SMC

Process Pump
Series PA3000/5000/PAX1000
Series PB1000

PA3000/5000 is now available with solenoid or air pilot actuation

Compact, high capacity transfer and recovery of

Long life, 2 to 5 times that of conventional pumps
Incorporates a new diaphragm material.
Enlarged bore size and shortened stroke extend life. (compared to series PA2000)

High abrasion resistance and low particle generation
No sliding parts in wetted areas.

Self-priming makes priming unnecessary

Process Pump
Series PA3000/5000

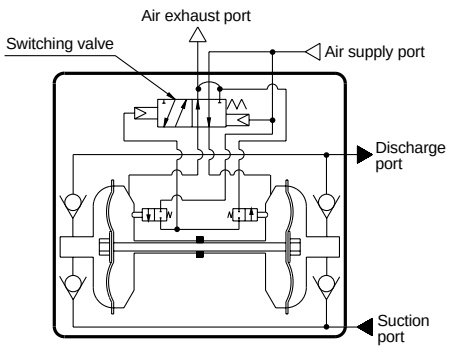
Automatically operated type/Air operated type
(internal switching type) **(external switching type)**

New

Automatically operated type

Compatible with a wide variety of fluids

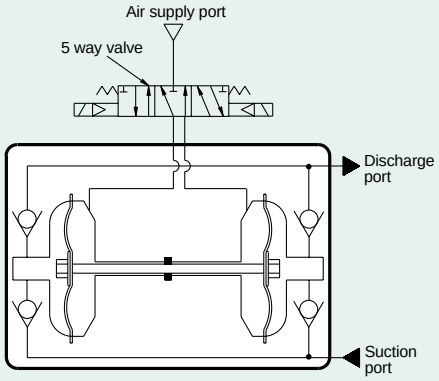
- **PA3000: Max. 20//min**
- **PA5000: Max. 45//min**

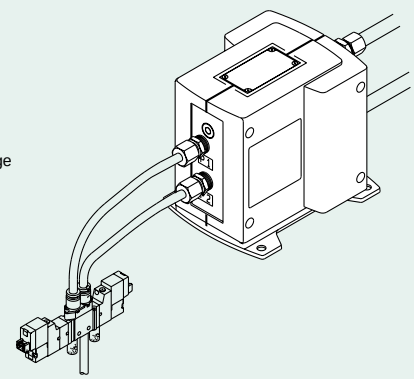


Air operated type

Control with external switching valve makes constant cycling possible

- **Discharge rate is easily controlled.**
  The flow rate can be easily adjusted by the number of external solenoid valve ON/OFF cycles.
- **Stable operation is possible even with a minimal flow rate, low pressure operation or the entrainment of gases.**
- **Can be used when there is repeated stopping of operation.**
- **Since a switching valve is not contained inside the body, life is longer than the automatically operated type.**





diaphragm pump for a wide variety of fluids

Process Pump Variations

Series PA/Double acting pump

Series	Model	Action		Discharge flow rate //min	Material	
					Body	Diaphragm
PA3000	PA3□□0	Automatically operated type	AIR SUP, AIR EXH, FLUID OUT, FLUID IN	1 to 20	ADC12 (aluminum) SCS14 (stainless steel)	PTFE NBR
	PA5□□0			5 to 45		
PA5000	PA3□13	Air operated type	P1, P2, FLUID OUT, FLUID IN	0.1 to 12		PTFE
	PA5□13			1 to 24		
PAX1000	PAX1□12	Automatically operated type with built-in pulsation attenuator	AIR SUP, AIR EXH, FLUID OUT, FLUID IN	0.5 to 10	ADC12 (aluminum) SCS14 (stainless steel)	PTFE

Series PB/Single acting pump

PB1000	PB1011	Built-in solenoid valve	AIR EXH, AIR SUP, FLUID OUT, FLUID IN	0.008 to 2	Polypropylene	PTFE
	PB1013	Air operated type	AIR SUP, FLUID OUT, FLUID IN	0.008 to 0.5		

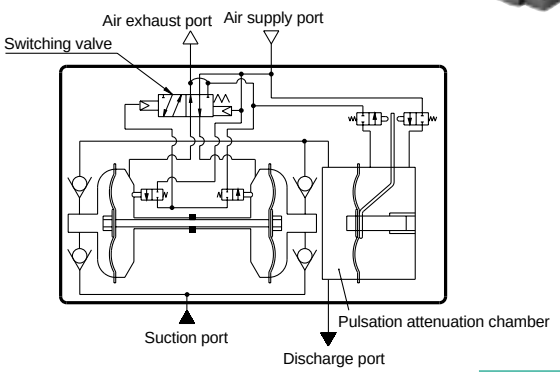
Built-in pulsation attenuator

Process Pump
Series PAX1000

Automatically operated type
(internal switching type)

Prevents spraying of discharge and foaming in tank

- Built-in pulsation attenuator saves space and makes separate piping unnecessary



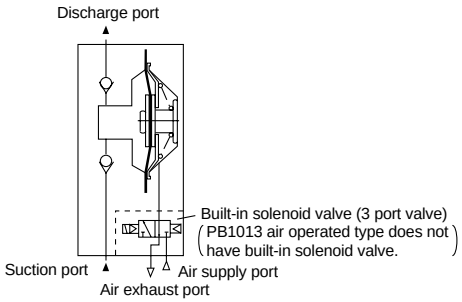
Compact single acting

Process Pump
Series PB1000

Built-in solenoid valve/ Air operated type
(external switching type)

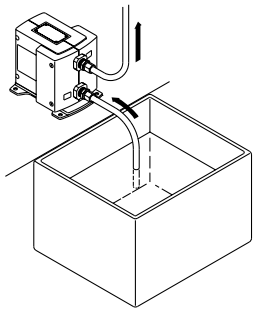
A solenoid valve operated pump that fits in the palm of the hand

- 60 x 60 x 41 (mm), 170g
- Piping and wiring centralized on one side saves space

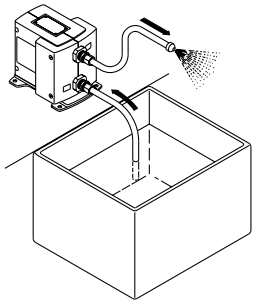


Application examples

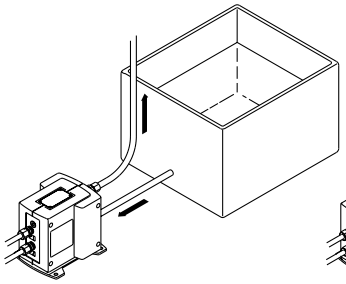
Transfer of liquid by suction



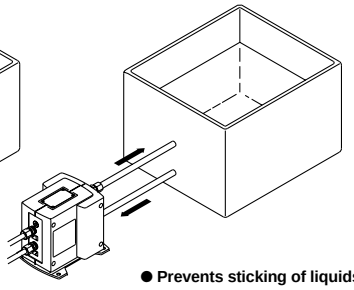
Atomizing of liquid



Transfer of liquid by pressure



Stirring of liquid



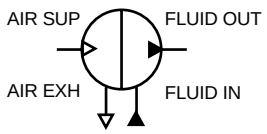
● Prevents sticking of liquids

Process Pump
Automatically Operated Type
(Internal Switching Type)
Series PA3000/5000

PA3000

PA5000

Symbol



Automatically operated type

How to Order

PA 3 1 1 0 — □ 03 — □

Body size

3	3/8 standard
5	1/2 standard

Liquid contact body material

1	ADC12 (aluminum)
2	SCS14 (stainless steel)

Diaphragm material

1	PTFE
2	NBR

Thread type

Nil	Rc
T*	NPTF
F*	G
N*	NPT

∗ T, F, N are order made specifications.

Automatically operated type

Connection port size

03	3/8 (10A): PA3
04	1/2 (15A): PA5
06	3/4 (20A): PA5

Option

Nil	Body only
N	With silencer*

∗ For AIR EXH: AN200-02

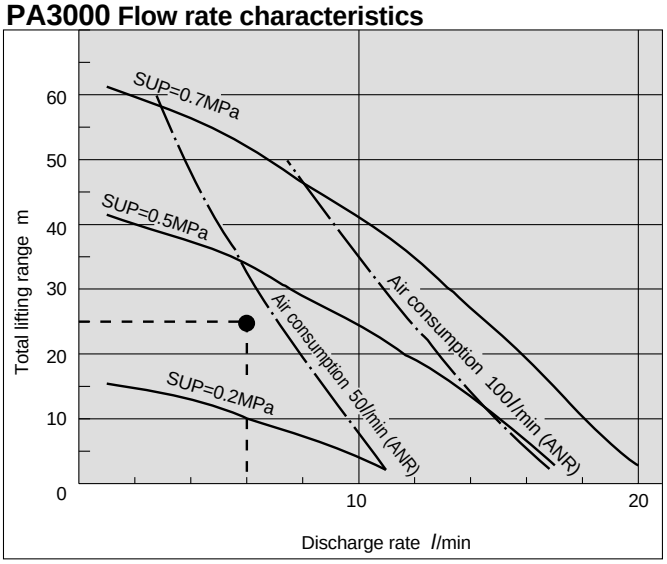
Specifications

Model		Automatically operated type			
		PA31□0	**PA32□0**	**PA51□0**	**PA52□0**
Port size	**Main fluid suction/ discharge port**	Rc 3/8		Rc 1/2, 3/4	
	Pilot air supply/ exhaust port	Rc 1/4			
Material	**Liquid contact areas**	ADC12	SCS14	ADC12	SCS14
	Diaphragm	PTFE, NBR			
	Check valve	PTFE, PFA			
Discharge rate		1 to 20//min		5 to 45//min	
Average discharge pressure		0 to 0.6MPa			
Pilot air consumption		Maximum 200//min (ANR)		Maximum 300//min (ANR)	
Suction lifting range	**Dry**	1m (interior of pump dry)		2m (interior of pump dry)	
	Wet	Up to 6m (liquid inside pump)			
Fluid temperature		0 to 60°C (with no freezing)			
Ambient temperature		0 to 60°C			
Pilot air pressure		0.2 to 0.7MPa			
Withstand pressure		1.05MPa			
Mounting position		Horizontal (with mounting foot at bottom)			
Weight		1.7kg	2.2kg	3.5kg	6.5kg

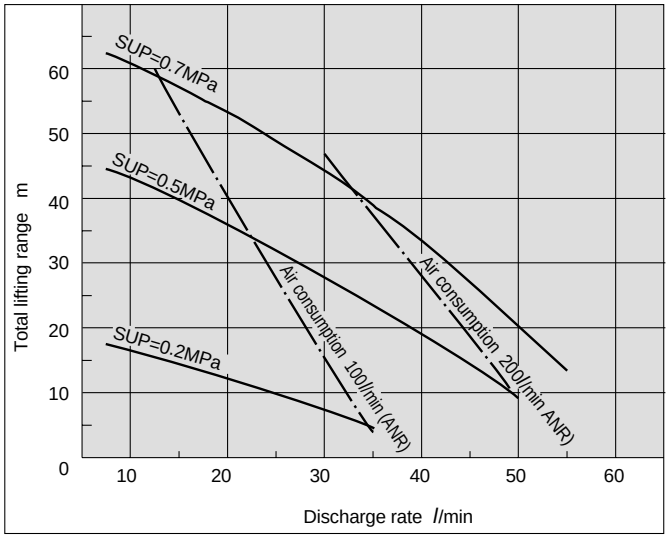
∗ Each of the values above indicates use at ordinary temperatures with fresh water.

Performance Curves/Automatically Operated Type

PA3000 Flow rate characteristics



PA5000 Flow rate characteristics



Selection from flow rate characteristic graphs (PA3000)

Required specification example:

Find the pilot air pressure and pilot air consumption for a discharge rate of 6l/min and a total lifting range of 25m. [The transfer fluid is fresh water (viscosity 1mPa·S, specific gravity 1.0).]

∗ If the discharge pressure is required instead of the total lifting height, a total lift of 10m corresponds to discharge pressure of 0.1MPa.

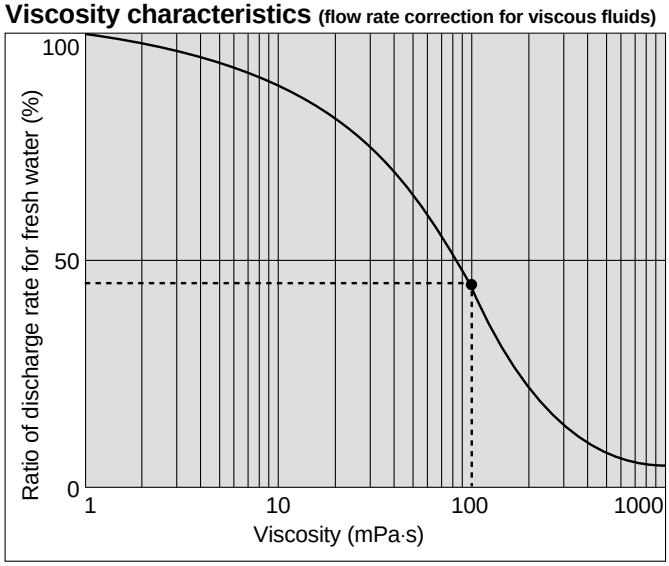
Selection procedures

1. First mark the intersection point for a discharge rate of 6l/min and a lifting range of 25m.
2. Find the pilot air pressure for the marked point. In this case, the point is between the discharge curves (solid lines) for SUP=0.2MPa and SUP=0.5MPa, and based on the proportional relationship to these lines, the pilot air pressure for this point is approximately 0.38MPa.
3. Next find the air consumption rate. Since the marked point is below the curve for 50l/min (ANR), the maximum rate will be about 50l/min (ANR).

⚠Caution

1. These flow rate characteristics are for fresh water (viscosity 1mPa·s, specific gravity 1.0).
2. The discharge rate differs greatly depending on properties (viscosity, specific gravity) of the fluid being transferred and operating conditions (lifting range, transfer distance), etc.
3. Use 0.75kW per 100l/min of air consumption as a guide for the relationship of the air consumption to the compressor.

Viscosity characteristics (flow rate correction for viscous fluids)



Selection from viscosity characteristic graph

Required specification example:

Find the pilot air pressure and pilot air consumption for a discharge rate of 2.7l/min, a total lifting range of 25m, and a viscosity of 100mPa·s.

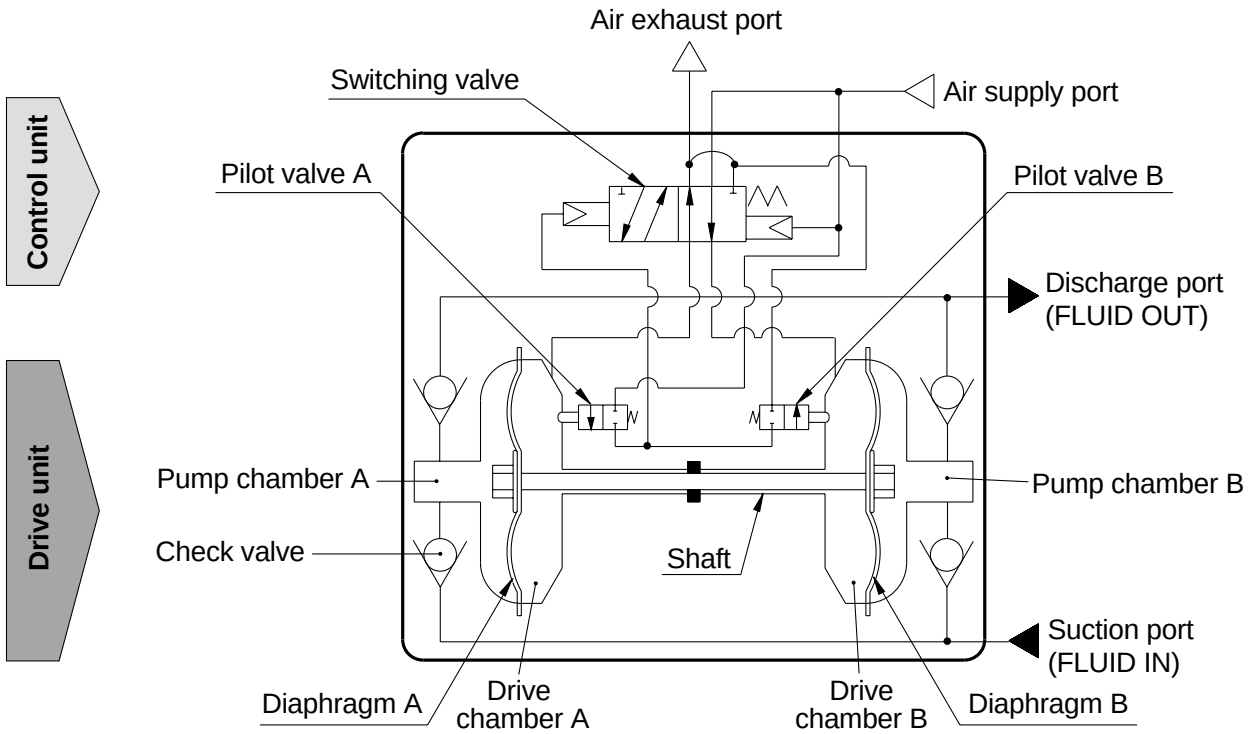
Selection procedures

1. First find the ratio of the discharge rate for fresh water when viscosity is 100mPa·s from the graph below. It is determined to be 45%.
2. Next, in the required specification example, the viscosity is 100mPa·s and the discharge rate is 2.7l/min. Since this is equivalent to 45% of the discharge rate for fresh water, 2.7l/min ÷ 0.45 = 6l/min, indicating that a discharge rate of 6l/min is required for fresh water.
3. Finally, find the pilot air pressure and pilot air consumption based on selection from the flow rate characteristic graphs.

⚠Caution

Viscosities up to 1000mPa·s can be used.

Operating Principle/Automatically Operated Type



Control unit

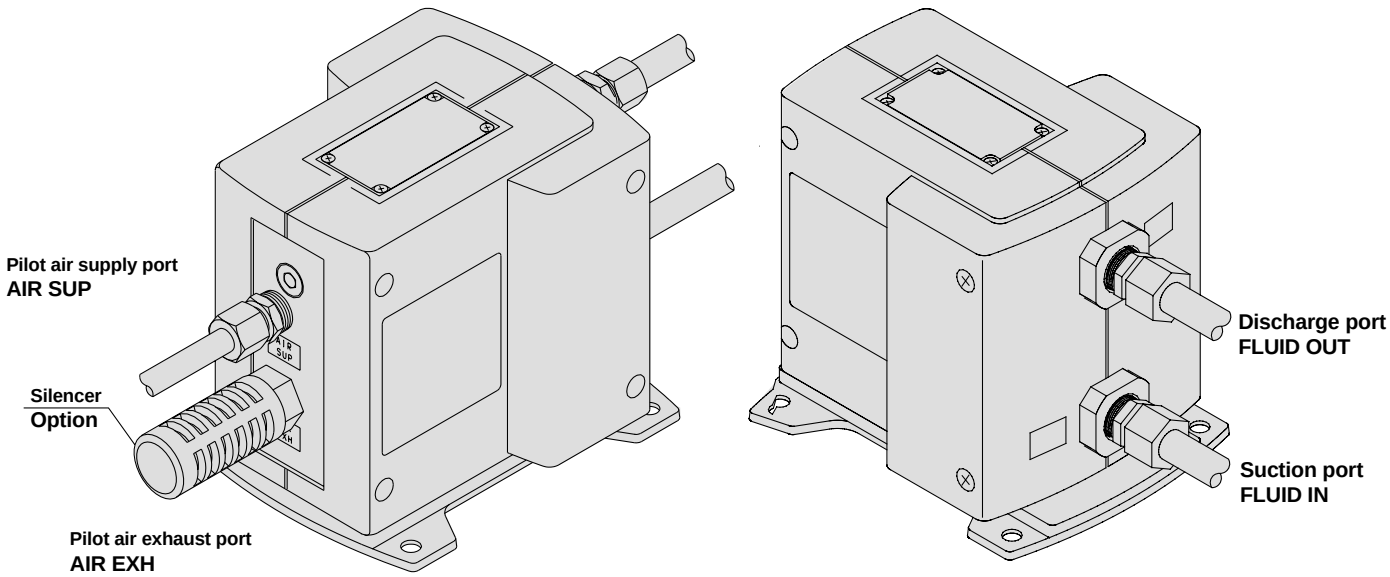
1. When air is supplied, it passes through the switching valve and enters drive chamber B.
2. Diaphragm B moves to the right, and at the same time diaphragm A also moves to the right pushing pilot valve A.
3. When pilot valve A is pushed, air acts upon the switching valve, drive chamber A switches to a supply state, and the air which was in drive chamber B is exhausted to the outside.
4. When air enters drive chamber A, diaphragm B moves to the left pushing pilot valve B.
5. When pilot valve B is pushed, the air which was acting upon the switching valve is exhausted, and drive chamber B once again switches to a supply state. A continuous reciprocal motion is generated by this repetition.

Drive unit

1. When air enters drive chamber B, the fluid in pump chamber B is forced out, and at the same time fluid is sucked into pump chamber A.
2. When the diaphragm moves in the opposite direction, the fluid in pump chamber A is forced out, and fluid is sucked into pump chamber B.
3. Continuous suction and discharge is performed by the reciprocal motion of the diaphragm.

Piping and Operation/Automatically Operated Type

Piping diagram



⚠ Caution

Maintain the proper tightening torque for fittings and mounting bolts, etc. Looseness can cause problems such as fluid and air leaks, while over tightening can cause damage to threads and parts, etc.

Operation

<Starting and Stopping> Refer to circuit example (1)

1. Connect air piping to the air supply port <AIR SUP> and connect piping for the fluid to be transferred to the suction port <FLUID IN> and the discharge port <FLUID OUT>.
2. Using a regulator, set the pilot air pressure within the range of 0.2 to 0.7MPa . Then, the pump operates when power is applied to the 3 port solenoid valve of the air supply port <AIR SUP>, the sound of exhaust begins from the air exhaust port <AIR EXH> and fluid flows from the suction port <FLUID IN> to the discharge port <FLUID OUT>. At this time, the ball valve on the discharge side is in an open state. The pump performs suction with its own power even without priming. (Dry state suction lifting range: max. 1m) To restrict exhaust noise, attach a silencer (AN200-02: option) to the air exhaust port <AIR EXH>.
3. To stop the pump, exhaust the air pressure being supplied to the pump by the 3 port solenoid valve of the air supply port <AIR SUP>. The pump will also stop if the ball valve on the discharge side is closed.

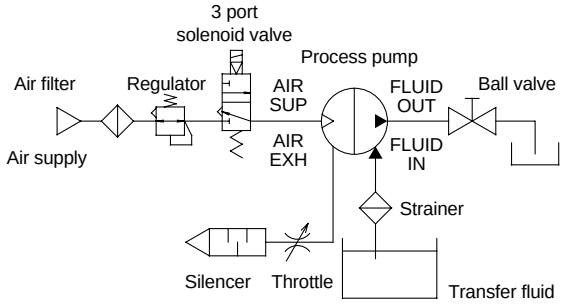
<Discharge Flow Rate Adjustment>

1. Adjustment of the flow rate from the discharge port <FLUID OUT> is performed with the ball valve connected on the discharge side or the throttle connected on the air exhaust side. For adjustment from the air side, use of the silencer with throttle ASN2 (port size 1/4) connected to the air exhaust port <AIR EXH> is effective. Refer to circuit example (1).
2. When operating with a discharge flow rate below the specification range, provide a by-pass circuit from the discharge side to the suction side to ensure the minimum flow rate inside the process pump. With a discharge flow rate below the minimum flow rate, the process pump may stop due to unstable operation. Refer to circuit example (2). (Minimum flow rates: PA3000 1l/min, PA5000 5l/min)

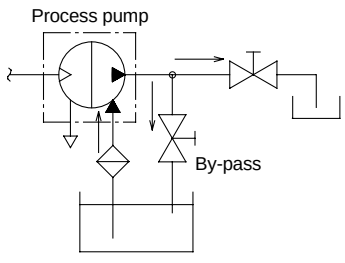
<Reset Button>

1. When the pump stops during operation, press the reset button. This makes it possible to restore operation in case the switching valve becomes clogged due to foreign matter in the supply air.

Circuit example (1)

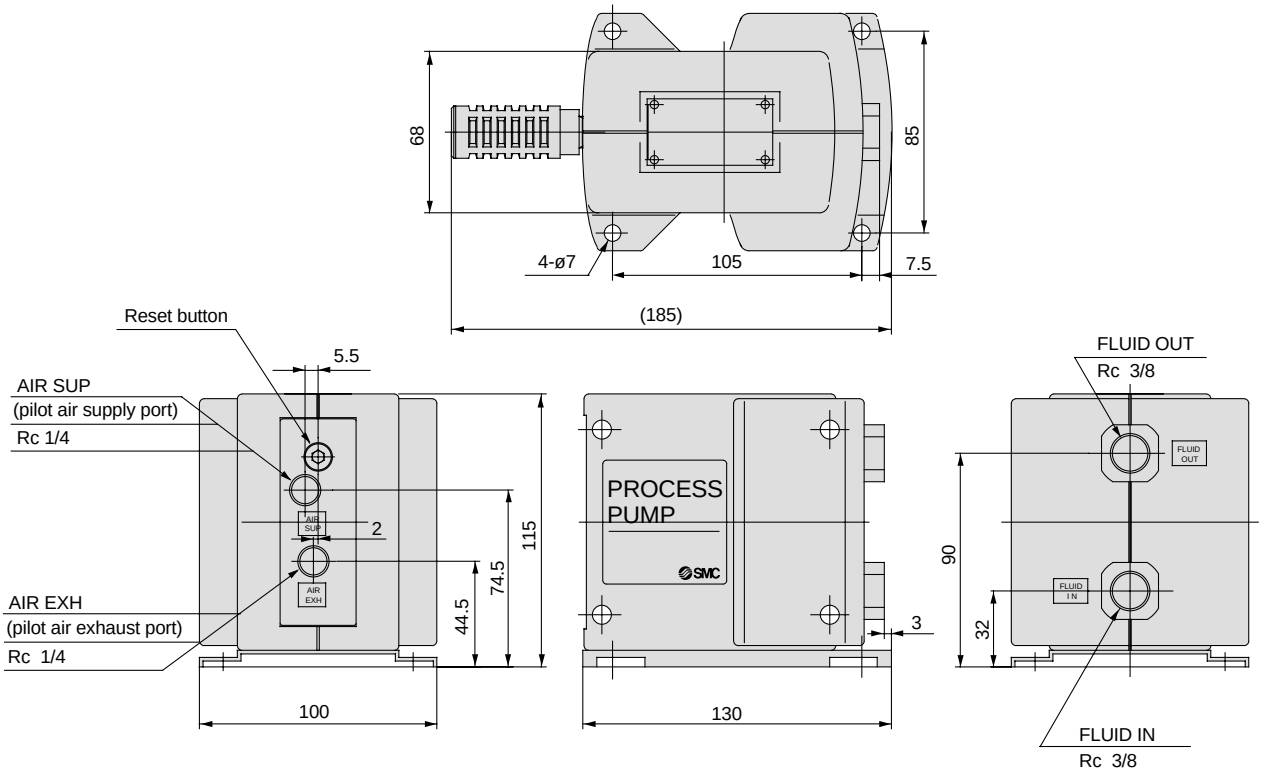


Circuit example (2)

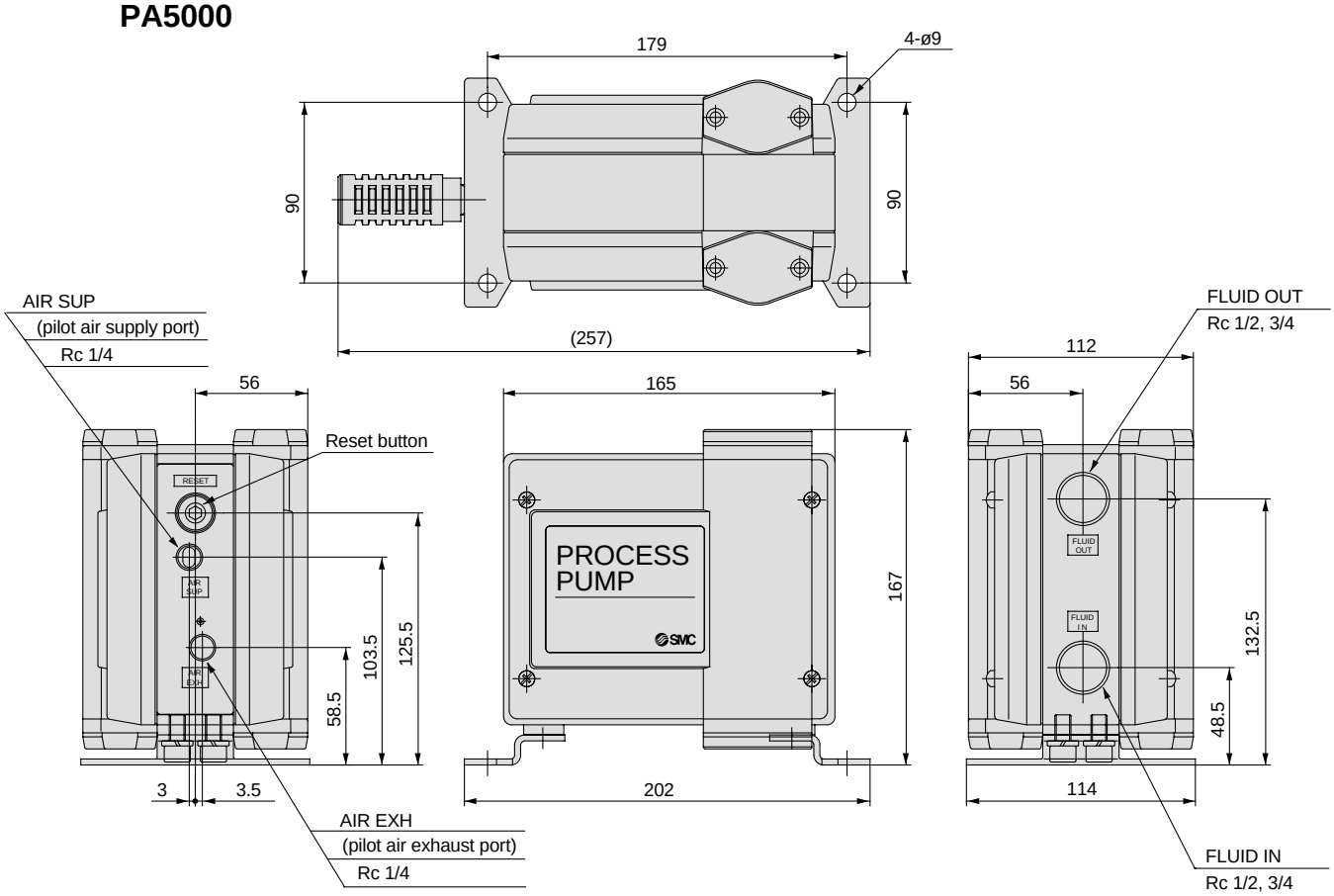


Dimensions/Automatically Operated Type

PA3000



PA5000

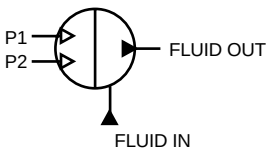


Process Pump
Air Operated Type (External Switching Type)
Series PA3000/5000

PA3000

PA5000

Symbol



Air operated type

How to Order

PA 3 1 1 3 — □ 03

Body size

3	3/8 standard
5	1/2 standard

Liquid contact body material

1	ADC12 (aluminum)
2	SCS14 (stainless steel)

Diaphragm material

1	PTFE

Air operated type

Thread type

Nil	Rc
T∗	NPTF
F∗	G
N∗	NPT

∗ T, F, N are order made specifications.

Connection port size

03	3/8 (10A): PA3
04	1/2 (15A): PA5
06	3/4 (20A): PA5

Specifications

Model		Air operated type			
		PA3113	**PA3213**	**PA5113**	**PA5213**
Port size	**Main fluid suction/ discharge port**	Rc 3/8		Rc 1/2, 3/4	
	Pilot air supply/ exhaust port	Rc 1/4			
Material	**Liquid contact areas**	ADC12	SCS14	ADC12	SCS14
	Diaphragm	PTFE			
	Check valve	PTFE, PFA			
Discharge rate		0.1 to 12//min		1 to 24//min	
Average discharge pressure		0 to 0.4MPa			
Pilot air consumption rate		Maximum 150//min (ANR)		Maximum 250//min (ANR)	
Suction lifting range Note1)	**Dry**	Up to 1m (interior of pump dry)		Up to 0.5m (interior of pump dry)	
	Wet	Up to 6m (liquid inside pump)			
Fluid temperature		0 to 60°C (with no freezing)			
Ambient temperature		0 to 60°C			
Pilot air pressure		0.1 to 0.5MPa			
Withstand pressure		0.75MPa			
Mounting position		Horizontal (with mounting foot at bottom)			
Weight		1.7kg	2.2kg	3.5kg	6.5kg
Recommended operating cycles		1 to 7Hz (0.2 to 1Hz also possible depending on conditions Note 2))			
Pilot air solenoid valve recommended Cv factor Note 3)		0.20		0.45	

∗ Each of the values above indicates use at ordinary temperatures with fresh water.

Note 1) With cycles at 2Hz or more

Note 2) After initial suction of liquid operating at 1 to 7Hz, it can be used with operation at lower cycles. Since a large quantity of liquid will be pumped out, use a suitable throttle in the discharge port if problems occur.

Note 3) With a low number of operating cycles, even a valve with a small Cv factor can be operated.

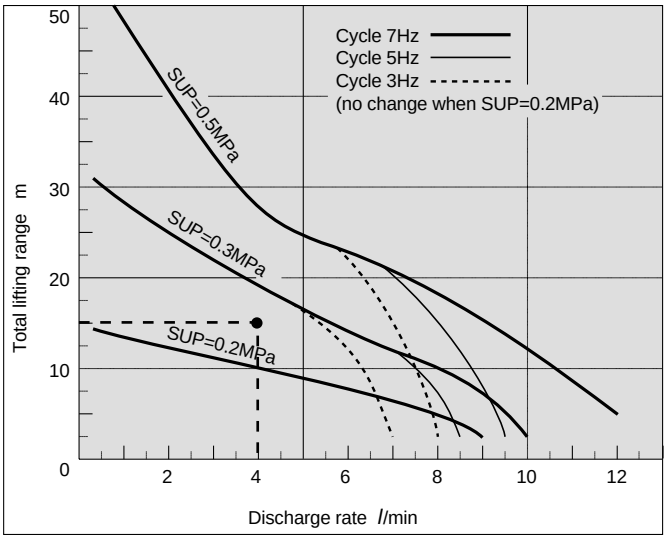
Recommended Valve

PA3000	VQZ14□0 (exhaust center)
PA5000	VQZ24□0 (exhaust center)

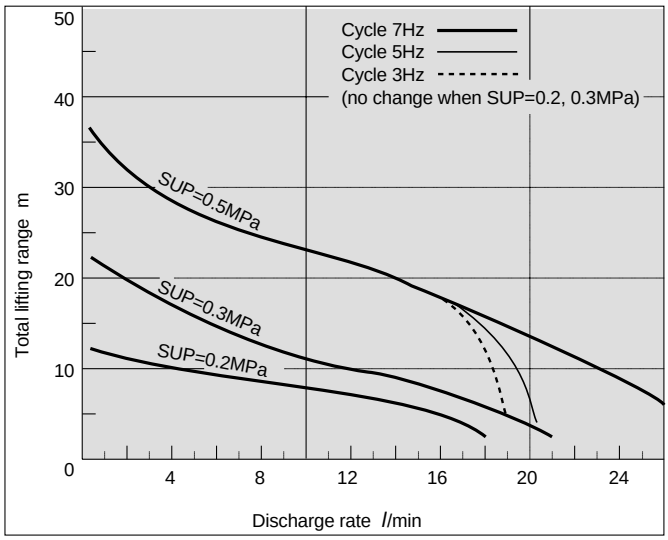
Refer to page 21 for further details.

Performance Curves/Air Operated Type

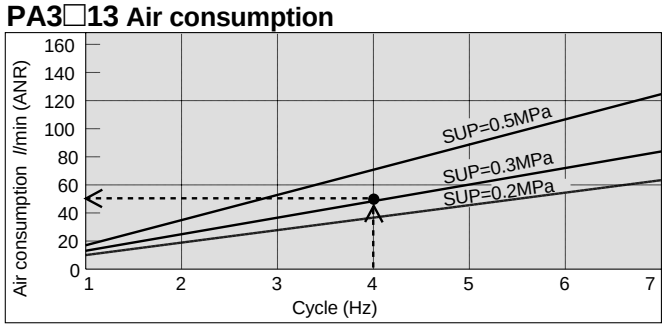
PA3□13 Flow rate characteristics



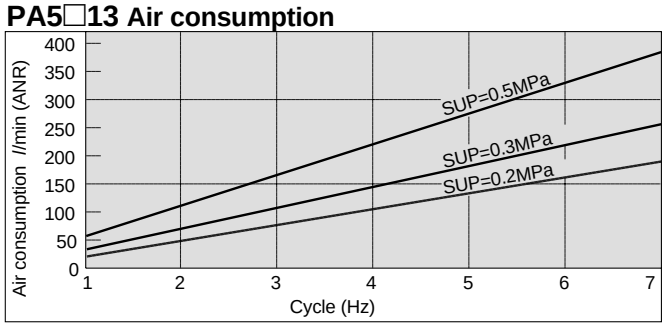
PA5□13 Flow rate characteristics



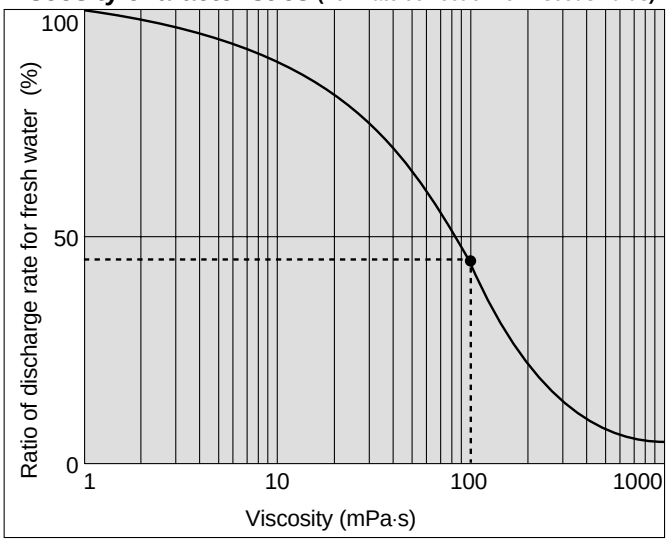
PA3□13 Air consumption



PA5□13 Air consumption



Viscosity characteristics (flow rate correction for viscous fluids)



Selection from flow rate characteristic graphs (for PA3000)

Required specification example:

Find the pilot air pressure for a discharge rate of 4l/min and a total lifting range of 15m. <The transferred fluid is clean water (viscosity 1mPa·s, specific gravity 1.0).>

Note 1) If the discharge pressure is required instead of the total lifting height, a total lift of 10m corresponds to a discharge pressure of 0.1MPa.

Note 2) 1 cycle discharge rate PA3000: Approx. 22m/ PA5000: Approx. 100m/

Selection procedure

1. First mark the intersection point for a discharge rate of 4l/min and a lifting range of 15m.
2. Find the pilot air pressure for the marked point. In this case, the point is between the discharge curves (solid lines) for SUP=0.2MPa and SUP=0.3MPa, and based on the proportional relationship to these lines, the pilot air pressure for this point is approximately 0.25MPa.

Note 1) Even when switching cycles are changed for PA3000 with SUP=0.2MPa or PA5000 with SUP=0.2MPa or 0.3MPa, there is almost no change in the lifting height.

Calculating air consumption (for PA3000)

Find the air consumption for operation with a 4Hz switching cycle and pilot air pressure of 0.3MPa from the air consumption graph.

Selection procedure

1. Look up from the 4Hz switching cycle to find the intersection with SUP=0.3MPa.
2. From the point just found, draw a line to the Y-axis to find the air consumption. The result is approximately 50l/min.

⚠Caution

1. These flow rate characteristics are for fresh water (viscosity 1mPa·s, specific gravity 1.0).
2. The discharge rate differs greatly depending on properties (viscosity, specific gravity) of the fluid being transferred and operating conditions (lifting range, transfer distance), etc.

Selection from viscosity characteristic graph

Required specification example:

Find the pilot air pressure for a discharge rate of 2.7l/min, a total lifting range of 25m, and a viscosity of 100mPa·s.

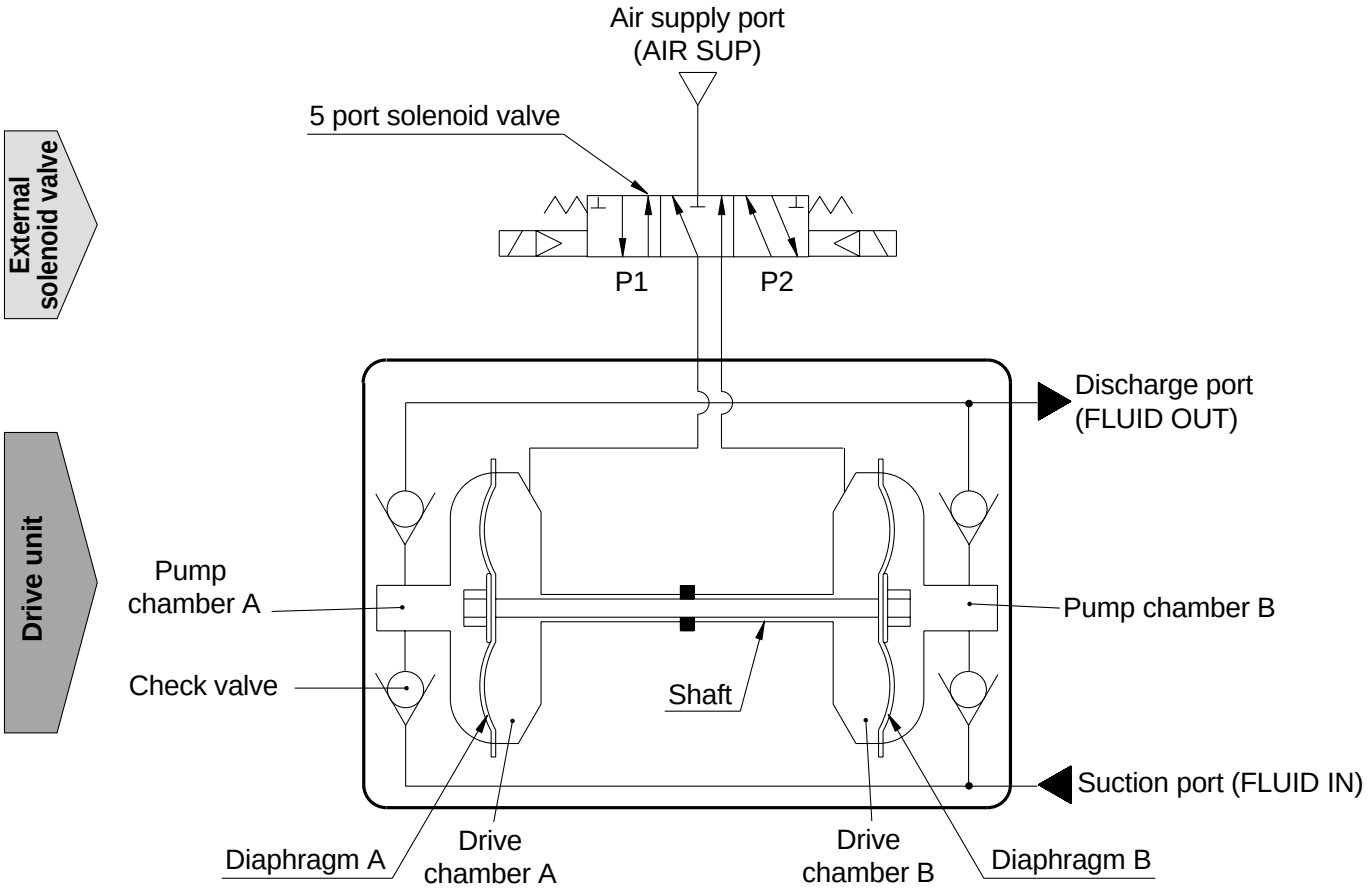
Selection procedure

1. First find the ratio of the discharge rate for fresh water when viscosity is 100mPa·s from the graph at the left. It is determined to be 45%.
2. Next, in the required specification example the viscosity is 100mPa·s and the discharge rate is 2.7l/min. Since this is equivalent to 45% of the discharge rate for fresh water, 2.7l/min ÷ 0.45 = 6l/min, indicating that a discharge rate of 6l/min is required for fresh water.
3. Finally, find the pilot air pressure and pilot air consumption rate based on selection from the flow rate characteristic graphs.

⚠Caution

Viscosities up to 1000mPa·s can be used.

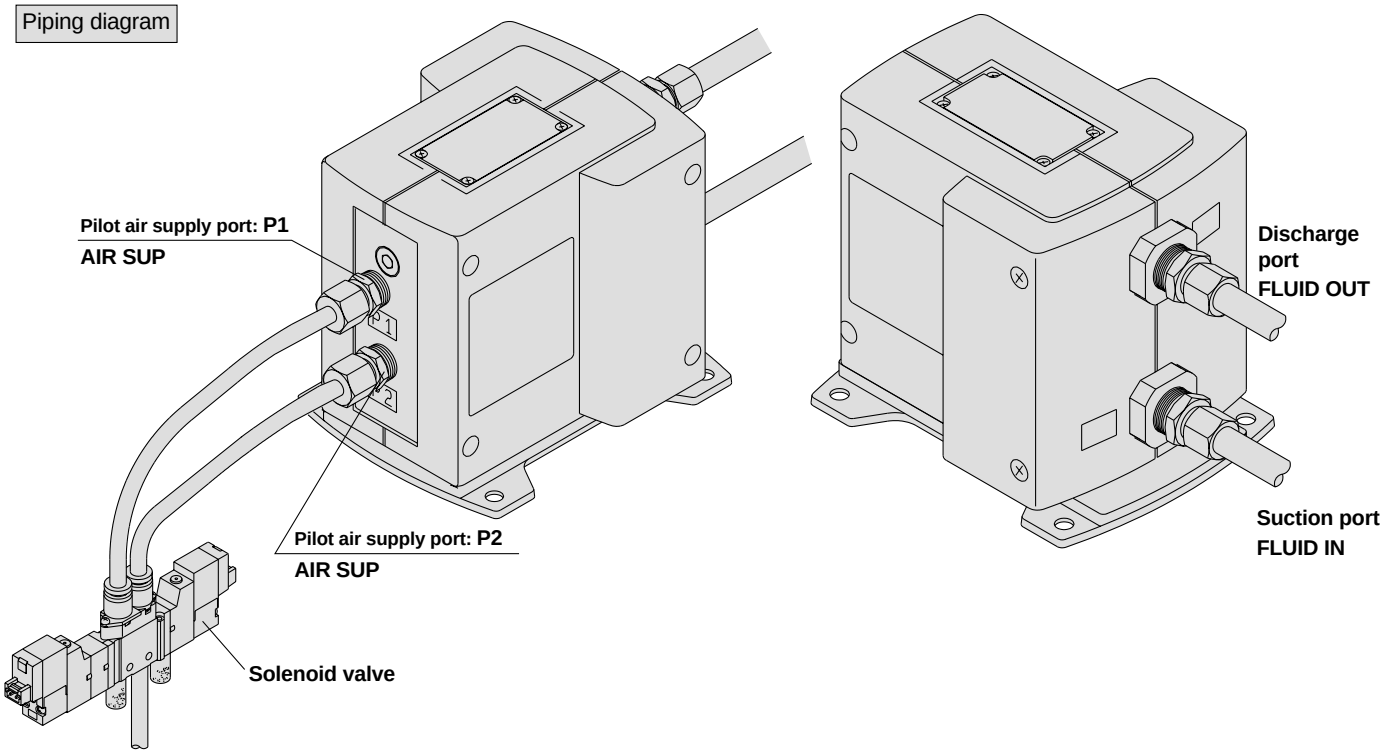
Operating Principle/Air Operated Type



1. When air is supplied to P1 port, it enters drive chamber A.
2. Diaphragm A moves to the left, and at the same time diaphragm B also moves to the left.
3. The fluid in pump chamber A is forced out to the discharge port, and the fluid is sucked into pump chamber B from the suction port.
4. If air is supplied to the P2 port, the opposite will occur. Continuous suction and discharge of fluid is performed by repeating this process with the control of an external solenoid valve (5 port valve).

Piping and Operation/Air Operated Type

Piping diagram



⚠Caution

Maintain the proper tightening torque for fittings and mounting bolts, etc. Looseness can cause problems such as fluid and air leaks, while over tightening can cause damage to threads and parts, etc.

Operation

<Starting and Stopping> Refer to circuit example

1. Connect air piping Note 1) to the pilot air supply ports <P1>, <P2> and connect piping for the fluid to be transferred to the suction port <FLUID IN> and the discharge port <FLUID OUT>.
2. Using a regulator, set the pilot air pressure within the range of 0.1 to 0.5MPa. Then, the pump operates when power is applied to the solenoid valve Note 2) of the pilot air supply port and fluid flows from the suction port <FLUID IN> to the discharge port <FLUID OUT>. At this time, the ball valve on the discharge side is in an open state. The pump performs suction with its own power even without priming. (Note 3) Dry state suction lifting range: PA3 1m, PA5 up to 0.5m) To restrict exhaust noise, attach a silencer to the solenoid valve air exhaust port.
3. To stop the pump, exhaust the air pressure being supplied to the pump with the solenoid valve of the air supply port.

Note 1) When used for highly permeable fluids, the solenoid valve may malfunction due to the gas contained in the exhaust. Implement measures to keep the exhaust from going to the solenoid valve side.

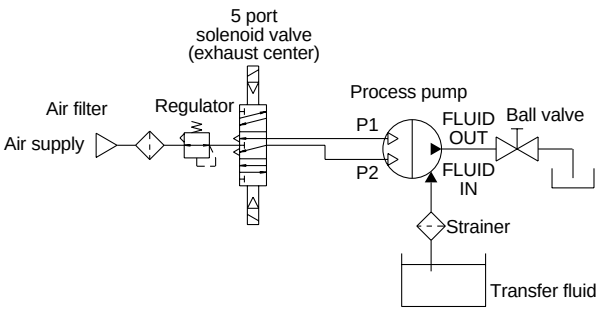
Note 2) For the solenoid valve, use an exhaust center 5 port valve, or a combination of residual exhaust 3 port valve and a pump drive 4 port valve. If air in the drive chamber is not released when the pump is stopped, the diaphragm will be subjected to pressure and its life will be shortened.

Note 3) When the pump is dry, operate the solenoid valve at a switching cycle of 1 to 7Hz. If operated outside of this range, the suction lifting height may not reach the prescribed value.

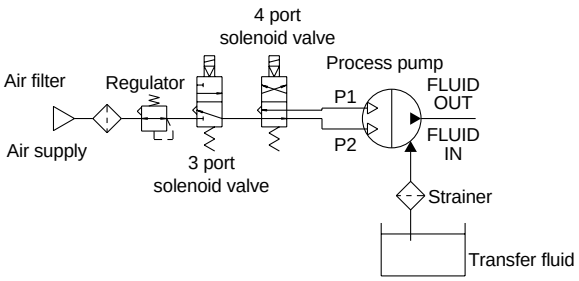
<Discharge Flow Rate Adjustment>

1. The flow rate from the discharge port <FLUID OUT> can be adjusted easily by changing the switching cycle of the solenoid valve on the air supply port.

Circuit example (1)

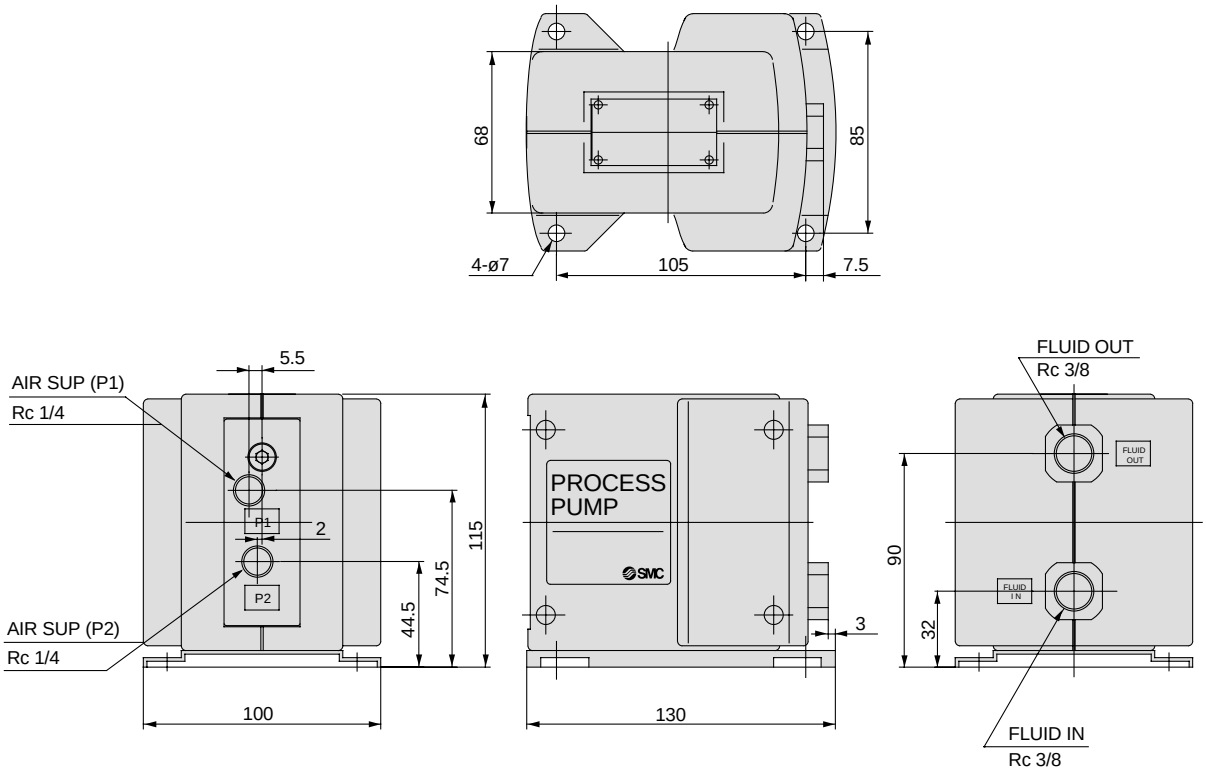


Circuit example (2)

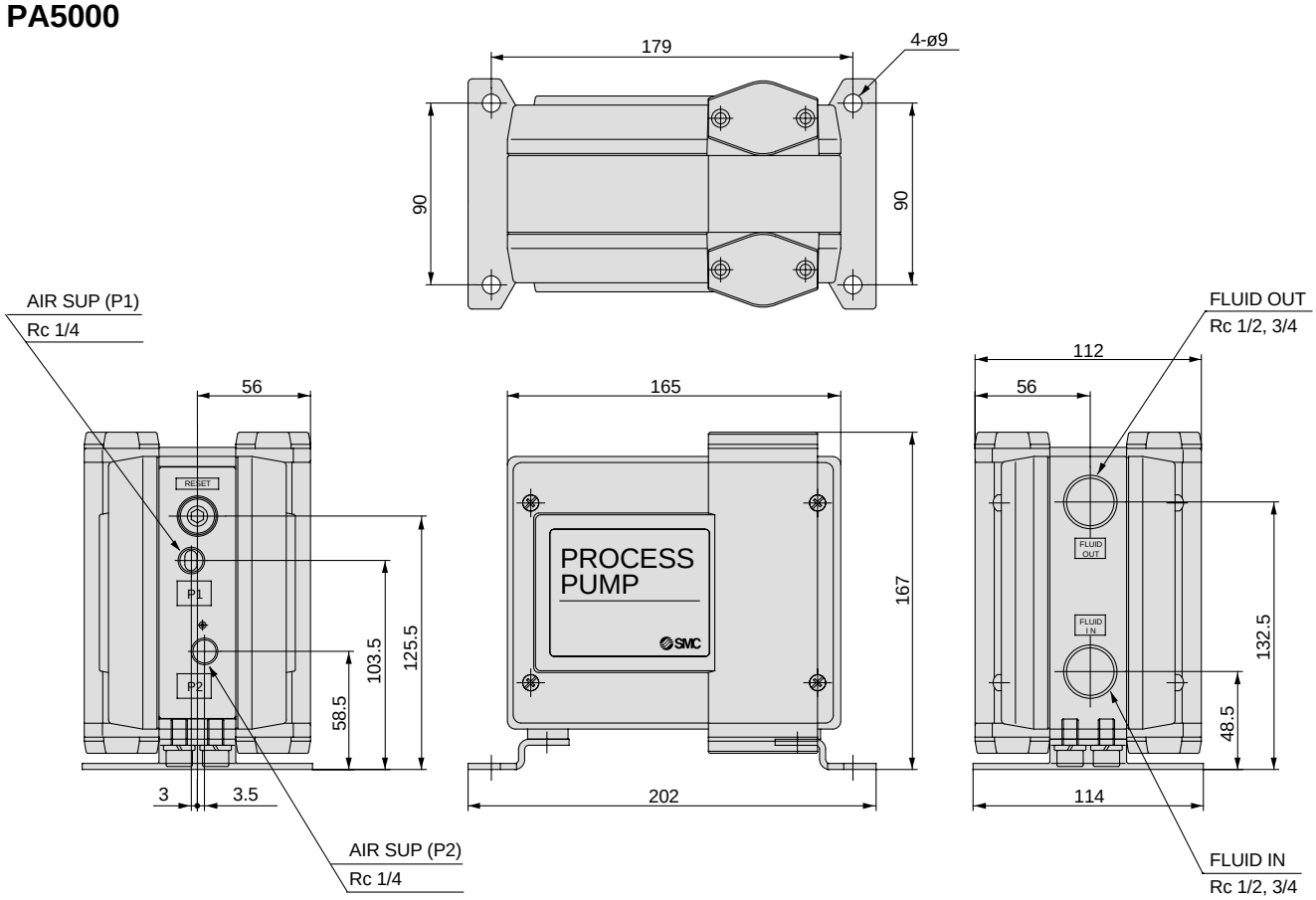


Dimensions/Air Operated Type

PA3000

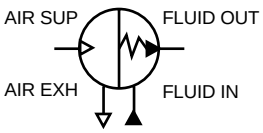


PA5000



Process Pump
Automatically Operated Type with Built-in Pulsation Attenuator (Internal Switching Type)
Series PAX1000

Symbol



Built-in pulsation attenuator
Automatically operated type

How to Order

PAX1 [1] 1 2 – [ ] [02] [ ]

Body material

1	ADC12 (aluminum)
2	SCS14 (stainless steel)

Diaphragm material

1	PTFE (fluororesin)

Type of operation

2	Automatically operated type with built-in pulsation attenuator

Thread type

Nil	Rc
T∗	NPTF
F∗	G
N∗	NPT

∗ T, F, N are order made specifications.

Connection port size

02	1/4 (8A)
03	3/8 (10A)

Option

Nil	Body only
N	With silencer ∗

∗ For AIR EXH: AN200-02

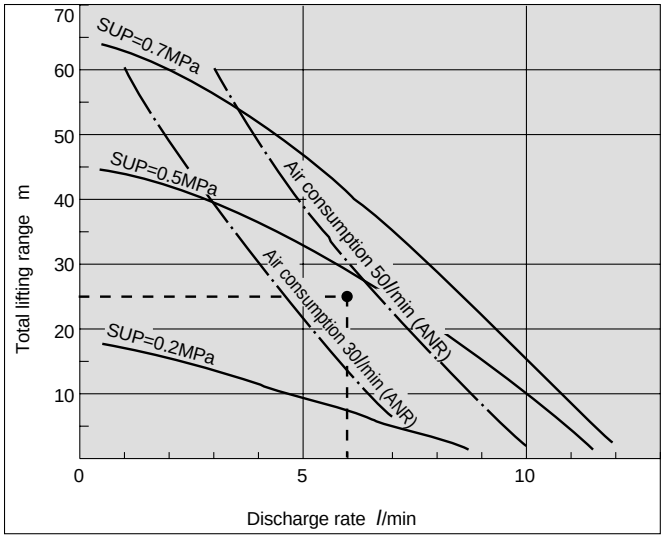
Specifications

Model		PAX1112	PAX1212
Port size	Main fluid suction/ discharge port	Rc 1/4, 3/8	
	Pilot air supply/ exhaust port	Rc 1/4	
Material	Fluid contact areas	ADC12	SCS14
	Diaphragm	PTFE	
	Check valve	PTFE, SCS14	
Discharge rate		0.5 to 10//min	
Average discharge pressure		0 to 0.6MPa	
Pilot air consumption		Maximum 150//min (ANR)	
Suction lifting range	Dry	Up to 2m (interior of pump dry)	
	Wet	Up to 6m (liquid inside pump)	
Discharge pulsation attenuating capacity		30% or less of maximum discharge pressure	
Fluid temperature		0 to 60°C (with no freezing)	
Ambient temperature		0 to 60°C	
Pilot air pressure		0.2 to 0.7MPa	
Withstand pressure		1.05MPa	
Mounting position		Horizontal (bottom facing down)	
Weight		2.0kg	3.5kg

∗ Each of the values above indicates use at ordinary temperatures with fresh water.

Performance Curves/Automatically Operated Type with Built-in Pulsation Attenuator

PAX1000 Flow rate characteristics



Selection from flow rate characteristic graph

Required specification example:

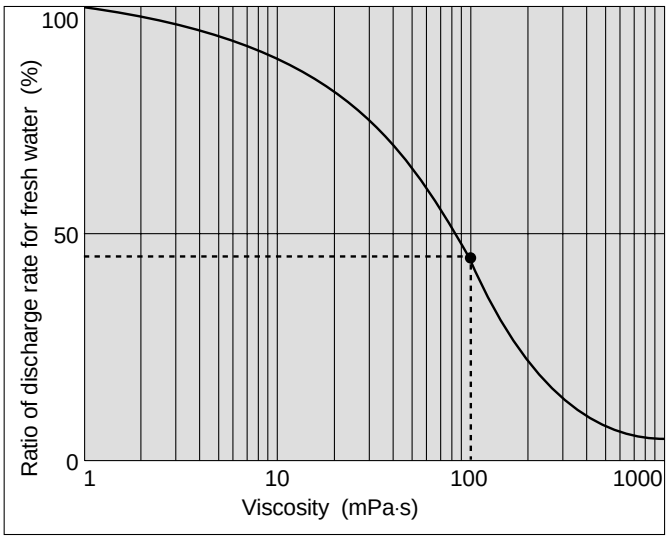
Find the pilot air pressure and pilot air consumption for a discharge rate of 6l/min and a total lifting range of 25m. [The transfer fluid is fresh water (viscosity 1mPa·S, specific gravity 1.0).]

∗ If the discharge pressure is required instead of the total lifting height, a total lift of 10m corresponds to discharge pressure of 0.1MPa.

Selection procedures

1. First mark the intersection point for a discharge rate of 6l/min and a lifting range of 25m.
2. Find the pilot air pressure for the marked point. In this case, the point is between the discharge curves (solid lines) for SUP=0.2MPa and SUP=0.5MPa, and based on the proportional relationship to these lines, the pilot air pressure for this point is approximately 0.45MPa.
3. Next find the air consumption. Since the marked point is below the curve for 50l/min (ANR), the maximum rate will be about 50l/min (ANR).

Viscosity characteristics (flow rate correction for viscous fluids)



Selection from viscosity characteristic graph

Required specification example:

Find the pilot air pressure and pilot air consumption for a discharge rate of 2.7l/min, a total lifting range of 25m, and a viscosity of 100mPa·s.

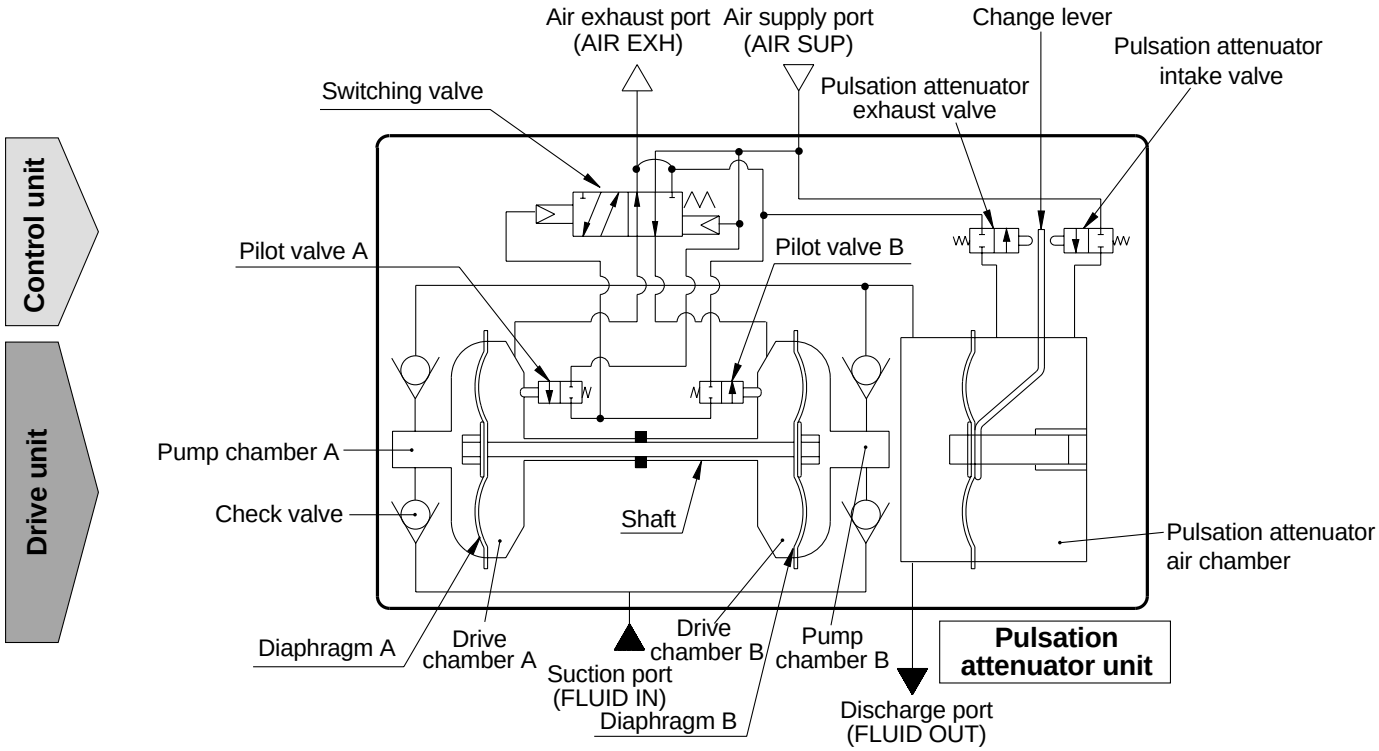
Selection procedure

1. First find the ratio of the discharge rate for fresh water when viscosity is 100mPa·s from the graph below. It is determined to be 45%.
2. Next, in the required specification example, the viscosity is 100mPa·s and the discharge rate is 2.7l/min. Since this is equivalent to 45% of the discharge rate for fresh water, 2.7l/min ÷ 0.45 = 6l/min, indicating that a discharge rate of 6l/min is required for fresh water.
3. Finally, find the pilot air pressure and pilot air consumption based on selection from the flow rate characteristic graph.

⚠Caution

Viscosities up to 1000mPa·s can be used.

Operating Principle/Automatically Operated Type with Built-in Pulsation Attenuator



Control unit

1. When air is supplied, it passes through the switching valve and enters drive chamber B.
2. Diaphragm B moves to the right, and at the same time diaphragm A also moves to the right pushing pilot valve A.
3. When pilot valve A is pushed, air acts upon the switching valve, drive chamber A is switched to a supply state, and the air which was in drive chamber B is exhausted to the outside.
4. When air enters drive chamber A, diaphragm B moves to the left pressing pilot valve B.
5. When pilot valve B is pushed, the air which was acting upon the switching valve is exhausted, and drive chamber B once again switches to a supply state. A continuous reciprocal motion is generated by this repetition.

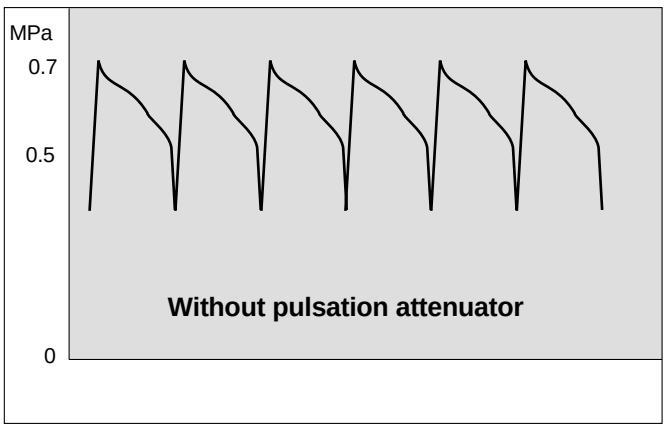
Drive unit

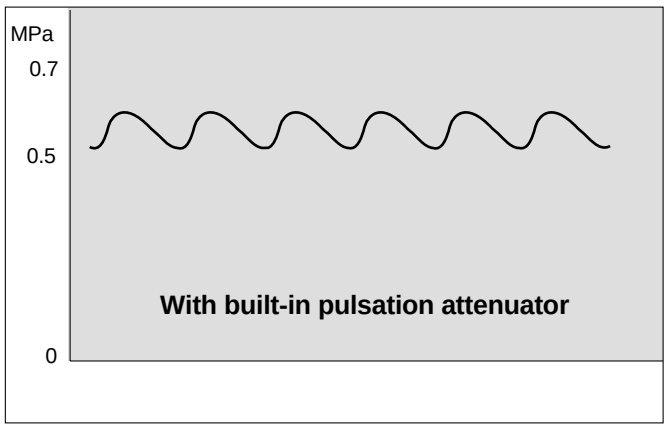
1. When air enters drive chamber B, the fluid in pump chamber B is forced out, and at the same time fluid is sucked into pump chamber A.
2. When the diaphragm moves in the opposite direction, the fluid in pump chamber A is pushed out, and fluid is sucked into pump chamber B.
3. The pressure of the fluid that is forced out of the pump chamber is adjusted in the pulsation attenuation chamber and is then exhausted.
4. Continuous suction/discharge is performed by the reciprocal motion of the diaphragm.

Pulsation attenuation chamber

1. Pulsation is attenuated by the elastic force of the diaphragm and air in the pulsation attenuation chamber.
2. When the pressure in the pulsation attenuation chamber rises, the change lever presses the pulsation attenuator intake valve, and air enters the pulsation attenuator air chamber.
3. Conversely, when pressure drops, the change lever presses the pulsation attenuator exhaust valve, exhausting the air from the air chamber and keeping the diaphragm in a constant position. Note that some time is required for the pulsation attenuator to operate normally.

Pulsation Attenuating Capacity

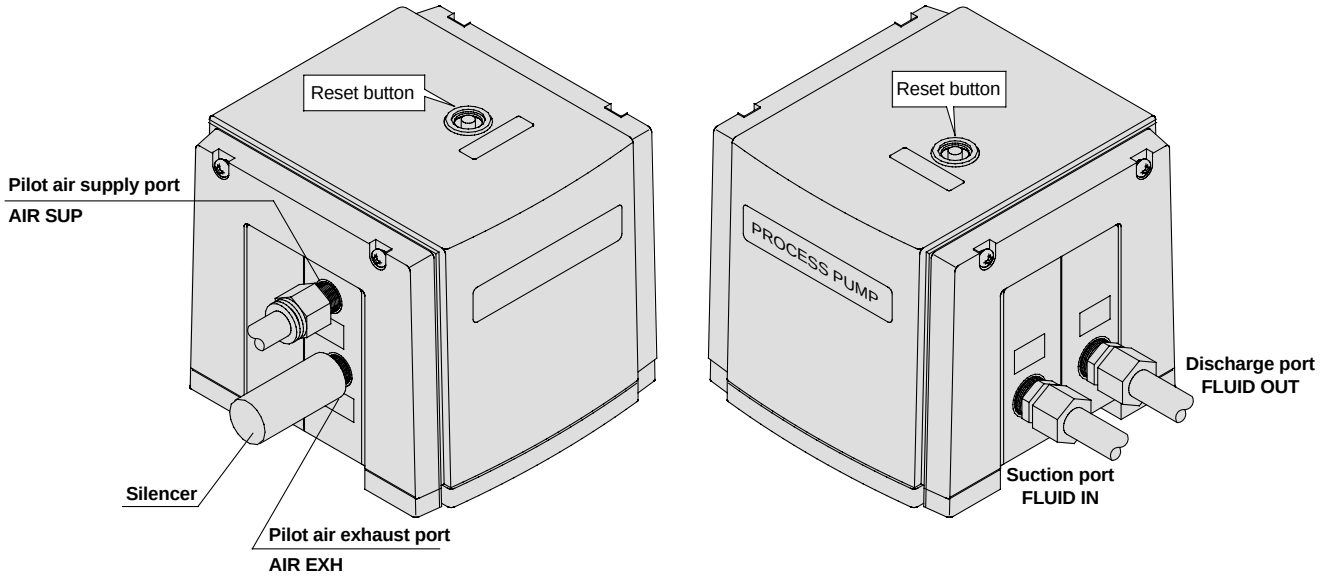




The process pump generates pulsation because it discharges a liquid using two diaphragms. The pulsation attenuator absorbs pressure when discharge pressure increases, and compensates the pressure when discharge pressure decreases. By this means pulsation is controlled.

Piping/Automatically Operated Type with Built-in Pulsation Attenuator

Piping diagram



⚠ Caution
Maintain the proper tightening torque for fittings and mounting bolts, etc. Looseness can cause problems such as fluid leakage, while over tightening can cause damage to threads and parts, etc.

Operation

<Starting and Stopping> Refer to circuit example (1)

1. Connect air piping to the air supply port <AIR SUP> and connect piping for the fluid to be transferred to the suction port <FLUID IN> and the discharge port <FLUID OUT>.
2. Using a regulator, set the pilot air pressure within the range of 0.2 to 0.7MPa. Then, the pump operates when power is applied to the 3 port solenoid valve of the air supply port <AIR SUP>, the sound of exhaust begins from the air exhaust port <AIR EXH> and fluid flows from the suction port <FLUID IN> to the discharge port <FLUID OUT>. At this time, the ball valve on the discharge side is in an open state. The pump performs suction with its own power even without priming. (Dry state suction lifting range: max. 2m) To restrict exhaust noise, attach a silencer (AN200-02: option) to the air exhaust port <AIR EXH>.
3. To stop the pump, exhaust the air pressure being supplied to the pump with the 3 port solenoid valve of the air supply port <AIR SUP>. The pump will also stop if the ball valve on the discharge side is closed.

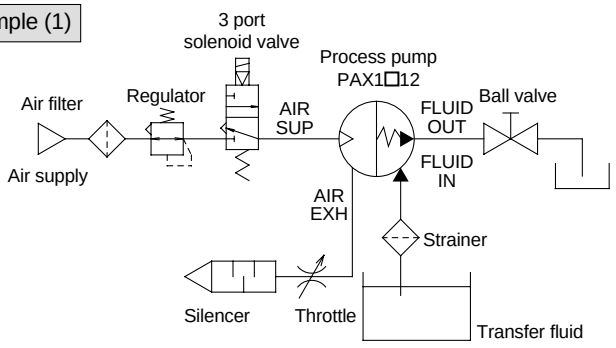
<Discharge Flow Rate Adjustment>

1. Adjustment of the flow rate from the discharge port <FLUID OUT> is performed with the ball valve connected on the discharge side or the throttle connected on the air exhaust side. For adjustment from the air side, use of the silencer with throttle ASN2 (port size 1/4) connected to the air exhaust port <AIR EXH> is effective. Refer to circuit example (1).
2. When operating with a discharge flow rate below the specification range, provide a by-pass circuit from the discharge side to the suction side to ensure the minimum flow rate inside the process pump. With a discharge flow rate below the minimum flow rate, the process pump may stop due to unstable operation. (Minimum flow rate: PAX1000 0.5//min)

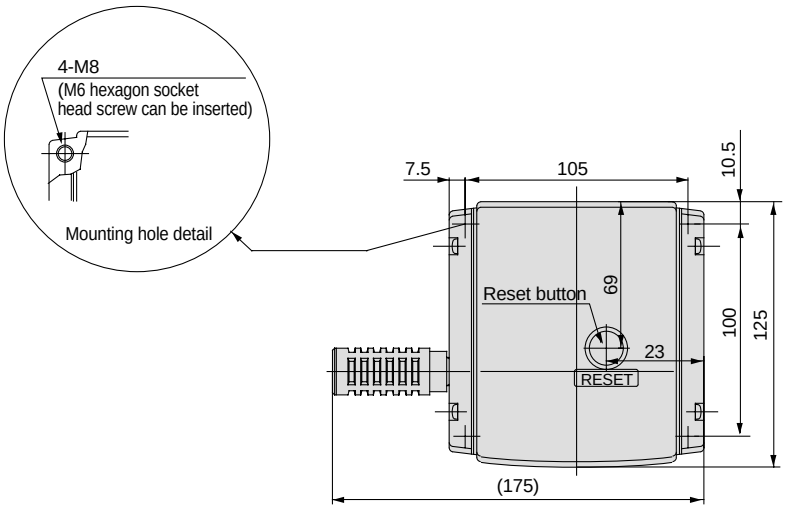
<Reset Button>

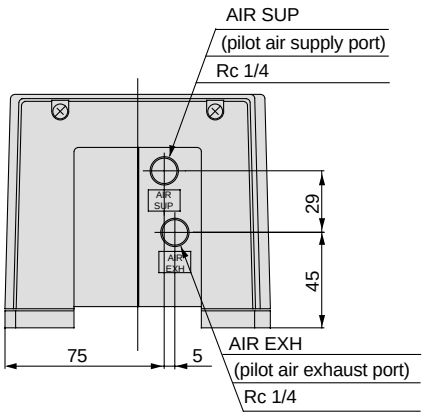
1. When the pump stops during operation, press the reset button. This makes it possible to restore operation in case the switching valve becomes clogged due to foreign matter in the supply air.

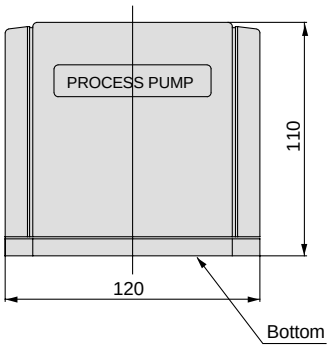
Circuit example (1)

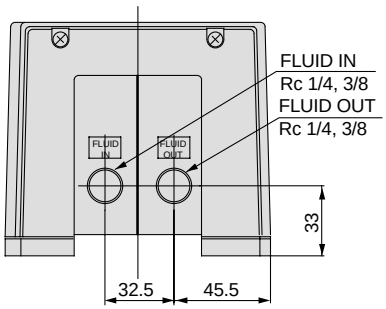


Dimensions


4-M8
(M6 hexagon socket
head screw can be inserted)
Mounting hole detail
7.5
105
10.5
Reset button
69
100
125
23
RESET
(175)

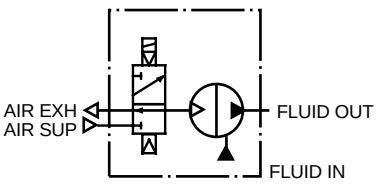

AIR SUP
(pilot air supply port)
Rc 1/4
AIR SUP
AIR EXH
29
45
75
5
AIR EXH
(pilot air exhaust port)
Rc 1/4


PROCESS PUMP
110
120
Bottom

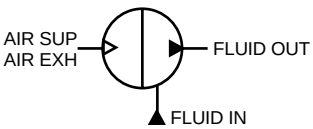

FLUID IN
Rc 1/4, 3/8
FLUID OUT
Rc 1/4, 3/8
FLUID IN
FLUID OUT
33
32.5
45.5

Process Pump
Built-in Solenoid Valve Type/Air operated Type (External Switching Type)
Series PB1000

Symbol



Built-in solenoid valve type



Air operated type

How to Order

PB1 0 1 1 — □ 01 — □

Body size

1	1/8 standard

Body material

0	Polypropylene

Diaphragm material

1	PTFE (fluororesin)

Type of operation

1	Built-in solenoid valve
3	Air operated

Thread type

Nil	Rc
T*	NPTF
F*	G
N*	NPT

* T, F, N are order made specifications.

Connection port size

01	1/8 (6A)

Option/Part no.

Nil	Pump only
B	With foot (bolts included) KT-PB1-3
N*	With silencer AN120-M5

* For AIR EXH
Air operated type is not available with silencer (symbol N).

Specifications

Model			PB1011	PB1013
Port size	Main fluid suction/discharge port		Rc 1/8	
	Pilot air	Supply port	Rc 1/8	
		Exhaust port	M5 x 0.8	
Material	Fluid contact areas		Polypropylene PP, Stainless steel (SUS316)	
	Diaphragm		PTFE	
	Check valve		PTFE	
	Liquid contact seals		FKM	
Discharge rate			8 to 2000m//min	8 to 500m//min
Average discharge pressure			0 to 0.6MPa	
Suction lifting range			Up to 2.5m (dry: interior of pump dry)	
Fluid temperature			0 to 50°C (with no freezing)	
Ambient temperature			0 to 50°C	
Pilot air pressure			0.2 to 0.7MPa	
Withstand pressure			1.05MPa	
Recommended operating cycle			1 to 10Hz (0.03 to 1Hz also possible depending on conditions Note 2)	
Lubrication			Not required	
Voltage			24VDC	—
Weight			0.17kg	0.15kg
Mounting position			OUT port at top (indication on name plate)	
Pilot air solenoid valve recommended Cv factor Note 1)			—	0.2

* Each of the values above indicates use at ordinary temperatures with fresh water.

Note on the transfer of slurry:

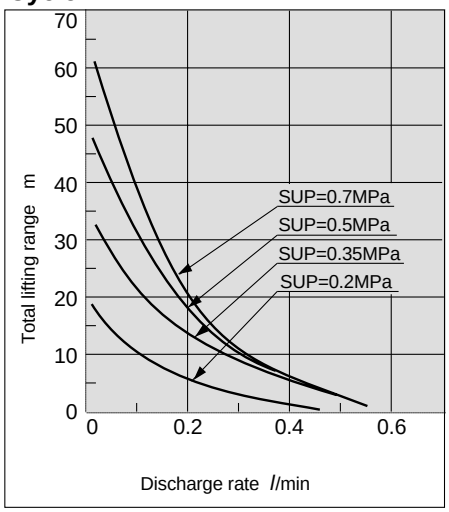
Slurry transfer is not possible with Series PB1000 because of deterioration and wear of the check valve seat and the accumulation of particles, which will render the pump inoperable.

Note 1) With low operating cycles, even a valve with a small Cv factor can be operated. Recommended valve/for PB1013 air operated type: SYJ3□4

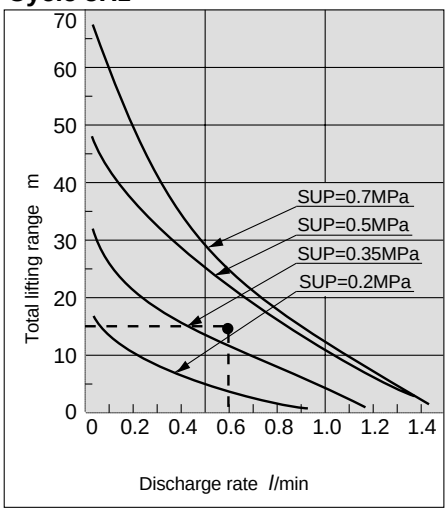
Note 2) After initial suction of liquid operating at 1 to 7Hz, it can be used with operation at lower cycles. Since a large quantity of liquid will be pumped out, use a suitable throttle in the discharge port if problems occur.

Performance Curves/Built-in Solenoid Type/Air Operated Type

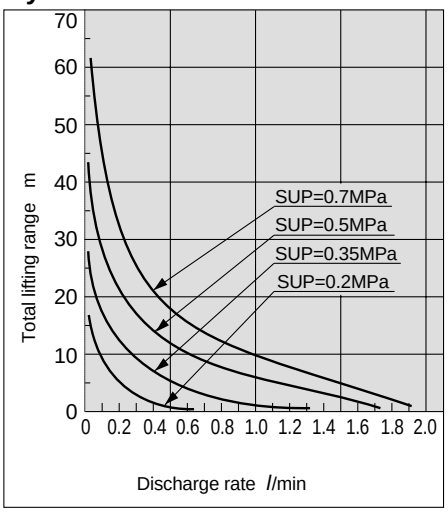
Cycle 1Hz



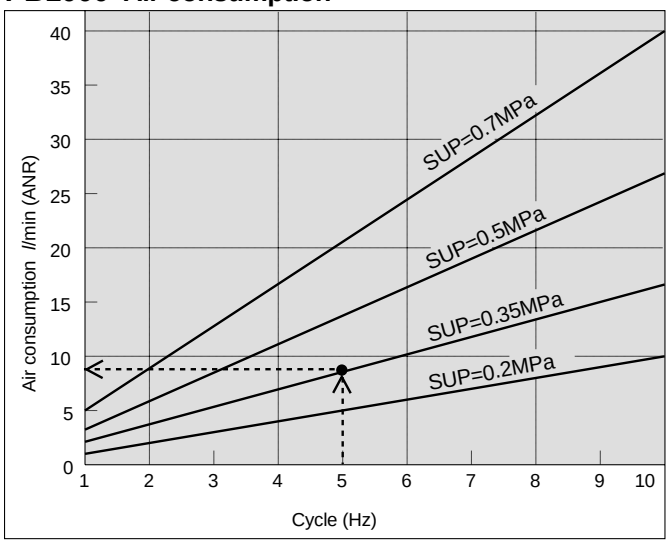
Cycle 5Hz



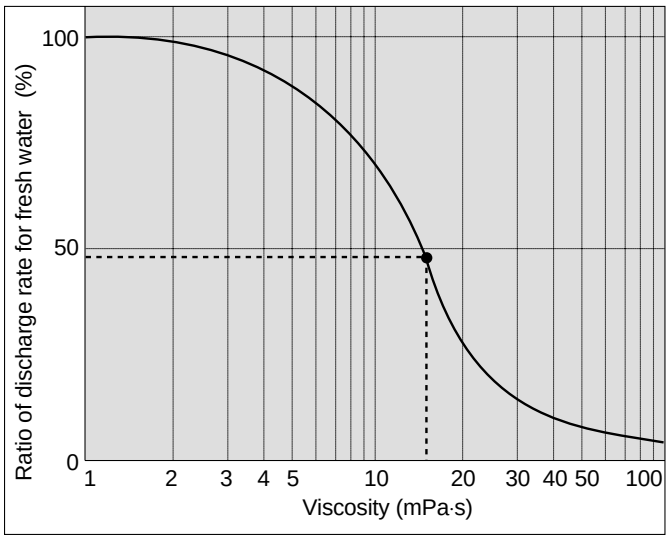
Cycle 10Hz



PB1000 Air consumption



Viscosity characteristics (flow rate correction for viscous fluids)



Selection from flow rate characteristic graphs

Required specification example:
Find the pilot air pressure and pilot air consumption for a discharge rate of 600m/min and a total lifting range of 15m.
<The transferred fluid is clean water (viscosity 1mPa·s, specific gravity 1.0) solenoid valve cycle 5Hz>

* If the discharge pressure is required instead of the total lifting height, a total lift of 10m corresponds to a discharge pressure of 0.1MPa.

Selection procedure

1. First mark the intersection point for a discharge rate of 600m/min and a lifting range of 15m.
2. Find the pilot air pressure for the marked point. In this case, the point is between the discharge curves (solid lines) for 0.35MPa and 0.5MPa, and based on the proportional relationship to these lines, the pilot air pressure for this point is approximately 0.4MPa.

Calculating air consumption

Find the air consumption for operation with a 5Hz switching cycle and pilot air pressure of 0.35MPa from the air consumption graph.

Selection procedure

1. Look up from the 5Hz switching cycle to find the intersection with SUP=0.35MPa.
2. From the point just found, draw a line to the Y-axis to find the air consumption. The result is approximately 9l/min (ANR).

⚠ Caution

1. These flow rate characteristics are for fresh water (viscosity 1mPa·s, specific gravity 1.0).
2. The discharge rate differs greatly depending on properties (viscosity, specific gravity) of the fluid being transferred and operating conditions (density, lifting range, transfer distance), etc.
3. If operated continuously at 10Hz, the diaphragm will reach its service life of 20 million cycles in approximately one month.

Selection from viscosity characteristic graph

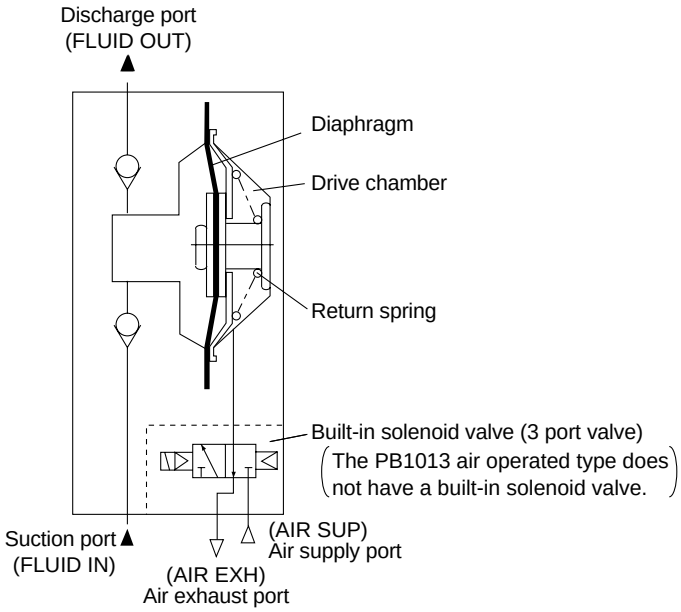
Required specification example:
Find the pilot air pressure and pilot air consumption for a discharge rate of 200m/min, a total lifting range of 10m, and a viscosity of 15mPa·s.

Selection procedure

1. First find the ratio of the discharge rate for fresh water when viscosity is 15mPa· s from the graph to the left. It is determined to be 48%.
2. Next, the viscosity of 15mPa· s and the discharge rate of 200/min in the required specification example are converted to the discharge rate for fresh water. Since 48% of the fresh water discharge rate is equivalent to 200m/min in the required specifications, 200m/min ÷ 0.48 = approximately 420m/min, indicating that a discharge rate of 420m/min is required for fresh water.
3. Finally, find the pilot air pressure and pilot air consumption based on viewing of the flow rate characteristics.

Viscosity: Transfer is possible up to about 100mPa· s.

Operating Principle/Built-in Solenoid Valve Type/Air Operated Type



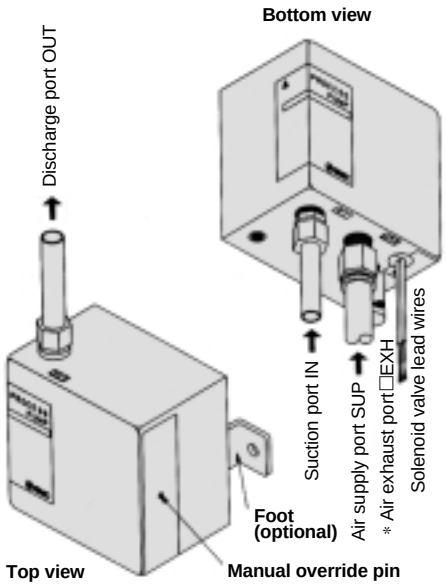
When air is supplied and the built-in solenoid valve is turned ON, air enters the drive chamber and the diaphragm moves to the left. Due to this movement, the fluid in the pump chamber passes through the upper check valve and is discharged to the OUT side.

When the solenoid valve is turned OFF, the air inside the drive chamber is evacuated to EXH, and the diaphragm is moved to the right by the return force of the return spring. Due to this movement, the fluid on the FLUID IN side passes through the lower check valve and is sucked into the pump chamber.

The PB1011 repeats this suction and discharge with the repetition of the built-in solenoid valve's ON/OFF operation. The PB1013 air operated type is operated by the ON/OFF operation of an external solenoid valve.

Piping and Operation/Built-in Solenoid Valve Type/Air Operated Type

Piping



∗ The PB1013 air operated type has a plug in the air exhaust port EXH.

⚠ Caution

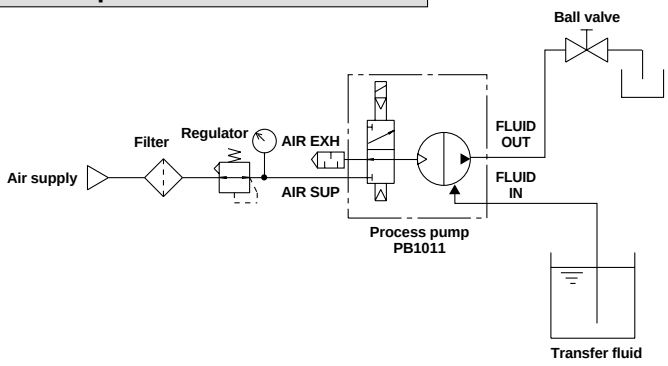
Be sure that the discharge side OUT is on top when the pump is mounted. Supply clean air that has passed through an AF filter, etc., to the air supply port SUP. Air that contains debris or drainage, etc., will have an adverse effect on the built-in solenoid valve, and will cause malfunction of the pump. In cases that particularly require air cleaning, use a filter (Series AF) together with a mist separator (Series AM).

Maintain the proper tightening torque for fittings and mounting bolts, etc. Looseness can cause problems such as fluid and air leakage, while over tightening can cause damage to threads and parts, etc.

Operation

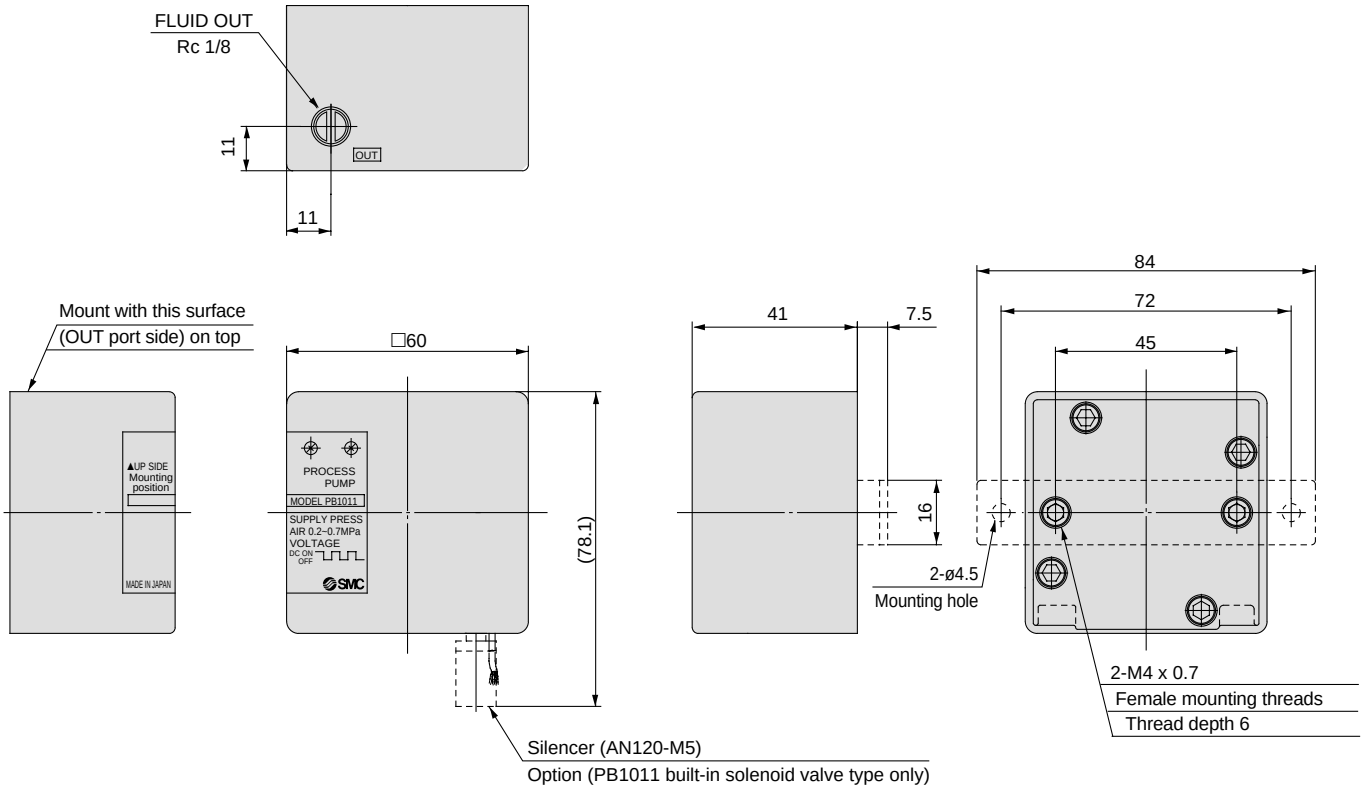
1. Connect air piping to the air supply port SUP, and connect piping for the transfer fluid to the suction port IN and the discharge port OUT.
2. Connect the solenoid valve lead wires to a 24VDC power supply. Red is (+) and Black is (–). (The PB1013 air operated type must be equipped with a separate solenoid valve.)
3. Using a regulator, set the pilot air pressure within the range of 0.2 to 0.7MPa. By continuously turning the 24VDC power ON/OFF the fluid flows from the suction port IN to the discharge port OUT. The pump performs suction with its own power even without priming.
4. To stop the pump turn OFF the 24VDC power. Also be sure to turn OFF the power when the discharge side is closed. The manual override pin is used for manual operation when there is no electric power. Each time it is pressed, there is one reciprocal operation.

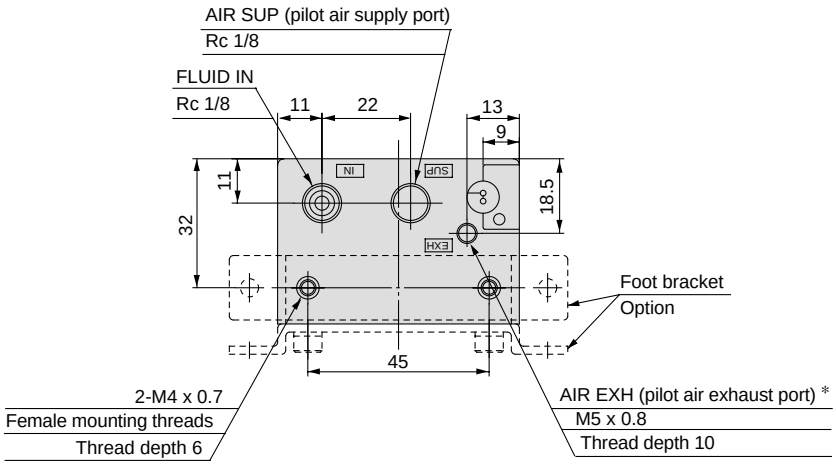
Circuit example/Built-in solenoid valve



Dimensions/Built-in Solenoid Valve Type/Air Operated Type

PB1000





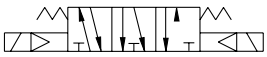
* The PB1013 air operated type has a plug.

Related Products

Related Products (Refer to the individual product catalogs for further details.)

5 port solenoid valve
VQZ14□0/24□0
(exhaust center)

Symbol



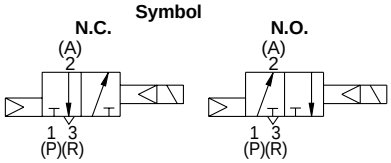
Specifications

Model	VQZ1420	VQZ1440	VQZ2420	VQZ2440
Piping	Body ported		Base mounted	
Valve construction	Metal seal			
Type of actuation	3 position exhaust center			
Maximum operating pressure	0.7MPa (high pressure type 1.0MPa)			
Minimum operating pressure	0.1MPa			
Effective area (Cv factor)	2.7 (0.15)	8.1 (0.45)	3.6 (0.2)	10.0 (0.55)
Maximum operating frequency	10Hz			

Refer to Best Pneumatics (1) Page 1.12-1

3 port solenoid valve
SYJ3□4

Symbol



Specifications

Model	SYJ314	SYJ324
Piping	Base mounted	
Valve construction	Rubber seal	
Type of actuation	N.C.	N.O.
Maximum operating pressure	0.7MPa	
Minimum operating pressure	0.15MPa	
Effective area (Cv factor)	1.8 (0.1)	
Maximum operating frequency	10HZ	

Refer to Best Pneumatics (1) Page 2.2-1

Mist Separator
Series AM

Series AM separates and removes the oil mist in compressed air which is troublesome for ordinary filters, and removes fine particles of rust and carbon, etc., of 0.3μm or larger. Should be used as the air supply for driving pilot type and metal type solenoid valves.

Models

Model	AM150	AM250
Rated flow rate //min (ANR)	300	750
Port size (nominal size B)	1/8, 1/4, 3/8	1/4, 3/8, 1/2
Weight (kg)	0.38	0.55

Specifications

Fluid	Compressed air
Maximum operating pressure	1.0MPa
Min. operating pressure Note 1)	0.05MPa
Proof pressure	1.5MPa
Ambient and fluid temperature	5 to 60°C
Filtration degree	0.3μm (95% filtered particle diameter)
Downstream oil mist concentration	Max.1.0mg/m³ (ANR) (approx. 0.8ppm) Note 2)
Element life	2 years, or when pressure drop reaches 0.1MPa

Note 1) With auto drain is 0.15MPa
Note 2) When compressor discharge oil mist concentration is 30mg/m³ (ANR)

Filter Regulator + Mist Separator
Air Combination
Series AC2040/3040

Models

Model		AC2040	AC3040
Component devices	Filter regulator	AW2000	AW3000
	Mist separator	AFM2000	AFM3000
Port size Rc		1/8 1/4	1/4 3/8
Pressure gauge port size Rc		1/8	1/8

Specifications

Model	AC2040	AC3040	AC4040	AC4040-06
Proof pressure	1.5MPa			
Maximum operating pressure	1.0MPa			
Minimum operating pressure	0.05MPa			
Regulating pressure range	0.05 to 0.85MPa			
Rated flow rate //min (ANR) Note 1)	150	330	800	800
Ambient and fluid temperature	– 5 to 60°C (with no freezing)			
Filtration degree	AW: 5μm, AFM: 0.3μm (95% filtered particle diameter)			
Downstream oil mist concentration	Max 1.0mgf/Nm³ (approx. 0.8ppm) Note 2)			
Case material	Polycarbonate			
Construction/Filter regulator	Relief type			
Weight (kg)	0.63	0.97	1.91	1.99

Note 1) Conditions: Upstream pressure 0.7MPa, Set pressure 0.5MPa
The rated flow rate varies depending on the set pressure.
Note 2) When compressor discharge concentration is 30mg/Nm³

Drain Catch
Series AMG

The AMG series is installed in air pressure lines to remove water droplets from compressed air. Use it when you want to remove water but air as dry as that from an air dryer is not necessary, or when a power supply for an air dryer is not available, etc.

Models

Model	AMG150	AMG250
Rated flow rate Note) //min (ANR)	300	750
Port size (nominal size B)	1/8, 1/4, 3/8	1/4, 3/8, 1/2
Weight (kg)	0.38	0.55

Note) Maximum flow rate at pressure 0.7MPa

Specifications

Fluid	Compressed air
Maximum operating pressure	1.0MPa
Min. operating pressure Note)	0.05MPa
Proof pressure	1.5MPa
Ambient and fluid temperature	5 to 60°C
Dehumidification rate	99%
Element life	2 years, or when pressure drop reaches 0.1MPa

Note) With auto drain is 0.15MPa

Related Products (Refer to the individual product catalogs for further details.)

Membrane Dyer
Series IDG

Macromolecular membrane dryers that act like filters

Standard specifications/Single style (standard dew point –20°C)

Model		Standard dew point –20°C				
		IDG5	**IDG10**	**IDG20**	**IDG30**	**IDG50**
Range of operating conditions	Fluid	Compressed air				
	Inlet air pressure MPa	0.3 to 0.85			0.3 to 1.0	
	Inlet air temperature °C Note 1)	–5 to 55			–5 to 50	
	Ambient temperature °C	–5 to 55			–5 to 50	
Standard performance	Outlet air atmospheric pressure dew point °C	–20				
Standard performance conditions	Inlet air flow rate //min (ANR) Note 2)	62	125	250	375	625
	Outlet air flow rate //min (ANR)	50	100	200	300	500
	Purge air flow rate //min (ANR) Note 3)	12	25	50	75	125
	Inlet air pressure MPa	0.7				
	Inlet air temperature °C	25				
	Inlet air saturation temperature °C	25				
	Ambient temperature °C	25				
Dew point indicator purge air flow rate		—	1//min (ANR) {inlet air pressure at 0.7MPa}			
Port size (nominal size B)		1/8, 1/4	1/4, 3/8			
Weight kg (with bracket)		0.25 (0.31)	0.43 (0.51)	0.66 (0.76)	0.74 (0.87)	0.77 (0.90)

Note 1) With no freezing

Note 2) ANR indicates the flow rate converted to the value for 20°C at atmospheric pressure.

Note 3) Includes dew point indicator purge air flow rate of 1//min (ANR) (inlet air pressure at 0.7MPa). (except IDG1, IDG5)

Maintenance Part Lists

PAX1000

Diaphragm kit (PTFE)	KT-PAX1-31
Check valve kit	KT-PAX1-36
Switching valve parts kit	KT-PAX1-37
Pilot valve kit	KT-PA5-38
Pulsation attenuator control valve kit	KT-PAX1-39

PB1000

Diaphragm kit	KT-PB1-2
Check valve kit	KT-PB1-1
Built-in solenoid valve kit	VJ314MY-5H

PA3000/Automatically operated type

Diaphragm kit (PTFE)	KT-PA3-31
Diaphragm kit (NBR)	KT-PA3-32
Check valve kit	KT-PA3-36
Switching valve assembly kit	KT-PA3-37
Pilot valve kit	KT-PA5-38

PA3000/Air operated type

Diaphragm kit (PTFE)	KT-PA3-31
Check valve kit	KT-PA3-36

PA5000/Automatically operated type

Diaphragm kit (PTFE)	KT-PA5-31
Diaphragm kit (NBR)	KT-PA5-32
Check valve kit	KT-PA5-36
Switching valve parts kit	KT-PA5-37
Pilot valve kit	KT-PA5-38

PA5000/Air operated type

Diaphragm kit (PTFE)	KT-PA5-31
Check valve kit	KT-PA5-36

Process Pump
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 a label of **"Caution", "Warning" or "Danger"**. To ensure safety, be sure to observe ISO4413 Note 1), ISO4414 Note 2), JISB8361 Note 3), JISB8370 Note 4), JISZ9102 Note 5) 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) ISO4413: Hydraulic fluid power-General rules for the application of equipment to transmission and control systems.
Note 2) ISO4414: Pneumatic fluid power – Recommendations for the application of equipment to transmission and control systems.
Note 3) JISB8361: General Rules for Hydraulic Systems
Note 4) JISB8370: General Rules for Pneumatic Systems
Note 5) JISZ9102: Piping identification markings

⚠ Warning

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

Since the products specified here are used in various operating conditions, their compatibility for the specific system must be based on specifications or after analysis and/or tests to meet your specific requirements. Be particularly careful in determining the compatibility of the fluid to be used.

2. Only trained personnel should operate machinery and equipment.

The fluid can be dangerous if handled incorrectly. Assembly, handling or repair of 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 after confirmation of measures to prevent danger from the fluid.
2. When equipment is to be removed, confirm the safety process as mentioned above and be certain there is no danger from fluid leakage or fluid remaining in the system.
3. Restart machinery carefully, confirming that there are no safety problems.

4. Contact SMC if the product is to be used in any of the following conditions:

1. Conditions or environments beyond the specifications given in the catalog and instruction manual.
2. With fluids whose application causes concern due to type or additives, etc.
3. Installation on equipment in conjunction with atomic energy, railway, air navigation, vehicles, medical equipment, food and beverages, recreation equipment, emergency stop circuits, press applications, or safety equipment.
4. An application which has the possibility of having negative effects on people, property, or animals, requiring special safety analysis.

Process Pump Common Precautions 1

Be sure to read before handling.
Refer to the main catalog sections for detailed precautions on each series.

Precautions on Design

⚠ Warning

1. Confirm the fluid to be used.

Be sure to confirm the specifications, as the fluids to be used differ depending on the product. When different fluids are used, characteristics change and this can cause faulty operation.

2. Fluid temperature

Use each model within its respective fluid temperature range.

3. Fluid quality

If fluid is used which contains foreign matter, troubles such as malfunction and seal failure may occur due to wearing of valve seats and sticking, etc. Install a suitable filter (strainer) immediately before the pump. As a general rule, mesh of about 80 to 100 can be used.

4. Be sure to observe the maximum operating pressure.

Operation above the maximum operating pressure can cause damage. In particular, avoid application of pressure above the specifications caused by water hammer.

<Example Pressure Reduction Measures>

a) Use a water hammer relief valve and slow the valve's closing speed.

b) Absorb impact pressure by using elastic piping material such as rubber, or an accumulator, etc.

5. Liquid seals

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

6. Quality of operating air

1. Use clean air.

   Do not use compressed air which contains chemicals, synthetic oils containing organic solvents, salts or corrosive gases, etc., as these can cause damage or malfunction.

2. Install an air filter.

   Install an air filter near valves on their upstream side. Choose a filtration degree of 5µm or finer. A mist separator (AM) is suitable.

3. Compressed air which includes a large amount of drainage can cause malfunction of valves and other pneumatic equipment. As a countermeasure, install and air dryer or after cooler, etc.

4. In situations where a large amount of carbon dust is generated, install a mist separator at the upstream side of valves to remove it. When a lot of carbon dust is generated from a compressor, it can adhere to the interior of valves and cause malfunction.

Refer to the SMC "Air Cleaning Equipment" catalog for details on air quality.

7. Ensure space for maintenance.

Be sure to allow the space required for maintenance activities.

8. Fluid properties

1. Do not use strong acids, strong bases or chemicals which can effect humans.

2. When inflammable fluids are transferred, give consideration to leakage during operation, and strictly prohibit flames. There is a danger of fire or explosion due to accidental leakage of the fluid.

⚠ Warning

9. Stopping the pump

1. Use a 3 port solenoid valve when starting or stopping an automatically operated type pump by means of pilot air. Do not use a 2 port solenoid valve. (In the case of a 2 port solenoid valve, the air pressure which remains after the solenoid valve closes is gradually consumed inside the process pump. This causes instability in the operating position of the pilot air switching unit, and it may become inoperable. Since the same kind of problem also occurs when the air supply pressure is gradually lost after operation is stopped, a 3 port solenoid valve should be used for stopping. When the unit will not be restarted, press the reset button.)

2. The solenoid valve used for the air operated type should be an exhaust center 5 port solenoid valve, or a combination of a residual pressure exhaust 3 port solenoid valve and a pump drive 4 port solenoid valve. (Refer to page 9.) If air in the drive chamber is not released when the pump is stopped, the diaphragm will be subjected to pressure and its life will be shortened. Make a selection after confirming the maximum operating frequency of a solenoid valve.

3. The air operated type can also be used for highly permeable fluids.

   In this case, since the exhaust contains gas from the fluid which permeates the diaphragm, employ measures to keep the exhaust from getting into the solenoid valve.

4. When an air operated pump is dry, operate the solenoid valve at a switching cycle of 1 to 7Hz. If operated outside of this range, the suction lifting height may be less than the rated value.

10. Other

1. Test the unit before using it in an actual equipment application. Furthermore, even if there is no problem in a short term test, there are cases in which trouble is caused by permeation through the fluororesin diaphragm to the air side.

2. Since the compatibility of fluids differs depending on type, additives, concentration and temperature, etc., give careful attention to the selection of materials.

3. When used with gases, the prescribed performance may not be achieved.

4. Do not operate for an extended time without liquid in the pump.

⚠ Caution

1. Use a design which prevents reverse pressure and reverse flow.

If reverse pressure or flow occurs, this can cause equipment damage or malfunction, etc. Give attention to safety measures, including the method of handling.

Process Pump Common Precautions 2

Be sure to read before handling.
Refer to the main catalog sections for detailed precautions on each series.

Selection

⚠ Warning

1. Confirm the specifications.

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

2. Type of fluid

Operate only after confirming the materials and applicable fluids for each model to determine which fluids can be used.

3. Equipment selection

When selecting equipment, make a selection from the latest catalog, staying within specified operating ranges, and carefully confirming the purpose of use, the required specifications and the operating conditions (pressure, flow rate, temperature, environment). In case of any unclear points, contact SMC in advance.

Mounting

⚠ Warning

1. Instruction manual

The product should be mounted after reading the manual carefully and having a good understanding of its contents. The manual should also be kept where it can be referred to whenever necessary.

2. Confirm the mounting position.

- Since the mounting position is different for each piece of equipment, this point should be confirmed either in this catalog or in the instruction manual.
- The mounting orientation is limited. (Refer to the cover photo.) Mount with the bottom (foot hole or mounting hole side) facing down.
- Since the reciprocal motion of the diaphragm propagates, the mounting bolts should be tightened securely. Furthermore, in cases where the propagation of vibration is not acceptable, insert vibro-isolating rubber when mounting.

3. Ensure sufficient maintenance space.

When installing and mounting, be sure to allow the space required for maintenance and inspections. Confirm the necessary maintenance space in the instruction manual for each piece of equipment.

4. Do not drop or bump.

Do not drop, bump or apply excessive impact (1000m/s²) when handling.

5. Never mount in a place which will be used as a scaffold during piping work.

Damage can be caused if subjected to an excessive load.

Piping

⚠ Caution

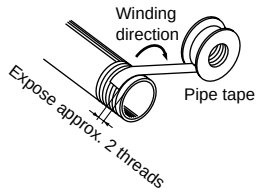
1. Preparation before piping

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.

2. Wrapping of pipe tape

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

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



3. Connection of piping to products

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

4. Always fasten threads with the proper tightening torque.

When screwing fittings into valves, fasten with the proper tightening torques as shown below.

PAX1000, PA3000, PA5000

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

PB1000

Connection threads	Proper tightening torque N·m
M5	1/6 turn after tightening by hand
Rc 1/8	2 to 3

Since the threaded sections of the PB1000 are resin, take particular care not to tighten any more than necessary.

Air Supply

⚠ Warning

1. Do not use compressed air which contains chemicals, organic solvents or corrosive gases.

Do not use compressed air containing chemicals, organic solvents, salt or corrosive gases, as this can cause damage and malfunction, etc.

2. Use within the operating pressure range.

The operating pressure range is determined by the equipment being used. Operation beyond this range can cause damage, failure or malfunction, etc.

Process Pump Common Precautions 3

Be sure to read before handling.
Refer to the main catalog sections for detailed precautions on each series.

Operating Environment

⚠ Warning

1. Do not use in the following environments, as this can cause failure.

1. Locations with an atmosphere of corrosive gases, organic solvents or chemical solutions, and where there may be contact with the same.
2. Locations where there is contact with sea spray, water or steam.
3. Locations which receive direct sunlight. (Sunlight should be blocked to prevent deterioration of resin from ultra violet rays and over heating, etc.)
4. Locations near heat sources with poor ventilation. (Heat sources should be blocked off, because radiated heat may cause damage due to softening of materials.)
5. Locations with impact or vibration.
6. Locations with high moisture and dust.

2. Adhere to the fluid and ambient temperature ranges.

The fluid and ambient temperatures are determined by the equipment being used. Operation beyond this range can cause damage, failure or malfunction, etc.

3. Employ suitable protective measures in locations where there is contact with water droplets, oil or welding spatter, etc.

⚠ Caution

1. Operating environment

- Do not allow corrosive fluids or solvents, etc., to come into contact with the outer surfaces of the pump.
- Do not use in water (or other liquid). Fluid may leak into the pilot switching valve and there may be corrosion of external parts, etc.

2. Low temperature operation

Do not allow freezing. Operation is possible down to an ambient temperature of 0°C, but do not allow solidification or freezing of drainage and moisture, etc.

3. Fluid leakage

- Take measures to deal with leakage. Fluid may leak when the pump is in operation due to aging of the diaphragm, etc. Take measures so that leakage in this type of situation will not have an adverse effect on equipment or personnel.
- Be careful not to touch fluid which has leaked. There is a danger of burns or other injury to the skin if hot fluids or chemicals, etc., are touched.

4. Perform periodic inspections to confirm normal operation.

- It may otherwise become impossible to assure safety in the event of unexpected malfunction or misoperation.

Maintenance

⚠ Warning

1. Shut off the compressed air if an abnormality occurs.

Stop the inflow of compressed air if there are abnormalities such as an unusual odor or sound.

2. Set the compressed air pressure to zero when performing maintenance.

In case of disassembly, first confirm that the pressure inside the pump is zero.

⚠ Caution

1. Do not step on or place heavy objects on the unit.

The equipment may be deformed or damaged, and if balance is lost, a fall may cause injury.

2. Discharge drainage regularly.

If drainage accumulates in equipment, in piping or other areas, this can cause malfunction of the equipment or unexpected trouble due to splash over into the downstream side, etc. Therefore, the amount of drainage and operation of auto drains should be checked every day.

3. Perform maintenance in accordance with the procedures in the instruction manual.

If handled improperly, this can cause damage or malfunction in machines and equipment, etc.

4. Perform demounting of the product in accordance with the procedures below.

1. Shut off the fluid supply and release the fluid pressure in the system.
2. In the case of the automatically operated type, shut off the air supply and exhaust the compressed air in the pilot piping.
3. Demount the product.

5. Transfer of dangerous fluids.

In case a dangerous fluid such as a strong acid or base is transferred by mistake, do not disassemble the product. There is a danger of serious injury if personnel come into contact with the remaining fluid.

Process Pump Common Precautions 4

Be sure to read before handling.
Refer to the main catalog sections for detailed precautions on each series.

Maintenance

⚠ Caution

6. Service life and replacement of consumable parts

- When the pump exceeds the number of service life cycles (∗), the diaphragm deteriorates and malfunction may occur. Furthermore, when the diaphragm is damaged by aging, the fluid escapes to the pilot air side, and it may become impossible to start the pump again. Using the number of service life cycles for reference, replace parts as soon as possible. Request maintenance parts (page 22) and replace them in accordance with the instruction manual.

∗Service life cycles/Discharge per cycle (reference)

Series	Diaphragm material		Discharge per cycle
	PTFE	NBR	
PA3000 automatically operated type	100 million cycles	50 million cycles	Approx. 40m/
PA5000 automatically operated type	50 million cycles	50 million cycles	Approx. 100m/
PA3000 air operated type	50 million cycles	—	Approx. 22m/
PA5000 air operated type	50 million cycles	—	Approx. 90m/
PAX1000 built-in attenuator type	50 million cycles	—	Approx. 21m/
PB1000 built-in solenoid valve type	20 million cycles	—	Approx. 4 to 5m/

These values are for pilot air pressure of 0.5MPa, ordinary temperatures, and fresh water, where 1 cycle is one reciprocal motion. This may be shorter depending on the type of fluid and operating conditions, etc.

• Calculation of diaphragm life

Example 1)
Discharge rate 5//min, when operating 8h/D (for PAX1000)

$$\frac{\text{Discharge rate}}{\text{Discharge per cycle}} = \frac{5}{0.021} = 238 \text{ (cycles/min) Cycles per minute}$$

$$\textbf{Service life} = \frac{\text{Reference life cycles}}{\text{Cycles per minute}} \times \frac{1}{60} \times \frac{1}{8 \text{ (daily operating time)}}$$

$$= \frac{50{,}000{,}000}{238} \times \frac{1}{60} \times \frac{1}{8}$$

$$= \textbf{437 days}$$

Example 2)
Discharge rate 5//min, when operating 8h/D (for PA3000 automatically operated type)

$$\frac{\text{Discharge rate}}{\text{Discharge per cycle}} = \frac{5}{0.040} = 125 \text{ (cycles/min) Cycles per minute}$$

$$\textbf{Service life} = \frac{\text{Reference life cycles}}{\text{Cycles per minute}} \times \frac{1}{60} \times \frac{1}{8 \text{ (daily operating time)}}$$

$$= \frac{100{,}000{,}000}{125} \times \frac{1}{60} \times \frac{1}{8}$$

$$= \textbf{1666 days}$$

Example 3)
Discharge rate 5//min, when operating 8h/D (for PA5000 automatically operated type)

$$\frac{\text{Discharge rate}}{\text{Discharge per cycle}} = \frac{5}{0.100} = 50 \text{ (cycles/min) Cycles per minute}$$

$$\textbf{Service life} = \frac{\text{Reference life cycles}}{\text{Cycles per minute}} \times \frac{1}{60} \times \frac{1}{8 \text{ (daily operating time)}}$$

$$= \frac{50{,}000{,}000}{50} \times \frac{1}{60} \times \frac{1}{8}$$

$$= \textbf{2083 days}$$

Lubrication

⚠ Caution

1. The pump does not require lubrication.

In the event that it is lubricated, use class 1 turbine oil (without additives), ISO VG32.

2. Do not lubricate the air operated type.

3. Filters and strainers

- Be careful regarding clogging of filters and strainers.
- Replace filter elements after one year of use, or earlier if the amount of pressure drop reaches 0.1MPa.
- Replace strainers when the amount of pressure drop reaches 0.1MPa.
- Flush drainage from air filters regularly.

4. Lubrication

If operated with lubrication, be sure to continue the lubrication.

5. Storage

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

Process Pump Common Precautions 5

Be sure to read before handling.
Refer to the main catalog sections for detailed precautions on each series.

Fluid Compatibility

⚠Caution

1. Select models by choosing liquid contact materials suitable for the liquids to be transferred.
   - In liquid contact areas, aluminum is suitable for use with oils, and stainless steel is suitable for solvents and industrial water.
   - For the diaphragm material, nitrile rubber is suitable with inert liquids, and fluororesin is suitable with non-permeating liquids.
   - Use fluids which will not corrode the liquid contact materials.
2. Transfer examples are shown below. Since the possible applications will change depending on operating conditions, be sure to confirm by means of experimentation.
3. These products are not suitable for use in medical applications or with food products.
4. Possible applications will change depending on additive agents. Take note of additives.
5. Possible applications will change depending on impurities. Take note of impurities.
6. Mixing of foreign substances will shorten service life. Operate with foreign substances removed.
7. When transferring liquids subject to coagulation, take measures to prevent coagulation inside the pump.

Fluid compatibility/Series PA3000/5000

Model		PA311 $^{0}_{3}$ PA511 $^{0}_{3}$	PA3120 PA5120	PA321 $^{0}_{3}$ PA521 $^{0}_{3}$	PA3220 PA5220
Body material		Aluminum (ADC12)		Stainless steel (SCS14)	
Diaphragm material		Fluororesin	Nitrile rubber	Fluororesin	Nitrile rubber
Examples of applicable liquids	Compatible liquids	Ethyl alcohol Toluene Cutting oil Brake fluid (High penetration liquids) *	Turbine oil	Methyl ethyl ketone Acetone, Flux Isopropyl alcohol Inert solvents (High penetration liquids) *	Industrial water Inert solvents
	Incompatible liquids	Cleaning solvents, Water, Acids, Bases High permeation liquids High penetration liquids Corrosive liquids	Cleaning solvents, Water, Solvents, Acids, Bases High permeation liquids High penetration liquids Corrosive liquids	Corrosive liquids Acids, Bases High permeation liquids High penetration liquids	Solvents Acids, Bases High permeation liquids High penetration liquids Corrosive liquids

* The air operated type can also be used for highly permeable liquids. In that case, since the exhaust air will include gas from the fluid which permeates the diaphragm, implement measures to keep the exhaust air from going into the solenoid valve side.

Fluid compatibility/Series PAX1000

Model		PAX1112	PAX1212
Body material		Aluminum (ADC12)	Stainless steel (SCS14)
Diaphragm material		Fluororesin	Fluororesin
Examples of applicable liquids	Compatible liquids	Ethyl alcohol Toluene Cutting oil Brake fluid	Methyl ethyl ketone Acetone Flux Isopropyl alcohol Inert solvents
	Incompatible liquids	Cleaning solvents, Water Acids, Bases High permeation liquids High penetration liquids Corrosive liquids	Corrosive liquids Acids, Bases High permeation liquids High penetration liquids

Fluid compatibility/Series PB1000

Model		PB1011	PB1013
Body material		Polypropylene (PP), Stainless steel (SUS316)	
Diaphragm material		Fluororesin	
Examples of applicable liquids	Compatible liquids	Tap water Detergents	Tap water Detergents Oils Ethyl alcohol Kerosene
	Incompatible liquids	Acids, Bases Thinners Flammable liquids	Acids, Bases Thinners

* Since the PB1011 has a built-in solenoid valve, it cannot be used for transfer of flammable fluids.

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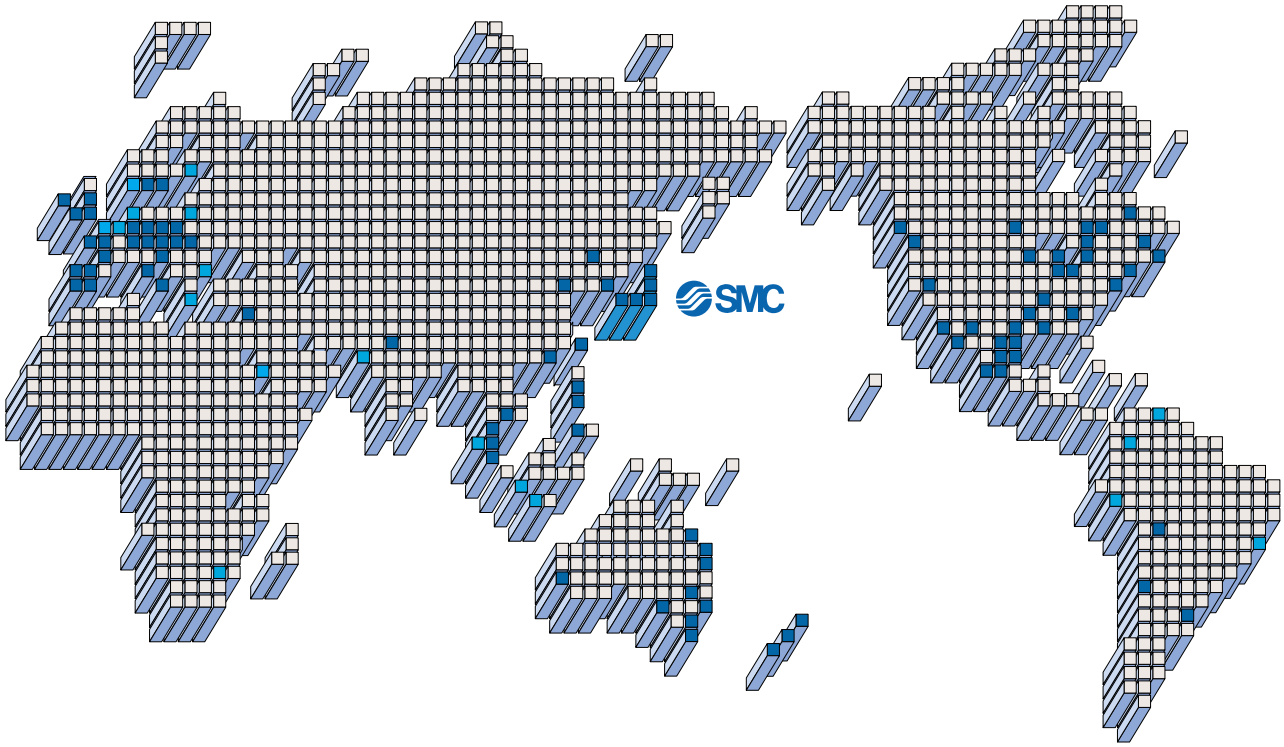

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