Compact Proportional Solenoid Valve

Series PVQ

Repeatability: 3% or less
Hysteresis: 10% or less

<table>
<thead>
<tr>
<th>Fluid</th>
<th>Flow rate control range (Note)</th>
<th>Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air, Inert gas</td>
<td>0 to 6 l/min</td>
<td>PVQ10</td>
</tr>
<tr>
<td></td>
<td>0 to 100 l/min</td>
<td>PVQ30</td>
</tr>
</tbody>
</table>

Note) Varies depending on the model.

Control the flow rate smoothly according to the current

Flow Characteristics

- Flow rate curve with decreasing current
- Flow rate curve with increasing current
- Hysteresis
- Repeatability
Service life: Lasts 25 million cycles. (PVQ30)
(SMC in-house life test conditions)
Specially coated sliding surface realized 25 million cycles within set operating range

Body material: Equivalent to C37 or Stainless Steel 304 (PVQ30)

Seal material: FKM (PVQ10, PVQ30)

Valve returns to closed position when power supply is turned off.

Leakage amount: 5 cm³/min or less at OFF

Can be used with vacuum. (Minimum operating pressure 0.1 Pa-abs)

Operation noise during opening/closing of the valve reduced

Can be mounted on manifolds
When continuously energizing adjacent valves at the same time, ambient temperature rises since the coil generates heat. Implement measures to exhaust excess heat so that the temperature remains within the range of the table on the right.

Coil Core Spring Armature

PVQ30

Proportional Solenoid Valve
Flow rate can be controlled smoothly with one proportional solenoid valve by current control.

Conventional (2 port valve)
One 2-port valve is required for each flow rate.

Proportional Solenoid Valve

Conventional (2 port valve)

Working Principle
The armature is attracted to the core by electromagnetic force as the coil is energized. When the applied current varies, the attraction force also varies proportionally to it. The flow rate is controlled by the movement (stroke) of the armature, depending on the balance between this attraction force and the spring load.

Note: Sliding resistance at this point is the hysteresis of the flow.
Applications

Air-blow
- Blow-off of debris or water.
- Work transportation

Spin control of handpiece

Blood pressure gauge

Vacuum chamber supply flow control
Smooth air supply/exhaust is possible by reducing the initial air supply. Prevents dust being stirred up inside the chamber.

<table>
<thead>
<tr>
<th>Model</th>
<th>PVQ13</th>
<th>PVQ31</th>
<th>PVQ33</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piping type</td>
<td>Base mounted</td>
<td>Body ported</td>
<td>Base mounted</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Valve construction</th>
<th>Direct operated poppet</th>
<th>Direct operated poppet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valve type</td>
<td>N.C.</td>
<td>N.C.</td>
</tr>
<tr>
<td>Orifice size (mm)</td>
<td>0.3 0.4 0.6 0.8</td>
<td>1.6 2.3 4</td>
</tr>
<tr>
<td>Max. operating pressure (MPa)</td>
<td>0.7 0.45 0.2 0.1</td>
<td>0.7 0.35 0.12</td>
</tr>
<tr>
<td>Flow rate (l/min)</td>
<td>0 to 5 0 to 6 0 to 5 0 to 100</td>
<td>0 to 75</td>
</tr>
<tr>
<td>Applied current (Power supply)</td>
<td>0 to 85 mA (24 VDC)</td>
<td>0 to 165 mA (24 VDC)</td>
</tr>
<tr>
<td>Port size</td>
<td>M5</td>
<td>1/8</td>
</tr>
</tbody>
</table>
<To use orifice ø1.6 (See PVQ30: Chart 1)>

Condition 1. \( P_1 = 0.7 \text{ MPa}, \ P_2 = 0 \text{ MPa} \) (Atmospheric pressure)

Refer to curve A when \( \Delta P \) is 0.7 MPa.

Ex) At increasing current, the flow rate when 140 mA current is applied is 85 l/min. (See ①.)
If current decreases at this point, the flow rate may not change by 135 mA due to hysteresis. (See ②.)
The flow rate at increasing current and decreasing current are not the same due to hysteresis. (① 85 l/min., ② 93 l/min.)

Condition 2. \( P_1 = 0.7 \text{ MPa}, \ P_2 = 0.2 \text{ MPa} \)

Refer to curve B when \( \Delta P \) is 0.5 MPa.

Ex) At increasing current, the flow rate when 150 mA current is applied is 65 l/min. (See ③.)
If the outlet pressure \( P_2 \) increases by 0.15 MPa, \( \Delta P \) decreases by 0.15 MPa and becomes 0.35 MPa (See curve C), and the flow rate when the same current is applied is 40 l/min. (See ⑤.)

• The flow rate decreases due to change (increase) in outlet pressure, even if the inlet pressure and current value are the same.

Condition 3. In a vacuum

• For vacuum specifications, the operating pressure range is from 0.1 Pa-abs to max. operating pressure differential.
• A(2) port is applicable with vacuum pressure.

<Chart 1> PVQ30 (ø1.6)
Q. Required flow rate = 0 to 75 l/min.

P₁ = No conditions, P₂ = 0 MPa (Atmospheric pressure)

In this case, all orifice sizes of PVQ30 series satisfy the required flow rate. (Flow rate when rated current is applied)

The table below shows the pressure differentials to satisfy the required flow rate. In the flow rate characteristic charts, a pressure differential over the flow rate indicated by the dashed line (75 l/min.) up to the max. operating pressure differential will satisfy the required flow rate.

Table. Pressure differential to satisfy required flow rate = 0 to 75 l/min.

<table>
<thead>
<tr>
<th>Pressure differential (ΔP)</th>
<th>ø1.6</th>
<th>ø2.3</th>
<th>ø4.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΔP = (P₁ – P₂) MPa</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P₁: Inlet pressure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P₂: Outlet pressure</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note

1) Follow the same procedure for selecting PVQ10 series.
2) Flow rate depends on individual differences between valves and piping conditions. Refer to flow characteristic chart to select the model with adequate margin for required flow rate.
Compact Proportional Solenoid Valve

Series PVQ10

How to Order

Base mounted

PVQ 13 - 5L - 03 - M5 - A

Valve type

13 N.C.

Voltage

5 24 VDC
6 12 VDC

Electrical entry

L L plug connector
M M plug connector

With / Without lead wire

Nil With lead wire
O Without lead wire

Body / Seal material

Symbol Body Seal
A C36 FKM

Port size

Nil Without sub-plate (with mounting screw M17 x 17L, 2 pcs.)

M5 With sub-plate M5 x 0.8

Orifice size

Symbol Orifice dia. Max. operating pressure
03 0.3 mm 0.7 MPa
04 0.4 mm 0.45 MPa
06 0.6 mm 0.2 MPa
08 0.8 mm 0.1 MPa

Specifications

Valve construction
Direct operated poppet

Fluid
Air, inert gas

Seal material
FKM

Body material
C36

Fluid temperature
0 to +50°C

Ambient temperature
0 to +50°C

Action
N.C. (Normally closed)

Mounting orientation
Unrestricted

Port size
M5

Power supply
24 VDC 12 VDC

Coil current
0 to 85 mA 0 to 170 mA

Power consumption
0 to 2 W

Coil insulation
Class B

Note 1) Ambient temperature is for the valve proximal section (approx. 1 mm).
When the valve is continuously energized at an ambient temperature of 50°C (when applying maximum current), the coil outer surface reaches 90°C. The temperature changes depending on the operating conditions, and the coil outer surface temperature must be kept at 90°C or lower.

Note 2) Maximum operating pressure differential indicates pressure differential (difference between inlet and outlet pressure) which can be allowed for operation with the valve closed or open. If the pressure differential exceeds the max. operating pressure differential of orifice, the valve may leak.

Note 3) For vacuum application, max. operating pressure range is 0.1 Pa abs. max. operating pressure differential. A(2) port is applicable for vacuum pressure.
Compact Proportional Solenoid Valve Series PVQ10

Flow Characteristics

PVQ10 (φ0.3)

PVQ10 (φ0.4)

PVQ10 (φ0.6)

PVQ10 (φ0.8)

Note: Flow rate varies depending on model differences and piping conditions.
Select the model that fully satisfies the necessary flow rate based on the flow characteristics graphs.

Construction

Component Parts

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Material</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Solenoid coil assembly</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Core</td>
<td>Stainless steel</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Return spring</td>
<td>Stainless steel</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Armature assembly</td>
<td>Stainless steel, Aluminum, FKM</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Body</td>
<td>C36</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>O-ring</td>
<td>FKM</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Round head combination screw</td>
<td>Steel</td>
<td>M1.7 x 0.35 x 17L, 2 pcs.</td>
</tr>
<tr>
<td>8</td>
<td>Sub-plate</td>
<td>C36</td>
<td>Part no: PVQ10-15-M5</td>
</tr>
</tbody>
</table>

(Shows with sub-plate)
Series PVQ10

Dimensions

L plug connector
PVQ13-□L-□-M5

M plug connector
PVQ13-□M-□-M5
Compact Proportional Solenoid Valve
Series PVQ30

How to Order

Valve type
31  N.C.
5 G
16 01

Port size
01 1/8 (6A)

Body / (Sub-plate) Seal material
Symbol Body Seal
Nil C37 FKM
F
G
H Stainless steel

Thread type (with sub-plate)
Nil Rc
G
N NPT
T NPTF

Electrical entry: Grommet

Orifice size
Symbol Orifice dia. Max. operating pressure
16 1.6 mmø 0.7 MPa
23 2.3 mmø 0.35 MPa
40 4 mmø 0.12 MPa

Specifications

Valve construction
Direct operated poppet
Fluid
Air, Inert gas
Seal material
FKM
Body material
C37 (Standard), Stainless steel
Ambient temperature (Note 1)
0 to +50°C
Action
N.C. (Normally closed)
Mounting orientation
Unrestricted
Enclosure
IP40
Port size
Rc 1/8
Power supply
24 VDC 12 VDC
Coil current
0 to 165 mA 0 to 330 mA
Power consumption
0 to 4 W
Coil insulation
Class B

Orifice diameter (mmø)
1.6
2.3
4.0
Max. operating pressure differential (MPa) (Note 2)
0.7
0.35
0.12
Max. operating pressure (MPa)
1 MPa
Min. operating pressure (MPa) (Vacuum) (Note 3)
0 (0.1 Pa.abs)
Flow rate (l/min) (at max. operating pressure differential)
0 to 100
0 to 75
Hysteresis (at max. operating pressure differential)
10% or less
13% or less
Repeatability (at max. operating pressure differential)
3% or less
Start-up current (at max. operating pressure differential)
50% or less
65% or less

Note 1) Ambient temperature is for the valve proximal section (approx. 1 mm).
When the valve is continuously energized at an ambient temperature of 50°C (when applying maximum current), the coil outer surface reaches 100°C. The temperature changes depending on the operating conditions, and the coil outer surface temperature must be kept at 100°C or lower.

Note 2) Maximum operating pressure differential indicates pressure differential (difference between inlet and outlet pressure) which can be allowed for operation with the valve closed or open. If the pressure differential exceeds the max. operating pressure differential of orifice, the valve may leak.

Note 3) For vacuum application, max. operating pressure range is 0.1 Pa abs to max. operating pressure differential. A(2) port is applicable for vacuum pressure.
Series PVQ30

Flow Characteristics

Air

**PVQ30 (φ1.6)**

- ΔP = 0.7 MPa
- ΔP = 0.5 MPa
- ΔP = 0.35 MPa
- ΔP = 0.2 MPa

**PVQ30 (φ2.3)**

- ΔP = 0.35 MPa
- ΔP = 0.25 MPa
- ΔP = 0.18 MPa
- ΔP = 0.1 MPa

**PVQ30 (φ4.0)**

- ΔP = 0.12 MPa
- ΔP = 0.08 MPa
- ΔP = 0.06 MPa
- ΔP = 0.04 MPa

Note: Flow rate varies depending on model, differences, and piping conditions. Select the model that fully satisfies the necessary flow rate based on the flow characteristics graphs.

Construction

Component Parts

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Material</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Solenoid coil assembly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Coil cover</td>
<td>SPCE</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Magnetic plate</td>
<td>SUY</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Adjusting screw</td>
<td>Stainless steel</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Tube assembly</td>
<td>Stainless steel</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Return spring</td>
<td>Stainless steel</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Armature assembly</td>
<td>Stainless steel, PPS, PTFE, FKM</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Body</td>
<td>C3 or Stainless steel</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Nut</td>
<td>Steel</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Wave washer</td>
<td>Stainless steel</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Round head combination screw</td>
<td>Copper</td>
<td>Base made only</td>
</tr>
<tr>
<td>12</td>
<td>Sub-plate</td>
<td>C3 or Stainless steel</td>
<td>Part no. PVQ30-15-01</td>
</tr>
<tr>
<td>13</td>
<td>O-ring</td>
<td>FKM</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>O-ring</td>
<td>FKM</td>
<td></td>
</tr>
</tbody>
</table>

Option (Body ported only)

- Bracket assembly: VDW20-15A-1

Sub-plate Part No.

PVQ30-15 □ -01 □ Thread type

- Material
  - C: C36
  - S: Stainless steel
Glossary

- **Proportional control**
  Control the fluid proportionally according to input signal (current).

- **Max. operating pressure differential**
  Indicates max. pressure differential (difference between inlet and outlet pressure) which is allowed for operation with the valve closed or open.

- **Max. operating pressure**
  This indicates the limit of pressure that can be applied to the inlet. (The pressure differential of the proportional valve must be no more than the maximum operating pressure differential.)

- **Orifice diameter**
  Diameter of the hole for sealing the valve body of the proportional valve. This does not indicate the effective cross section.

- **Hysteresis**
  Greatest flow rate difference between current increase and current decrease (with the same current). (Percentage divided by max. flow rate)

- **Repeatability**
  Deviation of output flow rate when the same current is applied. (Percentage divided by max. flow rate)

- **Start-up current**
  Current at which the flow rate is actually output while increasing current from zero. (Percentage divided by rated current)
Series PVQ
Specific Product Precautions
Be sure to read before handling.
Refer to front matters 42 and 43 for Safety Precautions.

⚠️ Caution
This product makes proportional control possible with constant current.
If controlled with voltage, the output flow rate cannot be kept constant due to current fluctuation. Use stable DC power source of sufficient capacity without much ripple.

⚠️ Caution
1. This product is adjusted to the respective specifications at SMC factory before delivery.
   Do not disassemble the product or remove parts as it could cause breakdown of the product.
2. Flow rate is controlled by balancing the valve body.
   Do not expose the product to external vibration and impact as it changes the flow rate.
   Vibration may occur depending on the piping conditions or control methods.

⚠️ Caution
Leakage from the valve may be caused if the pressure difference is larger than the maximum operating pressure differential of the respective models.

⚠️ Caution
Flow rate varies depending on model differences and piping conditions. Select the model that fully satisfies the necessary flow rate based on the flow characteristics graphs.

Power Source Selection

⚠️ Caution
When the product is used in vacuum, apply vacuum pressure to A (2) port.
The pressure at P(1) port should be larger than the pressure at A(2) port.

Operation in Vacuum

⚠️ Caution
When mounting a valve to the sub-plate, tighten the screw securely with the tightening torque shown in the table below after checking the installation condition of the O-ring on the interface side.

<table>
<thead>
<tr>
<th>Proper Tightening Torque (N·m)</th>
<th>PVQ10 (Base mounted)</th>
<th>PVQ30 (Base mounted)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.15 to 0.22</td>
<td>0.8 to 1.0</td>
</tr>
</tbody>
</table>

Valve Mounting

⚠️ Warning
Do not touch the valve directly with hands. The coil can be hot depending on the ambient temperature or energizing time.
Install a protective cover over the valve if it can be touched directly with hands.