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.

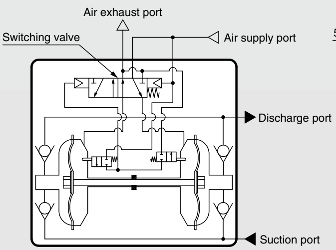
■ Self-priming makes priming unnecessary

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

Automatically operated type

Compatible with a wide variety of fluids

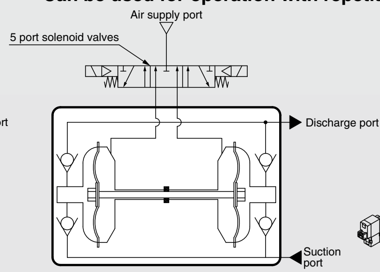
- PA3000: Max. discharge rate 20 L/min
- PA5000: Max. discharge rate 45 L/min

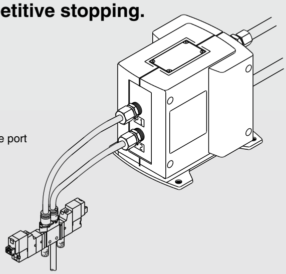


Air operated type

Control with external switching valve makes constant cycling possible

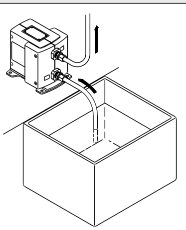
- Easily control the discharge rate.
  Easily adjust the flow with the external solenoid valve's ON/OFF cycle.
- Easy to operate, even for minute flow, low press operation or operation involving air.
- Can be used for operation with repetitive stopping.



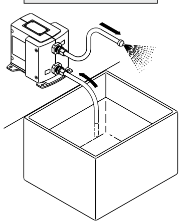


Application Example

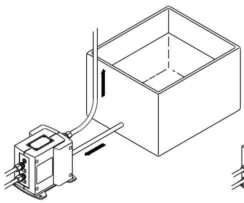
Transferring liquid by suction



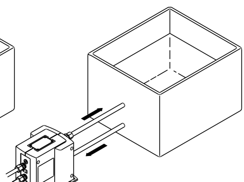
Atomizing liquid



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

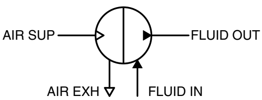
Port size

Symbol	Port size
03	3/8"

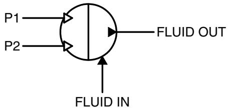
Option

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

Symbol



Automatically operated type



Air operated type

Made to Order

Made to order specifications
(For details, refer to pages 928 to 930)

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

Note) For automatically operated type only.

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 Note 1) lifting range	**Dry**	1 m (Interior of pump dry)					
	Wet	Up to 6 m (liquid inside pump)					
Noise		80 dB (A) or less (Option: with silencer, AN20)				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 Note 3) recommended Cv factor		—				0.20	
Weight		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 931 for maintenance parts.
∗ For related products, refer to pages 932 and 933.
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.

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

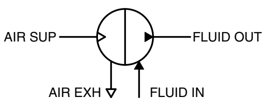
Port size

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

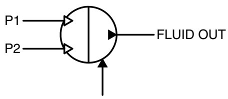
Option

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

Symbol



Automatically operated type



Air operated type

Made to order specifications
(For details, refer to pages 928 to 930)

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

Note) For automatically operated type only.

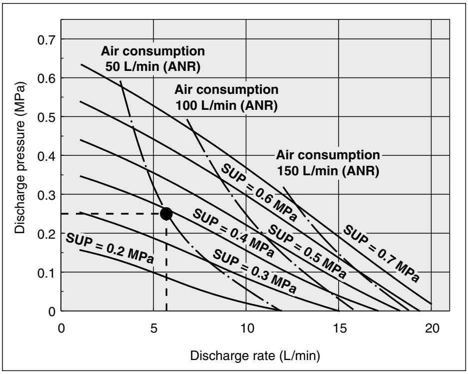
Specifications

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 20)				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	
Weight		3.5 kg		6.5 kg		3.5 kg	6.5 kg
Mounting orientation		Horizontal (with mounting foot at bottom)					
Packaging		General environment					

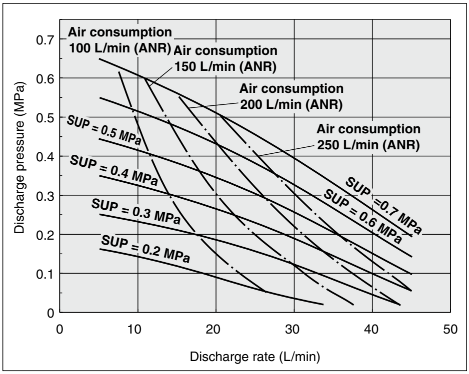
∗ Each of the values above are for normal temperatures and when the transferred fluid is fresh water.
∗ Refer to page 931 for maintenance parts.
∗ For related products, refer to pages 932 and 933.
Note 1) With cycles at 2 Hz or more
Note 2) After initial suction of liquid operating at 1 to 7 Hz, it can 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.

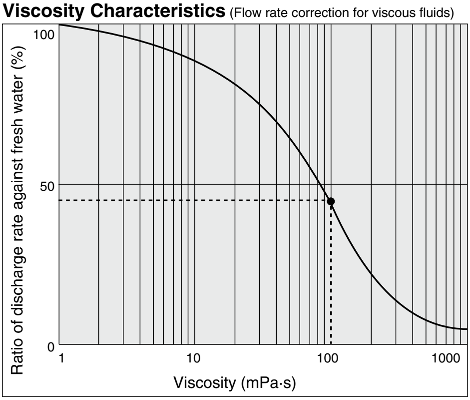
Selection procedures:

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 = 0.3 MPa and SUP = 0.4 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

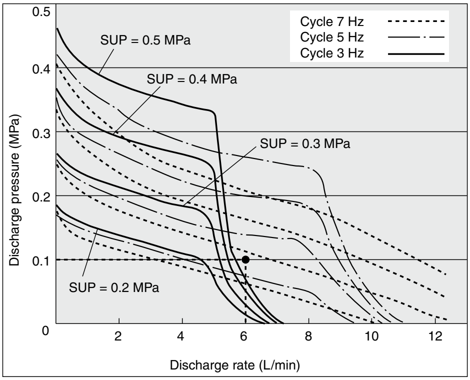
Viscosities up to 1000 mPa·s can be used.
Dynamic viscosity ν = Viscosity μ/Density ρ.

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

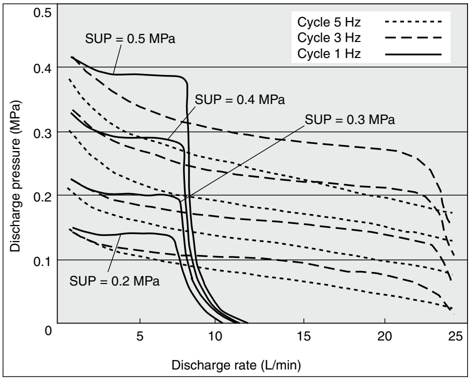
$\nu(10^{-3}\,m^2/s) = \mu(mPa\cdot s)/\rho(kg/m^3)$

Performance Curve: Air Operated Type

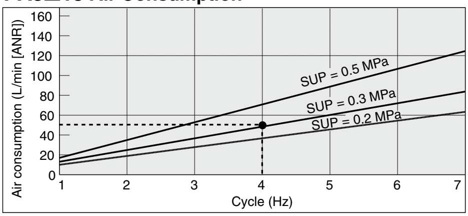
PA3□13 Flow Characteristics



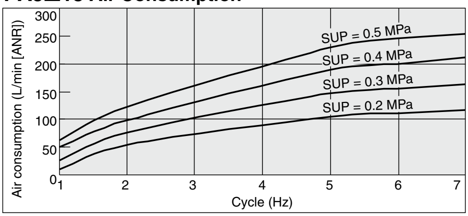
PA5□13 Flow Characteristics



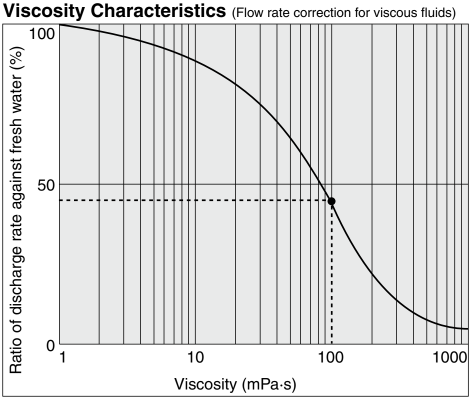
PA3□13 Air Consumption



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.

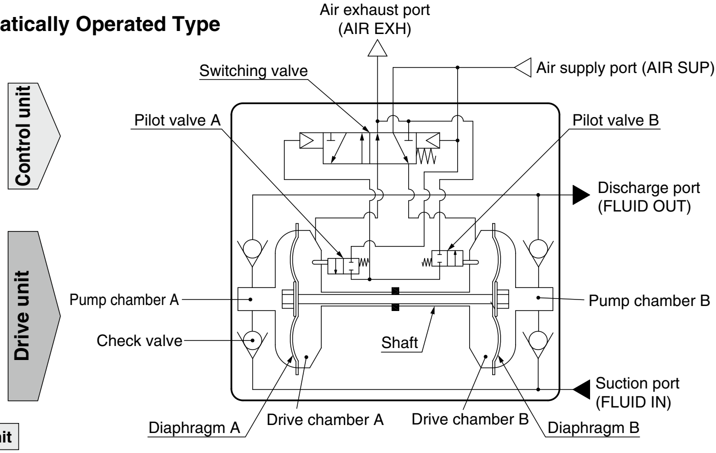
Dynamic viscosity ν = Viscosity μ/Density ρ.

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

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

Working Principle

Automatically Operated Type



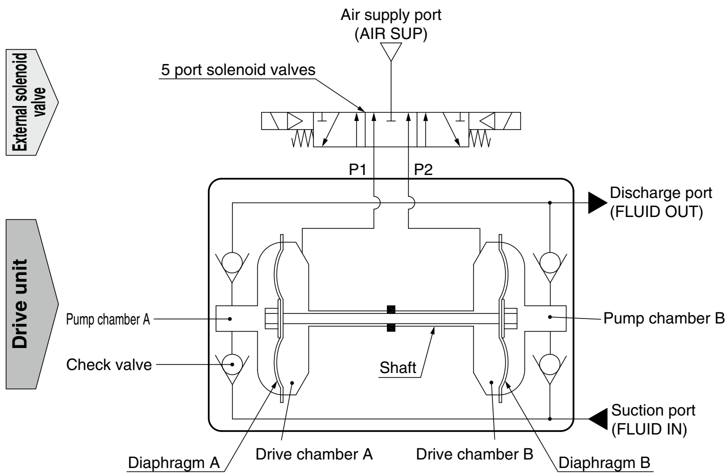
Control unit

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.

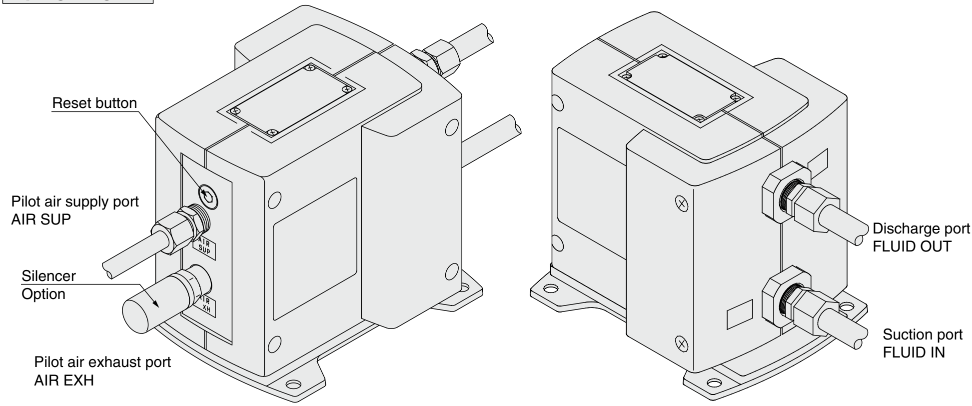
Air Operated Type



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 directional control 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 throttle 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 (AN20-02: 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 throttle on the discharge side is closed.

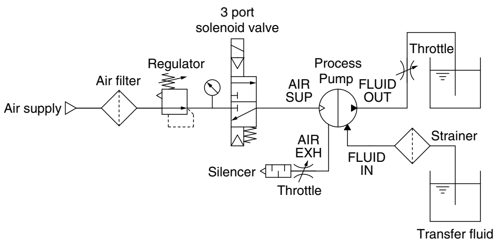
<Discharge Flow Rate Adjustment>

1. Adjustment of the flow rate from the discharge port <FLUID OUT> is performed with the throttle 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). (Adjust the throttle on the air side so that the exhaust air is fully exhausted.)
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>

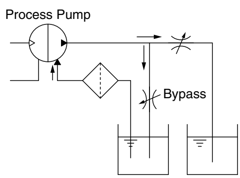
When the pump stops during operation, press the reset button. This makes it possible to restore operation in case the switching valve becomes clogged due to foreign matter in the supply air.

Circuit example (1)



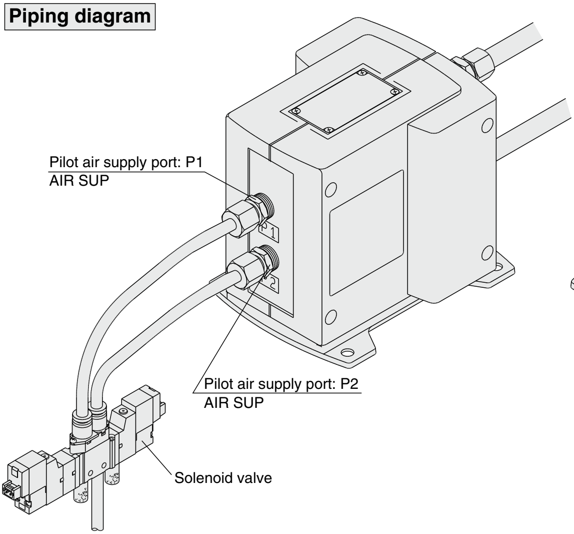
Circuit example (2)

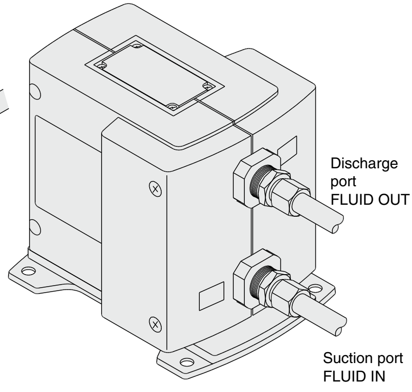
For related products, refer to pages 932 and 933.



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 throttle 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.

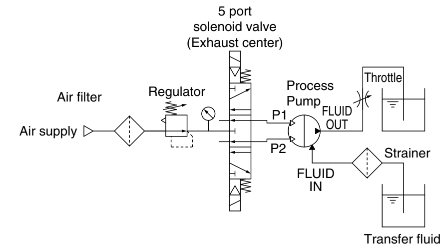
Note 2) For the solenoid valve, use an exhaust center 5 port valve, or a combination of residual exhaust 3 port valve and a pump drive 4 port valve. If air in the drive chamber is not released when the pump is stopped, the diaphragm will be subjected to pressure and its life will be shortened.

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>

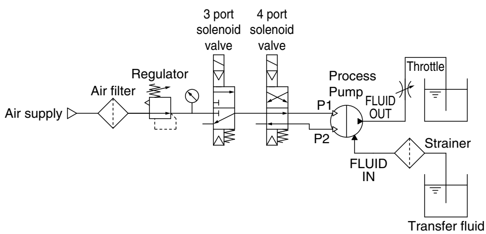
1. The flow rate from the discharge port <FLUID OUT> can be adjusted easily by changing the switching cycle of the solenoid valve on the air supply port.

Circuit example (1)



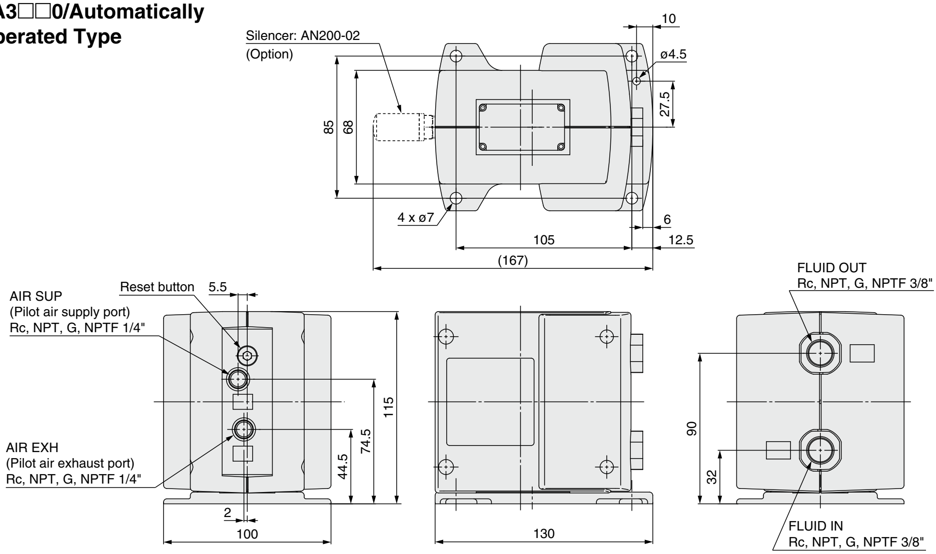
Circuit example (2)

For related products, refer to pages 932 and 933.

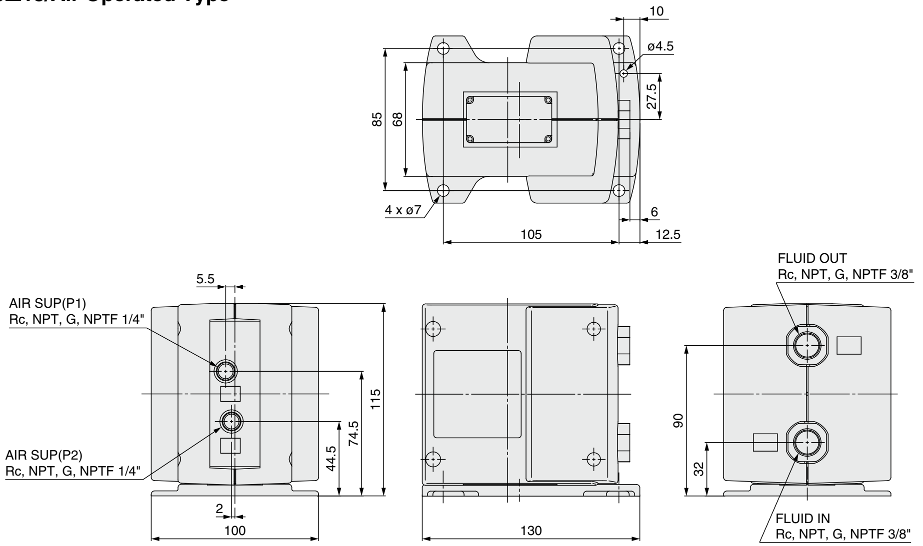


Dimensions

PA3□□0/Automatically Operated Type

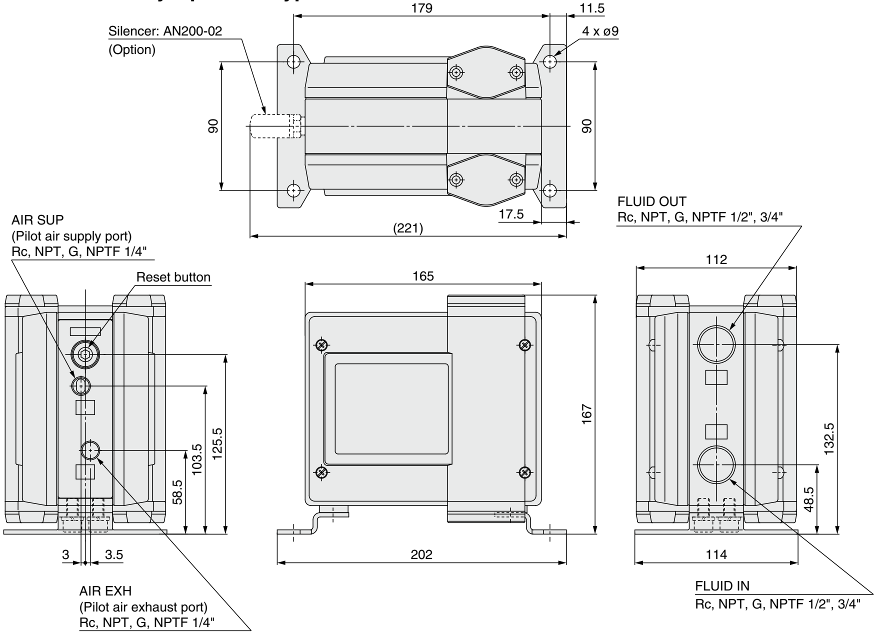


PA3□13/Air Operated Type

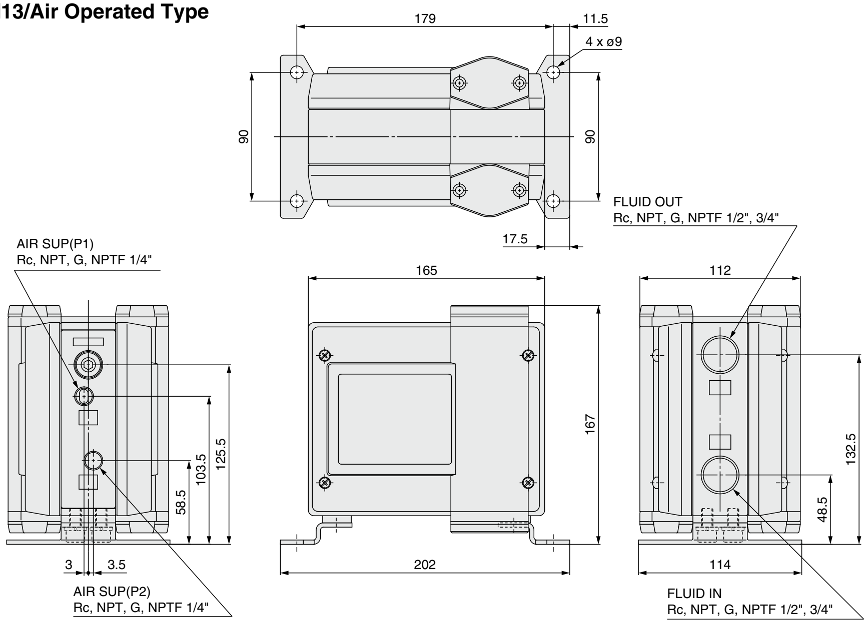


Dimensions

PA5□□0/Automatically Operated Type



PA5□13/Air Operated Type



Process Pump

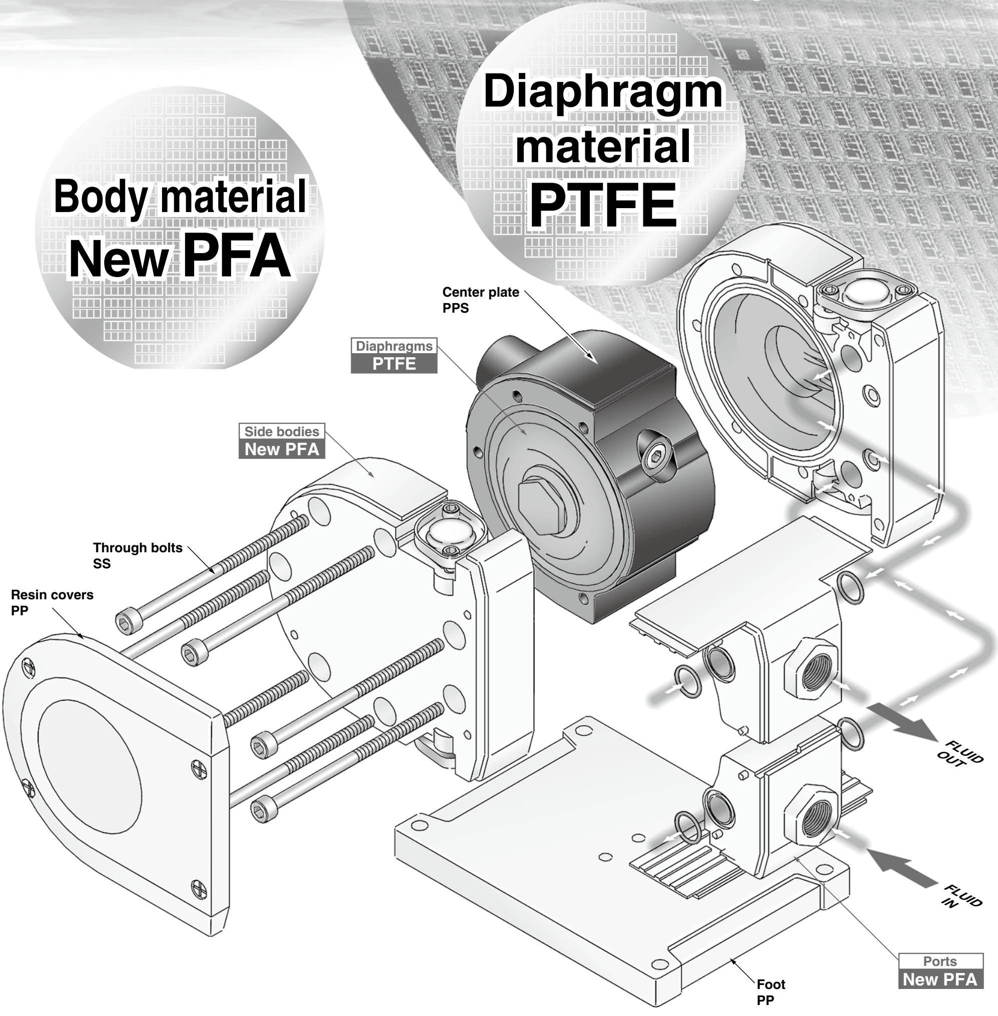
Series PAP3000

Fluororesin Type

RoHS

Body material made from New PFA for superior corrosion resistance.

With the use of New PFA for body material,

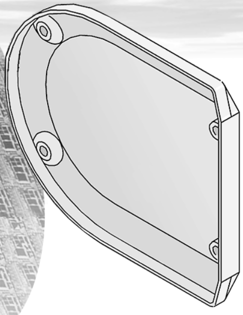


Variations

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

high corrosion resistance is achieved!



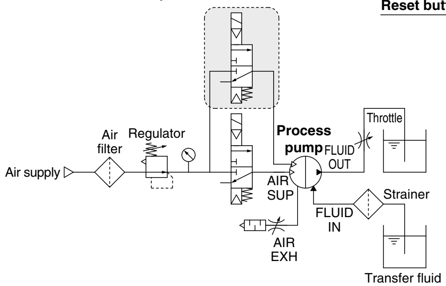
Clean

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



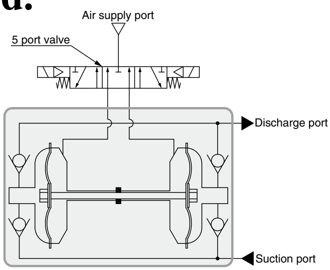
Compact & Lightweight (Without foot)

Weight: 2.1 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.**



PA
PAP
PAX
PB
PAF
PA□ PB

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

RoHS

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

PAP331 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

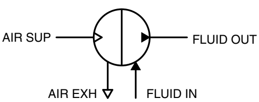
Option

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

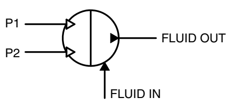
* When option is more than one, suffix in alphabetical order.

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

PAP331 [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

PAP331 [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.)

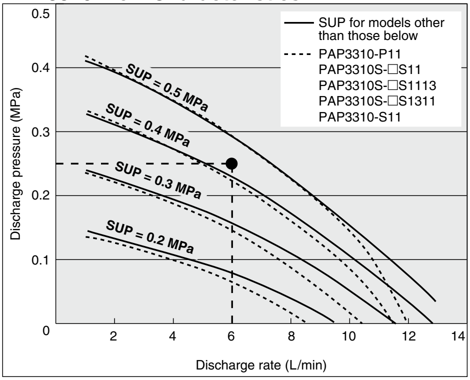
Specifications

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, AN20)		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	
Weight		2.1 kg (without foot)			
Mounting orientation		Horizontal (with mounting foot at bottom)			
Packaging		General environment	Clean double packaging	General environment	Clean double packaging

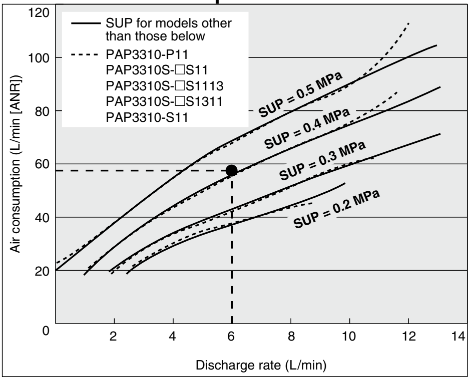
∗ Each value of above represents at normal temperatures with fresh water.
∗ Refer to page 931 for maintenance parts.
∗ For related products, refer to pages 932 and 933.
Note 1) The discharge rates for PAP3310-P11, PAP3310S-☐S11, PAP3310S-☐S1113, PAP3310S-☐S1311, PAP3310-S11 are between 1 to 12 L/min.

Performance Curve: Automatically Operated Type

PAP3310 Flow Characteristics



PAP3310 Air Consumption



Selection from Flow Characteristic Graph (PAP3310)

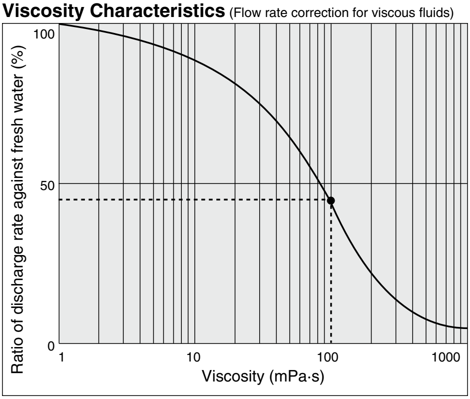
Required specifications example:
Find the pilot air pressure and pilot air consumption for a discharge rate of 6 L/min and a discharge pressure of 0.25 MPa. <The transfer fluid is fresh water (viscosity 1 mPa·s, specific gravity 1.0).
∗ If the total lifting height is required instead of the discharge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

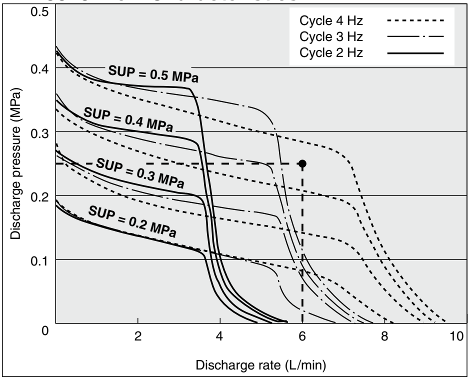
$$\nu = \frac{\mu}{\rho}$$

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

PA
PAP
PAX
PB
PAF
PA□ PB

Performance Curve: Air Operated Type

PAP3313 Flow Characteristics



Selection from Flow Characteristic Graph (PAP3313)

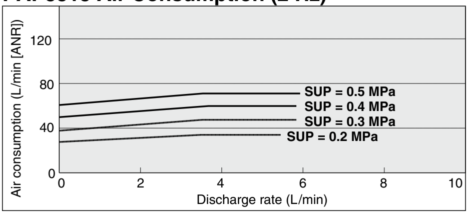
Required specification example: Find the pilot air pressure for a discharge rate of 6 L/min, a discharge pressure of 0.25 MPa, and a cycle of 4 Hz. <The transfer fluid is fresh water (viscosity 1 mPa·s, specific gravity 1.0).>

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.

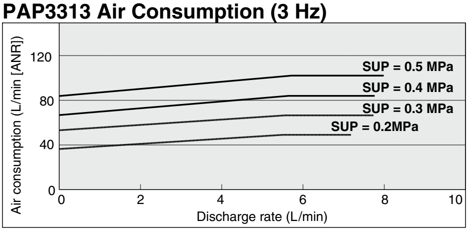
Selection procedures:

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.

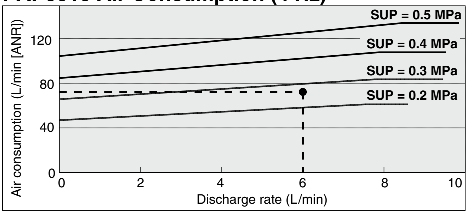
PAP3313 Air Consumption (2 Hz)



PAP3313 Air Consumption (3 Hz)



PAP3313 Air Consumption (4 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.

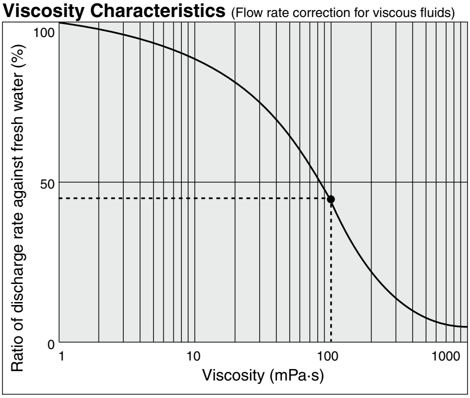
Selection procedures:

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.

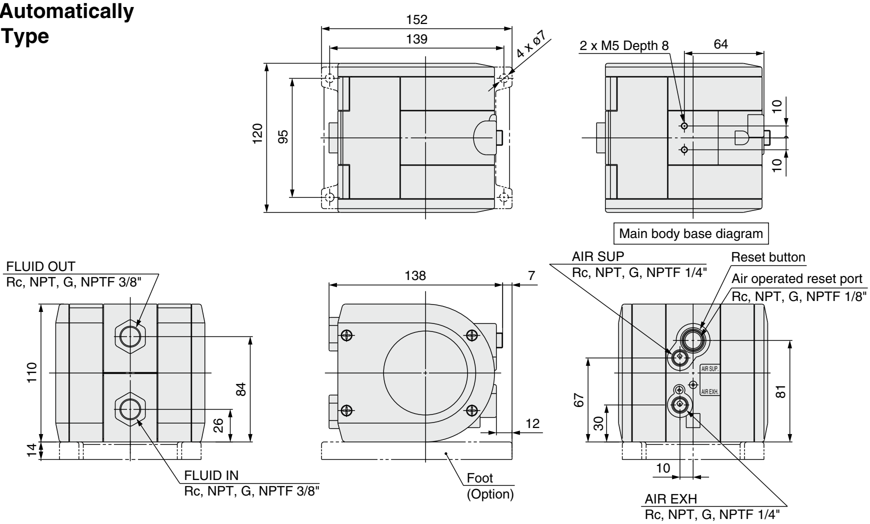
Dynamic viscosity ν = Viscosity μ/Density ρ.

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

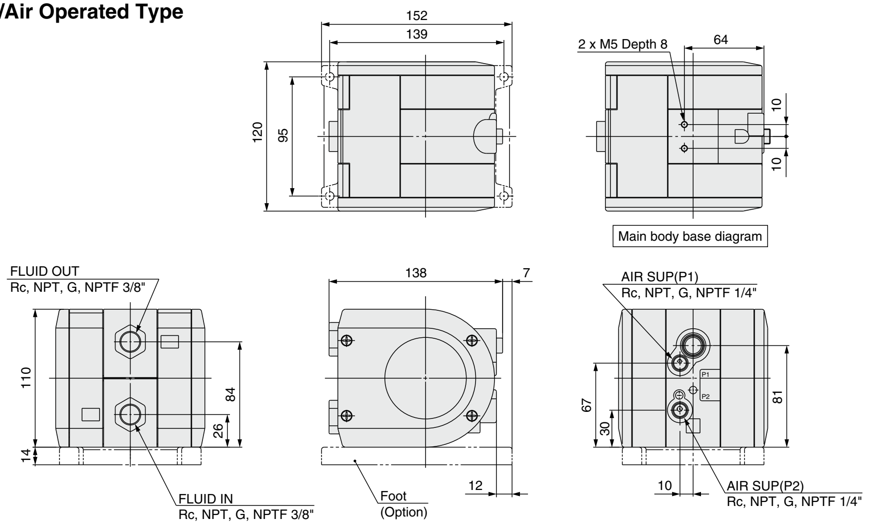
$\nu(10^{-3}\ m^2/s) = \mu(mPa\cdot s)/\rho(kg/m^3)$

Dimensions

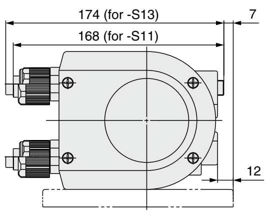
PAP3310/Automatically Operated Type



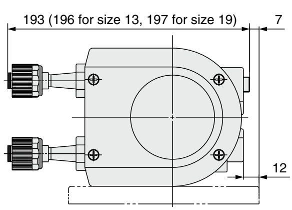
PAP3313/Air Operated Type



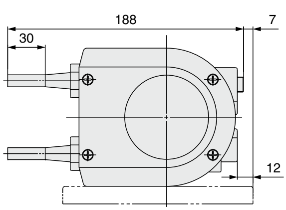
Integral fitting type



With nut



Tube extension



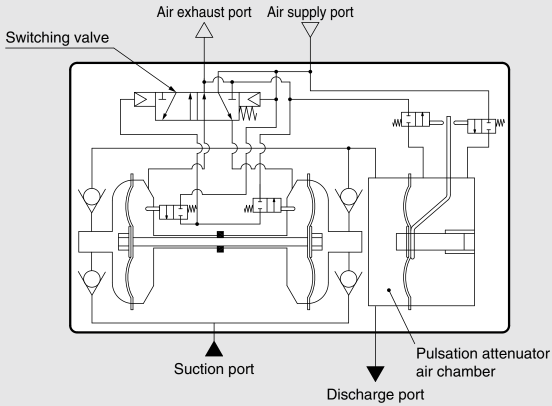
Process Pump

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

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

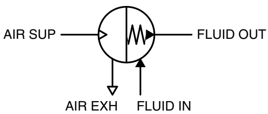
Symbol	Port size
02	1/4"
03	3/8"

Option

Symbol	Option
Nil	Body only
N	With silencer *

* For AIR EXH: AN20-02

Symbol



Automatically operated type, built-in pulsation attenuator

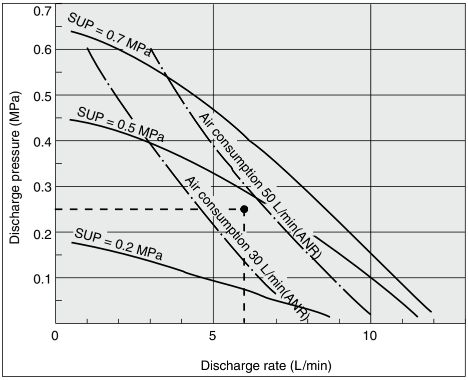
Specifications

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, AN20)	
Withstand pressure		1.05 MPa	
Diaphragm life		50 million cycles (For water)	
Fluid temperature		0 to 60°C (No freezing)	
Ambient temperature		0 to 60°C (No freezing)	
Weight		2.0 kg	3.5 kg
Mounting position		Horizontal (Bottom facing down)	
Packaging		General environment	

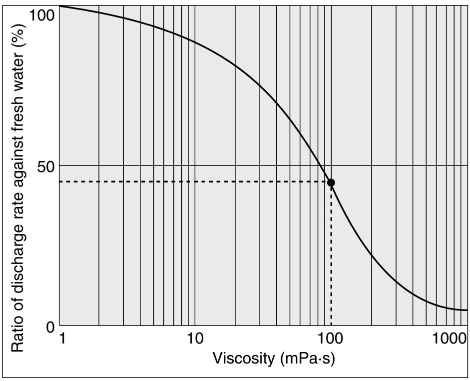
* Each of the values above are for normal temperatures and when the transferred fluid is fresh water.
* Refer to page 931 for maintenance parts.
* Refer to pages 932 and 933 for related products.

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 based on selection from the flow characteristic graphs.

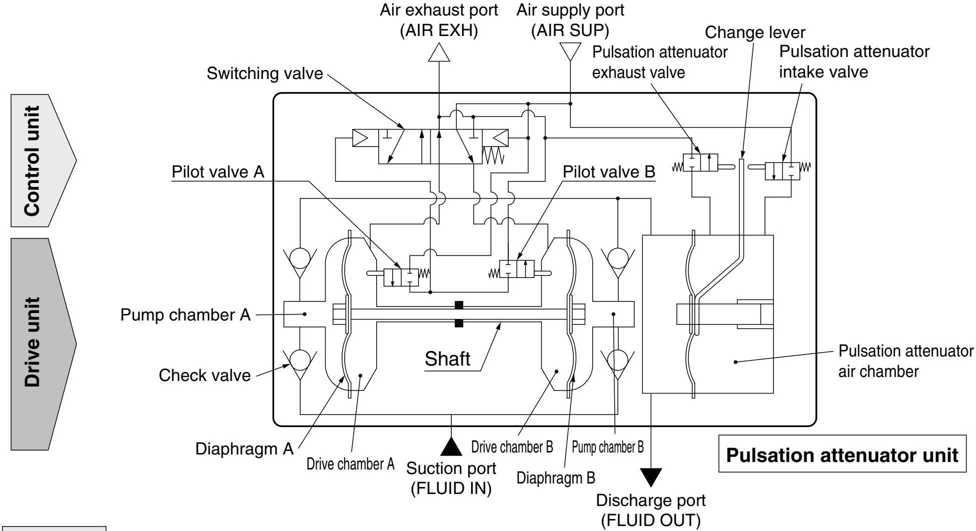
⚠ Caution

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, 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.

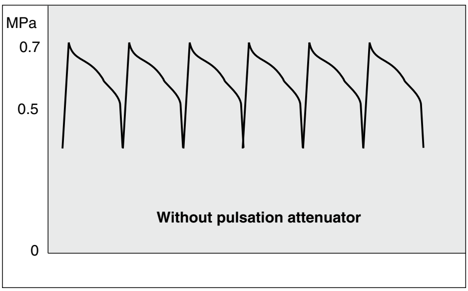
Drive unit

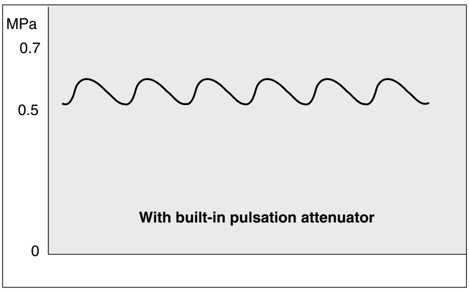
1. When air enters drive chamber B, the fluid in pump chamber B is forced out, and at the same time fluid is sucked into pump chamber A.
2. When the diaphragm moves in the opposite direction, the fluid in pump chamber A is forced out, and fluid is sucked into pump chamber B.
3. The pressure of the fluid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

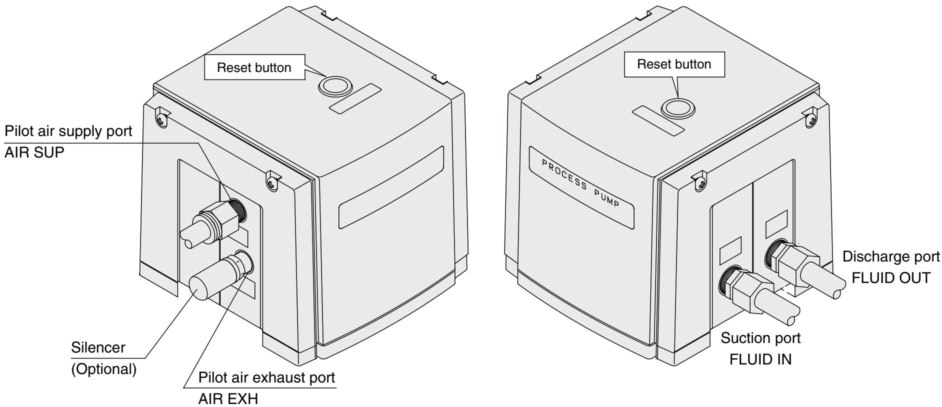




The process pump generates pulsation because it discharges a liquid using two diaphragms. The pulsation attenuator absorbs pressure when discharge pressure increases, and compensates the pressure when discharge pressure decreases. By this means pulsation is controlled.

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 throttle 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 (AN20-02: 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 throttle on the discharge side is closed.

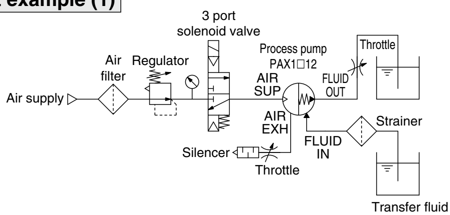
<Discharge Flow Rate Adjustment>

1. Adjustment of the flow rate from the discharge port <FLUID OUT> is performed with the throttle 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). (Adjust the throttle on the air side so that the exhaust air is fully exhausted.)
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)

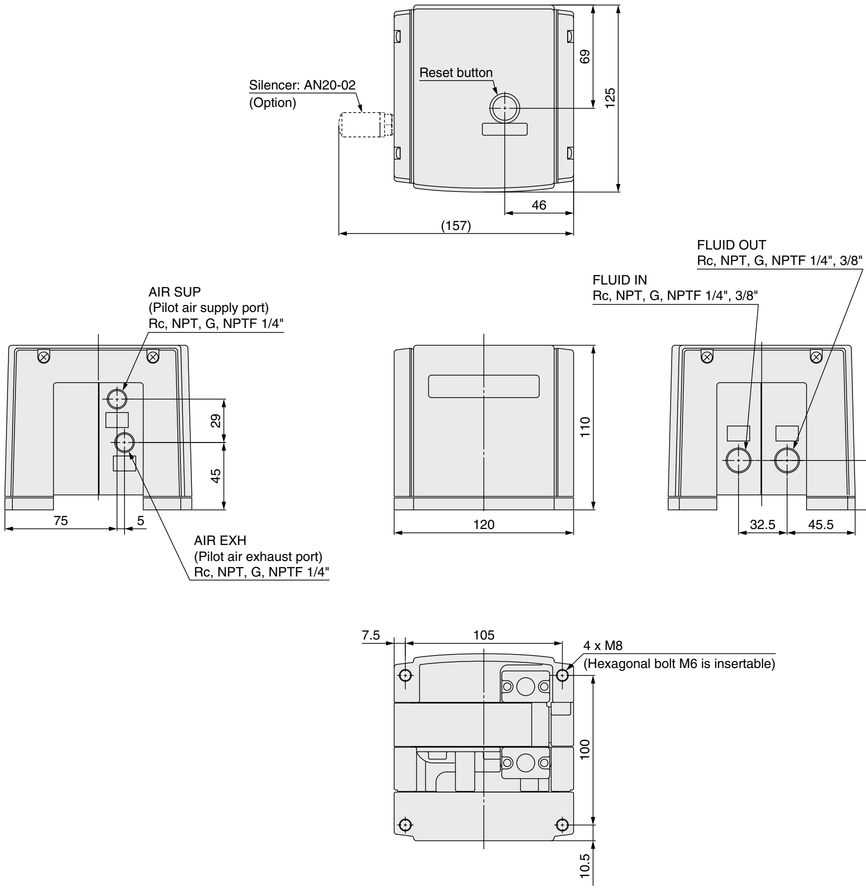
<Reset Button>

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: AN20-02
(Option)
Reset button
69
125
46
(157)
FLUID OUT
Rc, NPT, G, NPTF 1/4", 3/8"
FLUID IN
Rc, NPT, G, NPTF 1/4", 3/8"
AIR SUP
(Pilot air supply port)
Rc, NPT, G, NPTF 1/4"
29
45
75
5
AIR EXH
(Pilot air exhaust port)
Rc, NPT, G, NPTF 1/4"
110
120
33
32.5
45.5
7.5
105
4 x M8
(Hexagonal bolt M6 is insertable)
100
10.5