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.
Process Pump Variations
Series PA/Double acting pump

<table>
<thead>
<tr>
<th>Series</th>
<th>Model</th>
<th>Action</th>
<th>Discharge flow rate /min</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA3000</td>
<td>PA3100</td>
<td>Automatically operated type</td>
<td>1 to 20</td>
<td>ADC12 (aluminum)</td>
</tr>
<tr>
<td>PA5000</td>
<td>PA5100</td>
<td>Air operated type</td>
<td>5 to 45</td>
<td>SCS14 (stainless steel)</td>
</tr>
<tr>
<td></td>
<td>PA313</td>
<td>Air operated type</td>
<td>Air Sup -&gt; Fluid Out</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PA513</td>
<td></td>
<td>Air Sup -&gt; Fluid Out</td>
<td></td>
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<tr>
<td>PAX1000</td>
<td>PAX112</td>
<td>Automatically operated type with built-in pulsation attenuator</td>
<td>0.5 to 10</td>
<td>ADC12 (aluminum)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SCS14 (stainless steel)</td>
</tr>
</tbody>
</table>

Series PB/Single acting pump

| PB1000  | PB1011  | Built-in solenoid valve                     | 0.008 to 2               | Polypropylene |
|         | PB1013  | Air operated type                           | 0.008 to 0.5             | 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

Compartment single acting

Process Pump

Series PB1000
Built-in solenoid valve/
Air operated type
(external switching type)

A solenoid valve operated pump that fits in the palm of the hand
• 60 x 60 x 41 (mm), 170g
• Piping and wiring centralized on one side saves space

Series PA/Double acting pump

Air exhaust port
Air supply port
Switching valve
Suction port
Discharge port
Pulsation attenuation chamber

Series PB/Single acting pump

Air exhaust port
Air supply port
Discharge port
Suction port

Built-in solenoid valve (3 port valve)
P1013 air operated type does not have built-in solenoid valve.

Application examples

Transfer of liquid by suction
Atomizing of liquid
Transfer of liquid by pressure
Stirring of liquid

Prevents sticking of liquids
Process Pump
Automatically Operated Type
(Internal Switching Type)
Series PA3000/5000

How to Order

PA 3 1 1 0 – 03 –

Body size
3 3/8 standard
5 1/2 standard

Liquid contact body material
1 ADC12 (aluminum)
2 SCS14 (stainless steel)

Diaphragm material
1 PTFE
2 NBR

Option
Nil Body only
N With silencer

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

Thread type
Nil Rc
T* Rc
F* NPT
N* NPT

* T, F, N are order made specifications.

Automatically operated type

Specifications

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

* Each of the values above indicates use at ordinary temperatures with fresh water.
Performance Curves/Automatically Operated Type

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 1 mPa 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 $\text{SUP}=0.2\text{MPa}$ and $\text{SUP}=0.5\text{MPa}$, and based on the proportional relationship to these lines, the pilot air pressure for this point is approximately 0.38MPa.
3. Next find the air consumption rate. Since the marked point is below the curve for 50 l/min (ANR), the maximum rate will be about 50 l/min (ANR).

⚠️ Caution
1. These flow rate 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 0.75kW 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 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, $2.7\text{l/min} \div 0.45 = 6\text{l/min}$, 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 1000 mPa s can be used.
Operating Principle/Automatically Operated Type

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.

6. Continuous suction and discharge is performed by the reciprocal motion of the diaphragm.

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.

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.
Piping and Operation/Automatically Operated Type

**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 0.7 MPa. Then, the pump operates when power is applied to the 3 port solenoid valve of the air supply port <AIR SUP>, the sound of exhaust begins from the air exhaust port <AIR EXH> and fluid flows from the suction port <FLUID IN> to the discharge port <FLUID OUT>. At this time, the ball valve on the discharge side is in an open state. The pump performs suction with its own power even without priming. (Dry state suction lifting range: max. 1 m) To restrict exhaust noise, attach a silencer (AN200-02: option) to the air exhaust port <AIR EXH>.

3. To stop the pump, exhaust the air pressure being supplied to the pump by the 3 port solenoid valve of the air supply port <AIR SUP>. The pump will also stop if the ball valve on the discharge side is closed.

**<Discharge Flow Rate Adjustment>**

1. Adjustment of the flow rate from the discharge port <FLUID OUT> is performed with the ball valve connected on the discharge side or the throttle connected on the air exhaust side. For adjustment from the air side, use of the silencer with throttle ASN2 (port size 1/4) connected to the air exhaust port <AIR EXH> is effective. Refer to circuit example (1).

2. When operating with a discharge flow rate below the specification range, provide a by-pass circuit from the discharge side to the suction side to ensure the minimum flow rate inside the process pump. With a discharge flow rate below the minimum flow rate, the process pump may stop due to unstable operation. Refer to circuit example (2). (Minimum flow rates: PA3000 1 l/min, PA5000 5 l/min)

**<Reset Button>**

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.

---

**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.
Series PA3000/5000

Dimensions/Automatically Operated Type

PA3000

PA5000
Process Pump
Air Operated Type (External Switching Type)
Series PA3000/5000

How to Order

**PA**

- **Body size**
  - 3: 3/8 standard
  - 5: 1/2 standard

- **Diaphragm material**
  - 1: PTFE

- **Liquid contact body material**
  - 1: ADC12 (aluminum)
  - 2: SCS14 (stainless steel)

- **Connection port size**
  - 03: 3/8 (10A): PA3
  - 04: 1/2 (15A): PA5
  - 06: 3/4 (20A): PA5

- **Thread type**
  - Nil
  - Rc
  - T: NPTF
  - F: G
  - N: NPT
  - *T, F, N are order made specifications.*

- **Air operated type**

---

Specifications

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

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

Note 1) With cycles at 2Hz or more

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

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

Recommended Valve

- **PA3000** VOZ14C10 (exhaust centre)
- **PA5000** VOZ24C10 (exhaust centre)
**Performance Curves/Air Operated Type**

**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.

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

**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.

**Selection from viscosity characteristic graph**

**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**
- Viscosities up to 1000mPa⋅s can be used.
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

<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.

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

Operation

Circuit example (1)

Circuit example (2)
Process Pump
Automatically Operated Type with Built-in Pulsation Attenuator (Internal Switching Type)
Series **PAX1000**

### How to Order

**PAX1**

- **Body material**
  1. ADC12 (aluminum)
  2. SCS14 (stainless steel)

- **Diaphragm material**
  1. PTFE (fluoro resin)

- **Type of operation**
  2. Automatically operated type with built-in pulsation attenuator

- **Connection port size**
  02 1/4 (8A)
  03 3/8 (10A)

- **Thread type**
  0 Nil
  0 T  Rc
  0 F  NPTF
  0 N  G
  0 * For AIR EXH: AN200-02

- **Option**
  0 Nil
  1 Body only
  2 With silencer *

* T, F, N are order made specifications.

### Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>PAX1112</th>
<th>PAX1212</th>
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<tbody>
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<td><strong>Port size</strong></td>
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<tr>
<td>Main fluid suction/ discharge port</td>
<td>Rc 1/4, 3/8</td>
<td></td>
</tr>
<tr>
<td>Pilot air supply/ exhaust port</td>
<td>Rc 1/4</td>
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<tr>
<td><strong>Material</strong></td>
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<tr>
<td>Fluid contact areas</td>
<td>ADC12</td>
<td>SCS14</td>
</tr>
<tr>
<td>Diaphragm</td>
<td>PTFE</td>
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<tr>
<td>Check valve</td>
<td>PTFE, SCS14</td>
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<tr>
<td><strong>Discharge rate</strong></td>
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<tr>
<td>0.5 to 10l/min</td>
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<td>0 to 0.6MPa</td>
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<tr>
<td><strong>Pilot air consumption</strong></td>
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<td>Maximum 150l/min (ANR)</td>
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<tr>
<td><strong>Suction lifting range</strong></td>
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<tr>
<td>Dry</td>
<td>Up to 2m (interior of pump dry)</td>
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<tr>
<td>Wet</td>
<td>Up to 6m (liquid inside pump)</td>
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<tr>
<td><strong>Discharge pulsation attenuating capacity</strong></td>
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<td>30% or less of maximum discharge pressure</td>
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<tr>
<td><strong>Fluid temperature</strong></td>
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<tr>
<td>0 to 60°C (with no freezing)</td>
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<td><strong>Ambient temperature</strong></td>
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<tr>
<td>0 to 60°C</td>
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<tr>
<td><strong>Pilot air pressure</strong></td>
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<tr>
<td>0.2 to 0.7MPa</td>
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<td><strong>Withstand pressure</strong></td>
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<td>1.05MPa</td>
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</tbody>
</table>

* Each of the values above indicates use at ordinary temperatures with fresh water.
Performance Curves/Automatically Operated Type with Built-in Pulsation Attenuator

**Selection from flow rate characteristic graph**

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

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

**Selection procedures**

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

**Selection from viscosity characteristic graph**

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

**Selection procedure**

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

**Caution**
Viscosities up to 1000mPa·s can be used.
Operating Principle/Automatically Operated Type with Built-in Pulsation Attenuator

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.

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 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

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 0.7 MPa. Then, the pump operates when power is applied to the 3 port solenoid valve of the air supply port (AIR SUP). The sound of exhaust begins from the air exhaust port (AIR EXH) and fluid flows from the suction port (FLUID IN) to the discharge port (FLUID OUT). At this time, the ball valve on the discharge side is in an open state. The pump performs suction with its own power even without priming. (Dry state suction lifting range: max. 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.

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 0.7 MPa. Then, the pump operates when power is applied to the 3 port solenoid valve of the air supply port (AIR SUP). The sound of exhaust begins from the air exhaust port (AIR EXH) and fluid flows from the suction port (FLUID IN) to the discharge port (FLUID OUT). At this time, the ball valve on the discharge side is in an open state. The pump performs suction with its own power even without priming. (Dry state suction lifting range: max. 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.

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<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.
Process Pump
Built-in Solenoid Valve Type/Air operated
Type (External Switching Type)

Series PB1000

How to Order

**PB1 0 1 1**

- **Body size**
  - 1: 1/8 standard

- **Body material**
  - 0: Polypropylene
  - 1: PTFE (fluororesin)

- **Diaphragm material**
  - 1: PTFE (fluororesin)

- **Option/Part no.**
  - Nil: Pump only
  - B: With foot (bolts included) KT-PB1-3
  - N*: With silencer AN120-M5

- **Connection port size**
  - 01: 1/8 (6A)

- **Type of operation**
  - 1: Built-in solenoid valve
  - 3: Air operated

- **Thread type**
  - Nil: Rc
  - T*: NPTF
  - F*: G
  - N*: NPT

- **Port size**
  - Built-in solenoid valve type

- **Symbol**

---

**Specifications**

<table>
<thead>
<tr>
<th>Model</th>
<th>PB1011</th>
<th>PB1013</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Port size</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main fluid suction/discharge port</td>
<td>Rc 1/8</td>
<td>Rc 1/8</td>
</tr>
<tr>
<td>Pilot air</td>
<td>Supply port</td>
<td>Rc 1/8</td>
</tr>
<tr>
<td>Exhaust port</td>
<td>M5 x 0.8</td>
<td></td>
</tr>
<tr>
<td><strong>Material</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluid contact areas</td>
<td>Polypropylene PP, Stainless steel (SUS316)</td>
<td></td>
</tr>
<tr>
<td>Diaphragm</td>
<td>PTFE</td>
<td></td>
</tr>
<tr>
<td>Check valve</td>
<td>PTFE</td>
<td></td>
</tr>
<tr>
<td>Liquid contact seals</td>
<td>FKM</td>
<td></td>
</tr>
<tr>
<td><strong>Discharge rate</strong></td>
<td>8 to 2000m3/min</td>
<td>8 to 500m3/min</td>
</tr>
<tr>
<td><strong>Average discharge pressure</strong></td>
<td>0 to 0.6MPa</td>
<td></td>
</tr>
<tr>
<td><strong>Suction lifting range</strong></td>
<td>Up to 2.5m (dry: interior of pump dry)</td>
<td></td>
</tr>
<tr>
<td><strong>Fluid temperature</strong></td>
<td>0 to 50°C (with no freezing)</td>
<td></td>
</tr>
<tr>
<td><strong>Ambient temperature</strong></td>
<td>0 to 50°C</td>
<td></td>
</tr>
<tr>
<td><strong>Pilot air pressure</strong></td>
<td>0.2 to 0.7MPa</td>
<td></td>
</tr>
<tr>
<td><strong>Withstand pressure</strong></td>
<td>1.05MPa</td>
<td></td>
</tr>
<tr>
<td><strong>Recommended operating cycle</strong></td>
<td>1 to 10Hz (0.03 to 1Hz also possible depending on conditions [Note 2])</td>
<td></td>
</tr>
<tr>
<td><strong>Lubrication</strong></td>
<td>Not required</td>
<td></td>
</tr>
<tr>
<td><strong>Voltage</strong></td>
<td>24VDC</td>
<td>—</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>0.17kg</td>
<td>0.15kg</td>
</tr>
<tr>
<td><strong>Mounting position</strong></td>
<td>OUT port at top (indication on name plate)</td>
<td>—</td>
</tr>
</tbody>
</table>

- Note 1: With low operating cycles, even a valve with a small Cv factor can be operated.
- Note 2: After initial suction of liquid operating at 1 to 7Hz, it can be used with operation at lower cycles. Since a large quantity of liquid will be pumped out, use a suitable throttle in the discharge port if problems occur.

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

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

Note 1: With low operating cycles, even a valve with a small Cv factor can be operated.

Recommended valve for PB1013 air operated type: SYJ3/L52408

Note 2: After initial suction of liquid operating at 1 to 7Hz, it can be used with operation at lower cycles. Since a large quantity of liquid will be pumped out, use a suitable throttle in the discharge port if problems occur.
Performance Curves/Built-in Solenoid Type/Air Operated Type

**SUP=0.7MPa**
**SUP=0.5MPa**
**SUP=0.35MPa**
**SUP=0.2MPa**

**Required specification example:**
Find the pilot air pressure and pilot air consumption for a discharge rate of 600 l/min and a total lifting range of 15m.

- The transferred fluid is clean water (viscosity 1 mPa⋅s, specific gravity 1.0) solenoid valve cycle 5Hz

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

**Selection procedure**
1. First mark the intersection point for a discharge rate of 600 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 0.35MPa and 0.5MPa, and based on the proportional relationship to these lines, the pilot air pressure for this point is approximately 0.4MPa.

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

**Selection from flow rate characteristic graphs**
Required specification example:
Find the pilot air pressure and pilot air consumption for a discharge rate of 600m³/min and a total lifting range of 15m.

- The transferred fluid is clean water (viscosity 1mPa⋅s, specific gravity 1.0) solenoid valve cycle 5Hz

**Selection from viscosity characteristic graph**
Required specification example:
Find the pilot air pressure and pilot air consumption for a discharge rate of 200m³/min, a total lifting range of 10m, and a viscosity of 15mPa⋅s.

**Caution**
1. These flow rate 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), etc.
3. If operated continuously at 10Hz, the diaphragm will reach its service life of 20 million cycles in approximately one month.

**Selection from viscosity characteristic graph**
Required specification example:
Find the pilot air pressure and pilot air consumption for a discharge rate of 200m³/min, a total lifting range of 10m, and a viscosity of 15mPa⋅s.

**Selection procedure**
1. First find the ratio of the discharge rate for fresh water when viscosity is 15mPa⋅s from the graph to the left. It is determined to be 48%.
2. Next, the viscosity of 15mPa⋅s and the discharge rate of 200m³/min in the required specification example are converted to the discharge rate for fresh water. Since 48% of the fresh water discharge rate is equivalent to 200m³/min in the required specifications, 200m³/min ÷ 0.48 = approximately 420m³/min, indicating that a discharge rate of 420m³/min is required for fresh water.
3. Finally, find the pilot air pressure and pilot air consumption based on viewing of the flow rate characteristics.

**Viscosity:** Transfer is possible up to about 100mPa⋅s.
When air is supplied and the built-in solenoid valve is turned ON, air enters the drive chamber and the diaphragm moves to the left. Due to this movement, the fluid in the pump chamber passes through the upper check valve and is discharged to the OUT side.

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

The PB1011 repeats this suction and discharge with the repetition of the built-in solenoid valve’s ON/OFF operation. The PB1013 air operated type is operated by the ON/OFF operation of an external solenoid valve.
The PB1013 air operated type has a plug in the air exhaust port EXH.

**Caution**

Be sure that the discharge side OUT is on top when the pump is mounted. Supply clean air that has passed through an AF filter, etc., to the air supply port SUP. Air that contains debris or drainage, etc., will have an adverse effect on the built-in solenoid valve, and will cause malfunction of the pump. In cases that particularly require air cleaning, use a filter (Series AF) together with a mist separator (Series AM). Maintain the proper tightening torque for fittings and mounting bolts, etc. Looseness can cause problems such as fluid and air leakage, while over tightening can cause damage to threads and parts, etc.

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

**Circuit example/Built-in solenoid valve**
Dimensions/Built-in Solenoid Valve Type/Air Operated Type

**Series PB1000**

**PB1000**

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

**Diagrams**
- Schematic of PB1000 with dimensions and connections:
  - Air Supply (pilot air supply port) (**AIR SUP**) (Rc 1/8)
  - Fluid In (Rc 1/8)
  - Fluid Out (Rc 1/8)
  - Foot bracket
  - Option

**Maintenance Part Lists**

**PAX1000**
- Diaphragm kit (PTFE) KT-PAX1-31
- Check valve kit KT-PAX1-36
- Switching valve parts kit KT-PAX1-37
- Pilot valve kit KT-PAX5-38
- Pulsation attenuator control valve kit KT-PAX1-39

**PB1000**
- Diaphragm kit KT-PB1-2
- Check valve kit KT-PB1-1
- Built-in solenoid valve kit VJ314MY-5H

**PA3000/Automatically operated type**
- Diaphragm kit (PTFE) KT-PA3-31
- Diaphragm kit (NBR) KT-PA3-32
- Check valve kit KT-PA3-36
- Switching valve parts kit KT-PA3-37
- Pilot valve kit KT-PA5-38

**PA3000/Air operated type**
- Diaphragm kit (PTFE) KT-PA3-31
- Check valve kit KT-PA3-36

**PA5000/Automatically operated type**
- Diaphragm kit (PTFE) KT-PA5-31
- Diaphragm kit (NBR) KT-PA5-32
- Check valve kit KT-PA5-36
- Switching valve parts kit KT-PA5-37
- Pilot valve kit KT-PA5-38

**PA5000/Air operated type**
- Diaphragm kit (PTFE) KT-PA5-31
- Check valve kit KT-PA5-36

*The PB1013 air operated type has a plug.*

**Foot bracket Option**

**Process Pump**
- Built-in Solenoid Valve Type
- Air Operated Type

**Model PB1011**
- Supply air pressure: 0.2~0.7 MPa
- Voltage: DC
- Process: Pump

**Model PA1000/Air operated type**
- Diaphragm kit (PTFE)
- Check valve kit
- Built-in solenoid valve kit

**Model PA3000/Automatically operated type**
- Diaphragm kit (PTFE)
- Diaphragm kit (NBR)
- Check valve kit
- Switching valve parts kit
- Pilot valve kit

**Model PA5000/Automatically operated type**
- Diaphragm kit (PTFE)
- Diaphragm kit (NBR)
- Check valve kit
- Switching valve parts kit
- Pilot valve kit
Process Pump Common Precautions 1
Be sure to read before handling.
Refer to the main catalog sections for detailed precautions on each series.

### Precautions on Design

#### Warning

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

2. **Fluid temperature**
   
   Use each model within its respective fluid temperature range.

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

4. **Be sure to observe the maximum operating pressure.**
   
   Operation above the maximum operating pressure can cause damage. In particular, avoid application of pressure above the specifications caused by water hammer.
   
   **<Example Pressure Reduction Measures>**
   
   a) Use a water hammer relief valve and slow the valve's closing speed.
   
   b) Absorb impact pressure by using elastic piping material such as rubber, or an accumulator, etc.

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

6. **Quality of operating air**
   
   1. Use clean air.
      
      Do not use compressed air which contains chemicals, synthetic oils containing organic solvents, salts or corrosive gases, etc., as these can cause damage or malfunction.
   
   2. Install an air filter.
      
      Install an air filter near valves on their upstream side. Choose a filtration degree of 5µm or finer. A mist separator (AM) is suitable.
   
   3. Compressed air which includes a large amount of drainage can cause malfunction of valves and other pneumatic equipment. As a countermeasure, install and air dryer or after cooler, etc.
   
   4. In situations where a large amount of carbon dust is generated, install a mist separator at the upstream side of valves to remove it. When a lot of carbon dust is generated from a compressor, it can adhere to the interior of valves and cause malfunction.
      
      Refer to the SMC "Air Cleaning Equipment" catalog for details on air quality.

7. **Ensure space for maintenance.**
   
   Be sure to allow the space required for maintenance activities.

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

#### Warning

9. **Stopping the pump**
   
   1. Use a 3 port solenoid valve when starting or stopping an automatically operated type pump by means of pilot air. Do not use a 2 port solenoid valve. (In the case of a 2 port solenoid valve, the air pressure which remains after the solenoid valve closes is gradually consumed inside the process pump. This causes instability in the operating position of the pilot air switching unit, and it may become inoperable. Since the same kind of problem also occurs when the air supply pressure is gradually lost after operation is stopped, a 3 port solenoid valve should be used for stopping. When the unit will not be restarted, press the reset button.)
   
   2. The solenoid valve used for the air operated type should be an exhaust center 5 port solenoid valve, or a combination of a residual pressure exhaust 3 port solenoid valve and a pump drive 4 port solenoid valve. (Refer to page 4.7-12.) 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.

#### Caution

1. **Use a design which prevents reverse pressure and reverse flow.**
   
   If reverse pressure or flow occurs, this can cause equipment damage or malfunction, etc. Give attention to safety measures, including the method of handling.
Process Pump Common Precautions 2

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

**Selection**

⚠️ **Warning**

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

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

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

**Mounting**

⚠️ **Warning**

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

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

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

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

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

**Piping**

⚠️ **Caution**

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

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

<table>
<thead>
<tr>
<th>Connection threads</th>
<th>Proper tightening torque N·m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rc 1/4</td>
<td>12 to 14</td>
</tr>
<tr>
<td>Rc 3/8</td>
<td>22 to 24</td>
</tr>
<tr>
<td>Rc 1/2</td>
<td>28 to 30</td>
</tr>
<tr>
<td>Rc 3/4</td>
<td>28 to 30</td>
</tr>
</tbody>
</table>

   **PB1000**

<table>
<thead>
<tr>
<th>Connection threads</th>
<th>Proper tightening torque N·m</th>
</tr>
</thead>
<tbody>
<tr>
<td>M5</td>
<td>1/6 turn after tightening by hand</td>
</tr>
<tr>
<td>Rc 1/8</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

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

**Air Supply**

⚠️ **Warning**

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

2. **Use within the operating pressure range.**
   The operating pressure range is determined by the equipment being used. Operation beyond this range can cause damage, failure or malfunction, etc.
Process Pump Common Precautions 4

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

---

### Caution

**Maintenance**

6. Service life and replacement of consumable parts
- When the pump exceeds the number of service life cycles (+), the diaphragm deteriorates and malfunction may occur. Furthermore, when the diaphragm is damaged by aging, the fluid escapes to the pilot air side, and it may become impossible to start the pump again. Using the number of service life cycles for reference, replace parts as soon as possible. Request maintenance parts (page 4.7-23) and replace them in accordance with the instruction manual.

- **Service life cycles/Discharge per cycle (reference)**

<table>
<thead>
<tr>
<th>Series</th>
<th>Diaphragm material</th>
<th>Discharge per cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA3000 automatically operated type</td>
<td>100 million cycles</td>
<td>90 million cycles</td>
</tr>
<tr>
<td>PA5000 automatically operated type</td>
<td>50 million cycles</td>
<td>50 million cycles</td>
</tr>
<tr>
<td>PA3000 air operated type</td>
<td>50 million cycles</td>
<td>—</td>
</tr>
<tr>
<td>PA5000 air operated type</td>
<td>50 million cycles</td>
<td>—</td>
</tr>
<tr>
<td>PAX1000 built-in attenuator type</td>
<td>50 million cycles</td>
<td>—</td>
</tr>
<tr>
<td>PB1000 built-in solenoid valve type</td>
<td>20 million cycles</td>
<td>—</td>
</tr>
</tbody>
</table>

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 5l/min, when operating 8h/D (for PAX1000)

\[
\text{Discharge rate per cycle} = \frac{5}{0.021} = 238 \text{ Cycles per minute}
\]

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

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

= 437 days

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

\[
\text{Discharge rate per cycle} = \frac{5}{0.040} = 125 \text{ Cycles per minute}
\]

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

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

= 1666 days

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

\[
\text{Discharge rate per cycle} = \frac{5}{0.100} = 50 \text{ Cycles per minute}
\]

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

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

= 2083 days

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### Lubrication

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.

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4.7-26
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.
7. When transferring liquids subject to coagulation, take measures to prevent coagulation inside the pump.

Fluid Compatibility

### Fluid compatibility/Series PA3000/5000

<table>
<thead>
<tr>
<th>Model</th>
<th>PA311</th>
<th>PA312</th>
<th>PA321</th>
<th>PA322</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body material</td>
<td>Aluminum (ADC12)</td>
<td>Stainless steel (SCS14)</td>
<td>Fluororesin</td>
<td>Nitrile rubber</td>
</tr>
<tr>
<td>Diaphragm material</td>
<td>Fluororesin</td>
<td>Nitrile rubber</td>
<td>Methyl ethyl ketone, Acetone, Flux, Isopropyl alcohol, Inert solvents</td>
<td>Turbine oil</td>
</tr>
<tr>
<td>Compatible liquids</td>
<td>Ethyl alcohol, Toluene, Cutting oil, Brake fluid (High penetration liquids)</td>
<td>Turbine oil</td>
<td>Methyl ethyl ketone, Acetone, Flux, Isopropyl alcohol, Inert solvents</td>
<td>Industrial water, Inert solvents</td>
</tr>
</tbody>
</table>

### Fluid compatibility/Series PAX1000

<table>
<thead>
<tr>
<th>Model</th>
<th>PAX1112</th>
<th>PAX1212</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body material</td>
<td>Aluminum (ADC12)</td>
<td>Stainless steel (SCS14)</td>
</tr>
<tr>
<td>Diaphragm material</td>
<td>Fluororesin</td>
<td>Fluororesin</td>
</tr>
<tr>
<td>Compatible liquids</td>
<td>Ethyl alcohol, Toluene, Cutting oil, Brake fluid</td>
<td>Methyl ethyl ketone, Acetone, Flux, Isopropyl alcohol, Inert solvents</td>
</tr>
<tr>
<td>Incompatible liquids</td>
<td>Cleaning solvents, Water, Acids, Bases, High permeation liquids, Corrosive liquids</td>
<td>Corrosive liquids, Acids, Bases, High permeation liquids, High penetration liquids</td>
</tr>
</tbody>
</table>

### Fluid compatibility/Series PB1000

<table>
<thead>
<tr>
<th>Model</th>
<th>PB1011</th>
<th>PB1013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body material</td>
<td>Polypropylene (PP), Stainless steel (SUS316)</td>
<td>Polypropylene (PP), Stainless steel (SUS316)</td>
</tr>
<tr>
<td>Diaphragm material</td>
<td>Fluororesin</td>
<td>Fluororesin</td>
</tr>
<tr>
<td>Compatible liquids</td>
<td>Tap water, Detergents</td>
<td>Tap water, Detergents, Oils, Ethyl alcohol, Kerosene</td>
</tr>
<tr>
<td>Incompatible liquids</td>
<td>Acids, Bases, Thinners, Flammable liquids</td>
<td>Acids, Bases, Thinners</td>
</tr>
</tbody>
</table>

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