

# Compact Proportional Solenoid Valve

## PVQ Series

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

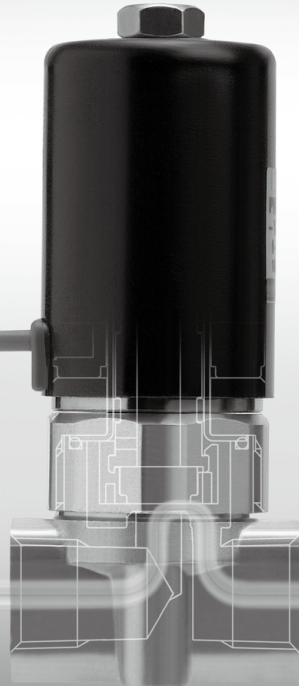
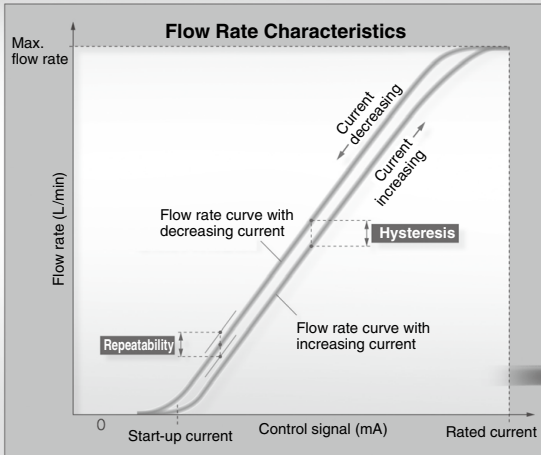
Fluid	Flow rate control range (Note)	Series
Air	0 to 6 L/min	<b>PVQ10</b>
	0 to 100 L/min	<b>PVQ30</b>

Note) Varies depending on the model.



- ARJ
- AR425 to 935
- ARX
- AMR
- ARM
- ARP
- IR□-A
- IR
- IRV
- VEV
- SRH
- SRP
- SRF
- ITV
- IC
- ITVH
- ITVX
- PVQ**
- VY1
- VBA
- VBAT
- AP100

Control the flow rate smoothly according to the current



● **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 cm<sup>3</sup>/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**

PVQ10	ON	30 dB or less	PVQ30	ON	43 dB or less
	OFF	32 dB or less		OFF	50 dB or less

\* Background noise: 20 to 25 dB

\* Background noise: 20 to 25 dB

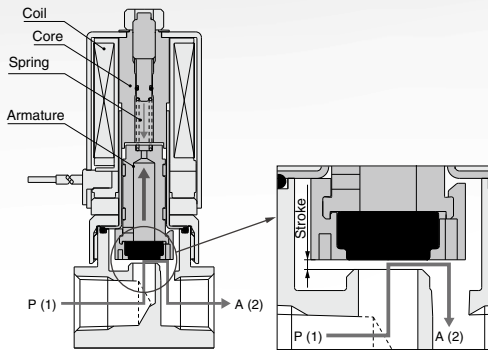
● **Can be mounted on manifolds**

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.

Table: Coil outer surface temperature range

Model	Coil outer surface temperature
PVQ10	90°C or less
PVQ30	100°C or less

\* Ambient temperature: 50°C at the valve proximal section (approx. 1 mm) when the maximum current is applied



PVQ30

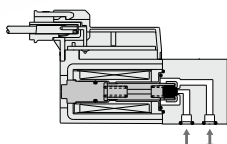
**Working Principle**

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.

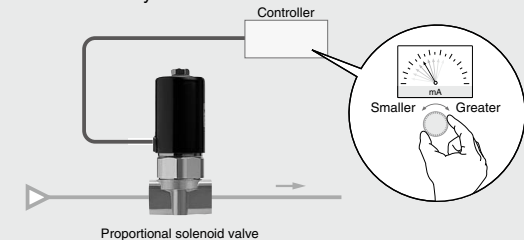
Note) Sliding resistance at this point is the hysteresis of the flow.



PVQ10 P (1) A (2)

**Proportional Solenoid Valve**

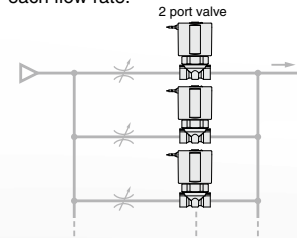
Flow rate can be controlled smoothly with one proportional solenoid valve by current control.



Proportional solenoid valve

**Current (2 port valve)**

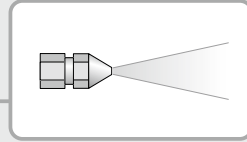
One 2-port valve is required for each flow rate.



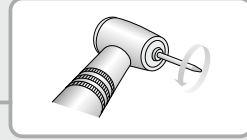
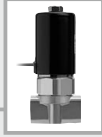
# Applications

## Air-blow

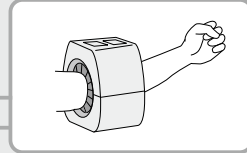
- Blow-off of debris or water.
- Work transportation



## Spin control of handpiece

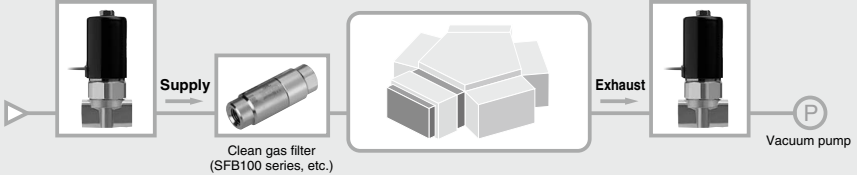





## Blood pressure gauge



## 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.



Model	PVQ13				PVQ31		PVQ33	
Piping type	Base mounted				Body ported		Base mounted	
								
Valve construction	Direct operated poppet				Direct operated poppet			
Valve type	N.C.				N.C.			
Orifice size (mm)	0.3	0.4	0.6	0.8	1.6	2.3	4	
Max. operating pressure differential (MPa)	0.7	0.45	0.2	0.1	0.7	0.35	0.12	
Flow rate (L/min)	0 to 5		0 to 6		0 to 5	0 to 100		0 to 75
Applied current (Power supply)	0 to 85 mA (24 VDC) 0 to 170 mA (12 VDC)				0 to 165 mA (24 VDC) 0 to 330 mA (12 VDC)			
Port size	M5				1/8			

- ARJ
- AR425 to 935
- ARX
- AMR
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- ARP
- IR□-A
- IR
- IRV
- VEX
- SRH
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- SRF
- ITV
- IC
- ITVH
- ITVX
- PVQ
- VY1
- VBA
- VBAT
- AP100

# PVQ Series

## Model Selection

### <To use orifice $\phi 1.6$ (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.,  
 ③ 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 ④.)  
 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.)

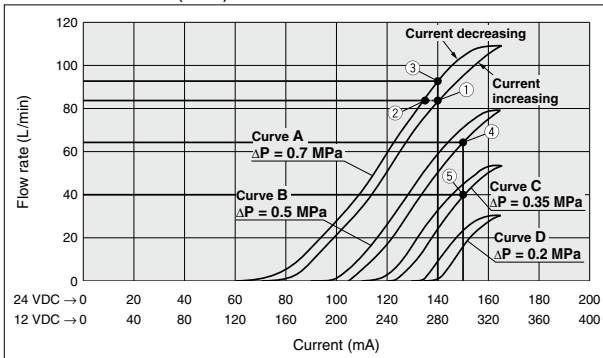
- The flow rate decreases due to change (increase) in outlet pressure, even if the inlet pressure and current value are the same.

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.

$\Delta P = (P_1 - P_2) \text{ MPa}$   
 $\Delta P$ : Pressure differential  
 $P_1$ : Inlet pressure  
 $P_2$ : Outlet pressure

<Chart 1> PVQ30 ( $\phi 1.6$ )



● **Q. Required flow rate = 0 to 75 L/min.**

$P_1$  = No conditions,  $P_2$  = 0 MPa (Atmospheric pressure)

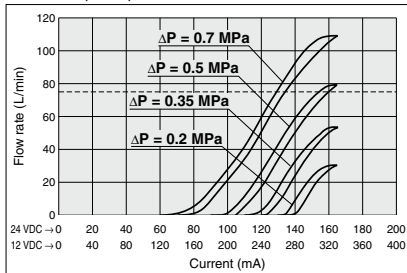
In this case, all orifice sizes of PVQ30 series satisfy the required flow rate. (Flow rate when rated current is applied)  
 The table below shows the pressure differentials to satisfy the required flow rate. In the flow rate characteristics charts, a pressure differential over the flow rate indicated 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.**

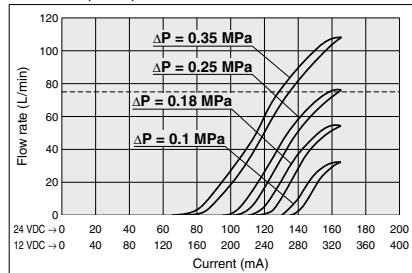
	ø1.6	ø2.3	ø4.0
Pressure differential ( $\Delta P$ )	0.5 to 0.7 MPa	0.25 to 0.35 MPa	0.12 MPa

$\Delta P = (P_1 - P_2)$  MPa  
 $\Delta P$ : Pressure differential  
 $P_1$ : Inlet pressure  
 $P_2$ : Outlet pressure

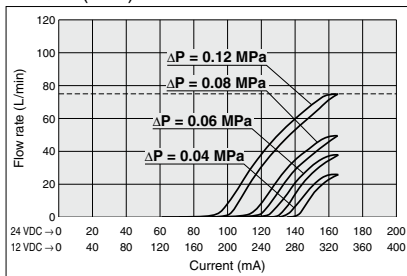
**PVQ30 (ø1.6)**



**PVQ30 (ø2.3)**



**PVQ30 (ø4.0)**



● **Note**

- 1) For this product, the max. operating pressure differential varies by orifice diameter.  
 Operate at a pressure differential which is 20% or more of the max. operating pressure differential.  
 If the product must be operated at a pressure differential which is less than 20% of the max. operating pressure differential, either change the size of the orifice or change to a size from the PVQ10 series.
- 2) The smaller the pressure differential the product is operating at is in relation to the max. operating pressure differential, the smaller the controllable flow rate range and electric current range will be. This may result in reduced controllability, and hunting phenomenon or valve opening failure may occur.
- 3) If this product is used for the charging and discharging of a tank, the valve pressure differential may get smaller due to pressure fluctuations in the tank, which may result in valve opening failure.
- 4) Flow rate depends on individual differences between valves and piping conditions. Refer to flow rate characteristics chart to select the model with adequate margin for required flow rate.
- 5) Follow the same procedure for selecting PVQ10 series.

ARJ
AR425 to 935
ARX
AMR
ARM
ARP
IR□-A
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ITVX
<b>PVQ</b>
VY1
VBA
VBAT
AP100

# Compact Proportional Solenoid Valve

# PVQ10 Series



## How to Order

Base mounted

PVQ 13 - 5 L - 03 - M5 - A

Valve type

13 N.C.

Voltage

5 24 VDC  
6 12 VDC

Electrical entry

L	L plug connector With lead wire (Length 300 mm)	
LO	L plug connector Without connector	
M	M plug connector With lead wire (Length 300 mm)	
MO	M plug connector Without connector	

\* Refer to page 981 for the different lead wire lengths of L and M plug connectors.

Body/Seal material

Symbol	Body	Seal
A	C36	FKM

Port size

Nil	Without sub-plate (with mounting screw M1.7 x 17L, 2 pcs.)	
M5	With sub-plate M5 x 0.8	

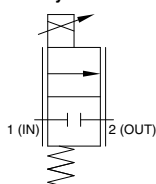
Orifice size

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

(Note) For selection, refer to Model Selection on pages 978 and 979.



Symbol



## Specifications

Standard specifications	Valve construction	Direct operated poppet	
	Fluid	Air	
	Seal material	FKM	
	Body material	C36	
	Fluid temperature	0 to +50°C	
	Ambient temperature <sup>(Note 1)</sup>	0 to +50°C	
	Action	N.C. (Normally closed)	
	Mounting orientation	Unrestricted	
	Port size	M5	
	Coil specifications	Power supply	24 VDC
Coil current		0 to 85 mA	0 to 170 mA
Power consumption		0 to 2 W	
Coil insulation		Class B	

Note 1) Indicates the ambient temperature when the valve is not energized.

Note 2) When the valve is continuously energized (when applying maximum current) and the ambient temperature is kept at 50°C due to the convection of the air around the valve, the coil outer surface reaches approximately 90°C, and the coil proximal section (1 mm) reaches approximately 60°C. Use the product at a temperature of not more than 50°C.

\* Refer to the Specific Product Precautions "Continuous Energization."

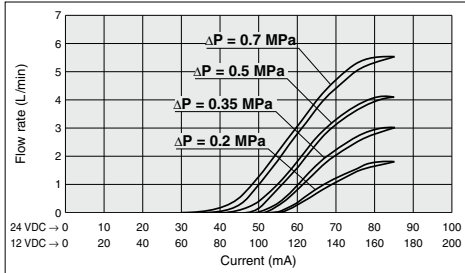
Note 2) Maximum operating pressure differential indicates pressure differential (difference between inlet and outlet pressure) which can be allowed for operation with the valve closed or open. If the pressure differential exceeds the max. operating pressure differential of orifice, the valve may leak.

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.

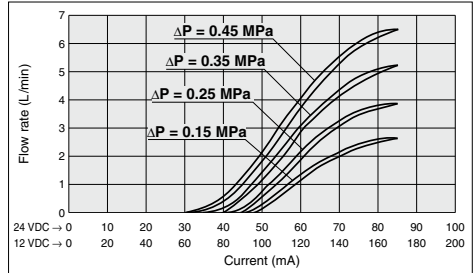
Characteristic specifications	Orifice diameter (mmφ)	0.3	0.4	0.6	0.8
	Max. operating pressure differential (MPa) <sup>(Note 2)</sup>	0.7	0.45	0.2	0.1
	Max. operating pressure (MPa)	1 MPa			
	Min. operating pressure (MPa) (Vacuum) <sup>(Note 3)</sup>	0 (0.1 Pa-abs)			
	Flow rate (L/min) (at max. operating pressure differential)	0 to 5	0 to 6	0 to 5	
	Hysteresis (at max. operating pressure differential)	10% or less			
	Repeatability (at max. operating pressure differential)	3% or less			
	Start-up current (at max. operating pressure differential)	50% or less			

## Flow Rate Characteristics

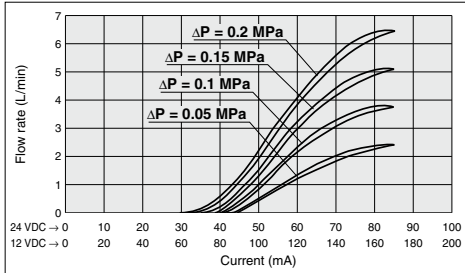
### PVQ10 (ø0.3)



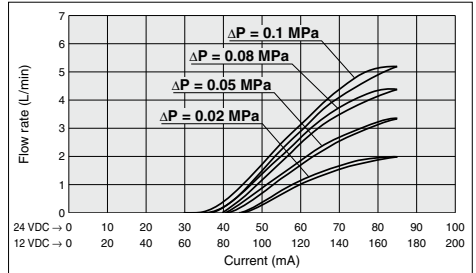
### PVQ10 (ø0.4)



### PVQ10 (ø0.6)

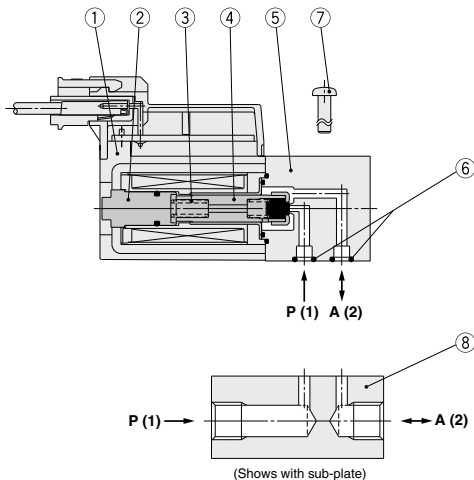


### PVQ10 (ø0.8)



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 rate characteristics graphs.

## Construction



## Component Parts

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

### \* Connector assembly

**AXT661 - 14A -**

Lead wire length	
Nil	300 mm
6	600 mm
10	1000 mm
20	2000 mm
30	3000 mm

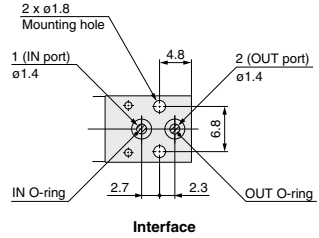
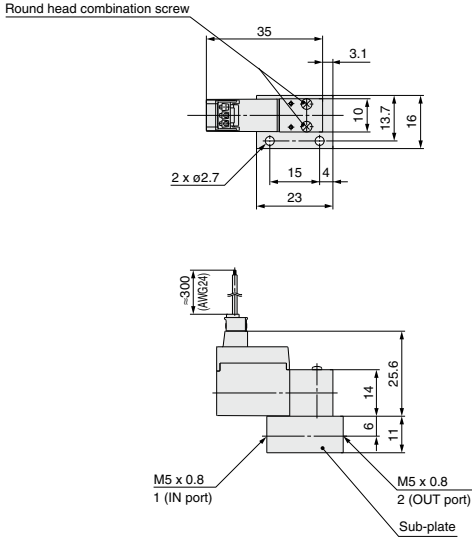
For the product with the lead wire, the lead wire length is 300 mm.  
To extend the lead wire length to 600 mm or more, select the valve without connector and order the connector assembly separately.

# PVQ10 Series

## Dimensions

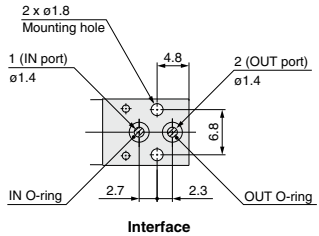
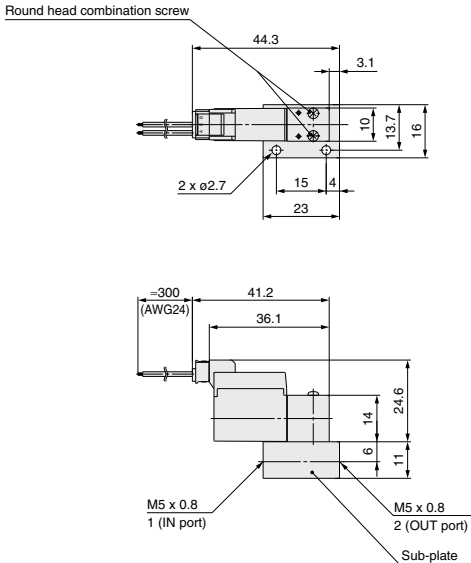
### L plug connector

PVQ13-□L-□-M5



### M plug connector

PVQ13-□M-□-M5





# Compact Proportional Solenoid Valve

## PVQ30 Series



### How to Order

Body ported

Valve type **31** N.C.      Port size **01** 1/8 (6A)

**PVQ 31 - 5 G - 16 - 01** - [ ] - [ ] - [ ]

Base mounted

Valve type **33** N.C.      Port size **01** 1/8 (6A)

**PVQ 33 - 5 G - 16 - 01** - [ ] - [ ] - [ ]



Valve type **33** N.C.

Voltage

5	24 VDC
6	12 VDC

Electrical entry: Grommet

#### Option

NII	None
F	Foot bracket

\* Bracket is not mounted but is provided at the time of shipment.

#### Body/(Sub-plate) Seal material

Symbol	Body	Seal
NII	C37	FKM
H	Stainless steel	

#### Thread type (with sub-plate)

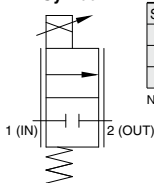
NII	Rc
F	G
N	NPT
T	NPTF

#### Orifice size

Symbol	Orifice dia.	Max. operating pressure differential
16	1.6 mm	0 to +50°C
23	2.3 mm	0.35 MPa
40	4 mm	0.12 MPa

(Note) For selection, refer to Model Selection on pages 978 and 979.

#### Symbol



#### Port size

Port size	Without sub-plate (with mounting screw M3 x 8L, 2 pcs.)	With sub-plate 1/8 (6A)
NII		
01		

## Specifications

Standard specifications	Valve construction	Direct operated poppet	
	Fluid	Air	
	Seal material	FKM	
	Body material	Brass C37 (Standard), Stainless steel	
	Fluid temperature	0 to +50°C	
	Ambient temperature <sup>Note 1)</sup>	0 to +50°C	
	Action	N.C. (Normally closed)	
	Mounting orientation	Unrestricted	
	Enclosure	IP40	
	Port size	Rc 1/8	
Coil specifications	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	

Note 1) Indicates the ambient temperature when the valve is not energized. When the valve is continuously energized (when applying maximum current) and the ambient temperature is kept at 50°C due to the convection of the air around the valve, the coil outer surface reaches approximately 100°C, and the coil proximal section (1 mm) reaches approximately 70°C. Use the product at a temperature of not more than 50°C.

\* Refer to the Specific Product Precautions "Continuous Energization."

Characteristic specifications	Orifice diameter (mm)	1.6	2.3	4.0
	Max. operating pressure differential (MPa) <sup>Note 2)</sup>	0.7	0.35	0.12
	Max. operating pressure (MPa)	1 MPa		
	Min. operating pressure (MPa) (Vacuum) <sup>Note 3)</sup>	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 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.

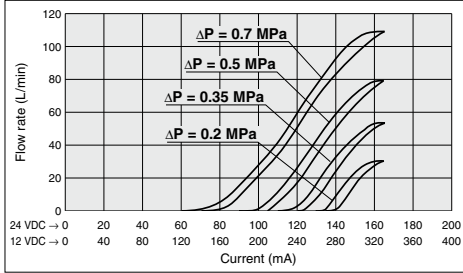
ARJ
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ITVH
ITVX
PVQ
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VBA
VBAT
AP100

# PVQ30 Series

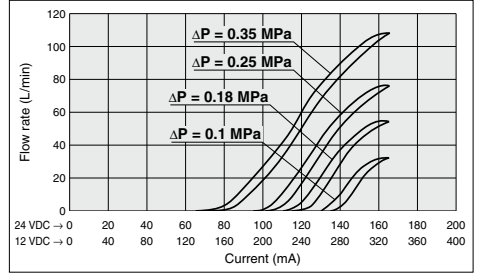
## Flow Rate Characteristics

Air

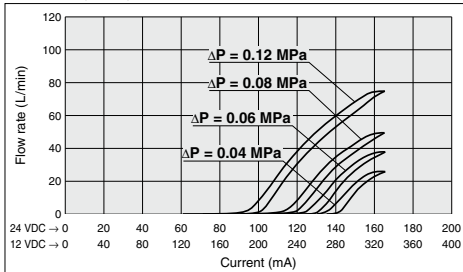
PVQ30 (ø1.6)



PVQ30 (ø2.3)

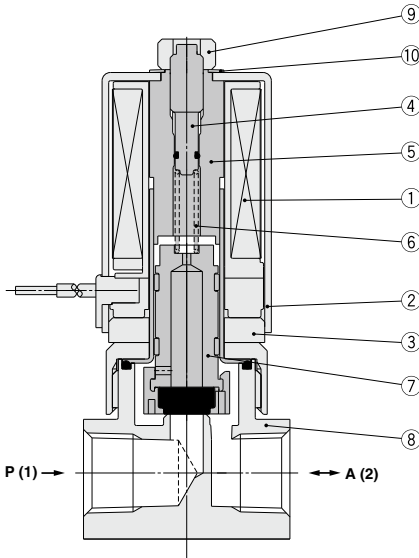


PVQ30 (ø4.0)



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 rate characteristics graphs.

## Construction



## Component Parts

No.	Description	Material	Note
1	Solenoid coil assembly	—	
2	Coil cover	SPCE	
3	Magnetic plate	SUY	
4	Adjusting screw	Stainless steel	
5	Tube assembly	Stainless steel	
6	Return spring	Stainless steel	
7	Armature assembly	Stainless steel, PPS, PTFE, FKM	
8	Body	Brass or Stainless steel	
9	Nut	Steel	
10	Wave washer	Stainless steel	
11	Round head combination screw	Copper	M3 x 0.5 x 8L, 2 pcs.
12	Sub-plate	Brass or Stainless steel	Part no.: PVQ30-15□-01□
13	O-ring	FKM	
14	O-ring	FKM	

Option (Body ported only)

• Bracket assembly: VDW20-15A-1

Sub-plate Part No.

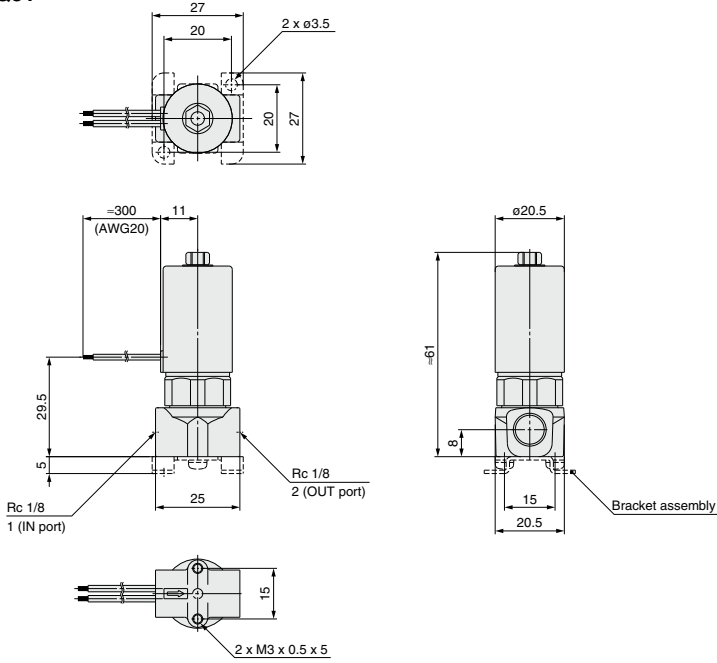
PVQ30-15 □ -01 □

Material      Thread type

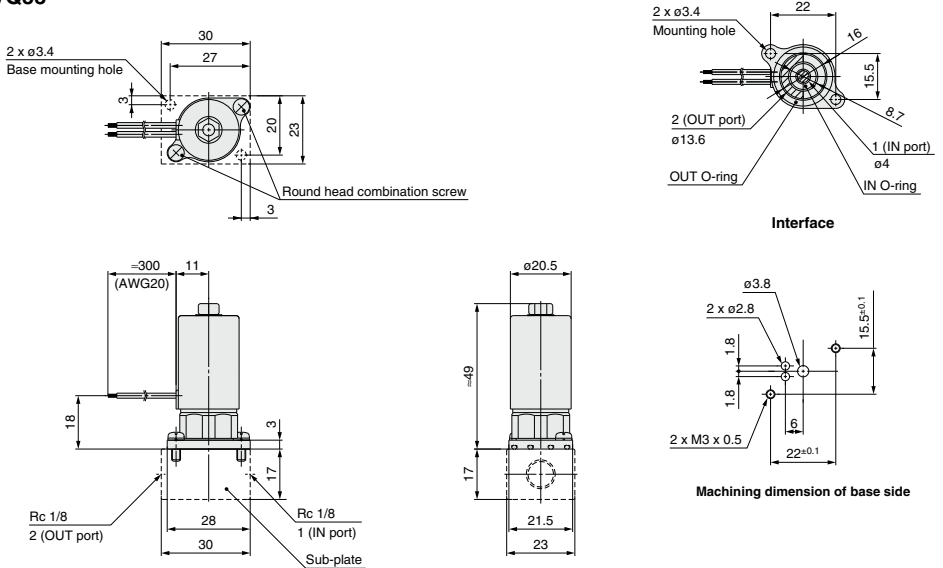
C	C36
S	Stainless steel

**Dimensions**

**PVQ31**



**PVQ33**



ARJ

AR425  
to 935

ARX

AMR

ARM

ARP

IR□-A

IR

IRV

VEV

SRH

SRP

SRF

ITV

IC

ITVH

ITVX

**PVQ**

VY1

VBA

VBAT

AP100

# *PVQ Series* 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)



# PVQ Series Specific Product Precautions

Be sure to read this before handling the products.  
Refer to back page 50 for Safety Instructions.

## Power Source Selection

### ⚠ 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.

## Handling

### ⚠ 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.

## Pressure Difference

### ⚠ Caution

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

## Flow Rate

### ⚠ 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 rate characteristics graphs.

## Operation in Vacuum

### ⚠ 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.

## Valve Mounting

### ⚠ 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.

Proper Tightening Torque (N·m)

PVQ10 (Base mounted)	PVQ30 (Base mounted)
0.15 to 0.22	0.8 to 1.0

## Continuous Energization

### ⚠ Warning

1. Ambient temperature and outer surface temperature

When the valve is continuously energized (when applying maximum current) and the ambient temperature is kept at 50°C due to the convection of the air around the valve, the coil outer surface reaches approximately 90°C for the PVQ10 series and 100°C for the PVQ30 series.

The valve proximal section (approx. 1 mm) reaches approximately 60°C for the PVQ10 series and 70°C for the PVQ30 series.

When the valve is mounted inside the enclosed control panel (in a state without convection of air), however, the above temperature may be exceeded due to the rise in coil temperature or the influence of other equipment. Take measures to release the heat, for example, to create a convection of the air around the valve or provide an air vent.

2. 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.

## Model Selection

### ⚠ Caution

1. For this product, the max. operating pressure differential varies by orifice diameter.

Operate at a pressure differential which is 20% or more of the max. operating pressure differential.

If the product must be operated at a pressure differential which is less than 20% of the max. operating pressure differential, either change the size of the orifice or change to a size from the PVQ10 series.

2. The smaller the pressure differential the product is operating at is in relation to the max. operating pressure differential, the smaller the controllable flow rate range and electric current range will be. This may result in reduced controllability, and hunting phenomenon or valve opening failure may occur.

3. If this product is used for the charging and discharging of a tank, the valve pressure differential may get smaller due to pressure fluctuations in the tank, which may result in valve opening failure.

ARJ

AR425  
to 935

ARX

AMR

ARM

ARP

IR□-A

IR

IRV

VEX

SRH

SRP

SRF

ITV

IC

ITVH

ITVX

PVQ

VY1

VBA  
VBAT

AP100