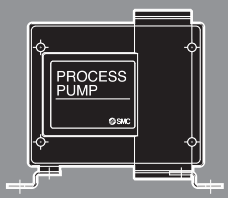


Process Pump

RoHS

Series PA3000/5000/PAX1000

Series PA5000

Series PA3000

Series PAX1000

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

Compact, high capacity transfer and recovery of

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

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

Self-priming makes priming unnecessary

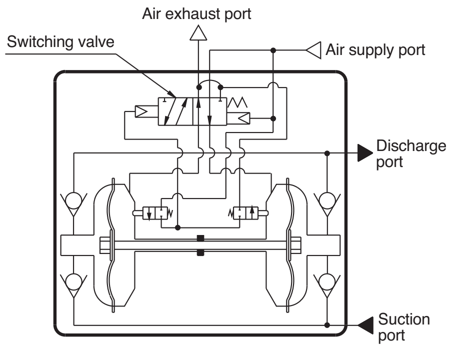
Process Pump
Series PA3000/5000

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

Automatically operated type

Compatible with a wide variety of fluids

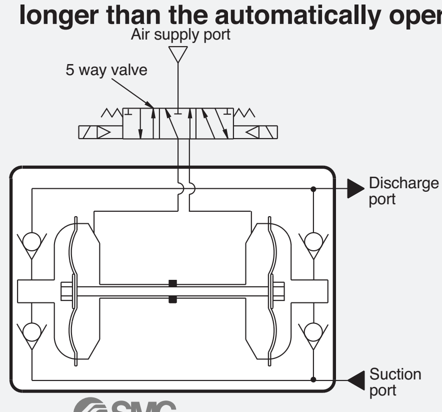
- **PA3000: Max. 20 L/min**
- **PA5000: Max. 45 L/min**

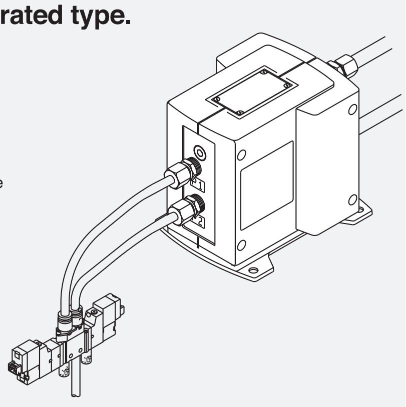


Air operated type

Control with external switching valve makes constant cycling possible

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





diaphragm pump for a wide variety of fluids

Process Pump Variations

Series PA/Double acting pump

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

Built-in pulsation attenuator

Process Pump

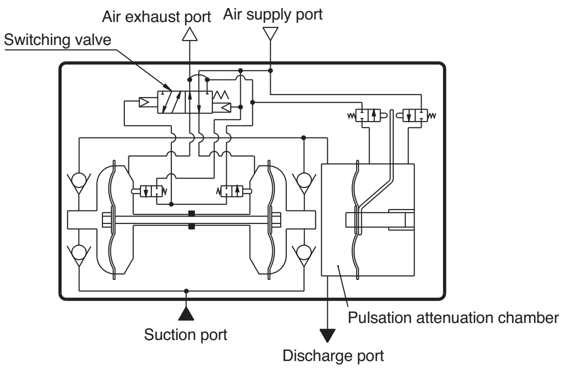
Series PAX1000

Automatically operated type

(internal switching type)

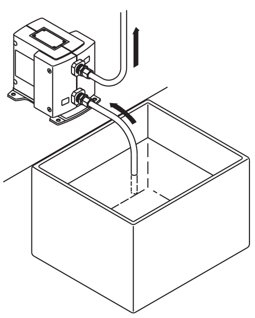
Prevents spraying of discharge and foaming in tank

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

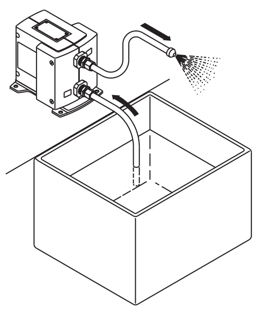


Application examples

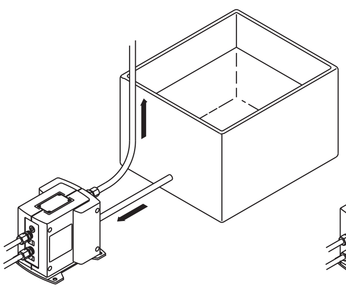
Transfer of liquid by suction



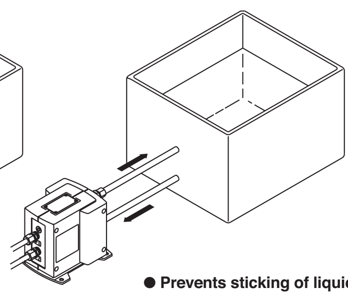
Atomizing of liquid



Transfer of liquid by pressure



Stirring of liquid



● Prevents sticking of liquids

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

RoHS

PA3000

PA5000

How to Order

PA 3 1 1 0 – □ 03 – □

Body size

3	3/8 standard
5	1/2 standard

Material of body wetted areas

1	ADC12 (aluminum)
2	SCS14 (stainless steel)

Diaphragm material

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

Actuation

Symbol	Actuation
0	Automatically operated
3	Air operated

Thread type

Nil	Rc
T	NPTF
F	G
N	NPT

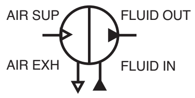
Connection port size

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

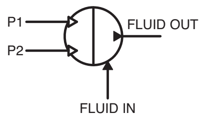
Option

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

Symbol



Automatically operated type



Air operated type

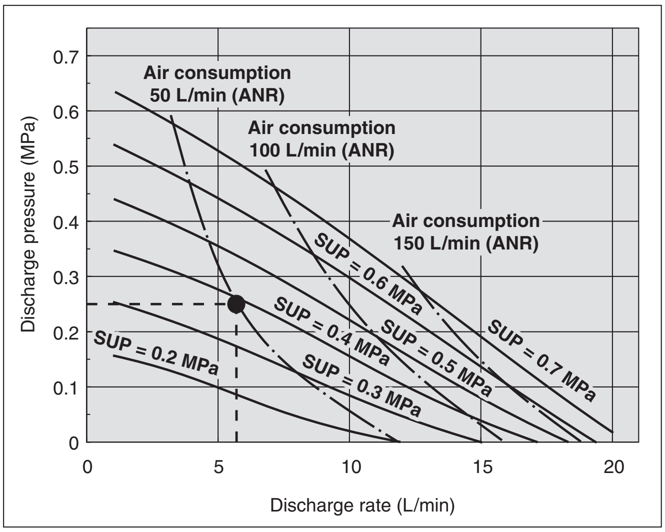
Specifications

Model		PA31□0	PA32□0	PA51□0	PA52□0	PA3113	PA3213	PA5113	PA5213
		Automatically operated type				Air operated type			
Actuation		Automatically operated				Air operated			
Port size	Main fluid suction/ discharge port	Rc, NPT, G, NPTF 3/8 Female thread		Rc, NPT, G, NPTF 1/2, 3/4 Female thread		Rc, NPT, G, NPTF 3/8 Female thread		Rc, NPT, G, NPTF 1/2, 3/4 Female thread	
	Pilot air supply/ exhaust port	Rc, NPT, G, NPTF 1/4 Female thread		Rc, NPT, G, NPTF 1/4 Female thread		Rc, NPT, G, NPTF 1/4 Female thread		Rc, NPT, G, NPTF 1/4 Female thread	
Material	Body wetted areas	ADC12	SCS14	ADC12	SCS14	ADC12	SCS14	ADC12	SCS14
	Diaphragm	PTFE, NBR				PTFE			
	Check valve	PTFE, PFA				PTFE, PFA			
Discharge rate		1 to 20 L/min		5 to 45 L/min		0.1 to 12 L/min		0.1 to 24 L/min	
Average discharge pressure		0 to 0.6 MPa		0 to 0.6 MPa		0 to 0.4 MPa		0 to 0.4 MPa	
Pilot air pressure		0.2 to 0.7 MPa		0.2 to 0.7 MPa		0.1 to 0.5 MPa		0.1 to 0.5 MPa	
Air consumption		Maximum 200 L/min (ANR)		Maximum 300 L/min (ANR)		Maximum 150 L/min (ANR)		Maximum 250 L/min (ANR)	
Suction lifting range	Dry	1 m (interior of pump dry)		Up to 2 m (interior of pump dry)		1 m (interior of pump dry)		Up to 0.5 m (interior of pump dry)	
	Wet	Up to 6 m (liquid inside pump)				Up to 6 m (liquid inside pump)			
Noise		80 dB (A) or less (Option: with silencer, AN20)		78 dB (A) or less (Option: with silencer, AN20)		72 dB (A) or less (excluding the noise from the quick exhaust and solenoid valve)			
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		—				0.20		0.45	
Diaphragm life		PA3□10: 100 million times PA3□20: 50 million times		50 million times		50 million times			
Fluid temperature		0 to 60°C (with no freezing)				0 to 60°C (with no freezing)			
Ambient temperature		0 to 60°C (with no freezing)				0 to 60°C (with no freezing)			
Withstand pressure		1.05 MPa				0.75 MPa			
Mounting position		Horizontal (with mounting foot at bottom)				Horizontal (with mounting foot at bottom)			
Weight		1.7 kg	2.2 kg	3.5 kg	6.5 kg	1.7 kg	2.2 kg	3.5 kg	6.5 kg
Packaging		General enviroment				General enviroment			

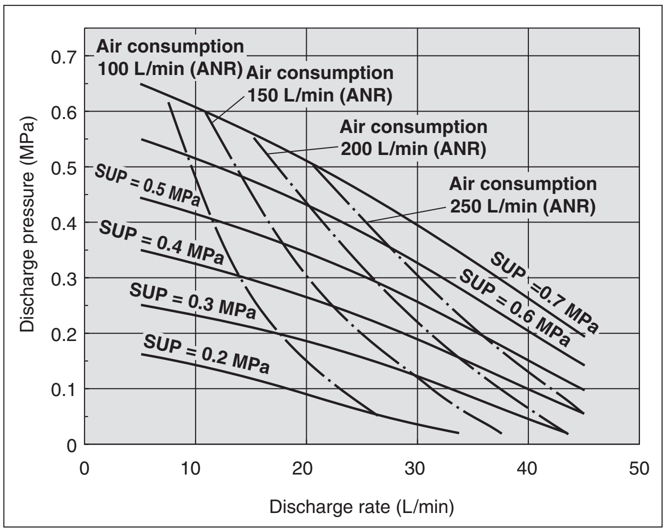
∗ Each of the values above indicates use at ordinary temperatures with fresh water.
Note 1) With cycles at 2 Hz or more
Note 2) After initial suction of liquid operating at 1 to 7 Hz, it can be used with operation at lower cycles.
Since a large quantity of liquid will be pumped out, use a suitable throttle 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 Curves/Automatically Operated Type

PA3□□0 Flow Characteristics



PA5□□0 Flow Characteristics



Selection from flow rate characteristic graphs (PA3000)

Required specification example:

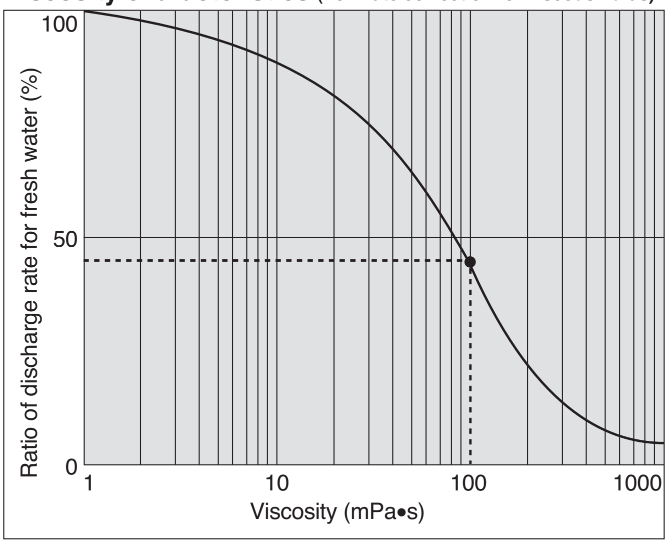
Find the pilot air pressure and pilot air consumption for a discharge rate of 6 L/min and a total lifting range of 25m. [The transfer fluid is fresh water (viscosity 1mPa•S, specific gravity 1.0).]

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

Selection procedures

1. First mark the intersection point for a discharge rate of 6 L/min and a lifting range of 25 m.
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).

Viscosity characteristics (flow rate correction for viscous fluids)



⚠Caution

1. These flow rate characteristics are for fresh water (viscosity 1mPa•s, specific gravity 1.0).
2. The discharge rate differs greatly depending on properties (viscosity, specific gravity) of the fluid being transferred and operating conditions (lifting range, transfer distance), etc.
3. Use 0.75kW per 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 total lifting range of 25m, and a viscosity of 100mPa•s.

Selection procedures

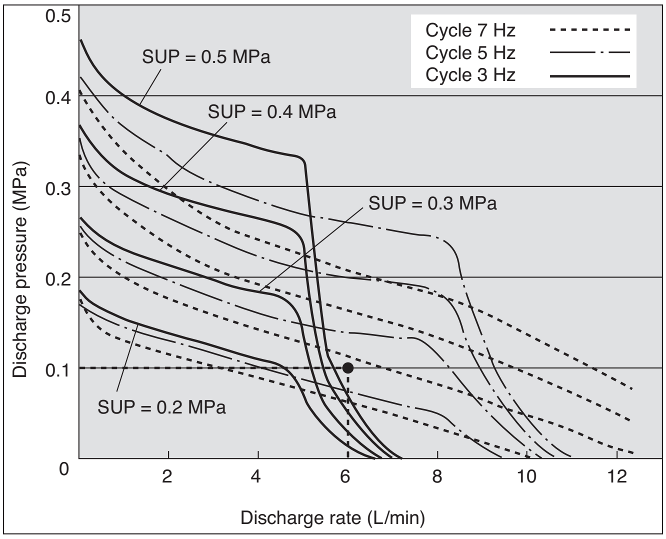
1. First find the ratio of the discharge rate for fresh water when viscosity is 100mPa•s from the graph below. It is determined to be 45%.
2. Next, in the required specification example, the viscosity is 100mPa•s and the discharge rate is 2.7 L/min. Since this is equivalent to 45% of the discharge rate 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 rate characteristic graphs.

⚠Caution

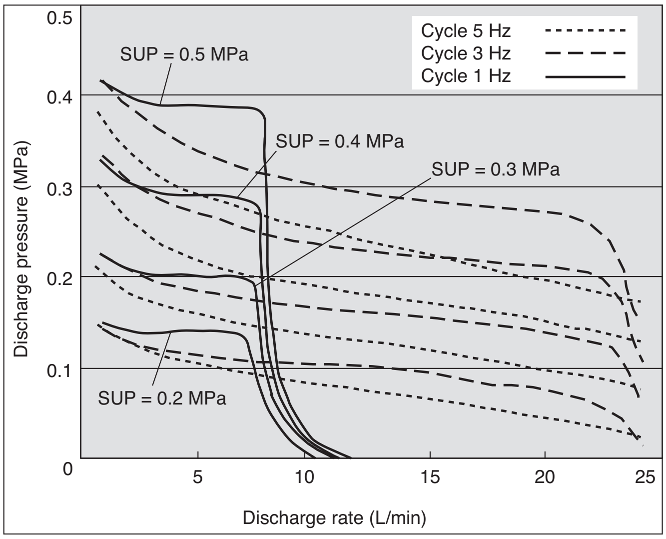
Viscosities up to 1000mPa•s can be used.

Performance Curve: Air Operated Type

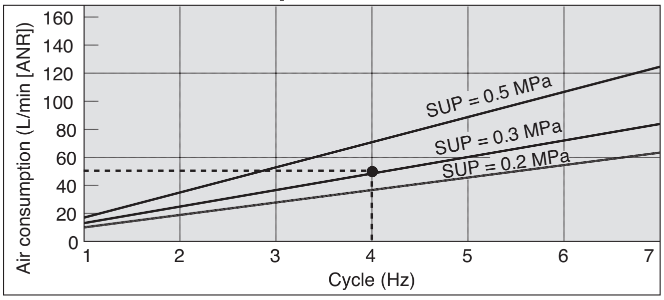
PA3□13 Flow Characteristics



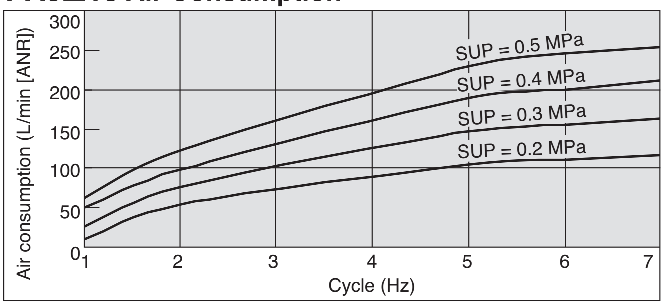
PA5□13 Flow Characteristics



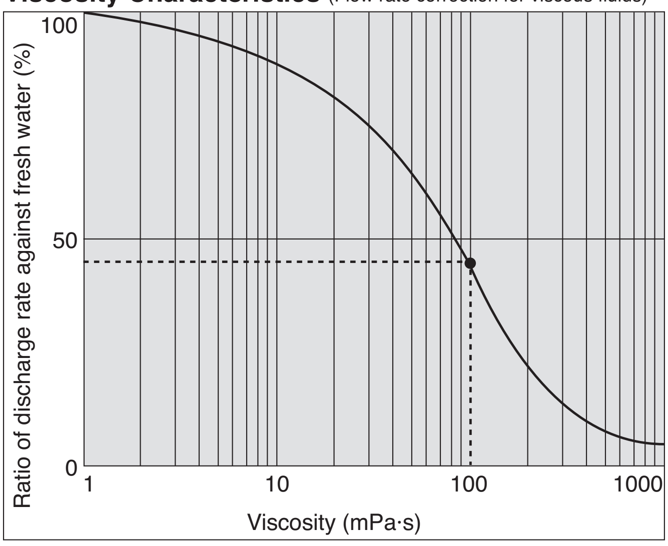
PA3□13 Air Consumption



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

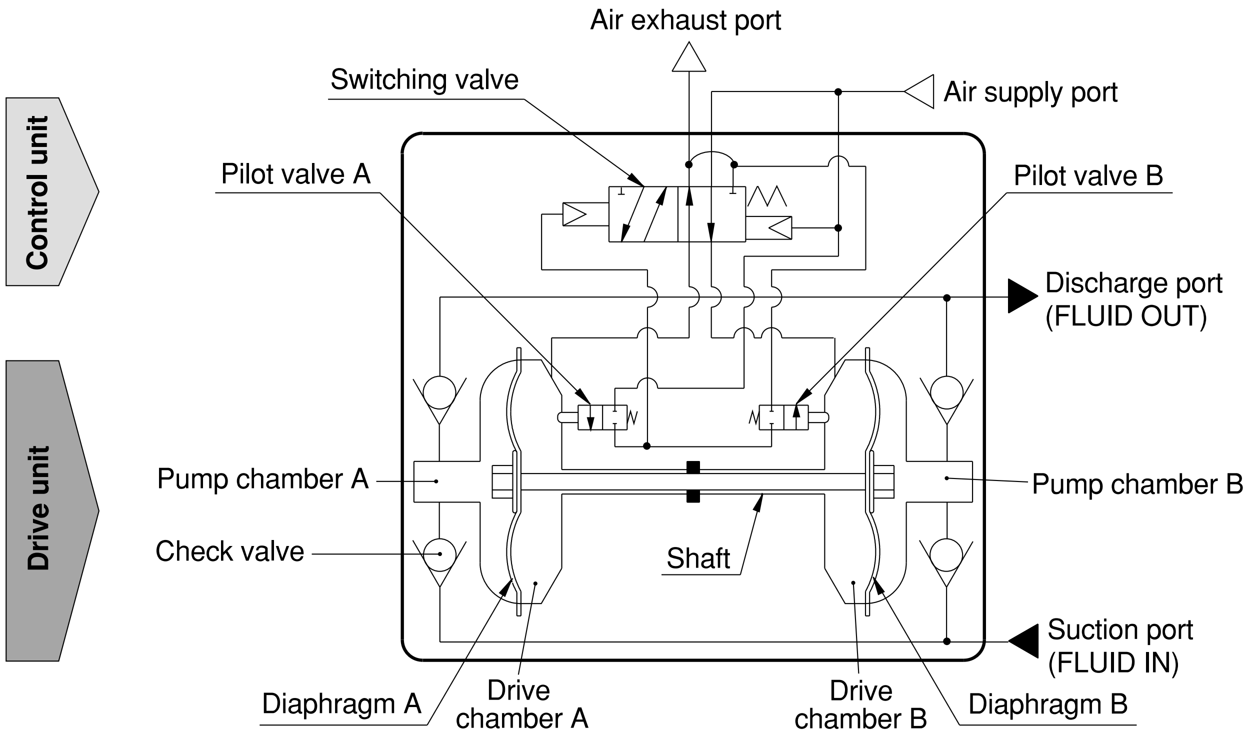
Viscosities up to 1000 mPa·s can be used.

Dynamic viscosity ν = Viscosity μ/Density ρ.

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

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

Operating Principle/Automatically Operated Type



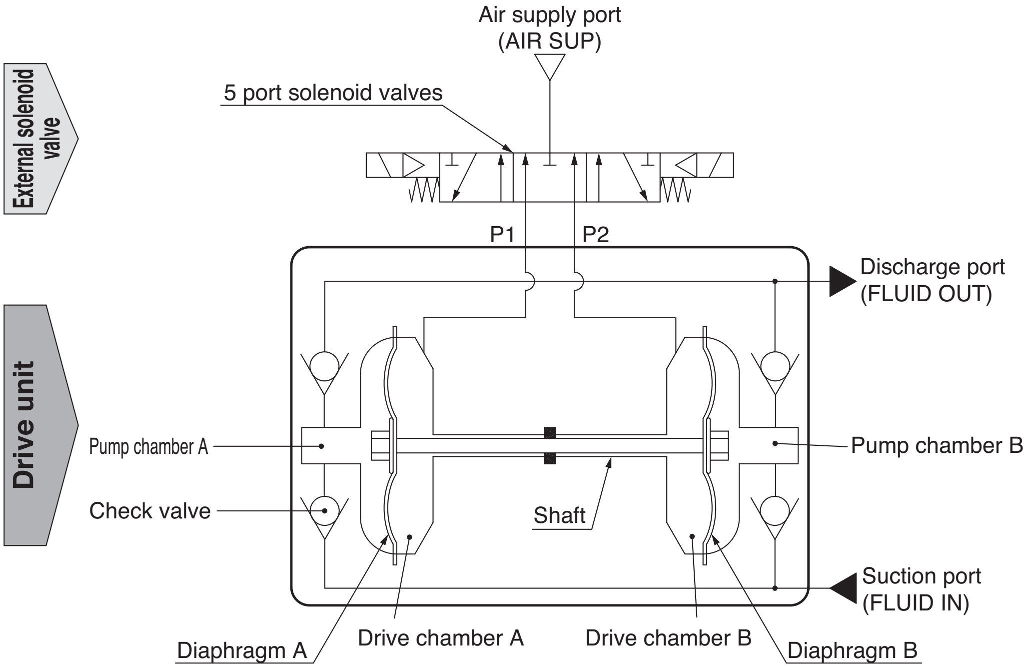
Control unit

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

Drive unit

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

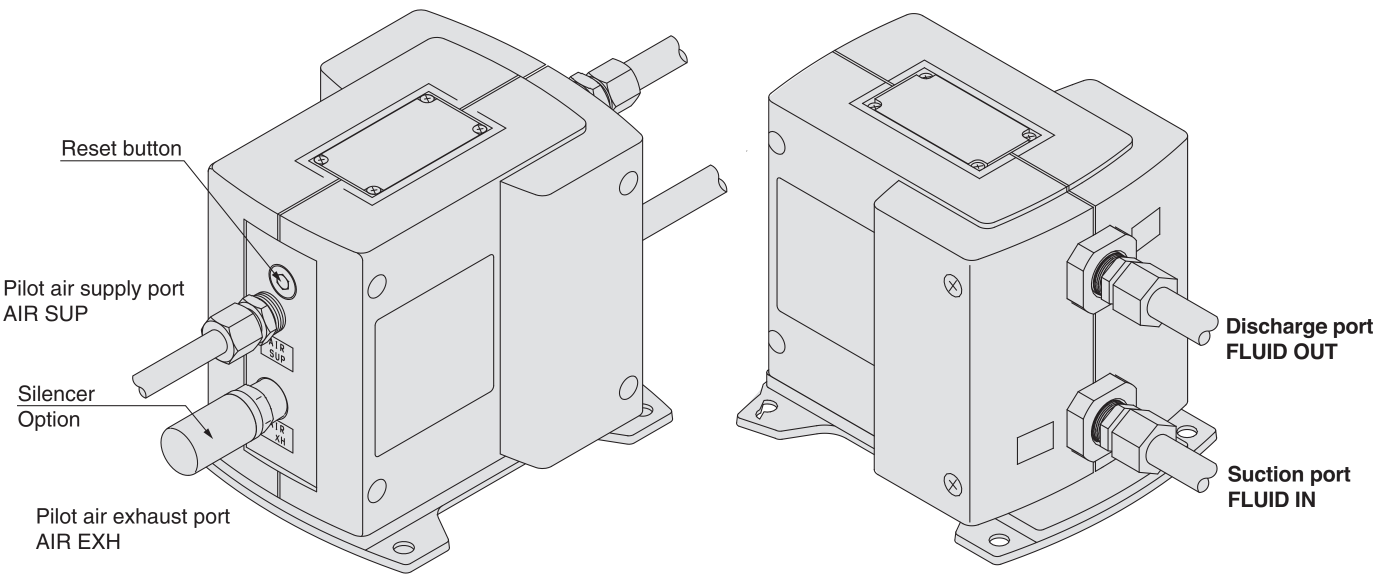
Air Operated Type



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

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

Operation

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

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

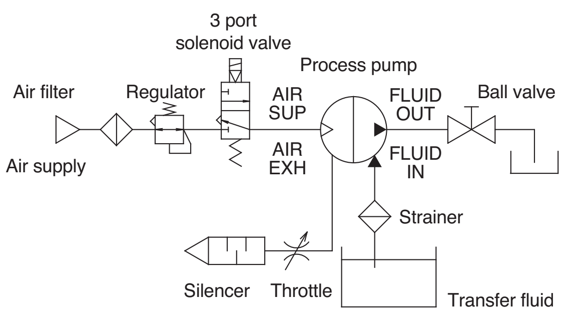
<Discharge Flow Rate Adjustment>

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

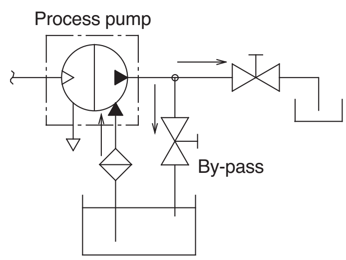
<Reset Button>

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

Circuit example (1)

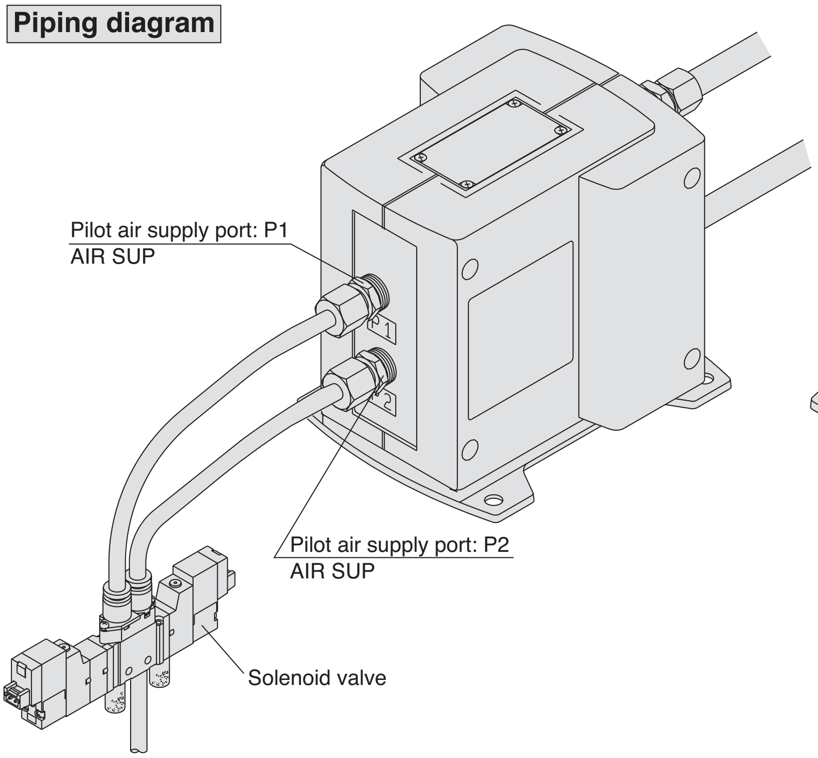


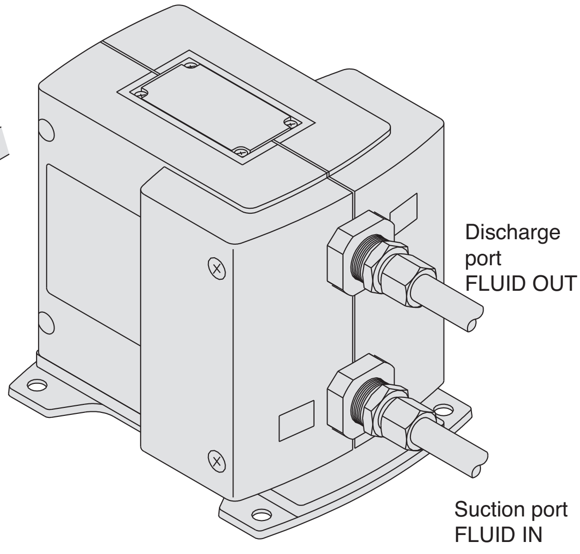
Circuit example (2)



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.

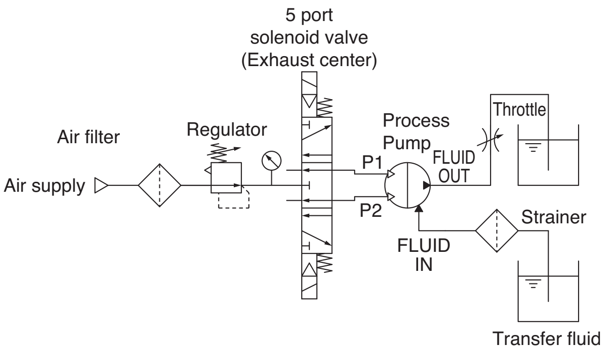
Note 2) For the solenoid valve, use an exhaust center 5 port valve, or a combination of residual exhaust 3 port valve and a pump drive 4 port valve. If air in the drive chamber is not released when the pump is stopped, the diaphragm will be subjected to pressure and its life will be shortened.

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.

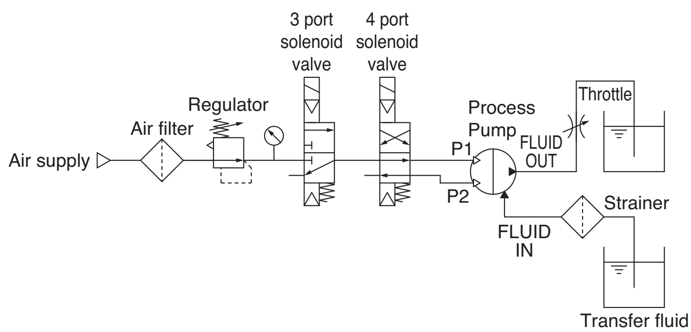
<Discharge Flow Rate Adjustment>

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)

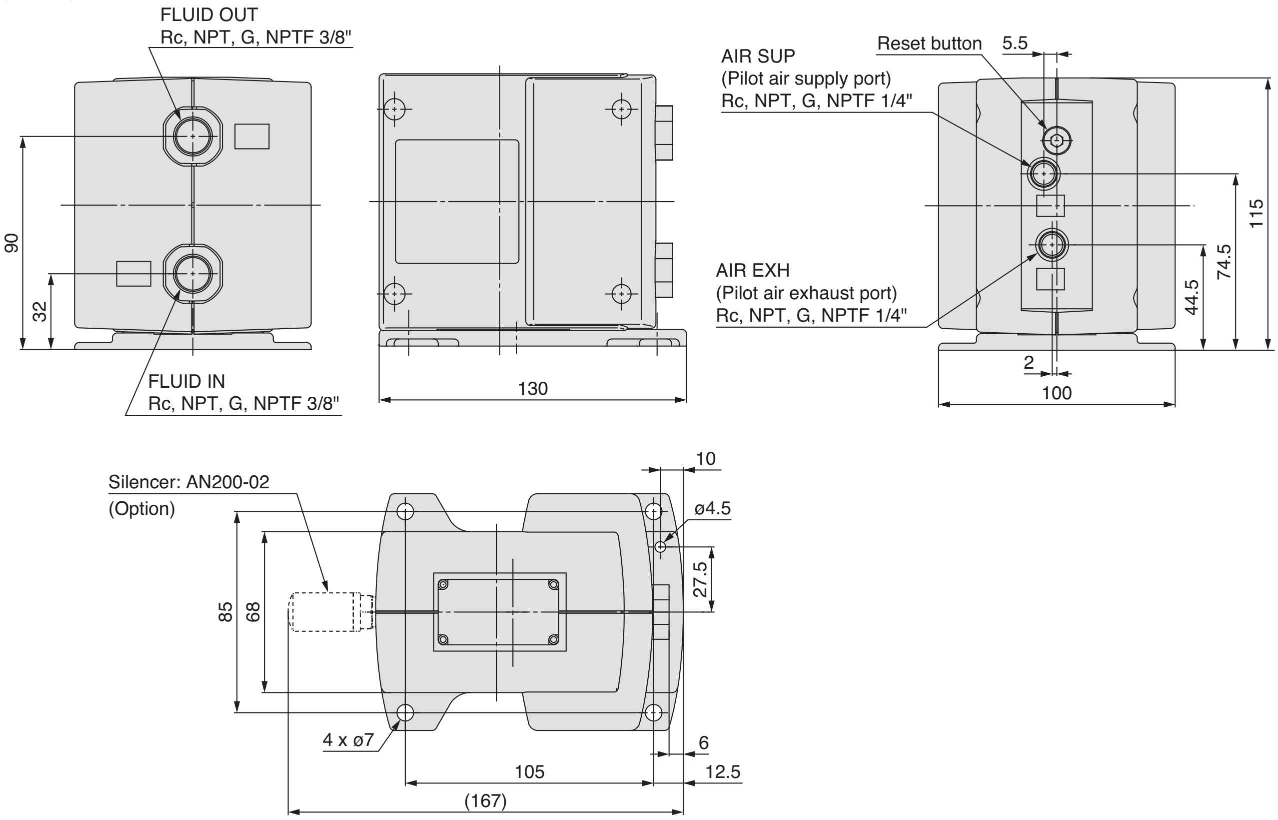


Circuit example (2)

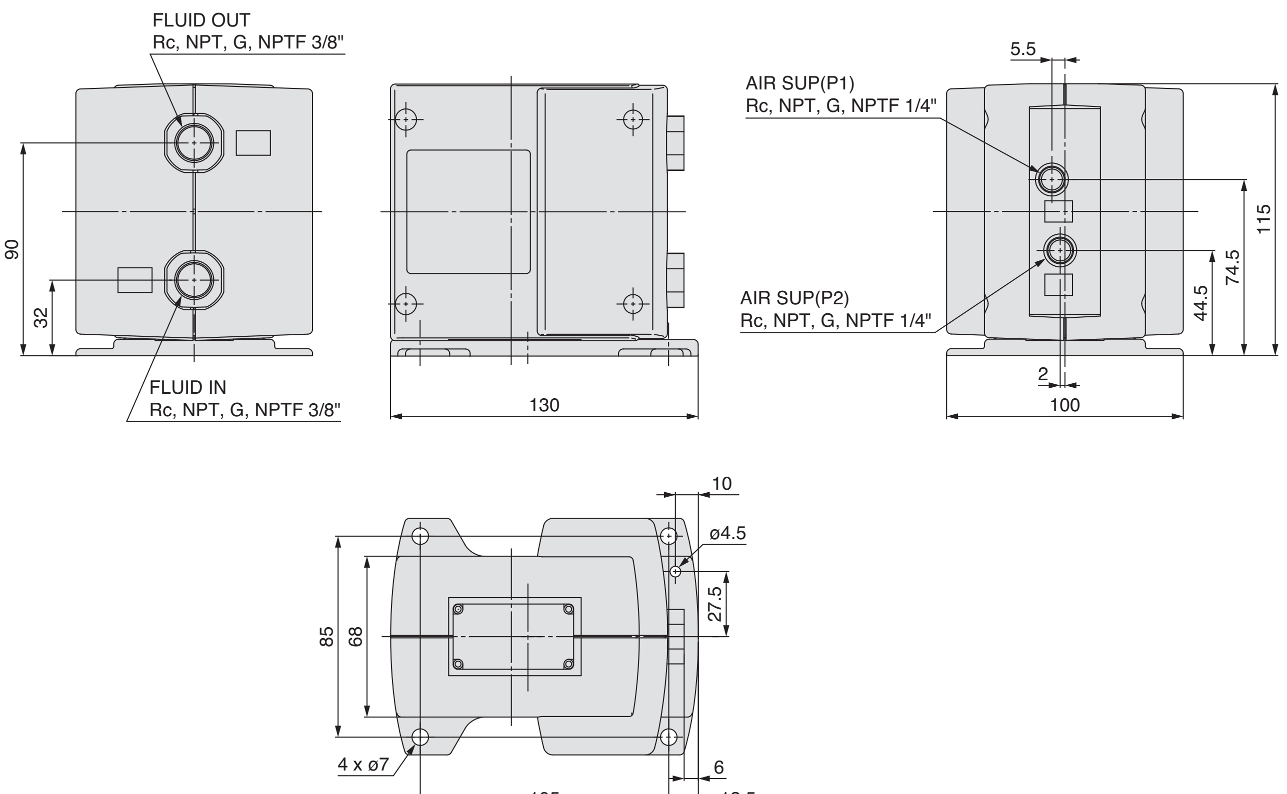


Dimensions/Automatically Operated Type

PA3□□0

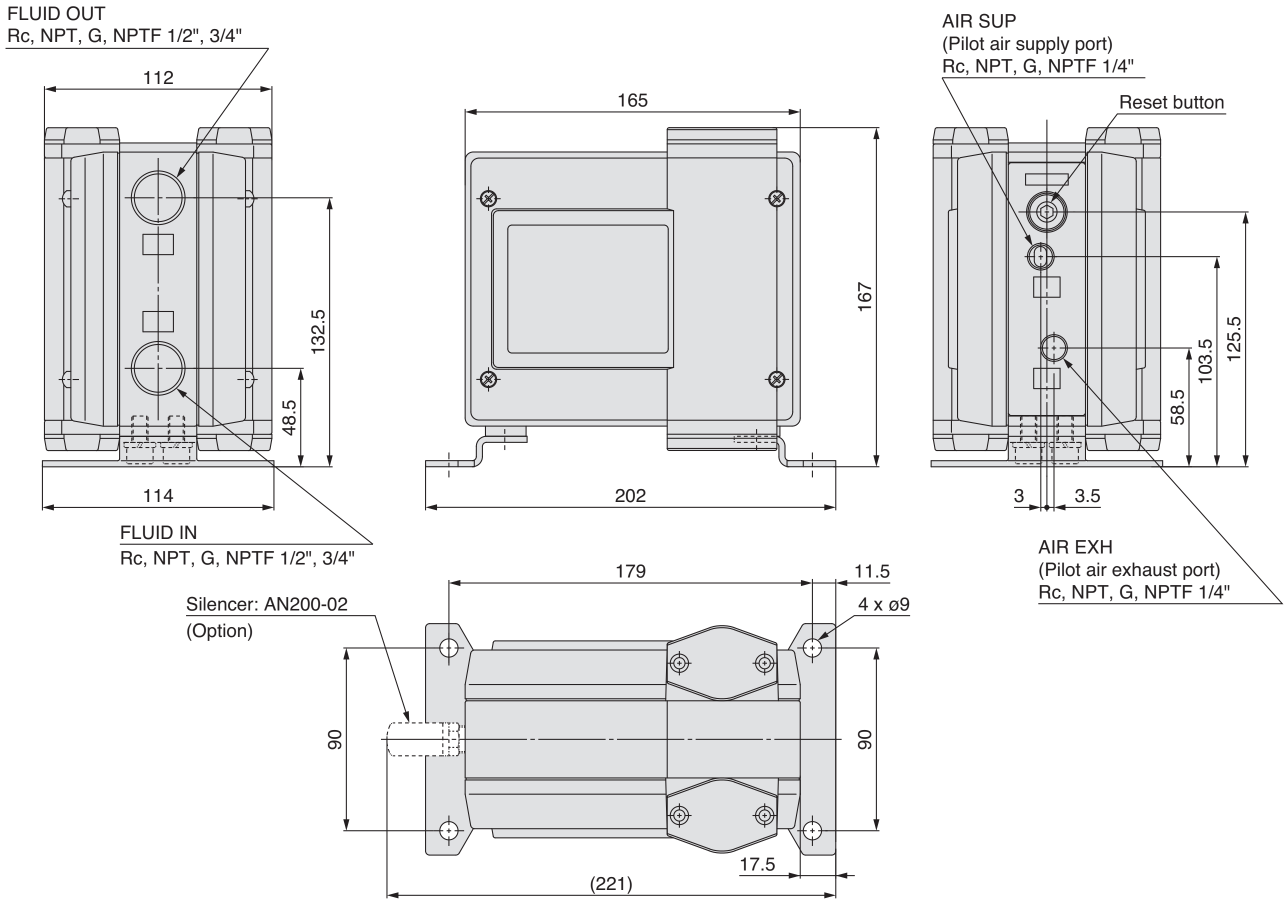


PA3□13/Air Operated Type

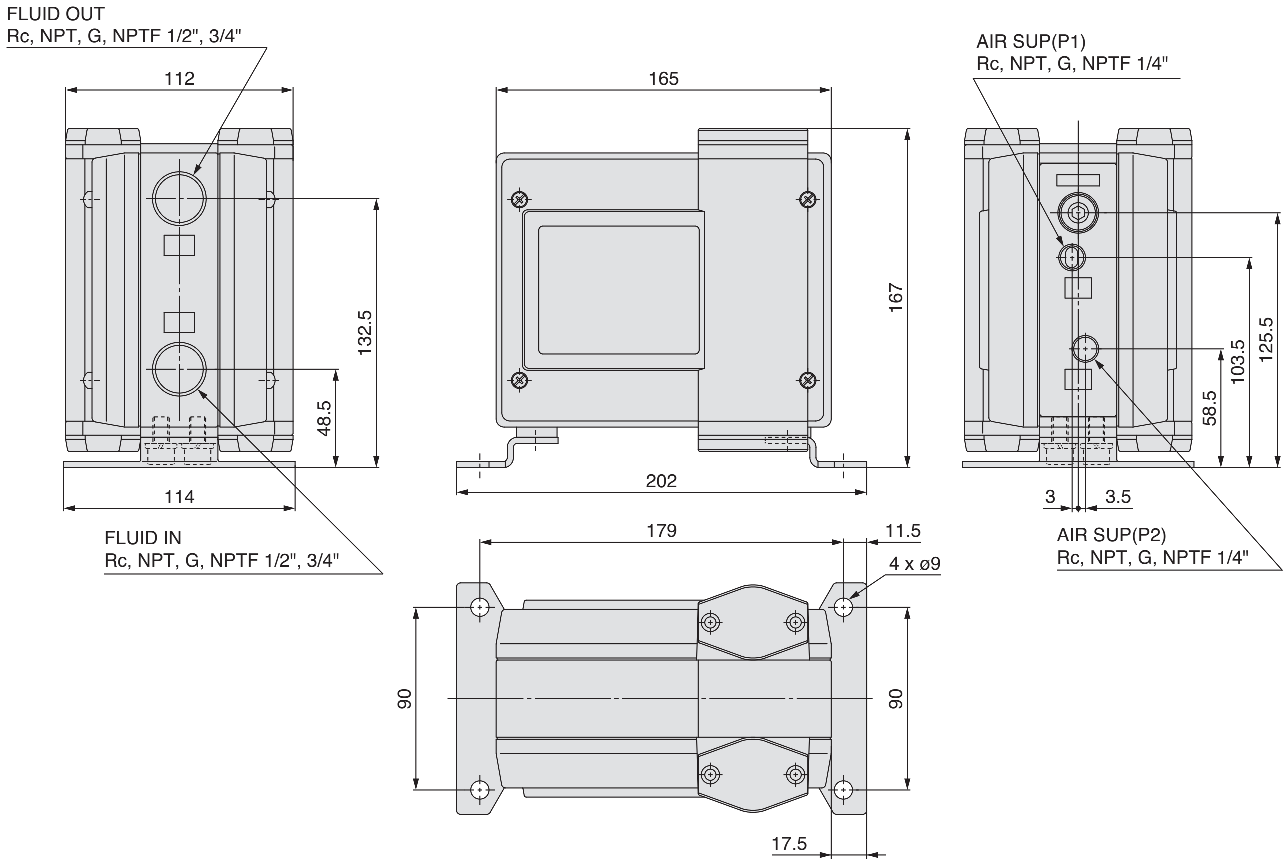


Dimensions

PA5□□0/Automatically Operated Type

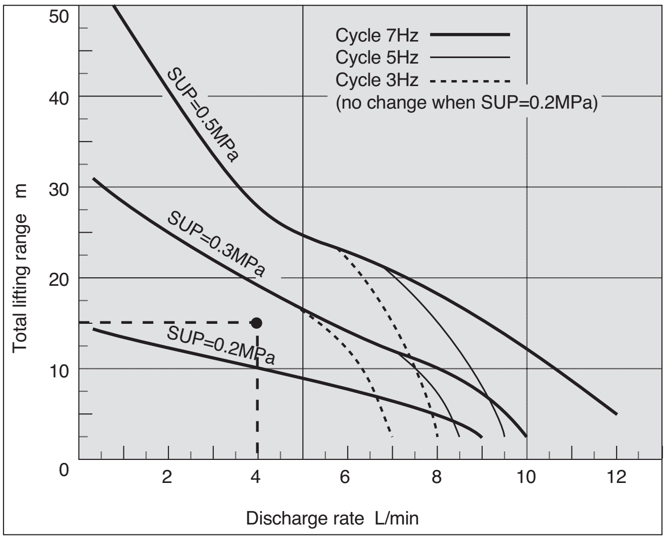


PA5□13/Air Operated Type

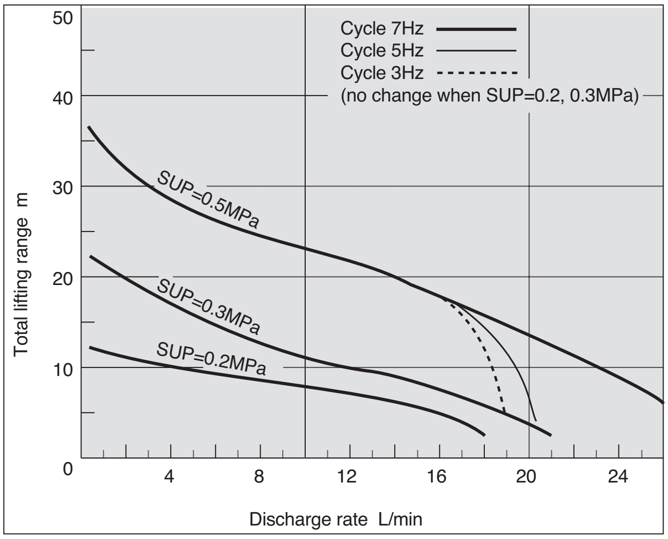


Performance Curves/Air Operated Type

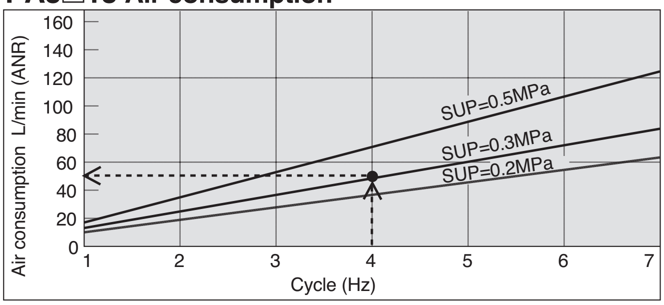
PA3□13 Flow rate characteristics



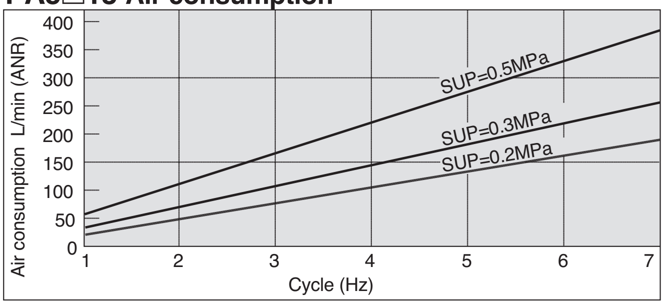
PA5□13 Flow rate characteristics



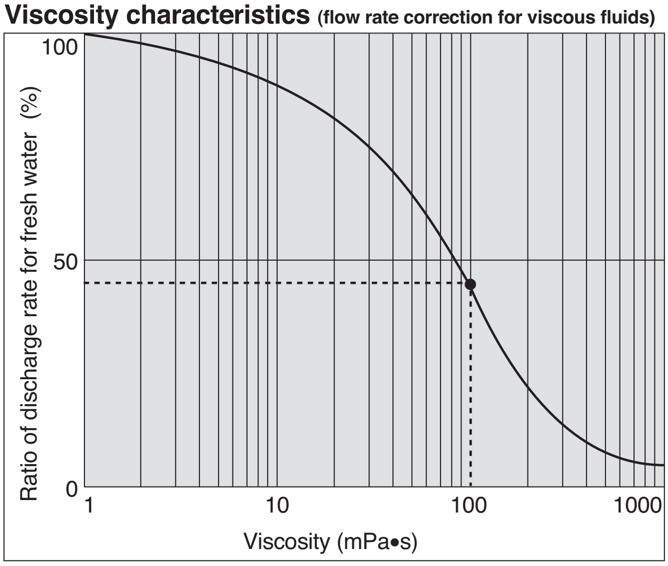
PA3□13 Air consumption



PA5□13 Air consumption



Viscosity characteristics (flow rate correction for viscous fluids)



Selection from flow rate characteristic graphs (for PA3000)

Required specification example:

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

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

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

Selection procedure

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

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

Calculating air consumption (for PA3000)

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

Selection procedure

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

⚠Caution

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

Selection from viscosity characteristic graph

Required specification example:

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

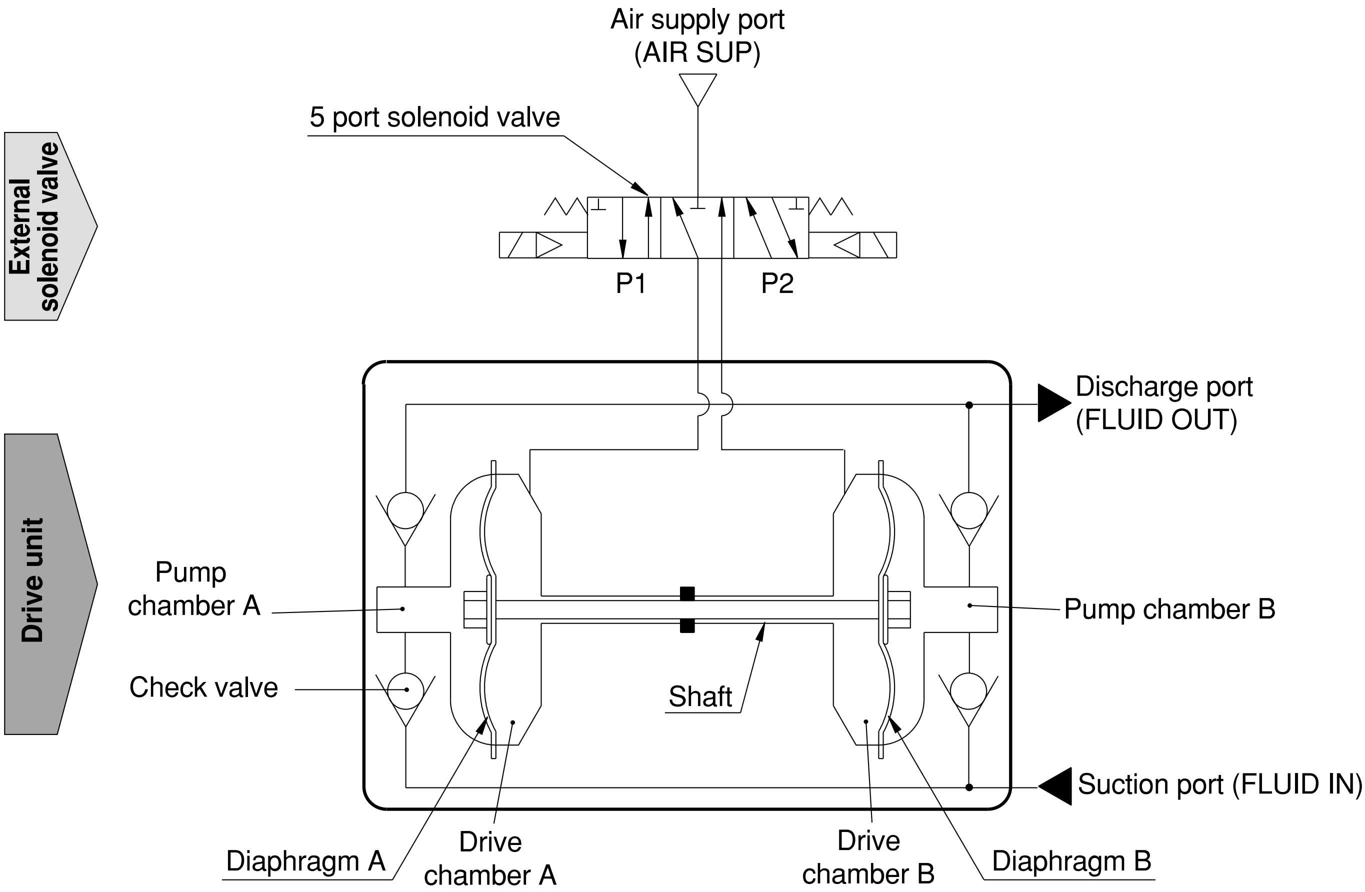
Selection procedure

1. First find the ratio of the discharge rate for fresh water when viscosity is 100mPa•s from the graph at the left. It is determined to be 45%.
2. Next, in the required specification example the viscosity is 100mPa◊s and the discharge rate is 2.7 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 rate based on selection from the flow rate characteristic graphs.

⚠Caution

Viscosities up to 1000mPa•s can be used.

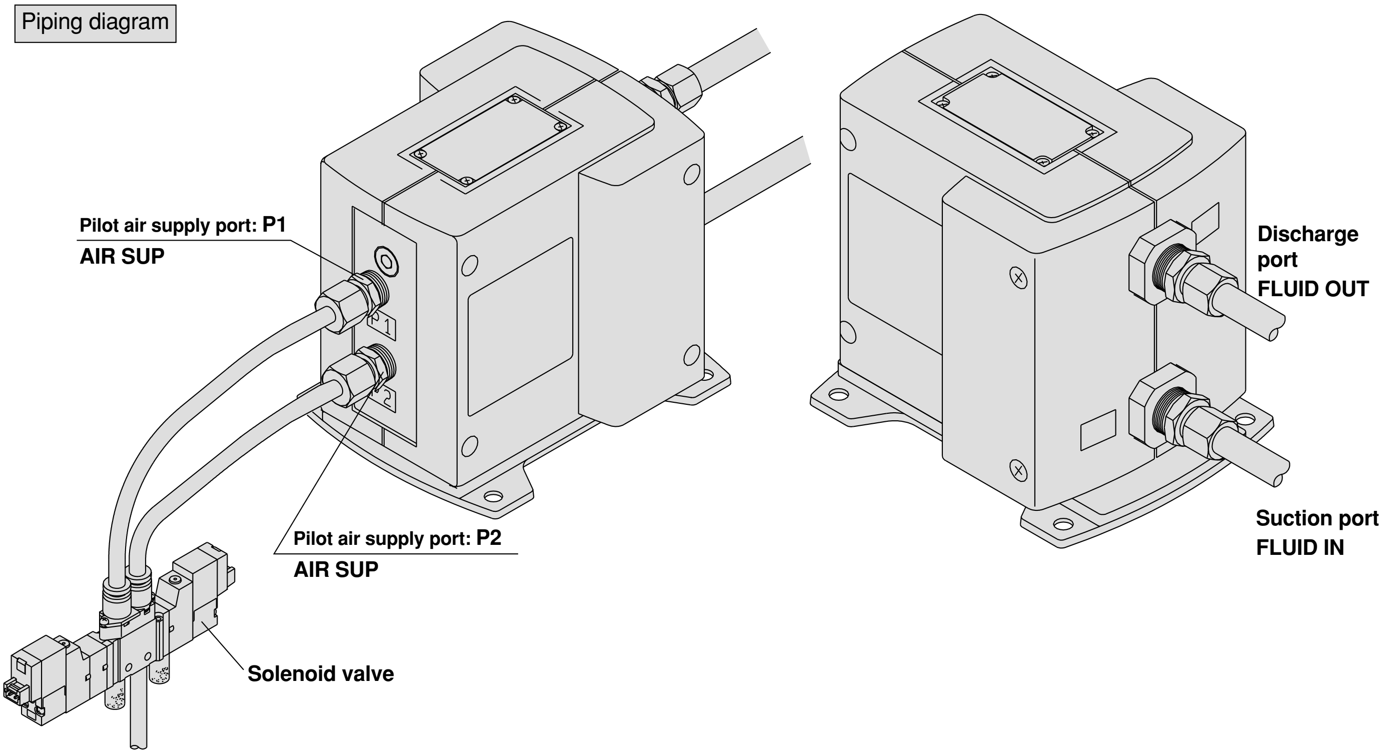
Operating Principle/Air Operated Type



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

Piping and Operation/Air Operated Type

Piping diagram



⚠Caution

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

Operation

<Starting and Stopping> Refer to circuit example

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

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

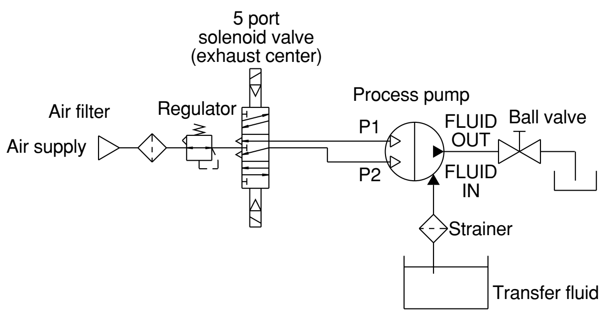
Note 2) For the solenoid valve, use an exhaust center 5 port valve, or a combination of residual exhaust 3 port valve and a pump drive 4 port valve. If air in the drive chamber is not released when the pump is stopped, the diaphragm will be subjected to pressure and its life will be shortened.

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

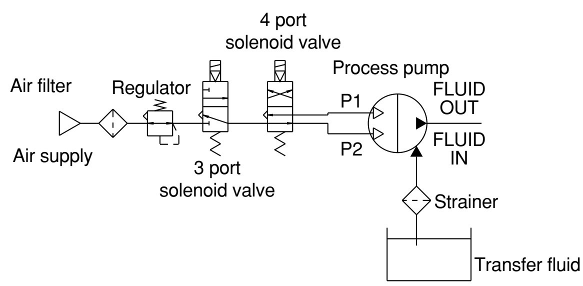
<Discharge Flow Rate Adjustment>

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

Circuit example (1)



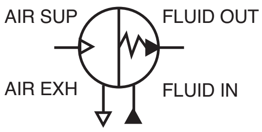
Circuit example (2)



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

RoHS

Symbol



Built-in pulsation attenuator
Automatically operated type

How to Order

PAX1 1 1 2 – □ 02 – □

Body material

1	ADC12 (aluminum)
2	SCS14 (stainless steel)

Diaphragm material

1	PTFE (fluororesin)

Type of operation

2	Automatically operated type with built-in pulsation attenuator

Thread type

–	Rc
T*	NPTF
F*	G
N*	NPT

* T, F, N are order made specifications.

Connection port size

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

Option

–	Body only
N	With silencer *

* For AIR EXH: AN20-02

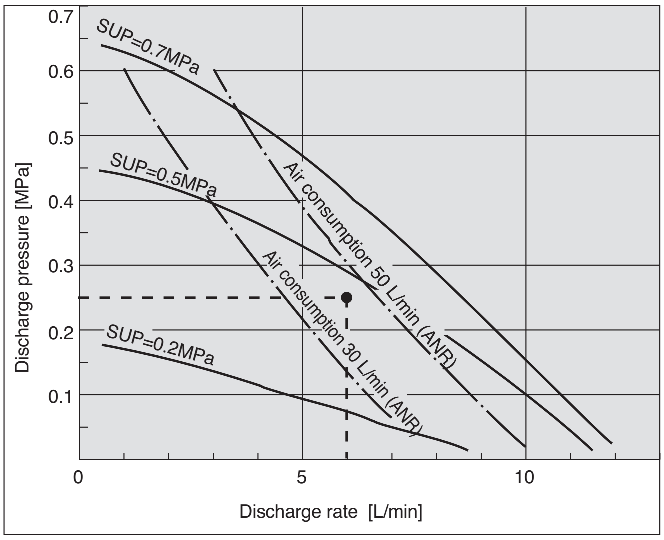
Specifications

Model		PAX1112	PAX1212
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	Fluid contact 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 consumption		Maximum 150 L/min (ANR)	
Suction lifting range	Dry	Up to 2m (interior of pump dry)	
	Wet	Up to 6m (liquid inside pump)	
Noise		84 dB (A) or less (Option: with silencer, AN20)	
Diaphragm life		50 million cycles (For water)	
Discharge pulsation attenuating capacity		30% or less of maximum discharge pressure	
Fluid temperature		0 to 60°C (with no freezing)	
Ambient temperature		0 to 60°C	
Pilot air pressure		0.2 to 0.7 MPa	
Withstand pressure		1.05 MPa	
Mounting position		Horizontal (bottom facing down)	
Weight		2.0 kg	3.5 kg

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

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

PAX1000 Flow rate characteristics



Selection from flow rate characteristic graph

Required specification example:

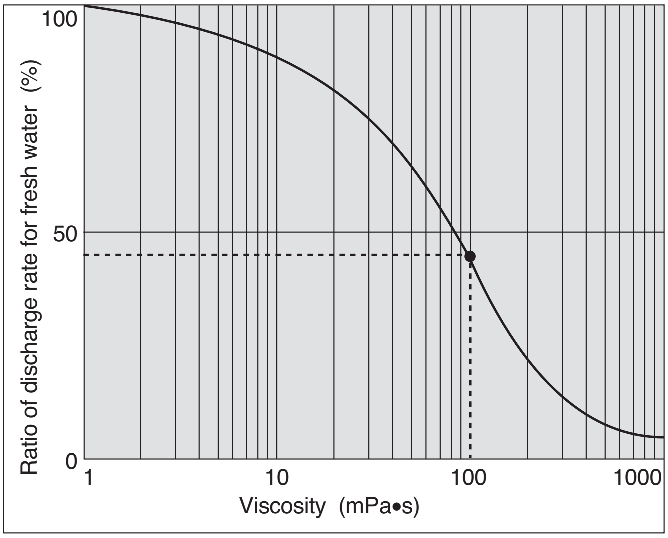
Find the pilot air pressure and pilot air consumption for a discharge rate of 6 L/min and a total lifting range of 25m. [The transfer fluid is fresh water (viscosity 1mPa◊S, specific gravity 1.0).]

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

Selection procedures

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

Viscosity characteristics (flow rate correction for viscous fluids)



Selection from viscosity characteristic graph

Required specification example:

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

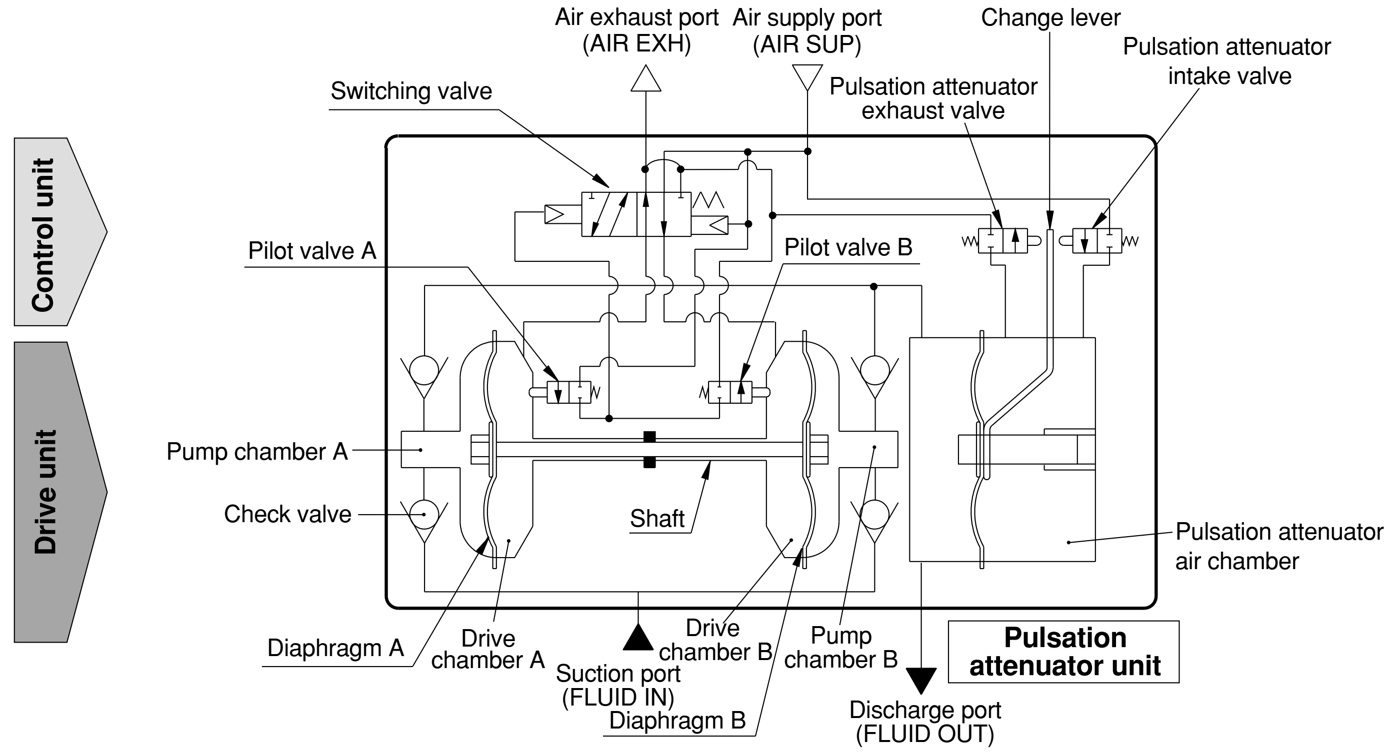
Selection procedure

1. First find the ratio of the discharge rate for fresh water when viscosity is 100mPa•s from the graph below. It is determined to be 45%.
2. Next, in the required specification example, the viscosity is 100mPa◊s and the discharge rate is 2.7 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 rate characteristic graph.

⚠Caution

Viscosities up to 1000mPa•s can be used.

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



Control unit

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

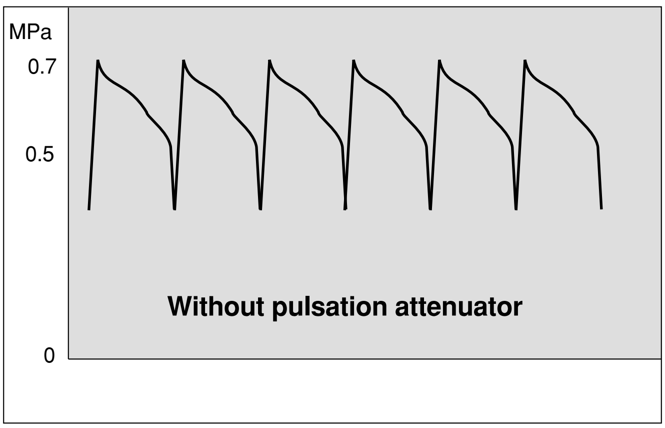
Drive unit

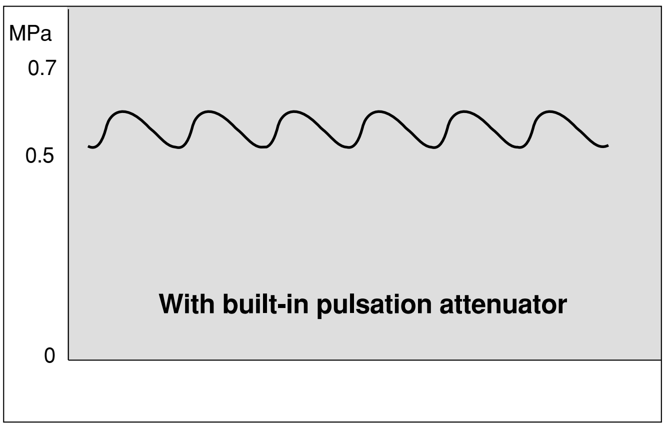
1. When air enters drive chamber B, the fluid in pump chamber B is forced out, and at the same time fluid is sucked into pump chamber A.
2. When the diaphragm moves in the opposite direction, the fluid in pump chamber A is pushed out, and fluid is sucked into pump chamber B.
3. The pressure of the fluid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

Pulsation attenuation chamber

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

Pulsation Attenuating Capacity

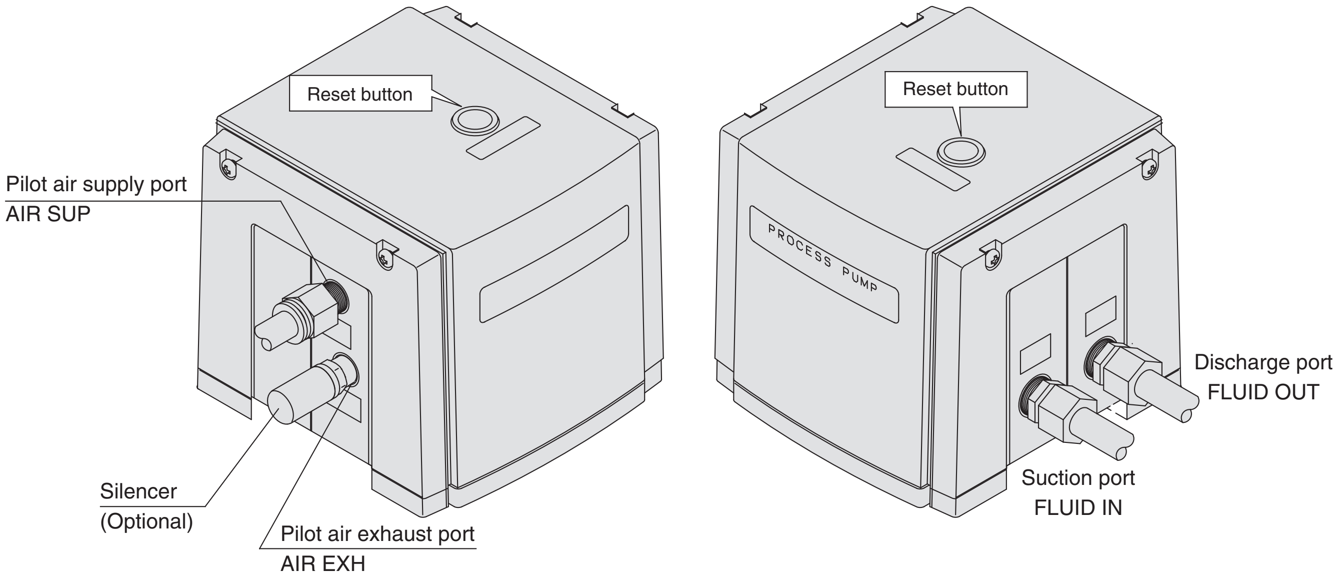




The process pump generates pulsation because it discharges a liquid using two diaphragms. The pulsation attenuator absorbs pressure when discharge pressure increases, and compensates the pressure when discharge pressure decreases. By this means pulsation is controlled.

Piping/Automatically Operated Type with Built-in Pulsation Attenuator

Piping diagram



⚠ **Caution**

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

Operation

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

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

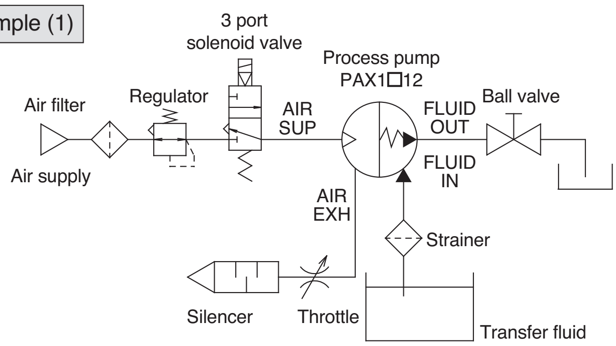
<Discharge Flow Rate Adjustment>

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

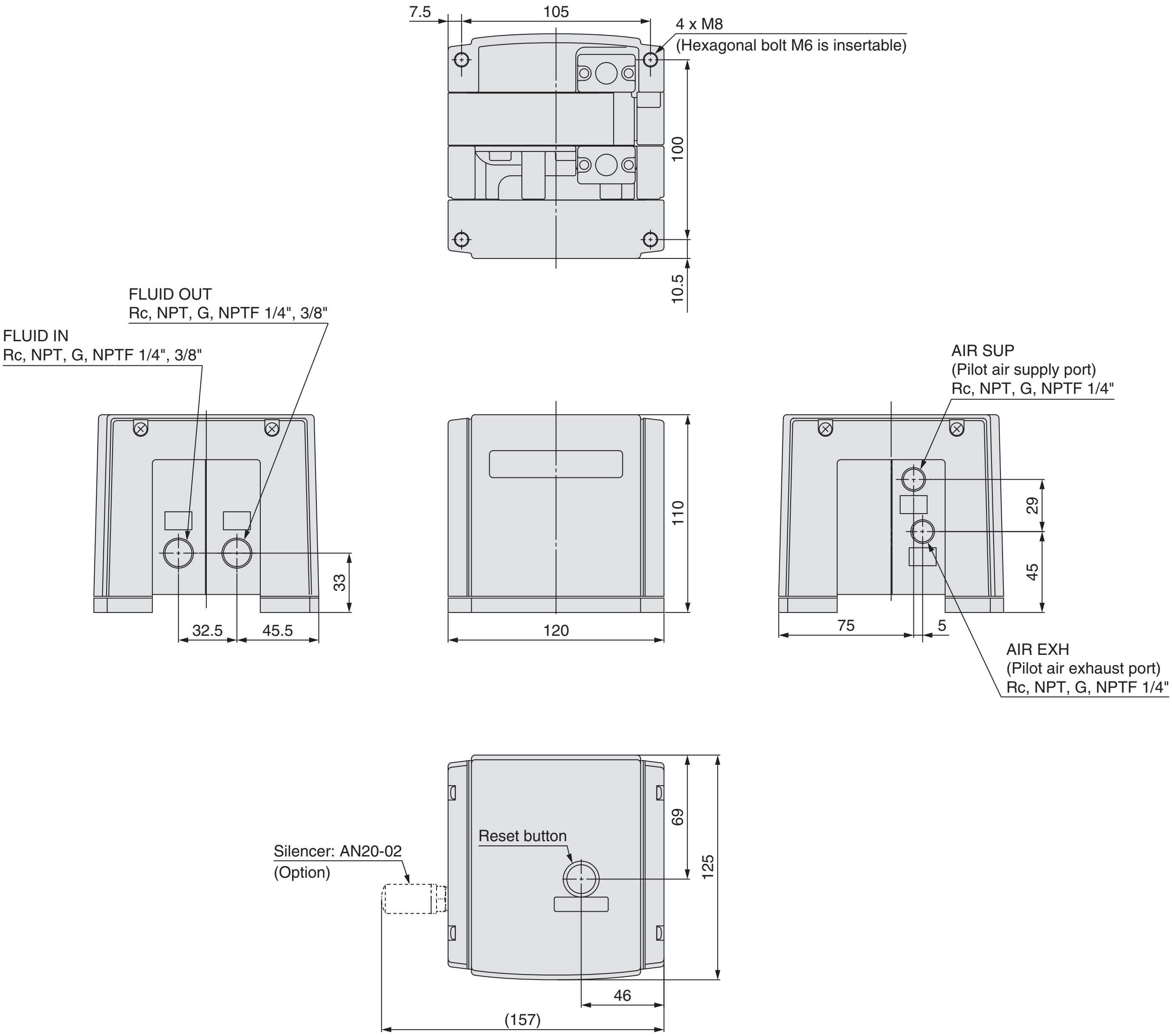
<Reset Button>

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.

Circuit example (1)



Dimensions


7.5
105
4 x M8
(Hexagonal bolt M6 is insertable)
100
10.5
FLUID OUT
Rc, NPT, G, NPTF 1/4", 3/8"
FLUID IN
Rc, NPT, G, NPTF 1/4", 3/8"
33
32.5
45.5
110
120
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"
Silencer: AN20-02
(Option)
Reset button
69
125
46
(157)

Process Pump Common Precautions 1

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

Precautions on Design

⚠ Warning

1. Confirm the fluid to be used.

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

2. Fluid temperature

Use each model within its respective fluid temperature range.

3. Fluid quality

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

4. Be sure to observe the maximum operating pressure.

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

<Example Pressure Reduction Measures>

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

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

5. Liquid seals

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

6. Quality of operating air

1. Use clean air.

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

   Install an air filter near valves on their upstream side. Choose a filtration degree of 5μm or finer. A mist separator (AM) is suitable.
3. Compressed air which includes a large amount of drainage can cause malfunction of valves and other pneumatic equipment. As a countermeasure, install and air dryer or after cooler, etc.
4. In situations where a large amount of carbon dust is generated, install a mist separator at the upstream side of valves to remove it. When a lot of carbon dust is generated from a compressor, it can adhere to the interior of valves and cause malfunction.

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

7. Ensure space for maintenance.

Be sure to allow the space required for maintenance activities.

8. Fluid properties

1. Do not use strong acids, strong bases or chemicals which can effect humans.
2. When inflammable fluids are transferred, give consideration to leakage during operation, and strictly prohibit flames. There is a danger of fire or explosion due to accidental leakage of the fluid.

⚠ Warning

9. Stopping the pump

1. Use a 3 port solenoid valve when starting or stopping an automatically operated type pump by means of pilot air. Do not use a 2 port solenoid valve. (In the case of a 2 port solenoid valve, the air pressure which remains after the solenoid valve closes is gradually consumed inside the process pump. This causes instability in the operating position of the pilot air switching unit, and it may become inoperable. Since the same kind of problem also occurs when the air supply pressure is gradually lost after operation is stopped, a 3 port solenoid valve should be used for stopping. When the unit will not be restarted, press the reset button.)
2. The solenoid valve used for the air operated type should be an exhaust center 5 port solenoid valve, or a combination of a residual pressure exhaust 3 port solenoid valve and a pump drive 4 port solenoid valve. If air in the drive chamber is not released when the pump is stopped, the diaphragm will be subjected to pressure and its life will be shortened. Make a selection after confirming the maximum operating frequency of a solenoid valve.
3. The air operated type can also be used for highly permeable fluids.

   In this case, since the exhaust contains gas from the fluid which permeates the diaphragm, employ measures to keep the exhaust from getting into the solenoid valve.
4. When an air operated pump is dry, operate the solenoid valve at a switching cycle of 1 to 7Hz. If operated outside of this range, the suction lifting height may be less than the rated value.

10. Other

1. Test the unit before using it in an actual equipment application. Furthermore, even if there is no problem in a short term test, there are cases in which trouble is caused by permeation through the fluororesin diaphragm to the air side.
2. Since the compatibility of fluids differs depending on type, additives, concentration and temperature, etc., give careful attention to the selection of materials.
3. When used with gases, the prescribed performance may not be achieved.
4. Do not operate for an extended time without liquid in the pump.

⚠ Caution

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

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

Process Pump Common Precautions 2

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

Selection

⚠ Warning

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

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

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

Mounting

⚠ Warning

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

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

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

4. Do not drop or bump.
Do not drop, bump or apply excessive impact (1000m/s^2) when handling.

5. Never mount in a place which will be used as a scaffold during piping work.
Damage can be caused if subjected to an excessive load.

Piping

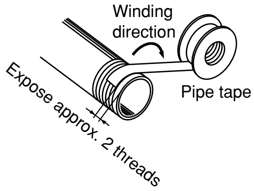
⚠ Caution

1. Preparation before piping
Before piping is connected, it should be thoroughly blown out with air (flushing) or washed to remove chips, cutting oil and other debris from inside the pipe.

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

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

3. Connection of piping to products



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

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

PAX1000, PA3000, PA5000

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

Air Supply

⚠ Warning

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

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

Process Pump Common Precautions 4

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

Maintenance

⚠ Caution

6. Service life and replacement of consumable parts

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

∗Service life cycles/Discharge per cycle (reference)

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

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

· Calculation of diaphragm life

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

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

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

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

= **437 days**

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

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

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

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

= **1666 days**

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

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

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

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

= **2083 days**

Lubrication

⚠ Caution

1. The pump does not require lubrication.

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

2. Do not lubricate the air operated type.

3. Filters and strainers

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

4. Lubrication

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

5. Storage

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

Process Pump Common Precautions 5

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

Fluid Compatibility

⚠Caution

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

Fluid compatibility/Series PA3000/5000

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

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

Fluid compatibility/Series PAX1000

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

Fluid compatibility/Series PB1000

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

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