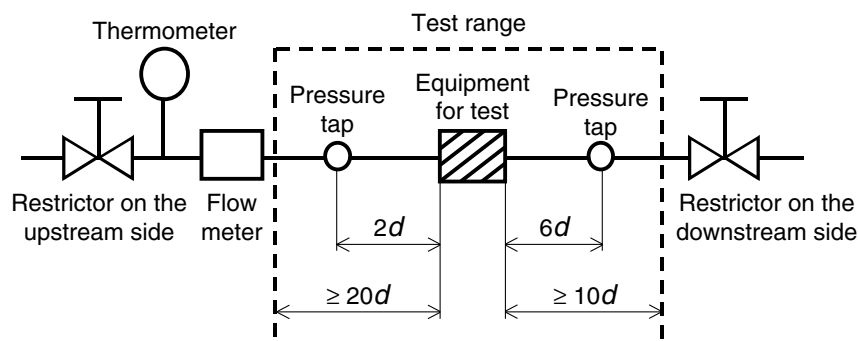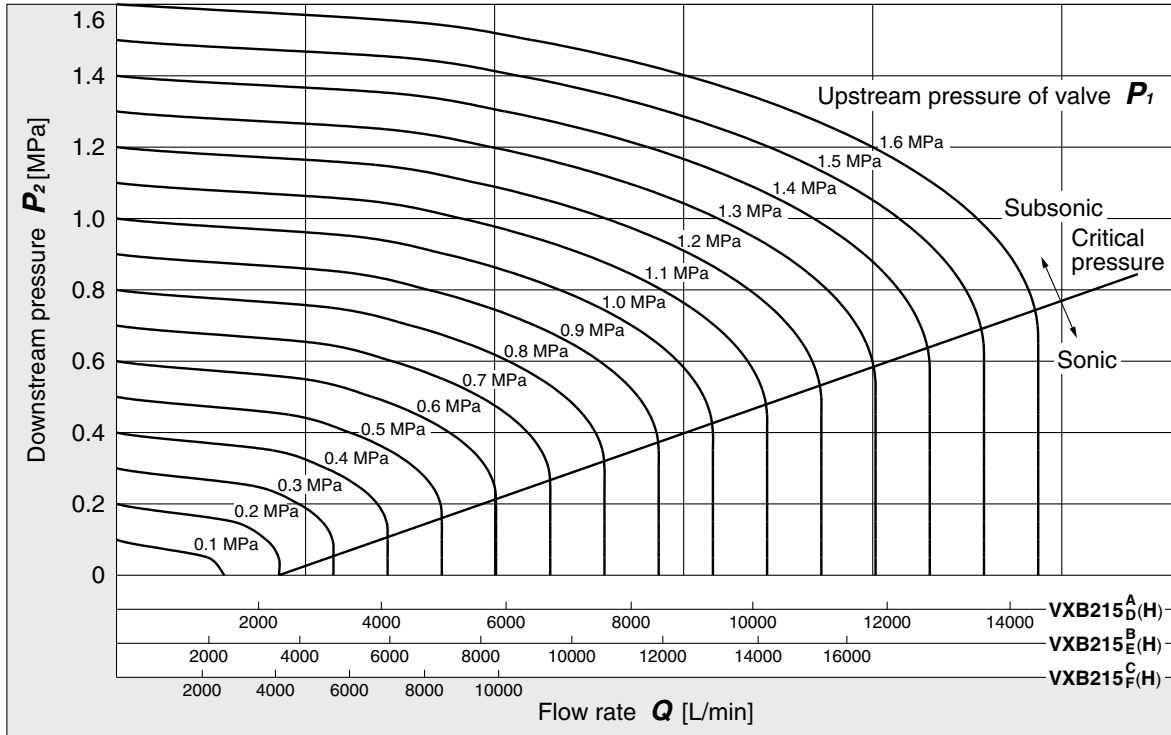By substituting the measurement results for formula (8) to figure out Av.

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

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Flow-rate Characteristics

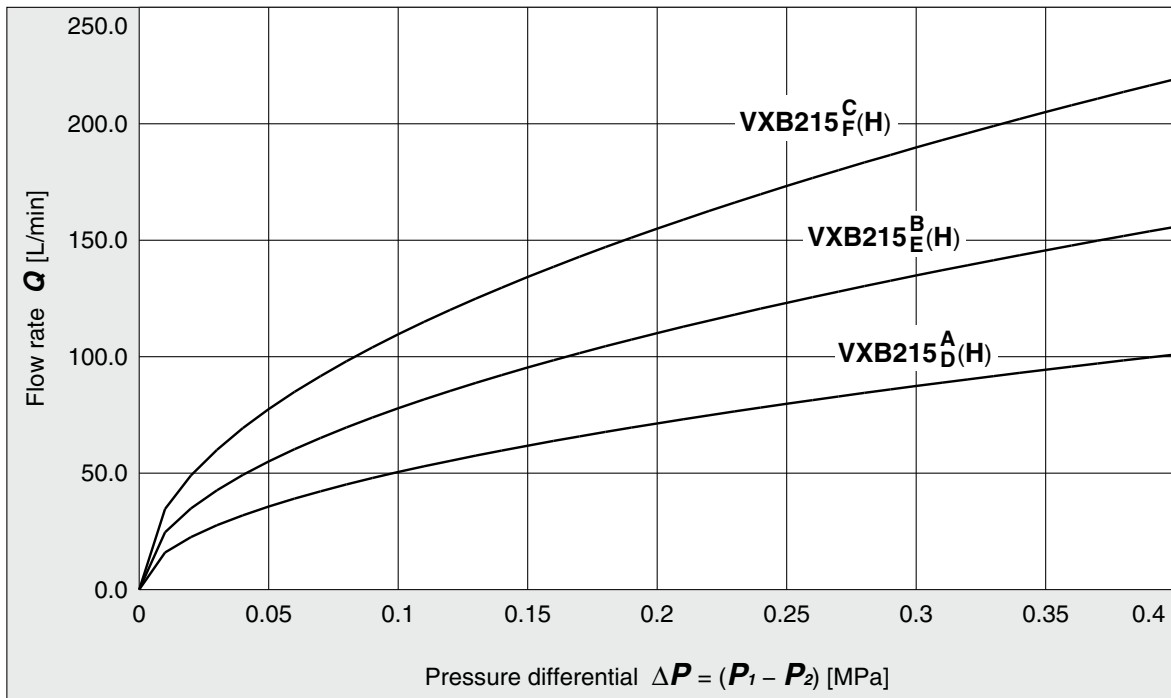Note) Use this graph as a guide. In the case of obtaining an accurate flow rate, refer to pages 8 to 12.

For Air

How to read the graph

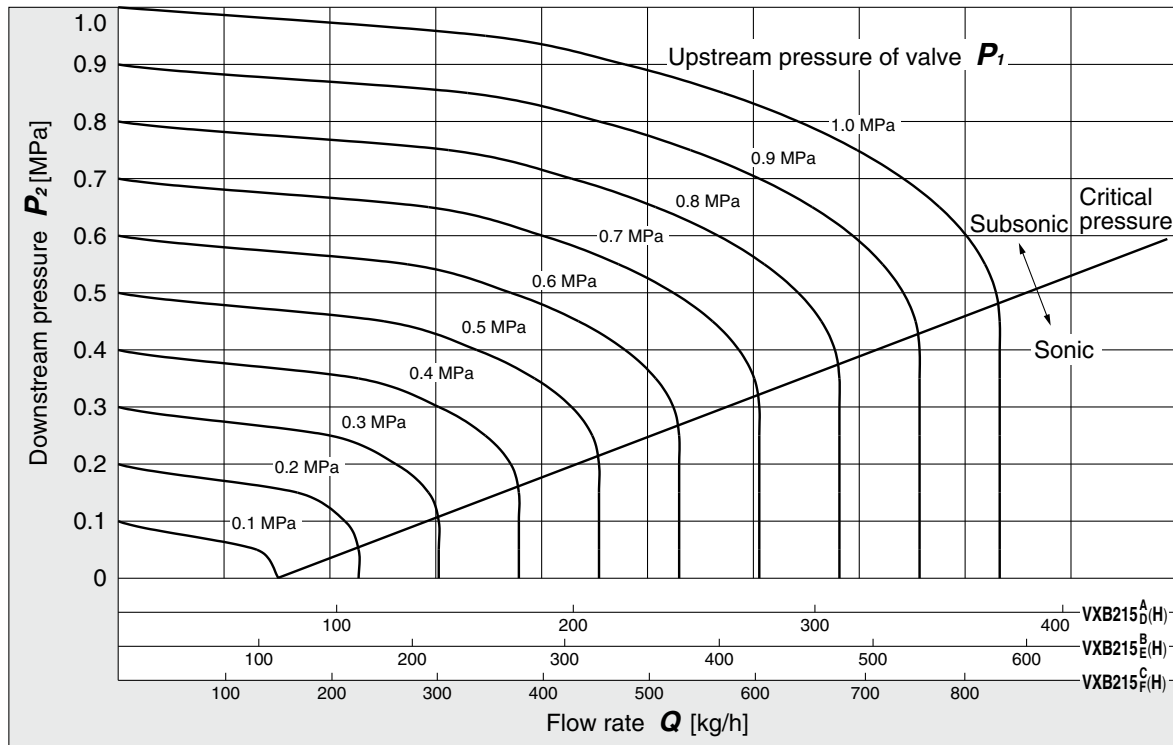The sonic range pressure to generate a flow rate of 4000 L/min (ANR) is $P_1 \approx 0.4$ MPa for the VXB215$_D^A$(H).

For Water

How to read the graph

When a water flow of 50 L/min is generated, $\Delta P \approx 0.1$ MPa for the VXB215$_D^A$(H).

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For Saturated Steam

How to read the graph
The sonic range pressure to generate a flow rate of 300 kg/h is P₁ ≈ 0.3 MPa for the VXB215^C_F(H).
The holding heat is approximate 196 Mcal/h at 300 kg/h.

Design

⚠ Warning

1. For usage of reverse pressure, please consult SMC.

2. 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.

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

Selection

⚠ Warning

1. Fluid

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

2. Air quality

<Steam, Water>

The use of a fluid that contains foreign matter can cause problems such as malfunction and seal failure by promoting wear of the valve seat and seal. Install a suitable filter (strainer) immediately upstream from the valve.

As a standard, the mesh count for the strainer is 100 mesh. However, the size and shape of foreign matter 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.

Selection

⚠ Warning

<Air>

• **Use clean air.**

Do not use compressed air that contains chemicals, synthetic oils including organic solvents, salt or corrosive gases, etc., as it can cause damage or malfunction.

• **Install an air filter.**

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

• **Install an aftercooler or air dryer, etc.**

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

• **If excessive carbon powder is generated, eliminate it by installing mist separators 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 the Best Pneumatics No.5 catalog for further details on compressed air quality.

3. 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.

4. Low temperature operation

1) The valve can be used in an ambient temperature of −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. 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.

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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 operating 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 operating section upward, not downward.

If the operating section is installed downward, foreign matter in the fluid may stick to the seal, causing a malfunction.

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

5. 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]
M5 (Insulated adapter)	0.4 to 0.6
Rc1/8	7 to 9
Rc3/8	22 to 24
Rc1/2	28 to 30
Rc3/4	

4. When connecting piping to a product, avoid mistakes regarding the connecting direction of the product.
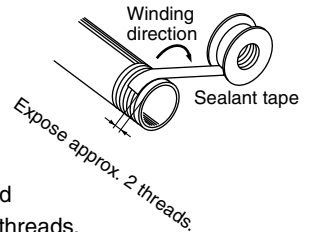
Piping

⚠ Caution

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.

Winding direction

Sealant tape

Expose approx. 2 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 a 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 valve.

Install the piping to the valve higher than peripheral piping. Be sure to avoid installing the piping to the valve at the lowest part of the piping layout. If condensate accumulates in the valve or peripheral piping, the steam entering the piping will cause steam hammer. This will lead to destruction and malfunction of the 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.

9. For the convenience of maintenance and repair, install a bypass circuit and use a union for piping.

10. To control the fluid in the tank, connect the piping a little higher than the bottom of the tank.

11. Pilot piping

If the fluid is steam, use the insulated adapter in page 5, Other Special Options. Or, use a heat resisting fitting and tube. (Metal One-touch fittings, self-align fittings, fluoropolymer tubing, copper tubing, etc.)

Series **VXB**
Specific Product Precautions 3
Be sure to read this before handling. Refer to the back cover for Safety Instructions.
For 2 Port Solenoid Valves for Fluid Control Precautions, refer to "Handling Precautions for SMC Products" and the Operation Manual on SMC website, http://www.smcworld.com

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. **When problems are caused by a steam hammer, install a steam hammer relief device such as an accumulator.**

3. **When the valve is closed, and pressure exceeding maximum operating 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.**

Adiabatic Space

⚠ Caution

There is a space between body and housing (∗: approximate 1 mm) for adiabatic effect.

Adiabatic space∗

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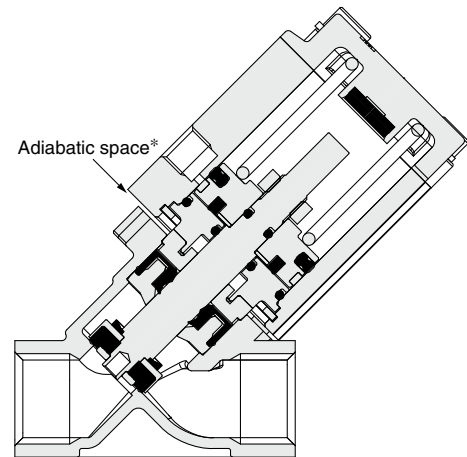
⚠ Safety Instructions

These safety instructions are intended to prevent hazardous situations and/or equipment damage. These instructions indicate the level of potential hazard with the labels of **"Caution," "Warning"** or **"Danger."** They are all important notes for safety and must be followed in addition to International Standards (ISO/IEC)∗1), and other safety regulations.

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

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

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

∗1) ISO 4414: Pneumatic fluid power – General rules relating to systems.
ISO 4413: Hydraulic fluid power – General rules relating to systems.
IEC 60204-1: Safety of machinery – Electrical equipment of machines.
　　　　　　(Part 1: General requirements)
ISO 10218-1: Manipulating industrial robots – Safety.
etc.

⚠Warning

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

Since the product specified here is used under various operating conditions, its compatibility with specific equipment must be decided by the person who designs the equipment or decides its specifications based on necessary analysis and test results. The expected performance and safety assurance of the equipment will be the responsibility of the person who has determined its compatibility with the product. This person should also continuously review all specifications of the product referring to its latest catalog information, with a view to giving due consideration to any possibility of equipment failure when configuring the equipment.

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

The product specified here may become unsafe if handled incorrectly. The assembly, operation and maintenance of machines or equipment including our products must be performed by an operator who is appropriately trained and experienced.

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

1. The inspection and maintenance of machinery/equipment should only be performed after measures to prevent falling or runaway of the driven objects have been confirmed.
2. When the product is to be removed, confirm that the safety measures as mentioned above are implemented and the power from any appropriate source is cut, and read and understand the specific product precautions of all relevant products carefully.
3. Before machinery/equipment is restarted, take measures to prevent unexpected operation and malfunction.

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

1. Conditions and environments outside of the given specifications, or use outdoors or in a place exposed to direct sunlight.
2. Installation on equipment in conjunction with atomic energy, railways, air navigation, space, shipping, vehicles, military, medical treatment, combustion and recreation, or equipment in contact with food and beverages, emergency stop circuits, clutch and brake circuits in press applications, safety equipment or other applications unsuitable for the standard specifications described in the product catalog.
3. An application which could have negative effects on people, property, or animals requiring special safety analysis.
4. Use in an interlock circuit, which requires the provision of double interlock for possible failure by using a mechanical protective function, and periodical checks to confirm proper operation.

⚠Caution

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

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

Limited warranty and Disclaimer/ Compliance Requirements

The product used is subject to the following "Limited warranty and Disclaimer" and "Compliance Requirements".
Read and accept them before using the product.

Limited warranty and Disclaimer

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

∗2) **Vacuum pads are excluded from this 1 year warranty.**
A vacuum pad is a consumable part, so it is warranted for a year after it is delivered.
Also, even within the warranty period, the wear of a product due to the use of the vacuum pad or failure due to the deterioration of rubber material are not covered by the limited warranty.

Compliance Requirements

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

⚠Caution

SMC products are not intended for use as instruments for legal metrology.
Measurement instruments that SMC manufactures or sells have not been qualified by type approval tests relevant to the metrology (measurement) laws of each country. Therefore, SMC products cannot be used for business or certification ordained by the metrology (measurement) laws of each country.

⚠ **Safety Instructions** | Be sure to read "Handling Precautions for SMC Products" (M-E03-3) before using.