Process Pump

Series PA3000/5000

Automatically Operated Type (Internal Switching Type)/Air Operated Type (External Switching Type)

High abrasion resistance and low particle generation

No sliding parts in wetted areas.

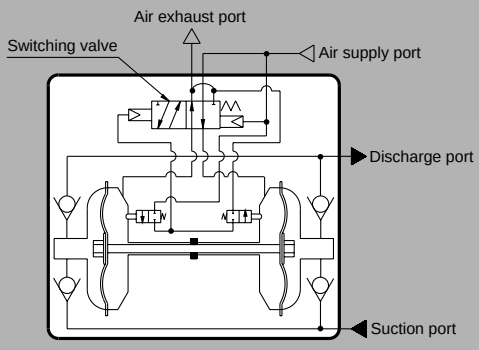
Self-priming makes priming unnecessary

Exhausts the air inside the suction pipe to suck up liquid.

Automatically operated type

Compatible with a wide variety of fluids

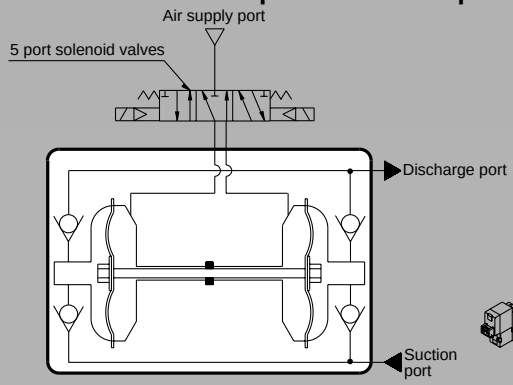
- **PA3000: Max. discharge rate 20 ℓ/min**
- **PA5000: Max. discharge rate 45 ℓ/min**

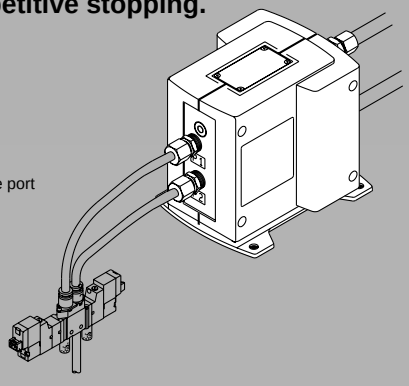


Air operated type

Control with external switching valve makes constant cycling possible

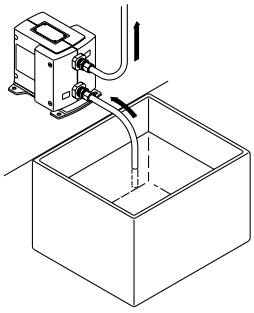
- **Easily control the discharge rate.**
  Easily adjust the flow with the external solenoid valve's ON/OFF cycle.
- **Easy to operate, even for minute flow, low press operation or operation involving air.**
- **Can be used for operation with repetitive stopping.**



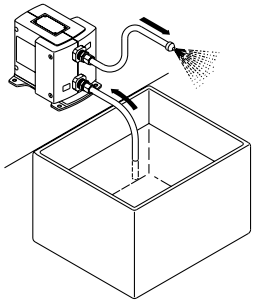


Application Example

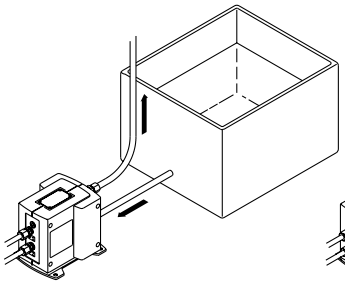
Transferring liquid by suction



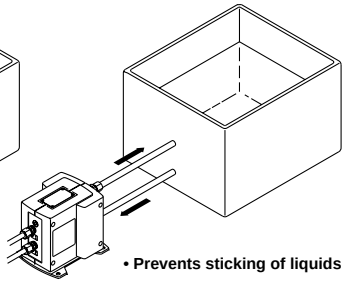
Atomizing liquid



Transferring liquid by pressure



Stirring liquid



- **Prevents sticking of liquids**

Process Pump
Automatically Operated Type (Internal Switching Type)
Air Operated Type (External Switching Type)
Series PA3000

How to Order

PA3000

PA 3 1 1 0 – □ 03 – □

Material of body wetted areas

Symbol	Material of body wetted areas
1	ADC12 (Aluminum)
2	SCS14 (Stainless steel)

Diaphragm material

Symbol	Diaphragm material	Applicable actuation	
		Automatically operated	Air operated
1	PTFE	●	●
2	NBR	●	—

Actuation

Symbol	Actuation
0	Automatically operated
3	Air operated

Thread type

Symbol	Type
Nil	Rc
N	NPT
F	G
T	NPTF

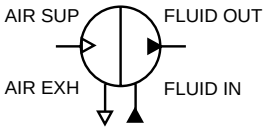
Port size

Symbol	Port size
03	3/8"

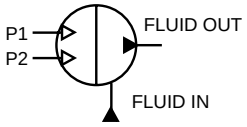
Option

Symbol	Option	Applicable actuation	
		Automatically operated	Air operated
Nil	Body only	●	●
N	With silencer	●	—

JIS Symbol



Automatically operated type



Air operated type

Specifications

Model		PA3110	PA3120	PA3210	PA3220	PA3113	PA3213
Actuation		Automatically operated				Air operated	
Port size	Main fluid suction discharge port	Rc, NPT, G, NPTF 3/8" Female thread					
	Pilot air supply/exhaust port	Rc, NPT, G, NPTF 1/4" Female thread					
Material	**Body wetted areas**	ADC12		SCS14		ADC12	SCS14
	Diaphragm	PTFE	NBR	PTFE	NBR	PTFE	
	Check valve	PTFE, PFA					
Discharge rate		1 to 20 ℓ/min				0.1 to 12 ℓ/min	
Average discharge pressure		0 to 0.6 MPa				0 to 0.4 MPa	
Pilot air pressure		0.2 to 0.7 MPa				0.1 to 0.5 MPa	
Air consumption		Max. 200 ℓ/min (ANR) or less				Max. 150 ℓ/min (ANR) or less	
Suction lifting range Note 1)	**Dry**	1 m (Interior of pump dry)					
	Wet	Up to 6 m (liquid inside pump)					
Noise		80 dB (A) or less (Option: with silencer, AN200)				72 dB (A) or less (excluding the noise from the quick exhaust and solenoid valve)	
Withstand pressure		1.05 MPa				0.75 MPa	
Diaphragm life		100 million times	50 million times	100 million times	50 million times	50 million times	
Fluid temperature		0 to 60°C (No freezing)					
Ambient temperature		0 to 60°C (No freezing)					
Recommended operating cycle		—				1 to 7 Hz (0.2 to 1 Hz also possible depending on conditions) Note 2)	
Pilot air solenoid valve recommended Cv factor Note 3)		—				0.20	
Mass		1.7 kg		2.2 kg		1.7 kg	2.2 kg
Mounting orientation		Horizontal (with mounting foot at bottom)					
Packaging		General environment					

∗ Each of the values above are for normal temperatures and when the transferred fluid is fresh water.
∗ Refer to page 727 for maintenance parts.
∗ For related products, refer to page 728 and 729.
Note 1) With cycles at 2 Hz or more
Note 2) After initial suction of liquid operating at 1 to 7 Hz, 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.

Made to Order

Made to order specifications
(For details, refer to pages 724 to 726)

Products complying with ATEX
With air operated reset port Note)
With operating cycle counting port Note)

Note) For automatically operated type only.

SMC

Process Pump
Automatically Operated Type (Internal Switching Type)
Air Operated Type (External Switching Type)
Series PA5000

How to Order

PA5000

PA 5 1 1 0 – □ 04 – □

Material of body wetted areas

Symbol	Material of body wetted areas
1	ADC12 (Aluminum)
2	SCS14 (Stainless steel)

Diaphragm material

Symbol	Diaphragm material	Applicable actuation	
		Automatically operated	Air operated
1	PTFE	●	●
2	NBR	●	—

Actuation

Symbol	Actuation
0	Automatically operated
3	Air operated

Thread type

Symbol	Type
Nil	Rc
N	NPT
F	G
T	NPTF

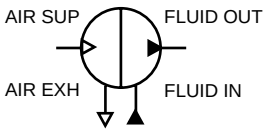
Port size

Symbol	Port size
04	1/2"
06	3/4"

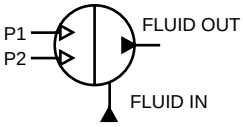
Option

Symbol	Option	Applicable actuation	
		Automatically operated	Air operated
Nil	Body only	●	●
N	With silencer	●	—

JIS Symbol



Automatically operated type



Air operated type

Made to order specifications
(For details, refer to pages 724 to 726)

Products complying with ATEX
With air operated reset port Note)
With operating cycle counting port Note)

Note) For automatically operated type only.

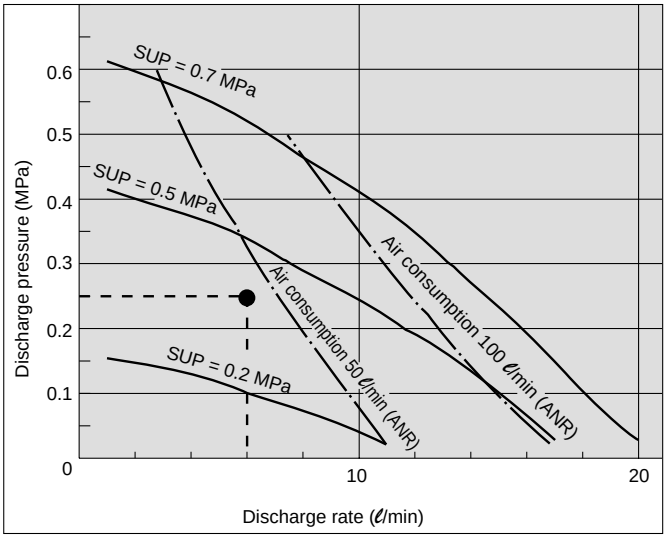
Specifications

Model		PA5110	PA5120	PA5210	PA5220	PA5113	PA5213
Actuation		Automatically operated				Air operated	
Port size	Main fluid suction discharge port	Rc, NPT, G, NPTF 1/2", 3/4" Female thread					
	Pilot air supply/exhaust port	Rc, NPT, G, NPTF 1/4" Female thread					
Material	**Body wetted areas**	ADC12		SCS14		ADC12	SCS14
	Diaphragm	PTFE	NBR	PTFE	NBR	PTFE	
	Check valve	PTFE, PFA					
Discharge rate		5 to 45 ℓ/min				1 to 24 ℓ/min	
Average discharge pressure		0 to 0.6 MPa				0 to 0.4 MPa	
Pilot air pressure		0.2 to 0.7 MPa				0.1 to 0.5 MPa	
Air consumption		Max. 300 ℓ/min (ANR) or less				Max. 250 ℓ/min (ANR) or less	
Suction lifting range Note 1)	**Dry**	Up to 2 m (Interior of pump dry)				Up to 0.5 m (Interior of pump dry)	
	Wet	Up to 6 m (Liquid inside pump)					
Noise		78 dB (A) or less (Option: with silencer, AN 200)				72 dB (A) or less (excluding the noise from the quick exhaust and solenoid valve)	
Withstand pressure		1.05 MPa				0.75 MPa	
Diaphragm life		50 million times					
Operating fluid temperature		0 to 60°C (No freezing)					
Ambient temperature		0 to 60°C (No freezing)					
Recommended operating cycle		—				1 to 7 Hz (0.2 to 1 Hz also possible depending on conditions) Note 2)	
Pilot air solenoid valve recommended Cv factor Note 3)		—				0.45	
Mass		3.5 kg		6.5 kg		3.5 kg	6.5 kg
Mounting orientation		Horizontal (with mounting foot at bottom)					
Packaging		General environment					

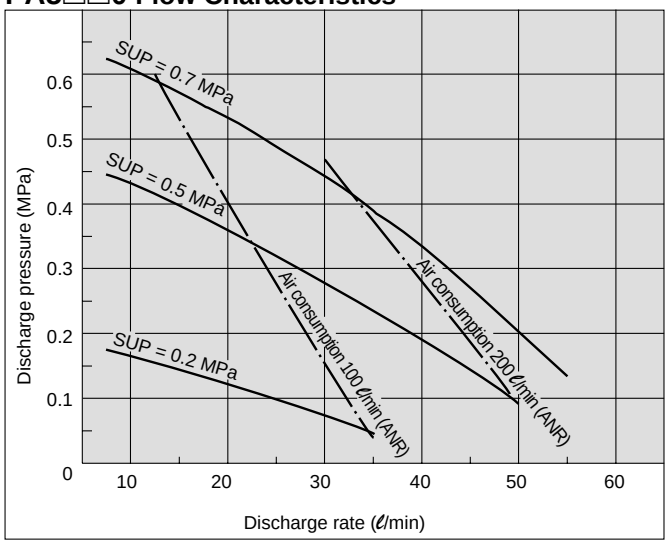
∗ Each of the values above are for normal temperatures and when the transferred fluid is fresh water.
∗ Refer to page 727 for maintenance parts.
∗ For related products, refer to page 728 and 729.
Note 1) With cycles at 2 Hz or more
Note 2) After initial suction of liquid operating at 1 to 7 Hz, it can 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.

Performance Curve: Automatically Operated Type

PA3□□0 Flow Characteristics



PA5□□0 Flow Characteristics



Selection from Flow Characteristic Graph (PA3□□0)

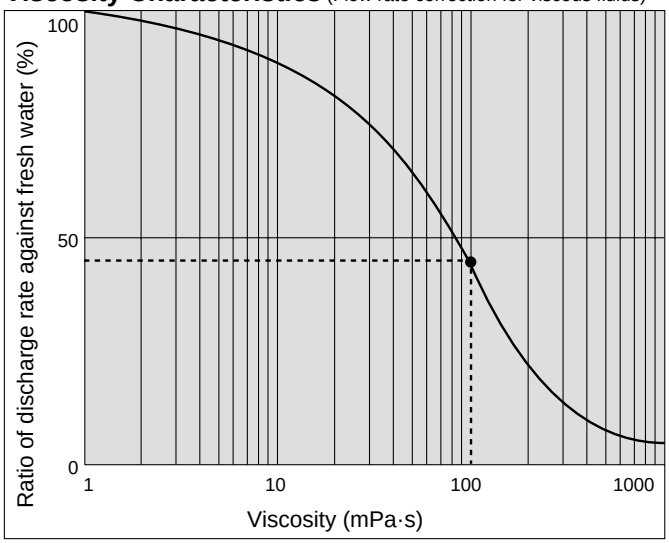
Required specifications example:
Find the pilot air pressure and pilot air consumption for a discharge rate of 6 ℓ/min and a discharge pressure of 0.25 MPa. <The transfer fluid is fresh water (viscosity 1 mPa·s, specific gravity 1.0).>
∗ If the total lifting height is required instead of the discharge pressure, a discharge pressure of 0.1 MPa corresponds to a total lift of 10 m.

Selection procedures:
1. First mark the intersection point for a discharge rate of 6 ℓ/min and a discharge pressure of 0.25 MPa.
2. Find the pilot air pressure for the marked point. In this case, the point is between the discharge curves (solid lines) for SUP = 0.2 MPa and SUP = 0.5 MPa, and based on the proportional relationship to these lines, the pilot air pressure for this point is approximately 0.38 MPa.
3. Next find the air consumption rate. Since the marked point is below the curve for 50 ℓ/min (ANR), the maximum rate will be about 50 ℓ/min (ANR).

⚠Caution

1. These flow characteristics are for fresh water (viscosity 1 mPa·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 0.75 kW per 100 ℓ/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 specifications example:
Find the pilot air pressure and pilot air consumption for a discharge rate of 2.7 ℓ/min, and a viscosity of 100 mPa·s.
Selection procedures:
1. First find the ratio of the discharge rate for fresh water when viscosity is 100 mPa·s from the graph below. It is determined to be 45%.
2. Next, in the required specification example, the viscosity is 100 mPa·s and the discharge rate is 2.7 ℓ/min. Since this is equivalent to 45% of the discharge rate for fresh water, 2.7 ℓ/min ÷ 0.45 = 6 ℓ/min, indicating that a discharge rate of 6 ℓ/min is required for fresh water.
3. Finally, find the pilot air pressure and pilot air consumption based on selection from the flow characteristic graphs.

⚠Caution

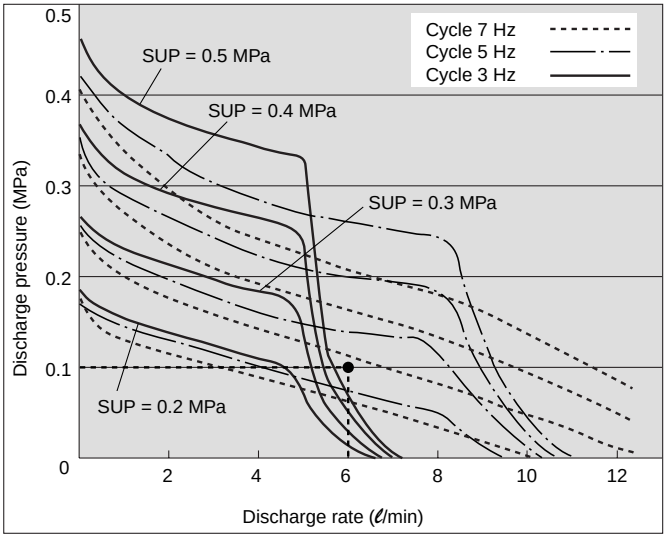
Viscosities up to 1000 mPa·s can be used.
Dynamic viscosity ν = Viscosity μ/Density ρ.

$$\nu = \frac{\mu}{\rho}$$

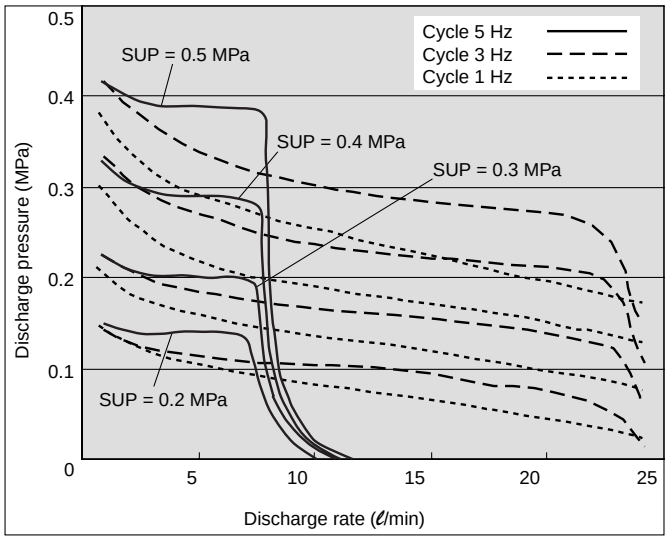
$\nu(10^{-3}\ m^2/s) = \mu(mPa{\cdot}s)/\rho(kg/m^3)$

Performance Curve: Air Operated Type

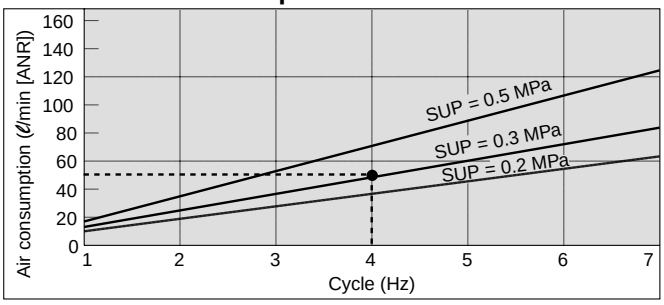
PA3□13 Flow Characteristics



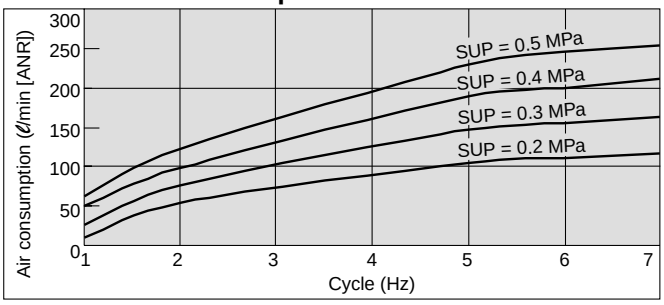
PA5□13 Flow Characteristics



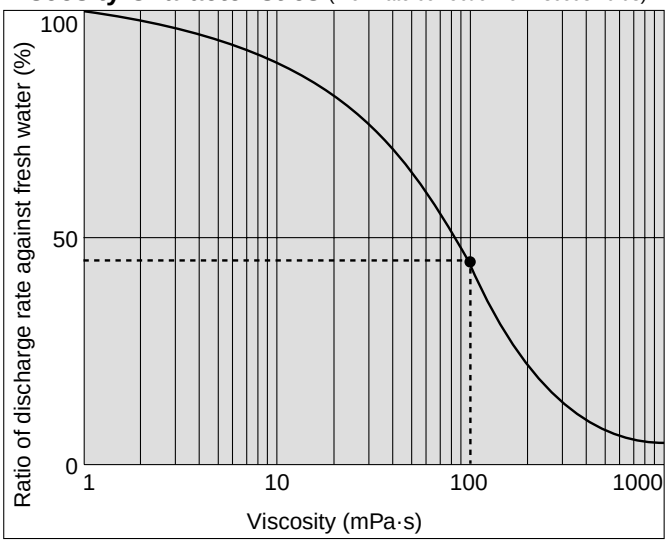
PA3□13 Air Consumption



PA5□13 Air Consumption



Viscosity Characteristics (Flow rate correction for viscous fluids)



Selection from Flow Characteristic Graph (PA3□13)

Required specification example: Find the pilot air pressure and pilot air consumption for a discharge rate of 6 ℓ/min. <The transfer fluid is fresh water (viscosity 1 mPa·s, specific gravity 1.0).>

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

Selection procedures:

1. First mark the intersection point for a discharge rate of 6 ℓ/min and a discharge pressure of 0.1 MPa.

2. Find the pilot air pressure for the marked point. In this case, the point is between the discharge curves (solid lines) for SUP = 0.2 MPa and SUP = 0.3 MPa, and based on the proportional relationship to these lines, the pilot air pressure for this point is approximately 0.25 MPa.

⚠Caution

1. These flow characteristics are for fresh water (viscosity 1 mPa·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).

Calculating Air Consumption (PA3□13)

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

Selection procedures:

1. Look up from the 4 Hz switching cycle to find the intersection with SUP = 0.3 MPa.

2. From the point just found, draw a line to the Y-axis to find the air consumption. The result is approximately 50 ℓ/min (ANR).

Selection from Viscosity Characteristic Graph

Required specification example: Find the pilot air pressure and pilot air consumption for a discharge rate of 2.7 ℓ/min, and a viscosity of 100 mPa·s.

Selection procedures:

1. First find the ratio of the discharge rate for fresh water when viscosity is 100 mPa·s from the graph below. It is determined to be 45%.

2. Next, in the required specification example, the viscosity is 100m Pa·s and the discharge rate is 2.7 ℓ/min. Since this is equivalent to 45% of the discharge rate for fresh water, 2.7 ℓ/min ÷ 0.45 = 6 ℓ/min, indicating that a discharge rate of 6 ℓ/min is required for fresh water.

3. Finally, find the pilot air pressure and pilot air consumption based on selection from the flow characteristic graphs.

⚠Caution

Viscosities up to 1000 mPa·s can be used.

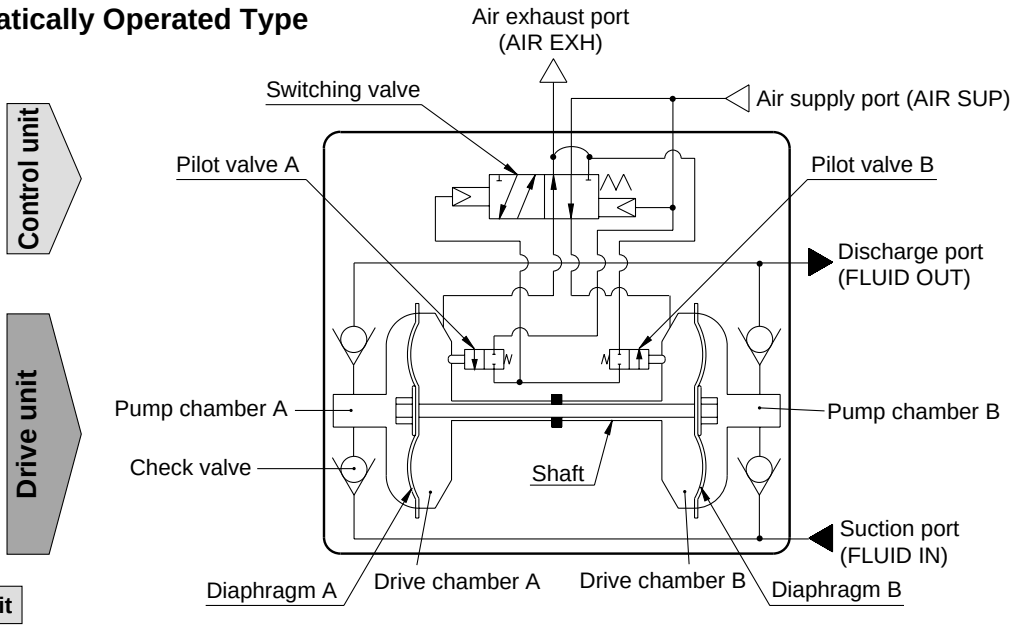
Dynamic viscosity ν = Viscosity μ/Density ρ.

$$\nu = \frac{\mu}{\rho}$$

$\nu(10^{-3}\ m^2/s) = \mu(mPa{\cdot}s)/\rho(kg/m^3)$

Working Principle

Automatically Operated Type



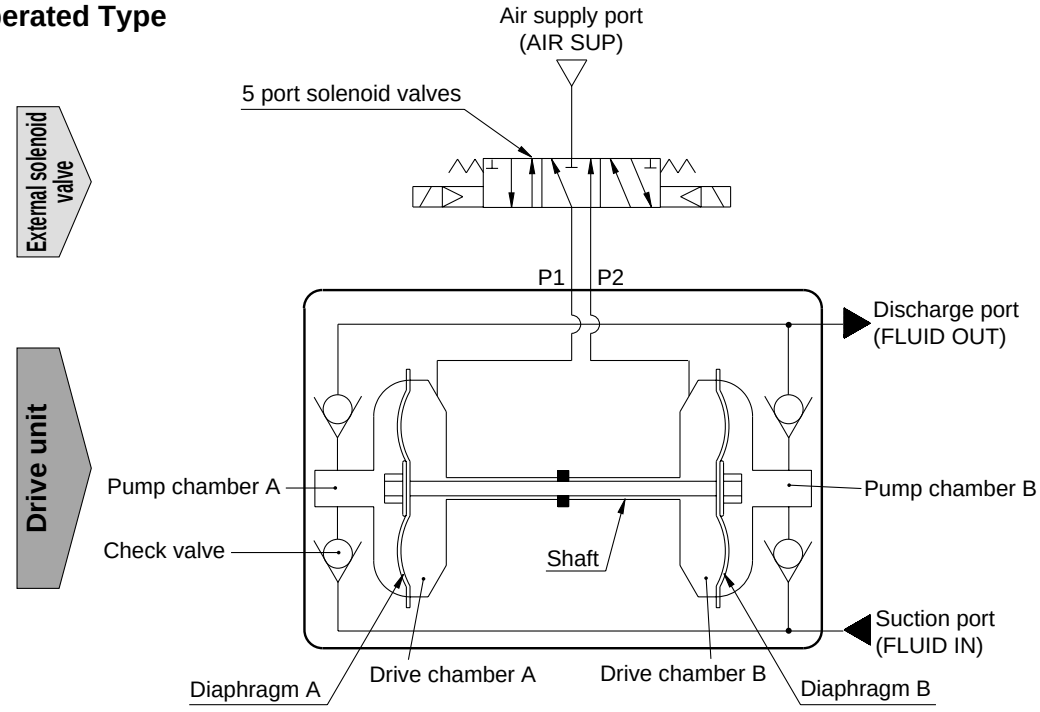
Control unit

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.

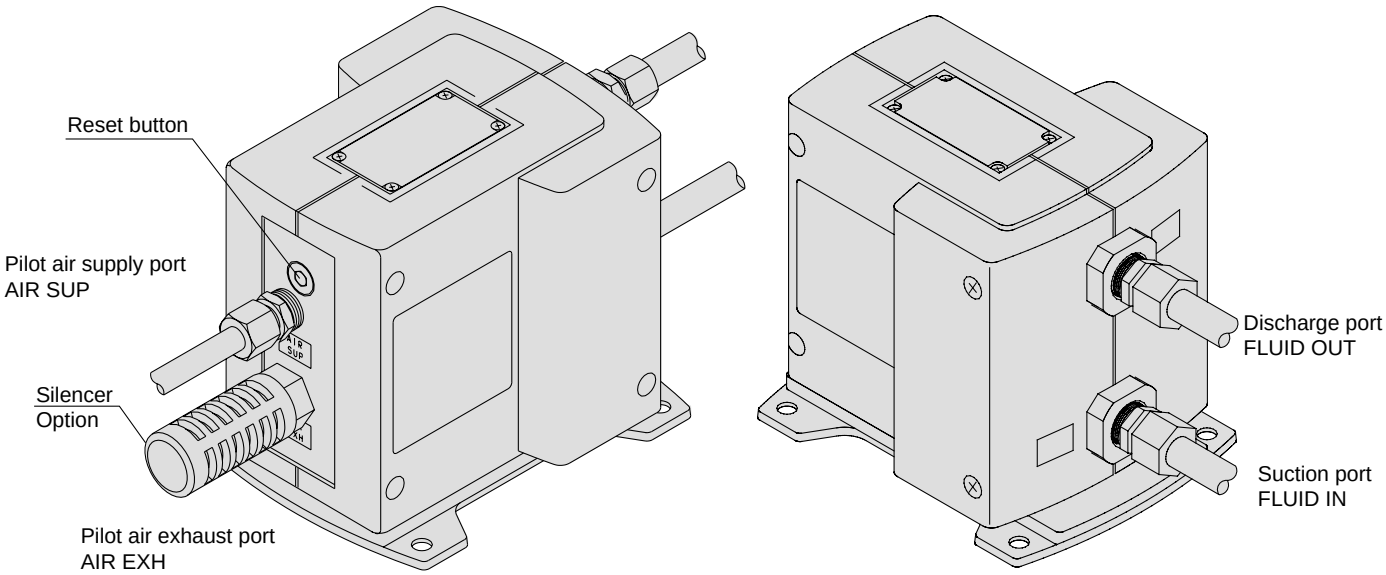
Air Operated Type



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: Automatically Operated Type

Piping diagram



⚠ Caution

Mounting posture of the pump is set with the mounting bracket facing downward. Air to be supplied to the air supply port <AIR SUP> should be cleaned and filtered through AF filter, etc. Air with foreign matter or drainage etc. will have negative effects on the built-in solenoid valve and will lead to malfunction. When air needs additional purification, use a filter (Series AF), and a mist separator (Series AM) together.

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 transfered 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 0.7 MPa. 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. 1 m) 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>

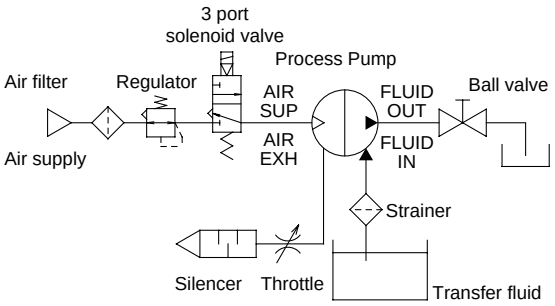
1. Adjustment of the flow rate from the discharge port <FLUID OUT> is performed with the ball valve connected on the discharge side or the throttle connected on the air exhaust side. For adjustment from the air side, use of the silencer with throttle ASN2 (port size 1/4) connected to the air exhaust 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 1 ℓ/min, PA5000 5 ℓ/min)

<Reset Button>

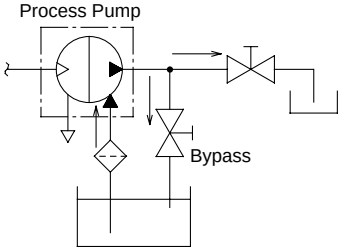
When the pump stops during operation, press the reset button. This makes it possible to restore operation in case the switching valve becomes clogged due to foreign matter in the supply air.

Circuit example (1)



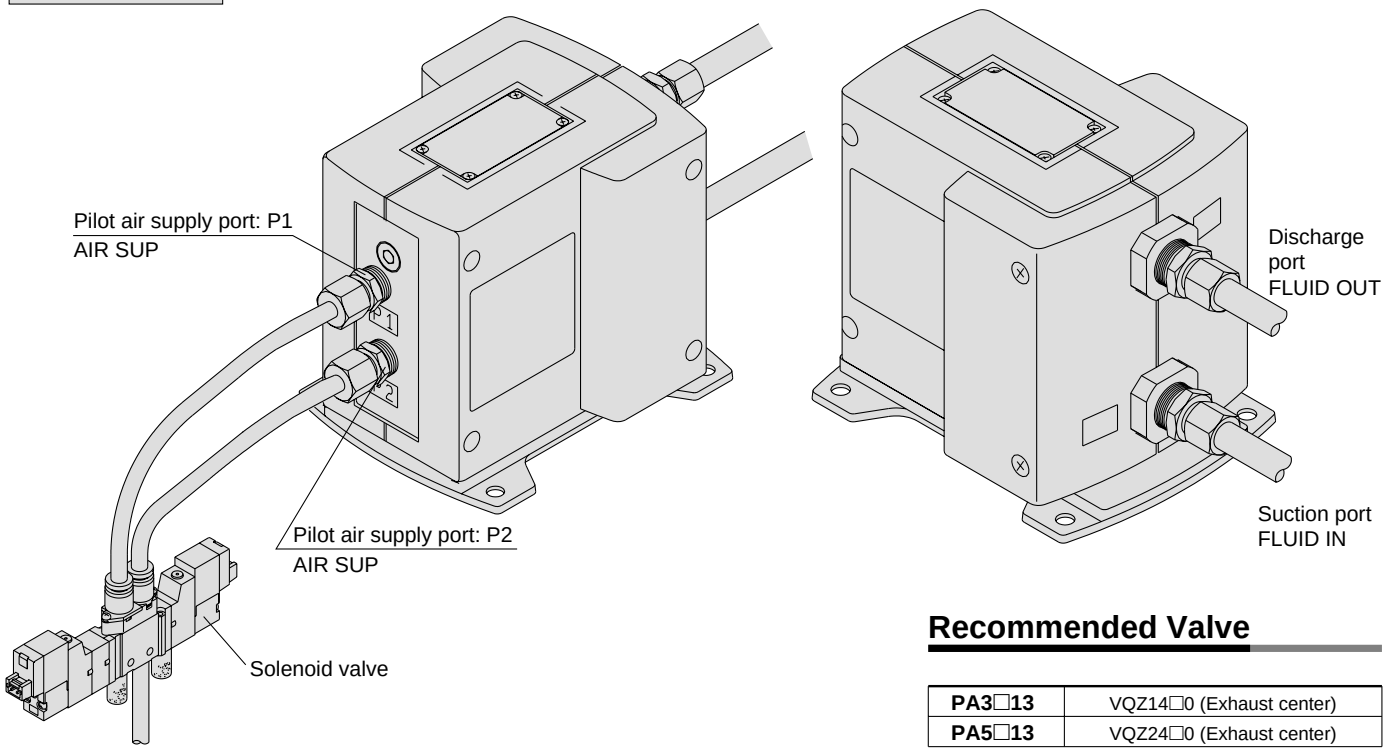
Circuit example (2)

For related products, refer to page 728 and 729.



Piping and Operation: Air Operated Type

Piping diagram



Recommended Valve

PA3□13	VQZ14□0 (Exhaust center)
PA5□13	VQZ24□0 (Exhaust center)

⚠ 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 port <P1>, <P2> and connect piping for the fluid to be transfered 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 0.5 MPa. 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. (Dry state suction lifting range: PA3 1 m, PA5 up to 0.5 m Note 3)) 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.

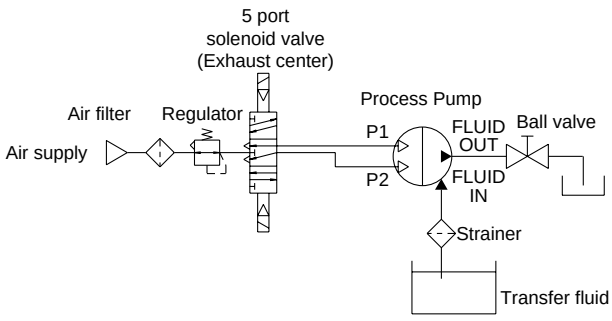
Note 2) For the solenoid valve, use an exhaust center 5 port valve, or a combination of residual exhaust 3 port valve and a pump drive 4 port valve. If air in the drive chamber is not released when the pump is stopped, the diaphragm will be subjected to pressure and its life will be shortened.

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

<Discharge Flow Rate Adjustment>

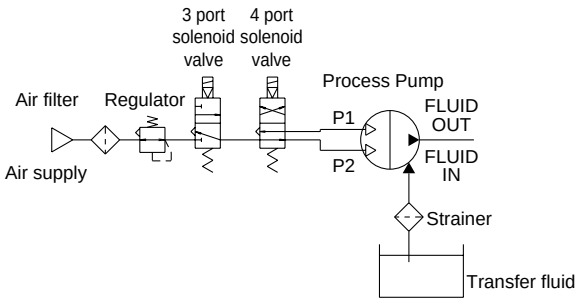
1. The flow rate from the discharge port <FLUID OUT> can be adjusted easily by changing the switching cycle of the solenoid valve on the air supply port.

Circuit example (1)



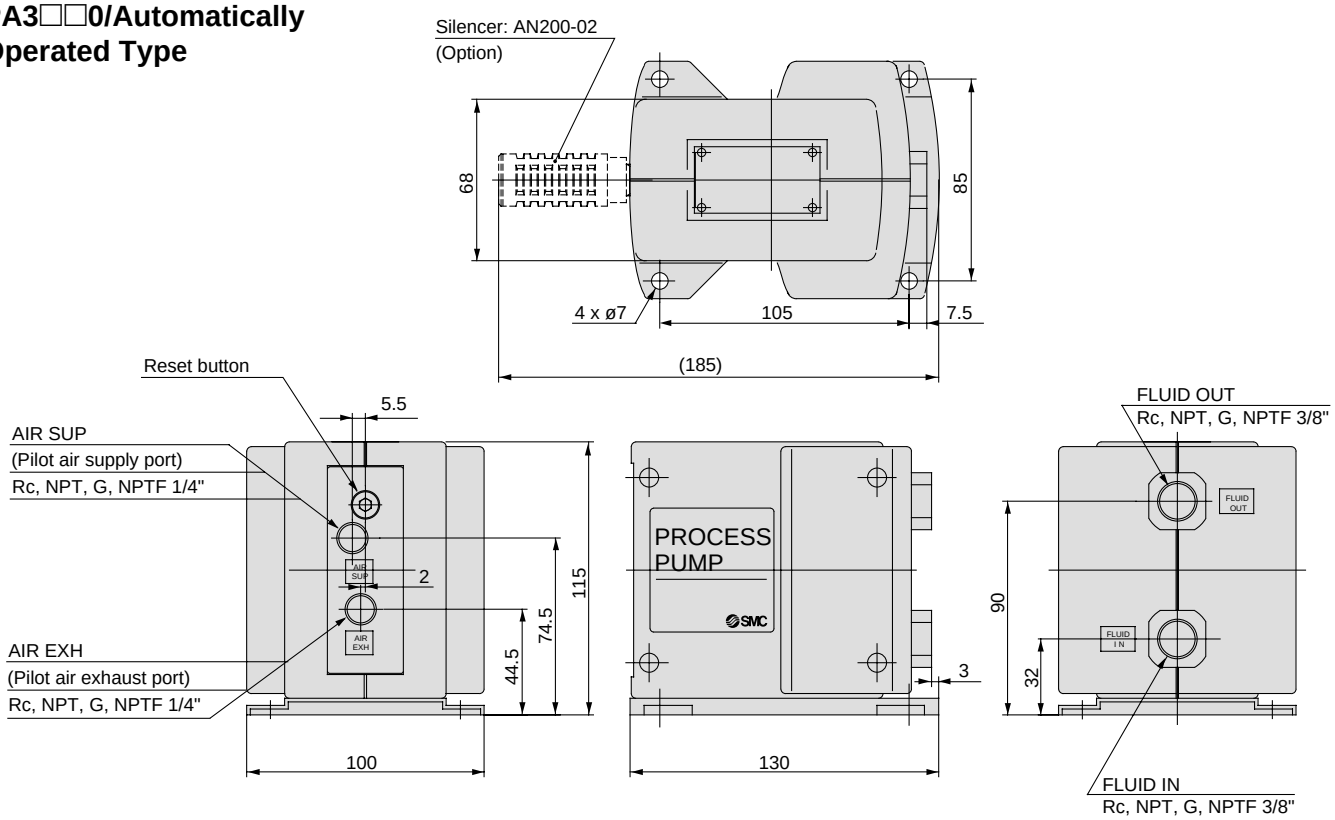
Circuit example (2)

For related products, refer to page 728 and 729.

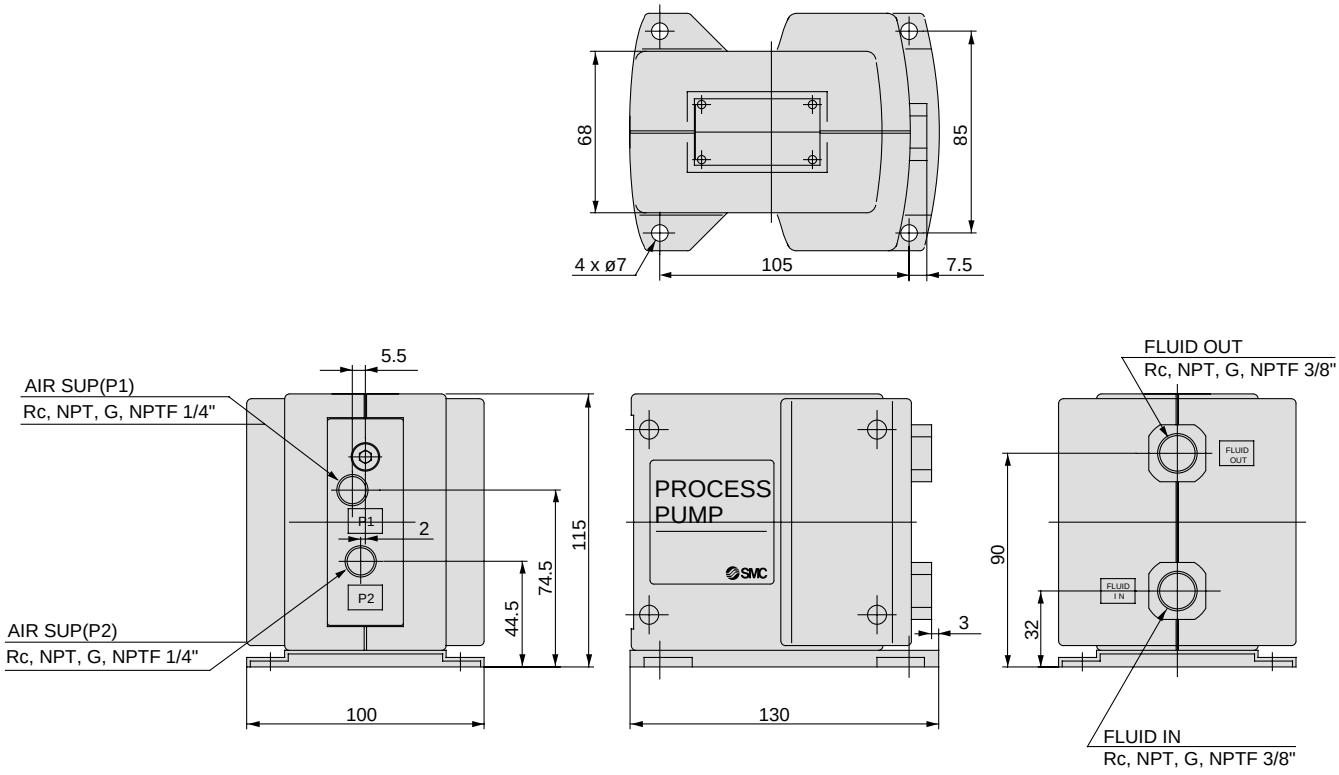


Dimensions

PA3□□0/Automatically Operated Type

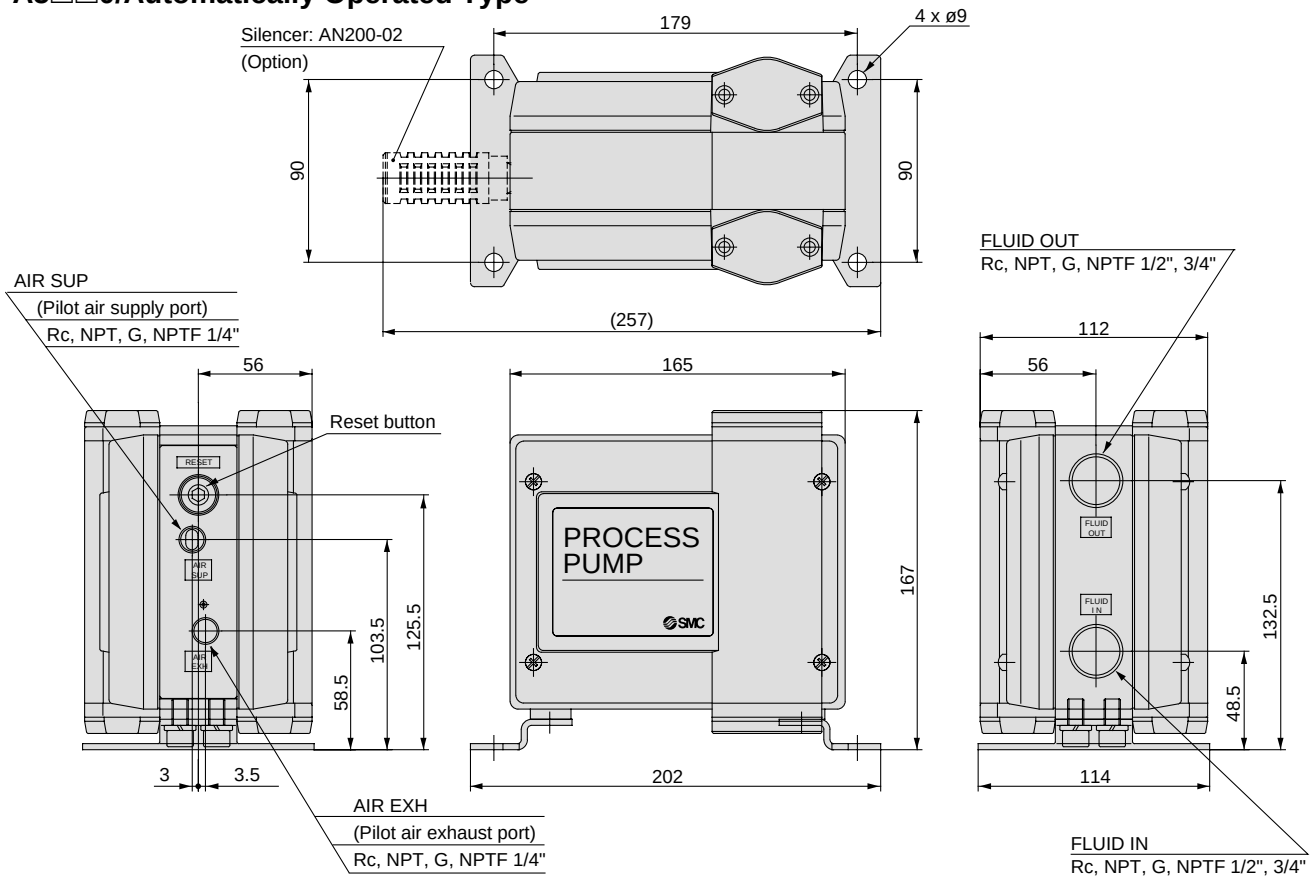


PA3□13/Air Operated Type

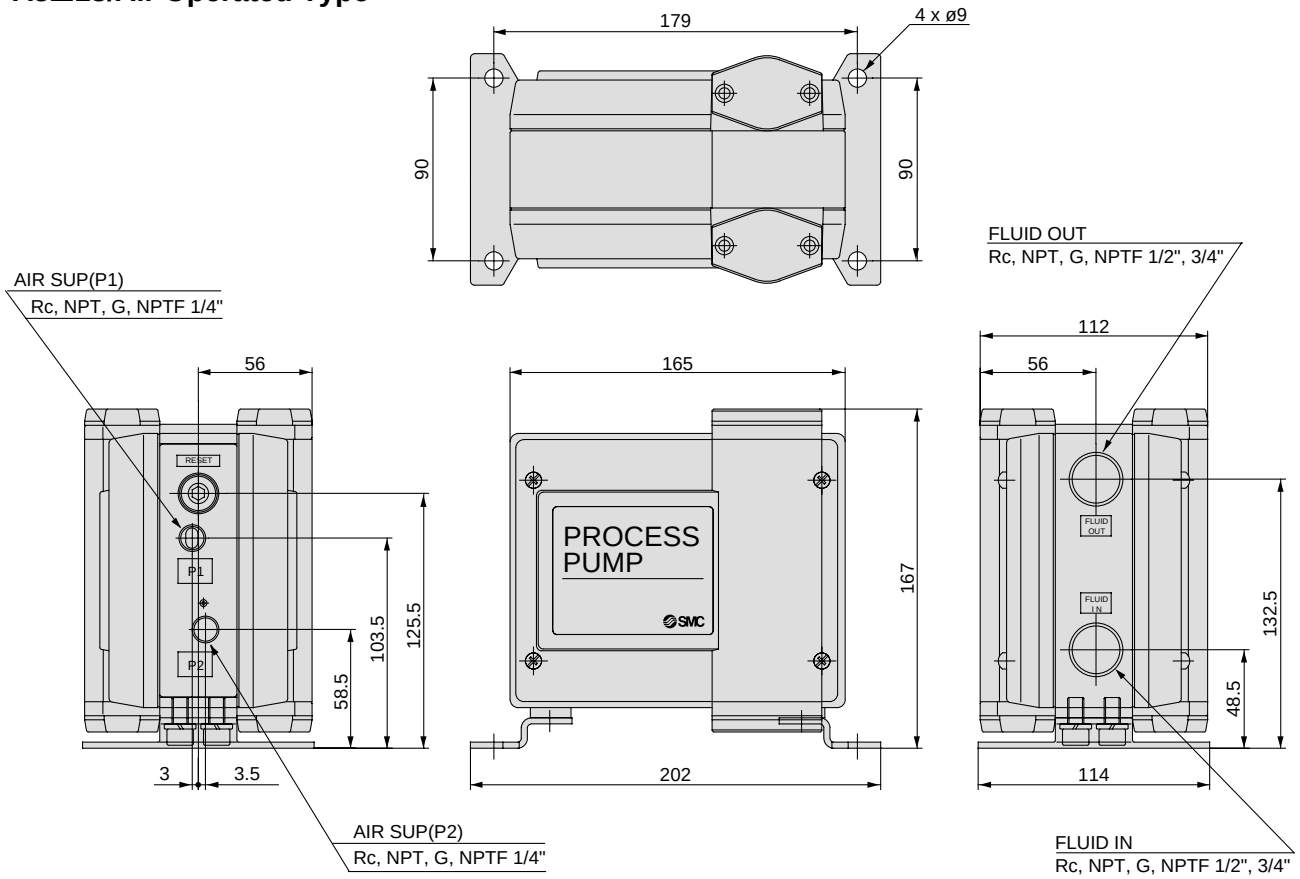


Dimensions

PA5□□0/Automatically Operated Type



PA5□13/Air Operated Type

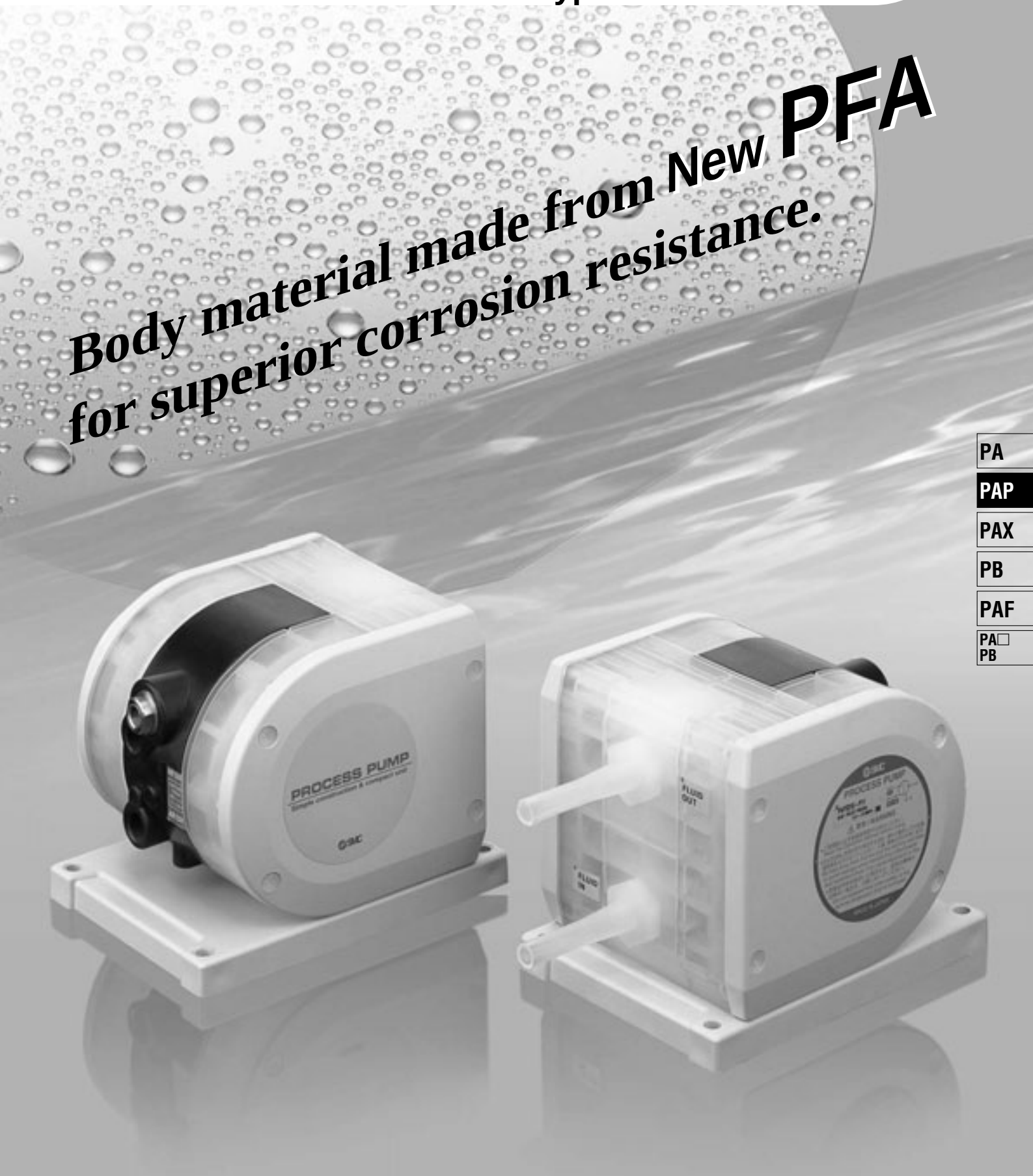


Process Pump

Series PAP3000

Fluororesin Type

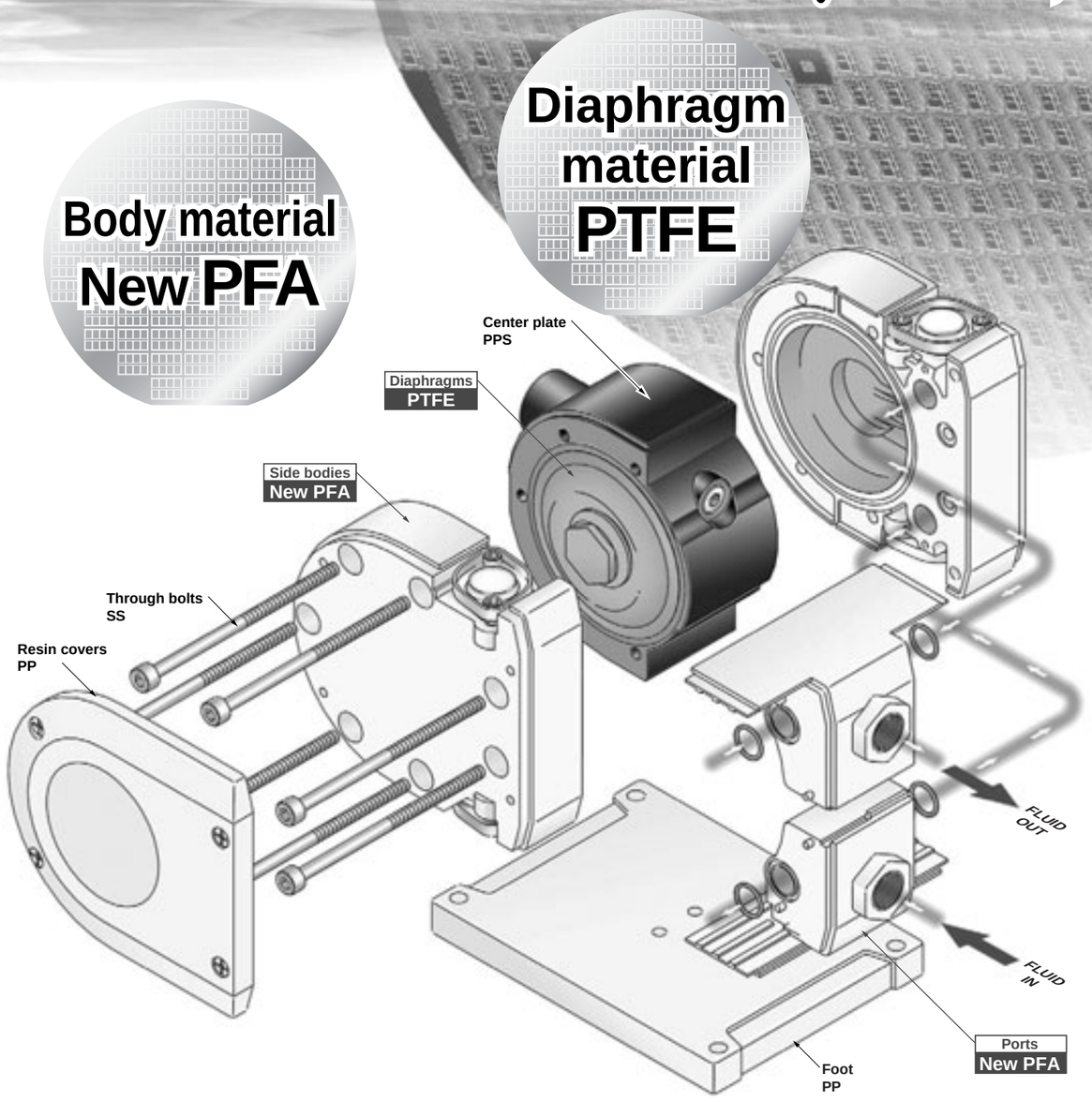
Body material made from New PFA for superior corrosion resistance.

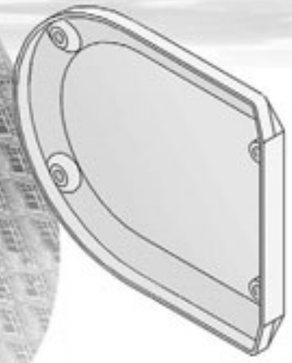


With the use of New PFA for body material, high corrosion resistance is achieved!

Body material
New PFA

Diaphragm material
PTFE





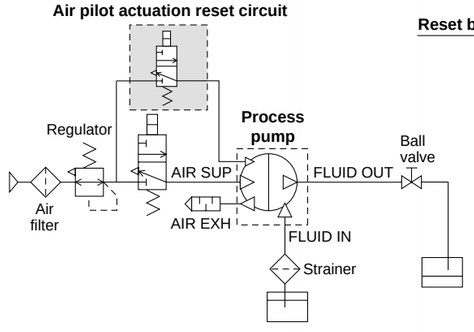
Clean

You can order your process pump assembled in a **Clean room** environment and double-packaged (Order number PAP331□).
Side bodies and ports are **molded** to achieve a great reduction in dust generation.

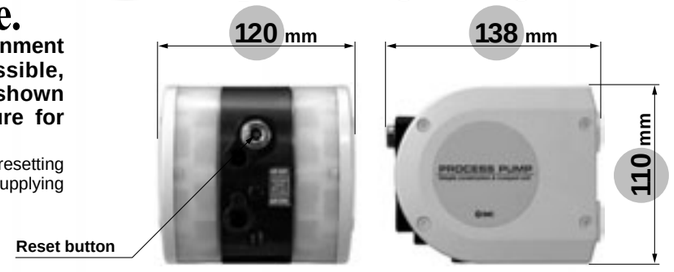
Air pilot actuation reset is now a standard feature.

When the pump is used in an environment where manual reset is not possible, designing a circuit as the one shown below allows the use of air pressure for reset purposes.
With the use of an air pilot actuation reset circuit, resetting can be done by releasing the air pressure after supplying it to the reset port.

Air pilot actuation reset circuit



Compact & Light weight (Without foot)

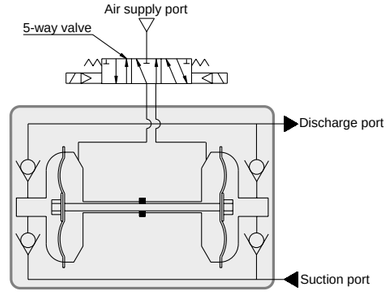


Mass: 21 kg

Air pilot actuation is standard.

External switching valve control makes constant cycling possible.

- **Discharge rate is easily controlled.**
  The flow rate can be easily adjusted by the number of ON/OFF cycles of the external solenoid valve.
- **Stable operation is possible in spite of such conditions as a minimal flow rate, low pressure operation, or the entrainment of gasses.**
- **Can be used for operation with repetitive stopping.**



Variations

Model		Body material	Diaphragm material	Assembly environment	Discharge rate (ℓ/min)	Option
Automatically operated type	PA3310	New PFA	PTFE	Standard	1 to 13*	•Foot •Silencer
	PAP3310			Clean room		
Air pilot operated type	PA3313			Standard	0.1 to 9	•Foot
	PAP3313			Clean room		

*With 3/8" inlet/outlet tube:1 to 12

Process Pump Clean Room
Automatically Operated Type (Internal Switching Type)
Air Operated Type (External Switching Type)
Series PAP3000

How to Order

Female thread PA P 331 0 – □ 03 – □

Actuation Note 1)

Symbol	Actuation
0	Automatically operated
3	Air operated

Assembly environment

Symbol	Assembly environment
P	Clean room

Thread type Note 2)

Symbol	Type
Nil	Rc
N	NPT
F	G
T	NPTF

Port size

Symbol	Port size
03	3/8"

Option

Symbol	Option	Applicable actuation	
		Automatically operated	Air operated
Nil	None	●	●
B	With foot	●	●
N	With silencer	●	—

∗ When option is more than one, suffix in alphabetical order.

Tube extension PA P 331 0 – P 13 □ – □

Actuation Note 1)

Symbol	Actuation
0	Automatically operated
3	Air operated

Assembly environment

Symbol	Assembly environment
P	Clean room

Tubing size

Symbol	Main fluid connection size
11	3/8"
13	1/2"

Thread type Note 2)

Symbol	Type
Nil	Rc
N	NPT
F	G
T	NPTF

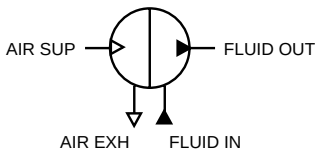
Option

Symbol	Option	Applicable actuation	
		Automatically operated	Air operated
Nil	None	●	●
B	With foot	●	●
N	With silencer	●	—

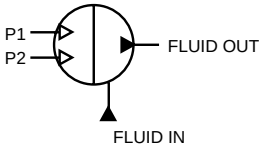
∗ When option is more than one, suffix in alphabetical order.

Note 1) The port size of the pilot port is 1/4".
Note 2) The thread type is applied to the pilot port thread and the female thread piping connection.

Symbol



Automatically operated type



Air operated type

With nut

PA P 331 0 S − 1 S 13 □ − □

Assembly environment

Symbol	Assembly environment
P	Clean room

Actuation Note 1)

Symbol	Actuation
0	Automatically operated
3	Air operated

Fitting type

Symbol	Fitting type
1	LQ1
2	LQ2

Fitting size

Symbol	IN side	OUT side
11	3	3
1113	3	4
1311	4	3
13	4	4
1319	4	5
1913	5	4
19	5	5

Thread type Note 2)

Symbol	Type
Nil	Rc
N	NPT
F	G
T	NPTF

Option

Symbol	Option	Applicable actuation	
		Automatically operated	Air operated
Nil	None	●	●
B	With foot	●	●
N	With silencer	●	—

∗ When option is more than one, suffix in alphabetical order.

Integral fitting type

PA P 331 0 − S 13 □ − □

Assembly environment

Symbol	Assembly environment
P	Clean room

Actuation Note 1)

Symbol	Actuation
0	Automatically operated
3	Air operated

Fitting size

Symbol	Fitting size
11	LQ2 3/8"
13	LQ2 1/2"

Thread type Note 2)

Symbol	Type
Nil	Rc
N	NPT
F	G
T	NPTF

Option

Symbol	Option	Applicable actuation	
		Automatically operated	Air operated
Nil	None	●	●
B	With foot	●	●
N	With silencer	●	—

∗ When option is more than one, suffix in alphabetical order.

Note 1) The port size of the pilot port is 1/4".
Note 2) The thread type is applied to the pilot port thread and the female thread piping connection.
Note 3) Refer to the pamphlet "High-Purity Fluoropolymer Fittings HYPER FITTING®/Series LQ1, 2 Work Procedure Instructions" (M-E05-1) for connecting tubing with special tools. (Downloadable from our website.)

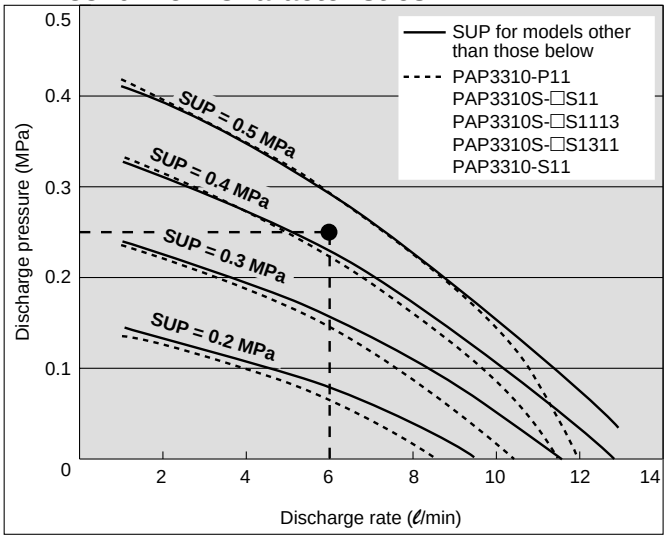
Specifications

Model		PA3310	PAP3310	PA3313	PAP3313
Actuation		Automatically operated		Air operated	
Port size	**Main fluid suction discharge port**	Rc, NPT, G, NPTF 3/8" Female thread	Rc, NPT, G, NPTF 3/8" Female thread 3/8", 1/2" Tube extension With nut (size 3, 4, 5) 3/8", 1/2" Integral fitting type	Rc, NPT, G, NPTF 3/8" Female thread	Rc, NPT, G, NPTF 3/8" Female thread 3/8", 1/2" Tube extension With nut (size 3, 4, 5) 3/8", 1/2" Integral fitting type
	Pilot air supply/exhaust port	Rc, NPT, G, NPTF 1/4" Female thread			
Material	**Body wetted areas**	New PFA			
	Diaphragm	PTFE			
	Check valve	PTFE, New PFA			
Discharge rate		1 to 13 ℓ/min Note 1)		0.1 to 9 ℓ/min	
Average discharge pressure		0 to 0.4 MPa			
Pilot air pressure		0.2 to 0.5 MPa			
Pilot air consumption		140 ℓ/min (ANR) or less			
Suction lifting range	**Dry**	0.5 m (Interior of pump dry)			
	Wet	Up to 4 m (liquid inside pump)			
Noise		80 dB (A) or less (Option: with silencer, AN200)		75 dB (A) or less (excluding the noise from the quick exhaust and solenoid valve)	
Withstand pressure		0.75 MPa			
Diaphragm life		50 million times			
Fluid temperature		0 to 100°C (No freezing, heat cycle not applied)			
Ambient temperature		0 to 100°C (No freezing, heat cycle not applied)			
Recommended operating cycle		—		2 to 4 Hz	
Mass		2.1 kg (without foot)			
Mounting orientation		Horizontal (with mounting foot at bottom)			
Packaging		General environment	Clean double packaging	General environment	Clean double packaging

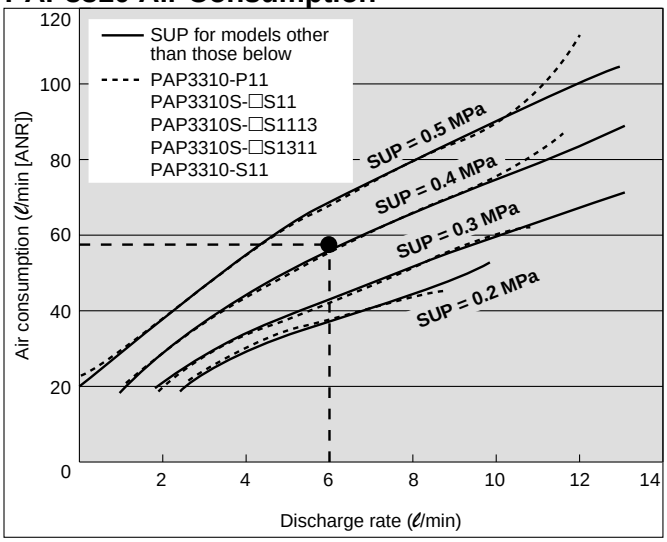
∗ Each value of above represents at normal temperatures with fresh water.
∗ Refer to page 727 for maintenance parts.
∗ For related products, refer to page 728 and 729.
Note 1) The discharge rates for PA(P)3310-P11, PA(P)3310S-□S11, PA(P)3310S-□S1113, PA(P)3310S-□S1311, PA(P)3310-S11 are between 1 to 12 ℓ/min.

Performance Curve: Automatically Operated Type

PAP3310 Flow Characteristics



PAP3310 Air Consumption



Selection from Flow Characteristic Graph (PAP3310)

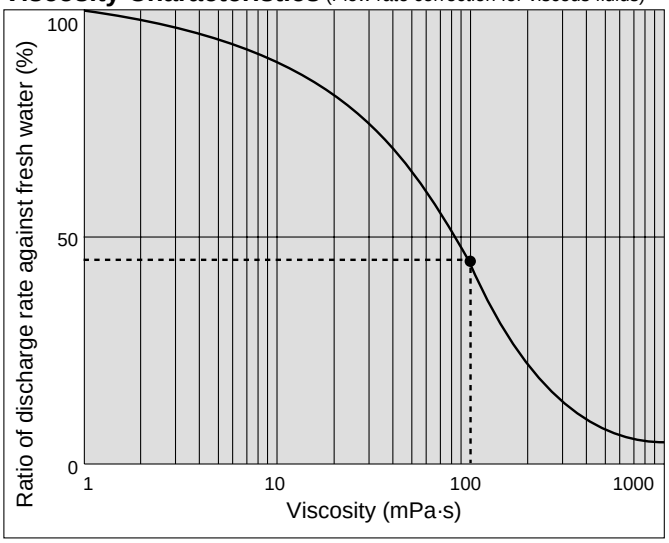
Required specifications example:
Find the pilot air pressure and pilot air consumption for a discharge rate of 6 ℓ/min and a discharge pressure of 0.25 MPa. <The transfer fluid is fresh water (viscosity 1 mPa·s, specific gravity 1.0).
∗ If the total lifting height is required instead of the discharge pressure, a discharge pressure of 0.1 MPa corresponds to a total lift of 10 m.

Selection procedures:
1. First mark the intersection point for a discharge rate of 6 ℓ/min and a discharge pressure of 0.25 MPa.
2. Find the pilot air pressure for the marked point. In this case, the point is between the discharge curves (solid lines) for SUP = 0.4 MPa and SUP = 0.5 MPa, and based on the proportional relationship to these lines, the pilot air pressure for this point is approximately 0.43 MPa.
3. Next find the air consumption rate. Find the intersection point for a discharge rate of 6 ℓ/min and a discharge curve (solid line) for SUP = 0.43 MPa. Draw a line from this point to the Y axis to determine the air consumption rate. The result should be approx. 58 ℓ/min (ANR).

⚠Caution

1. These flow characteristics are for fresh water (viscosity 1 mPa·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 0.75 kW per 100 ℓ/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 specifications example:
Find the pilot air pressure and pilot air consumption for a discharge rate of 2.7 ℓ/min, and a viscosity of 100 mPa·s.
Selection procedures:
1. First find the ratio of the discharge rate for fresh water when viscosity is 100 mPa·s from the graph below. It is determined to be 45%.
2. Next, in the required specification example, the viscosity is 100 mPa·s and the discharge rate is 2.7 ℓ/min. Since this is equivalent to 45% of the discharge rate for fresh water, 2.7 ℓ/min ÷ 0.45 = 6 ℓ/min, indicating that a discharge rate of 6 ℓ/min is required for fresh water.
3. Finally, find the pilot air pressure and pilot air consumption based on selection from the flow characteristic graphs.

⚠Caution

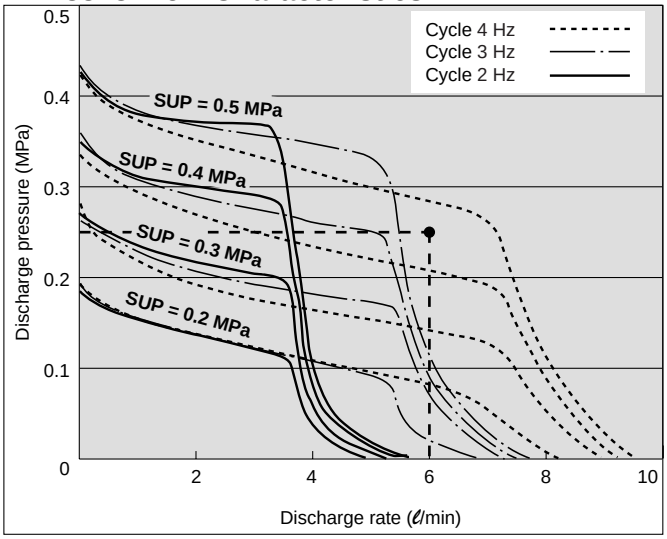
Viscosities up to 1000 mPa·s can be used.
Dynamic viscosity ν = Viscosity μ/Density ρ.

$$\nu = \frac{\mu}{\rho}$$

$\nu(10^{-3}\ m^2/s) = \mu(mPa{\cdot}s)/\rho(kg/m^3)$

Performance Curve: Air Operated Type

PAP3313 Flow Characteristics



Selection from Flow Characteristic Graph (PAP3313)

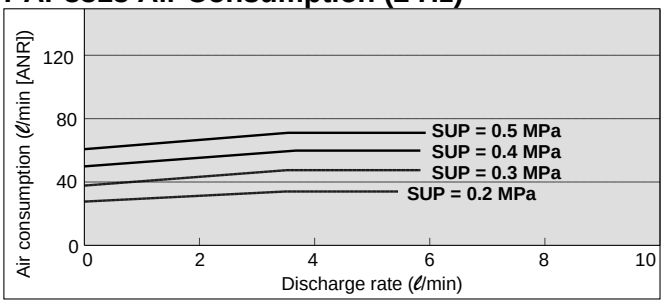
Required specification example: Find the pilot air pressure for a discharge rate of 6 ℓ/min, a discharge pressure of 0.25 MPa, and a cycle of 4 Hz. <The transfer fluid is fresh water (viscosity 1 mPa·s, specific gravity 1.0).>

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

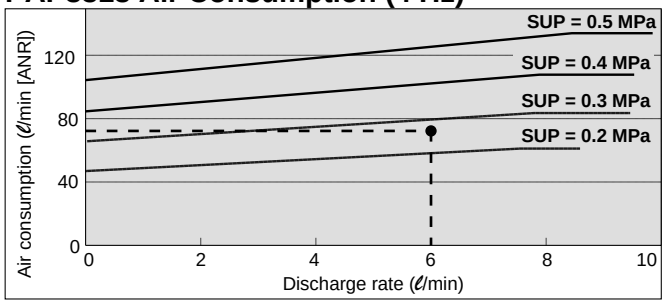
Selection procedures:

1. First mark the intersection point for a discharge rate of 6 ℓ/min and a discharge pressure of 0.25 MPa.
2. Find the pilot air pressure for the marked point. In this case, the point is between the discharge curves (solid lines) for SUP = 0.4 MPa and SUP = 0.5 MPa, and based on the proportional relationship to these lines, the pilot air pressure for this point is approximately 0.45 MPa.

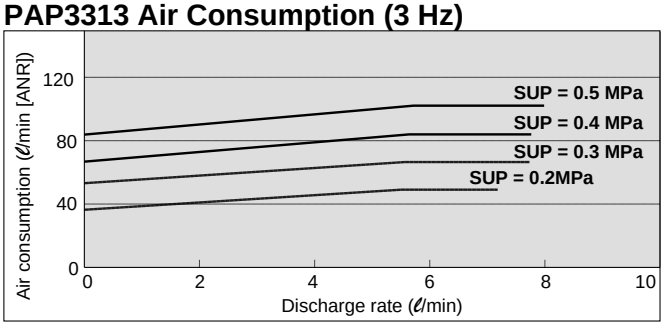
PAP3313 Air Consumption (2 Hz)



PAP3313 Air Consumption (4 Hz)



PAP3313 Air Consumption (3 Hz)



Calculating Air Consumption (PAP3313)

Required specifications example:

Find the pilot air consumption for a discharge rate of 6 ℓ/min, a cycle of 4 Hz and a pilot air pressure of 0.25 MPa.

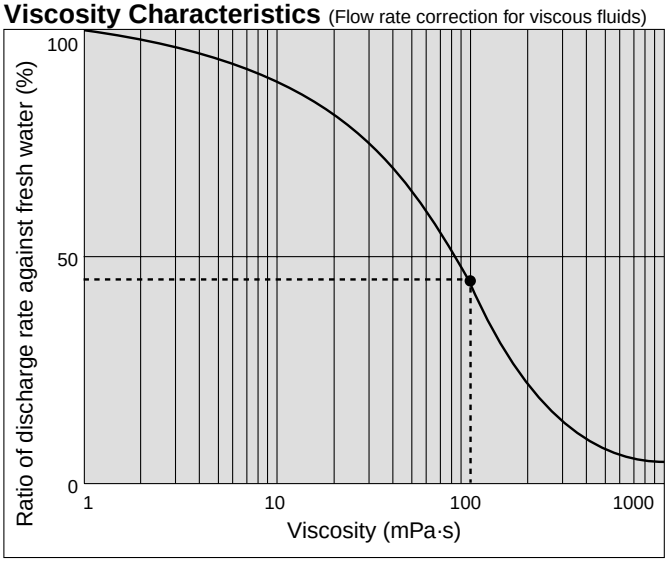
Selection procedures:

1. In the graph for air consumption (4 Hz), start at a discharge rate of 6 ℓ/min.
2. Mark where this point intersects with the air consumption rate. Based on the proportional relationship between these lines, the intersection point will be between the discharge curves SUP = 0.2 MPa and SUP = 0.3 MPa.
3. From the point just found, draw a line to the Y-axis to find the air consumption. The result is approximately 70 ℓ/min (ANR).

⚠Caution

1. These flow characteristics are for fresh water (viscosity 1 mPa·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).

Viscosity Characteristics (Flow rate correction for viscous fluids)



Selection from Viscosity Characteristic Graph

Required specification example: Find the pilot air pressure for a discharge rate of 2.7 ℓ/min, discharge pressure of 0.25 MPa and a viscosity of 100 mPa·s.

Selection procedures:

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

⚠Caution

Viscosities up to 1000 mPa·s can be used.

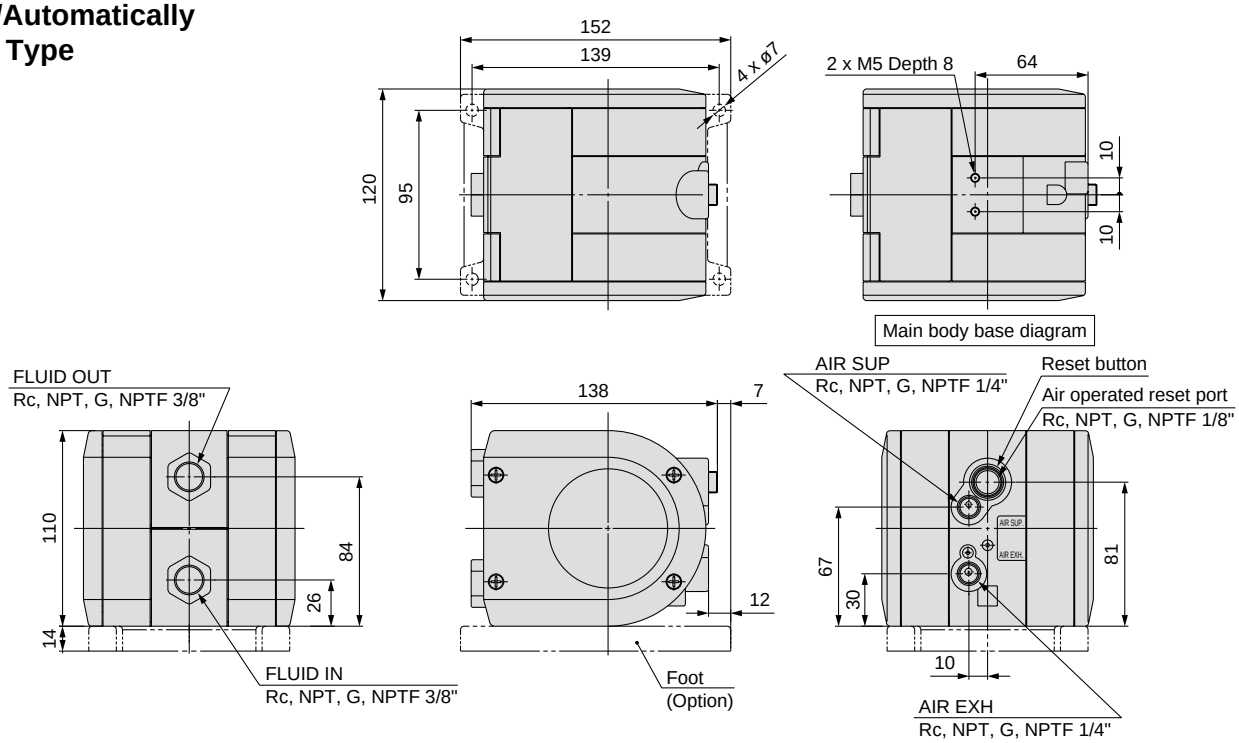
Dynamic viscosity ν = Viscosity μ/Density ρ.

$$\nu = \frac{\mu}{\rho}$$

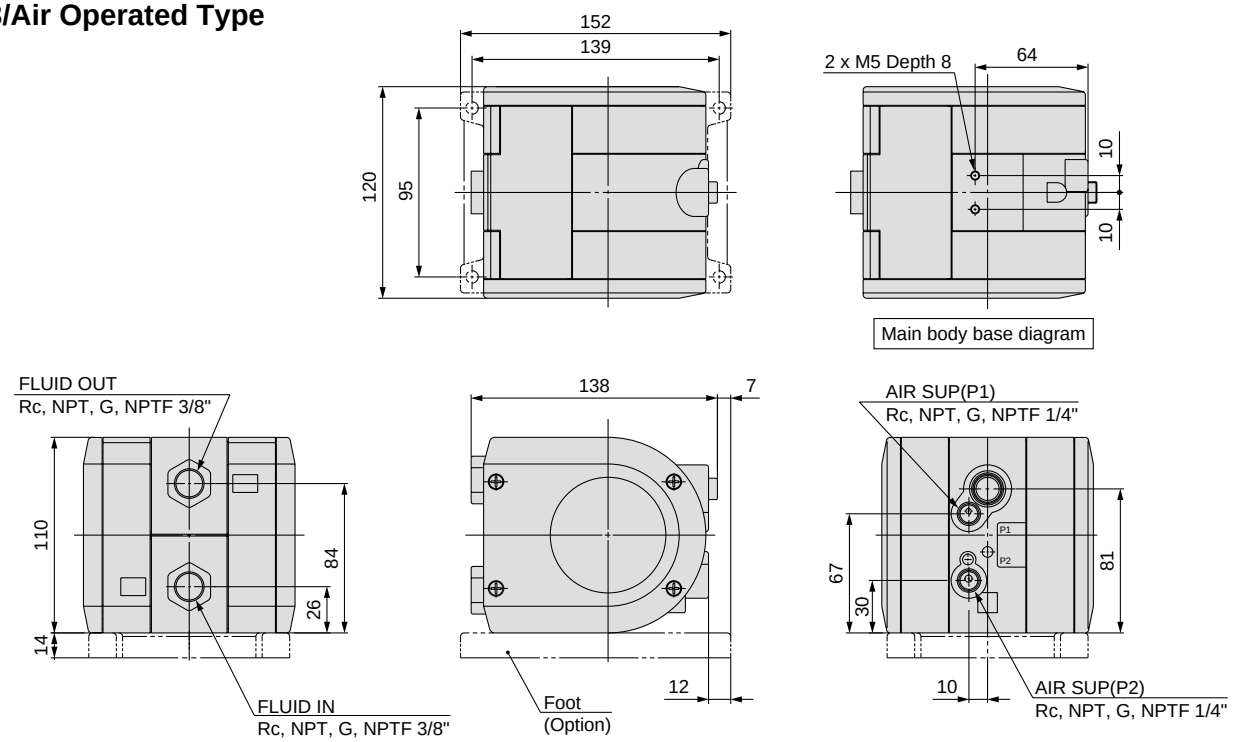
$\nu(10^{-3}\ m^2/s) = \mu(mPa{\cdot}s)/\rho(kg/m^3)$

Dimensions

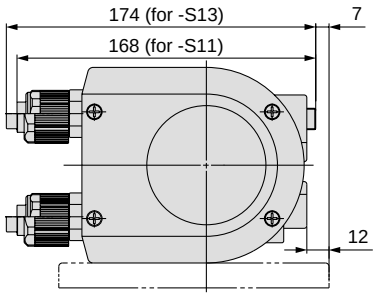
PAP3310/Automatically Operated Type



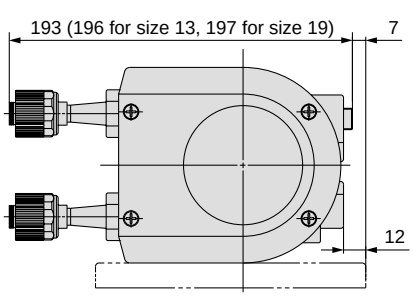
PAP3313/Air Operated Type



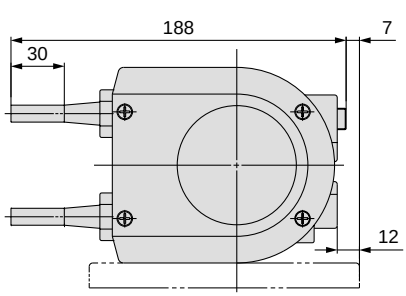
Integral fitting type



With nut



Tube extension



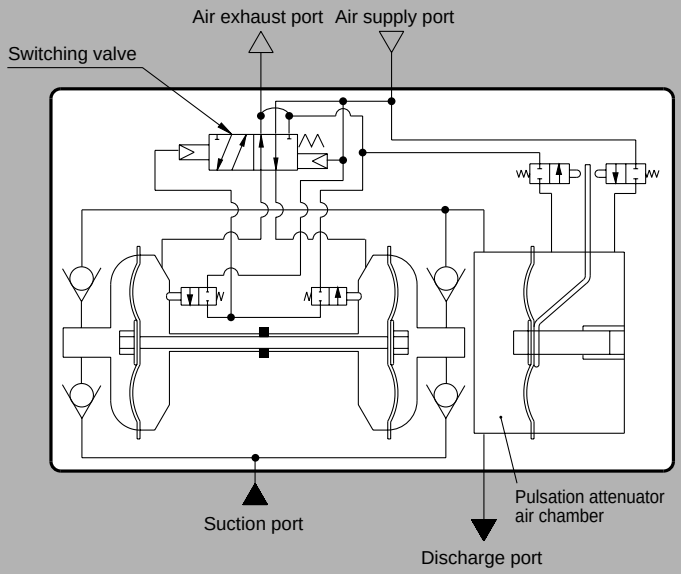
Process Pump

Series PAX1000

Automatically Operated Type, Built-in Pulsation Attenuator (Internal Switching Type)

Prevents spraying of discharge and foaming in tank

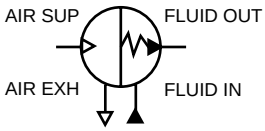
- **Space-saving design eliminates separate piping with built-in pulsation attenuator**



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

How to Order

JIS Symbol



Automatically operated type, built-in pulsation attenuator

PAX1 [1] 1 [2] – [ ] [02] – [ ]

Body material

Symbol	Body material
1	ADC12 (Aluminum)
2	SCS14 (Stainless steel)

Actuation

Symbol	Actuation
2	Automatically operated type built-in pulsation attenuator

Thread type

Symbol	Type
Nil	Rc
N	NPT
F	G
T	NPTF

Port size

Symbol	Port size
02	1/4"
03	3/8"

Option

Symbol	Option
Nil	Body only
N	With silencer *

∗ For AIR EXH: AN200-02

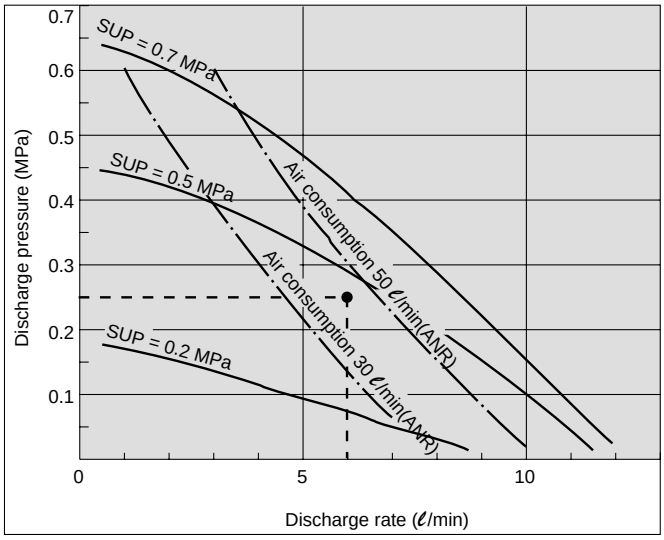
Specifications

Model		PAX1112	PAX1212
Actuation		Automatic operation	
Port size	**Main fluid suction discharge port**	Rc, NPT, G, NPTF 1/4", 3/8" Female thread	
	Pilot air supply/ exhaust port	Rc, NPT, G, NPTF 1/4" Female thread	
Material	**Body wetted areas**	ADC12	SCS14
	Diaphragm	PTFE	
	Check valve	PTFE, SCS14	
Discharge rate		0.5 to 10 ℓ/min	
Average discharge pressure		0 to 0.6 MPa	
Pilot air pressure		0.2 to 0.7 MPa	
Air consumption		Max. 150 ℓ/min (ANR)	
Suction lifting range	**Dry**	Up to 2 m (Interior of pump dry)	
	Wet	Up to 6 m (Liquid inside pump)	
Noise		84 dB(A) or less (Option: with silencer, AN200)	
Withstand pressure		1.05 MPa	
Diaphragm life		50 million cycles	
Fluid temperature		0 to 60°C (No freezing)	
Ambient temperature		0 to 60°C (No freezing)	
Mass		2.0 kg	3.5 kg
Mounting position		Horizontal (Bottom facing down)	
Packaging		General environment	

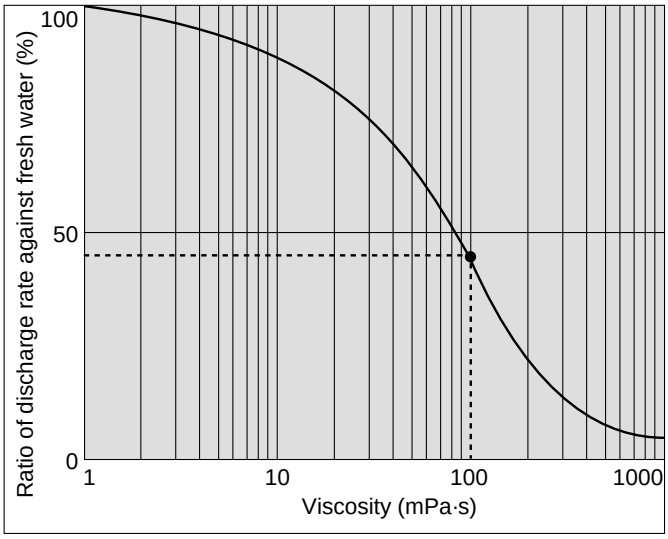
∗ Each of the values above are for normal temperatures and when the transferred fluid is fresh water.
∗ Refer to page 727 for maintenance parts.
∗ Refer to pages 728 and 729 for related products.

Performance Curve: Automatically Operated Type, Built-in Pulsation Attenuator

PAX1000 Flow Characteristics



Viscosity Characteristics (Flow rate correction for viscous fluids)



Selection from Flow Characteristic Graph

Required specification example:
Find the pilot air pressure and pilot air consumption for a discharge rate of 6 ℓ/min and a discharge pressure of 0.25 MPa. <The transfer fluid is fresh water (viscosity 1 mPa·s, specific gravity 1.0).>

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

1. First mark the intersection point for a discharge rate of 6 ℓ/min and a discharge pressure of 0.25 MPa.

2. Find the pilot air pressure for the marked point. In this case, the point is between the discharge curves (solid lines) for SUP = 0.2 MPa and SUP = 0.5 MPa, and based on the proportional relationship to these lines, the pilot air pressure for this point is approximately 0.45 MPa.

3. Next find the air consumption. Since the marked point is below the curve for 50 ℓ/min (ANR), the maximum rate will be about 45 ℓ/min (ANR).

⚠ Caution

1. These flow characteristics are for fresh water (viscosity 1 mPa·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 0.75 kW per 100 ℓ/min of air consumption as a guide for the relationship of the air consumption to the compressor.

Selection from Viscosity Characteristic Graph

Required specification example:
Find the pilot air pressure and pilot air consumption for a discharge rate of 2.7 ℓ/min, a discharge pressure of 0.25 MPa, and a viscosity of 100 mPa·s.
Selection procedures

1. First find the ratio of the discharge rate for fresh water when viscosity is 100 mPa·s from the graph below. It is determined to be 45%.

2. Next, in the required specification example, the viscosity is 100 mPa·s and the discharge rate is 2.7 ℓ/min. Since this is equivalent to 45% of the discharge rate for fresh water, 2.7 ℓ/min ÷ 0.45 = 6 ℓ/min, indicating that a discharge rate of 6 ℓ/min is required for fresh water.

3. Finally, find the pilot air pressure and pilot air consumption

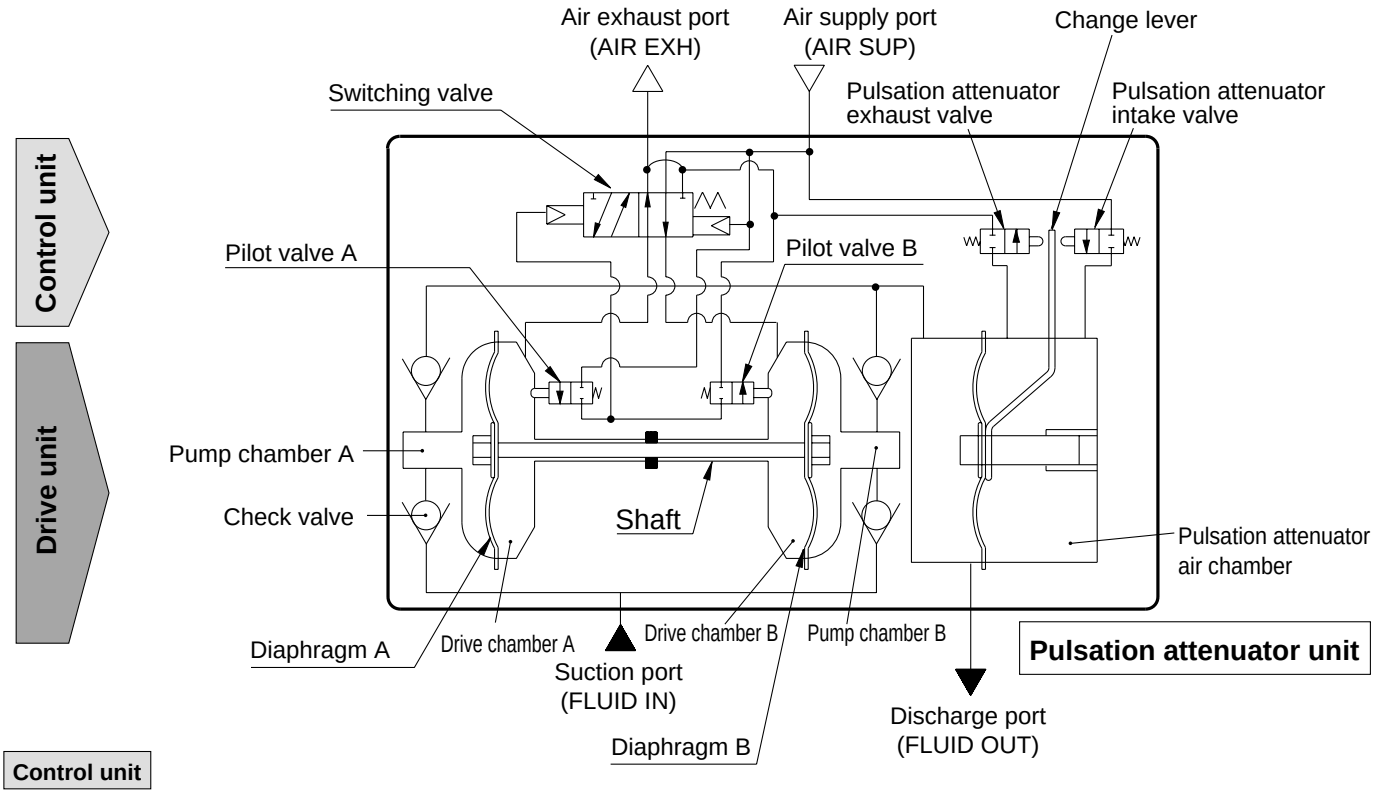
⚠ Caution

Viscosities up to 1000 mPa·s can be used.
Dynamic viscosity ν = Viscosity μ/Density ρ.

$$\nu = \frac{\mu}{\rho}$$

$\nu(10^{-3}m^2/s) = \mu(mPa{\cdot}s)/\rho(kg/m^3)$

Working Principle: Automatically Operated Type, 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 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.

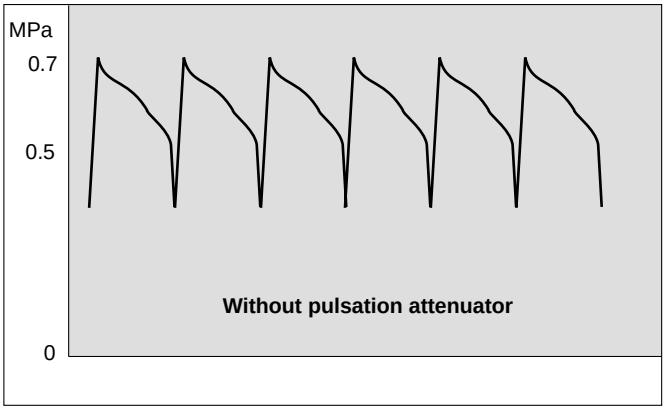
Drive unit

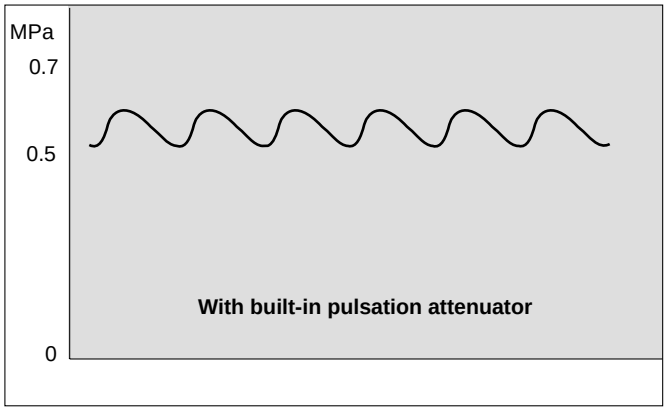
1. When air enters drive chamber B, the fluid in pump chamber B is forced out, and at the same time fluid is sucked into pump chamber A.
2. When the diaphragm moves in the opposite direction, the fluid in pump chamber A is forced out, and fluid is sucked into pump chamber B.
3. The pressure of the fluid 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

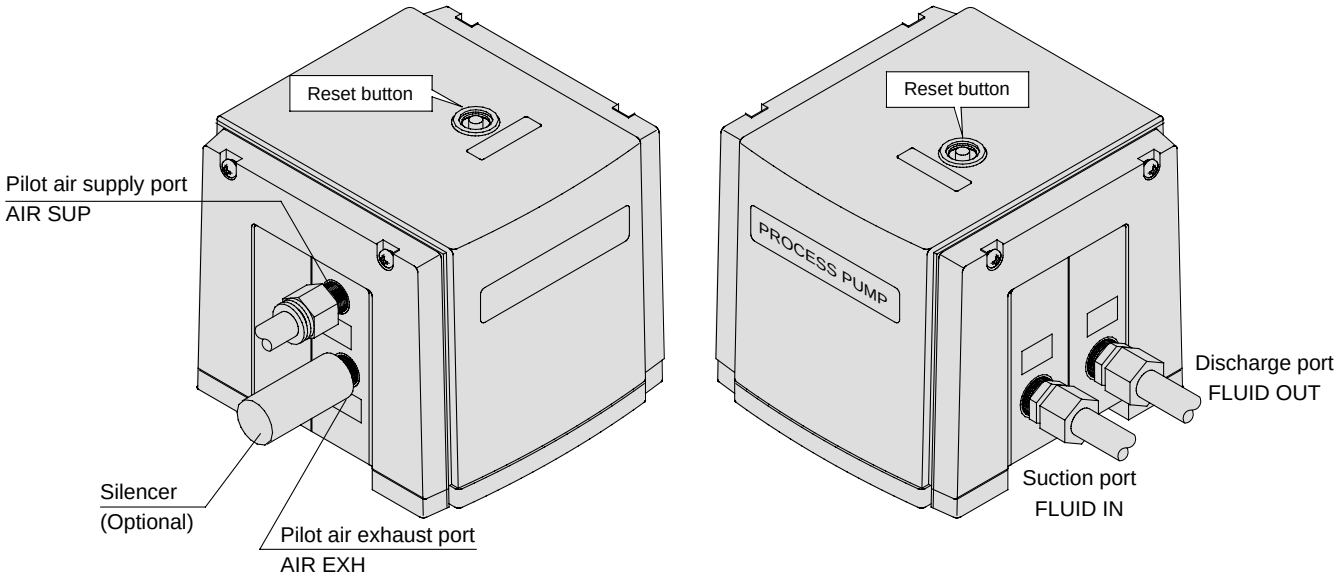




The process pump generates pulsation because it discharges a liquid using two diaphragms. The pulsation attenuator absorbs pressure when discharge pressure increases, and compensates the pressure when discharge pressure decreases. By this means pulsation is controlled.

Piping: Automatically Operated Type, Built-in Pulsation Attenuator

Piping diagram



⚠ Caution

Mounting posture of the pump is set with the bottom surface at the bottom. Air to be supplied to the AIR SUP port should be cleaned and filtered through AF filter, etc. Air with foreign matter or drainage etc. will have negative effects on the built-in switching valve and will lead to malfunction. When air needs additional purification, use a filter (Series AF), and a mist separator (Series AM) together.
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 SUR> 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 0.7 MPa. 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. 2 m) 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>

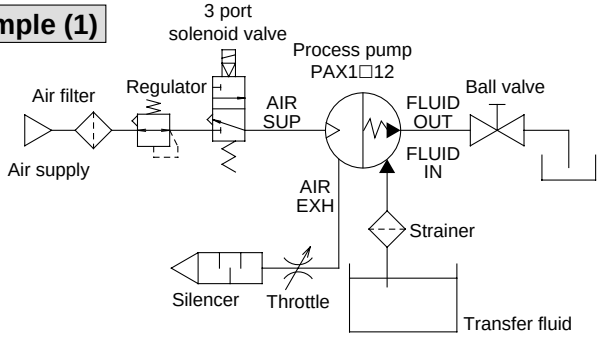
1. Adjustment of the flow rate from the discharge port <FLUID OUT> is performed with the ball valve connected on the discharge side or the throttle connected on the air exhaust side. For adjustment from the air side, use of the silencer with throttle ASN2 (port size 1/4) connected to the air exhaust 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: PAX1000 0.5 ℓ/min)

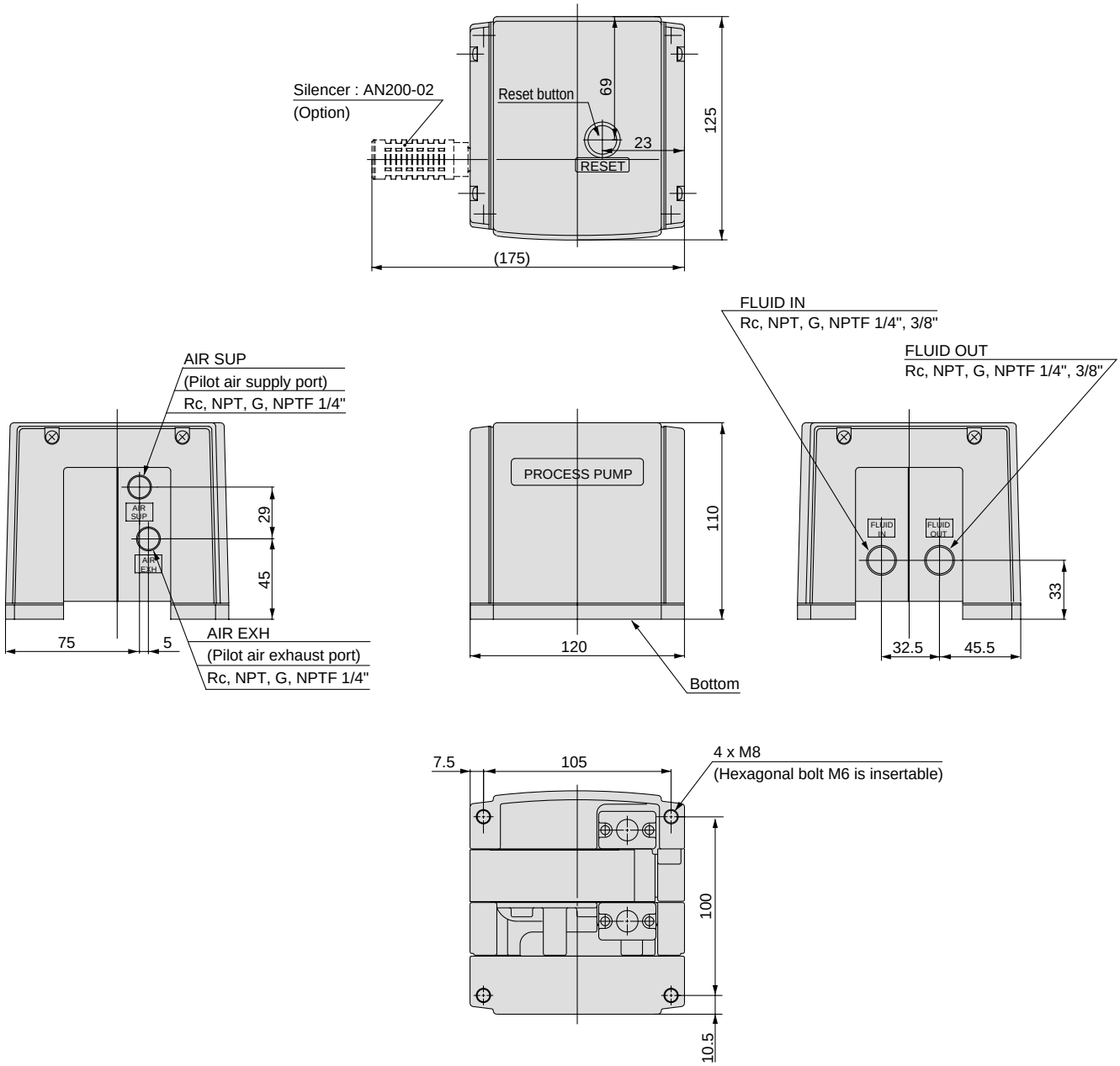
<Reset Button>

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. Maintenance is necessary if the reset button needs to be pressed frequently.

Circuit example (1)



Dimensions


Silencer : AN200-02
(Option)
Reset button
69
125
23
RESET
(175)
FLUID IN
Rc, NPT, G, NPTF 1/4", 3/8"
FLUID OUT
Rc, NPT, G, NPTF 1/4", 3/8"
AIR SUP
(Pilot air supply port)
Rc, NPT, G, NPTF 1/4"
AIR SUP
AIR EXH
29
45
75
5
AIR EXH
(Pilot air exhaust port)
Rc, NPT, G, NPTF 1/4"
PROCESS PUMP
110
120
Bottom
FLUID IN
FLUID OUT
33
32.5
45.5
7.5
105
4 x M8
(Hexagonal bolt M6 is insertable)
100
10.5

Series PA□
Product Specific Precautions 1

Be sure to read before handling.
Refer to front matters 42 and 43 for Safety Instructions.

Caution on Design

⚠Warning

1. Confirm the specifications.

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

2. Fluids

- For the compatibility between the materials composing the product and the fluids, check the compatibility check list. Since the compatibility of the fluid used may vary depending on its type, additives, concentration, temperature, etc., give sufficient consideration when selecting the material.
- For fluids other than those listed on the check list, please consult us. Also, use them within the range of the operating fluid temperatures.
- If foreign matters are mixed in the fluid, these may cause abrasion of the inside of the pump resulting in a problem. Use an appropriate filter (strainer) to remove them. In general, 80 to 100 mesh (150 to 180 μm) filters are recommended.
- When transferring a coagulable liquid, take measures to prevent it from coagulating in the pump.

3. Water hammer

If a valve is operated abruptly etc., a high pressure may be applied due to water hammer. Take measures to prevent pressures higher than specified from being applied.

<Examples of measures>

- Use a water hammer resistant valve to reduce the valve closing speed.
- Use an elastic piping material such as rubber hose or an accumulator to absorb the impact pressure.

4. Liquid seals

Provide a relief valve in the system to prevent it from becoming a liquid-sealed circuit.

5. Fluid pressure

Do not pressurize or decompress the fluid supplied.

6. Ensure space for maintenance.

Secure the space required for maintenance and inspection. Take into consideration also leakage from the product. When transferring a flammable liquid or a liquid that may affect the human body or environment, take measures including fire ban and keeping the area off limits.

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

If reverse pressure or flow occurs, this can cause equipment damage or malfunction, etc. Take safety measures in designing the circuit.

8. Measures against static electricity

Take measures against static electricity as static electricity may occur depending on the fluid.

9. Cannot be used for transferring gases.

If transferring gases, the product cannot provide sufficient transfer volume as it should due to the nature of compression. Besides, as the operational cycle is too short, unexpected malfunctions may occur within short periods of time. Therefore, do not operate the product for a long period of time with no liquid inside or with gas-liquid mixing.

10. Condensation and freezing of the pilot port

For the automatically operated type, the location around the switching valve and the air exhaust port can cool down quickly due to expansion of the supply air, and this may cause condensation on the piping and the condensation may freeze during operation in winter. Take measures to ensure that water droplets from condensation are not splashed onto any electric parts or equipment.

⚠Caution

1. Suspension of the pump operation

- When the process pump is started or stopped by the pilot air for the automatically operated type, use a 3-port solenoid valve to discharge the residual pressure. If the pump should stop while consuming the residual pressure, the built-in pilot air switching unit may become unstable and unable to be restarted. If it cannot be restarted, press the reset button.
- For the air operated type, combine an exhaust center 5-port solenoid valve or a 3-port solenoid valve for residual pressure release and a 4-port solenoid valve for driving the pump to discharge the residual pressure inside the pump when stopping it. If the pump is pressurized during suspension, its life will become shorter.

2. Use the constant pilot air pressure.

The automatically operated type of some models adopts an air spring for the built-in air control circuit, and the pump may malfunction and stop when the pilot air pressure fluctuation exceeds 50 kPa.

Series PA□
Product Specific Precautions 2

Be sure to read before handling.
Refer to front matters 42 and 43 for Safety Instructions.

Mounting

⚠Caution

1. Read the instruction manual before mounting the product.
Read the instruction manual carefully and understand the contents before mounting the product. The manual should also be kept where it can be referred to whenever necessary.

2. Open the sealed package inside a clean room.
Products specified for clean room are sealed and double packaged inside a clean room. We recommend that the inner package should be opened inside a clean room or clean environment.

3. Confirm the mounting orientation of the product.
Since the mounting orientation varies depending on the product, check it in the instruction manual or the specifications herein.
Also, secure all specified mounting positions when using the product.
If the propagation of the vibration of the pump is not acceptable, insert vibro-isolating rubber when mounting.

Piping

⚠Caution

1. Flush the piping.
Flush and clean the piping before connecting the product. Any dirt or scale and the like left in the piping may cause malfunction or failure.

2. Use fittings with resin threads when connecting piping to the product with resin threads at the ports.
Using fittings with metal threads may cause damage to the ports.

3. Tighten screws with proper tightening torque.
When screwing fittings into the product, tighten them with proper tightening torque as shown below.

PA3000, PA5000, PAX1000

Connection thread	Proper tightening torque (N·m)
Rc, NPT, G, NPTF 1/4	12 to 14
Rc, NPT, G, NPTF 3/8	22 to 24
Rc, NPT, G, NPTF 1/2	28 to 30
Rc, NPT, G, NPTF 3/4	28 to 30

PAX1000

Connection thread	Proper tightening torque (N·m)
M5	1/6 turn after tightening by hand
Rc, NPT, G, NPTF 1/8	2 to 3

PA3300, PAP3300, PAF3000, PAF5000

Connection thread	Proper tightening torque (N·m)
Rc, NPT, G, NPTF 1/8	0.4 to 0.5
Rc, NPT, G, NPTF 1/4 (PAF3000)	0.8 to 1
Rc, NPT, G, NPTF 1/4	1.5 to 2
Rc, NPT, G, NPTF 3/8	2 to 2.5
Rc, NPT, G, NPTF 3/4	4 to 5

Air Supply

⚠Warning

1. Use clean air.
Do not use compressed air that includes chemicals, synthetic oils containing organic solvents, salinities or corrosive gases, etc., as it can cause damage or malfunction.

2. Pay attention to avoid freezing when operating the product in low temperatures.
The equipment operates while expanding the compressed air. During this time, the temperature inside the product decreases due to adiabatic expansion. If the ambient temperature is low, using compressed air containing a lot of moisture may cause freezing because heat cannot be gained from the surroundings. In this case, take freeze prevention measures by using a membrane air dryer (such as series IDG).

⚠Caution

1. Quality of operating air
- Be sure to use only air filtrated by a micro mist separator (such as series AMD). Use of a super mist separator (such as series AME) is recommended to extend maintenance intervals.
- If a pump is operated by dried air and N_2 gas, etc., the deterioration of the gaskets inside the switching valve will be accelerated and may result in substantially shortening the life span of the product.

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 where ultraviolet deterioration or overheating of resin may occur due to direct sunlight.
4) Locations near heat sources with poor ventilation (heat sources should be shielded by heat insulating material).
5) Locations with impact or vibration.
6) Locations with excessive moisture and dust.

2. The product cannot be used under water.
Do not use the product immersing it in water (liquid). Otherwise, liquid will enter the openings inside the product, resulting in malfunction.

3. Compressed air with low dew point
Using super dry air as the fluid may affect the reliability (service life) of the equipment, because the lubrication characteristics inside the equipment will deteriorate. Please consult with SMC when using it.

Series PA□
Product Specific Precautions 3

Be sure to read before handling.
Refer to front matters 42 and 43 for Safety Instructions.

Maintenance

⚠Warning

1. Perform maintenance after consulting the instruction manual.
Obtain the instruction manual for the equipment from SMC or our distributor and have sufficient knowledge of the equipment before performing maintenance. Incorrect handling may cause damage or malfunction of the equipment or system.

2. Perform maintenance work after confirming the safety of the system.
Turn off the compressed air and power supply and exhaust any remaining compressed air in the system before removing the equipment and the compressed air supply/exhaust unit. Discharge the residual liquid or sufficiently displace it as necessary. Also, when reinstalling the equipment or restarting it after replacement, confirm the safety of the product before checking that it operates normally.

3. Do not disassemble the product, as disassembly will invalidate the product's warranty.
When disassembly is necessary, please consult with SMC or our distributor.

4. Drain discharge
Operating the system with drain accumulated in the equipment or piping may cause malfunction of the equipment, splash over into the downstream side, or unexpected accident. Periodically discharge drain from components including the air filter.

5. Caution when transferring a high-temperature fluid
The product itself will become hot due to the high-temperature fluid. Since touching the product directly may cause burns, allow sufficient time for the product to cool down when transferring a high-temperature fluid. The measurement of the product temperature is recommended to confirm the safety of the system before performing work.

6. Caution when a temperature history cycle is applied.
When a temperature history (heat cycle) is applied for Series PAF3000/5000, the resin thread may extend. Additionally tighten with the specified torque (M3: 0.11 to 0.12 N·m) to prevent liquid leakage.

⚠Caution

1. Caution when transferring a highly penetrating liquid
When transferring a liquid that is highly penetrating through fluoropolymer, components of the transfer liquid may enter the openings inside the equipment. Also, they may become attached to the external surface of the equipment. In this case, take the same measures as handling the transfer liquid.

Maintenance

⚠Caution

2. Service life of diaphragm and maintenance of consumable items
- Regular maintenance is required for items including diaphragms, check valves, switching valves, pilot valves and manual caps.
- If the operating cycle of the process pump exceeds the service life of diaphragm, the diaphragm may be damaged due to deterioration. If it is damaged, the fluid will leak from the pilot air exhaust port and the air will blow out into the liquid circuit. Consider the pump operation (breathing, decline of discharge pressure, etc.) and the reference service life of diaphragm, and conduct necessary maintenance as early as possible.
- Items such as check valves, switching valves, pilot valves and manual caps may experience malfunction earlier than the diaphragm depending on the operating conditions. Please conduct periodic maintenance.
- When conducting maintenance, obtain the necessary parts indicated in the maintenance parts list (see page 727), and perform work according to the maintenance and instruction manuals.

[Calculation of reference service life (days) of diaphragm]

<Automatically operated type>

$$\text{Reference service life (days)} = \frac{\text{A (amount of discharge per cycle)} \times \text{B (reference number of cycles in service life)}}{\text{Flow (}\ell\text{/min)} \times \text{Operating time per day (hour)} \times 60\text{ (min)}}$$

<Air operated type>

The amount of discharge per cycle for the air operated type varies depending on the piping resistance. Therefore, calculate the service life (days) using the operating frequency of a solenoid valve.

$$\text{Reference service life (days)} = \frac{\text{B (reference number of cycles in service life)}}{\text{Operating frequency of solenoid valve (Hz)} \times 60\text{ (sec)} \times \text{Operating time per day (hour)} \times 60\text{ (min)}}$$

Model	Operating method	Diaphragm material	Amount of discharge per cycle A	Reference number of cycles in service life B	Volume inside pump (wetted part)
PA3□10	Automatically operated type	PTFE	Approx. 0.04 ℓ	100 million cycles	Approx. 75 mℓ
PA3□20		NBR		50 million cycles	
PA3□13	Air operated type	PTFE	Approx. 0.022 ℓ *	50 million cycles	
PA5□10	Automatically operated type	PTFE	Approx. 0.10 ℓ	50 million cycles	Approx. 315 mℓ
PA5□20		NBR			
PA5□□3	Air operated type	PTFE	Approx.0.09 ℓ *		
PA (P) 3310	Automatically operated type	PTFE	Approx. 0.025 ℓ	50 million cycles	Approx. 85 mℓ
PA (P) 3313	Air operated type		Approx. 0.037 ℓ		
PAX1000	Automatically operated type	PTFE	Approx. 0.021 ℓ	50 million cycles	Approx. 90 mℓ
PB1011	Solenoid valve driving	PTFE	Approx. 0.004 ℓ	20 million cycles	Approx. 9 mℓ
PB1013	Air operated type		Approx. 0.004 ℓ		
PAF3410	Automatically operated type	PTFE	Approx. 0.054 ℓ	50 million cycles	Approx. 105 mℓ
PAF3413	Air operated type		Approx. 0.050 ℓ *		Approx. 100 mℓ
PAF5410	Automatically operated type	PTFE	Approx. 0.130 ℓ		Approx. 600 mℓ
PAF5413	Air operated type		Approx. 0.190 ℓ *		

* The amount of discharge per cycle for the air operated type is indicated assuming no piping resistance.

Series PA□
Product Specific Precautions 4

Be sure to read before handling.
Refer to front matters 42 and 43 for Safety Instructions.

Lubrication

⚠Caution

1. The pump can be used without lubrication.
Do not lubricate the air operated type, the PAF series.

2. If lubricating the pump, continue lubrication.
If lubricating a pump other than the air operated type or the PAF series, use turbine oil Class 1 (with no additives) ISO VG 32, and be sure to continue lubricating the pump.

Caution on Handling

⚠Warning

1. Test before using with the actual equipment.
Test the pump before using it with the actual equipment. Even if there is no problem in a short-term test, the liquid may penetrate through the fluoropolymer diaphragm causing malfunction in the pump air circuit.

2. Storage
In the case of long-term storage after use, first thoroughly remove the liquid, and clean and dry the inside to prevent deterioration of the pump materials.

3. After a long period of non-use, perform a trial run prior to operation.