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

- High abrasion resistance and low particle generation
  No sliding parts in wetted areas.
- Self-priming makes priming unnecessary
  Exhausts the air inside the suction pipe to suck up liquid.

Automatically operated type
Compatible with a wide variety of fluids
- PA3000: Max. discharge rate 20 l/min
- PA5000: Max. discharge rate 45 l/min

Air operated type
Control with external switching valve makes constant cycling possible
- Easily control the discharge rate.
  Easily adjust the flow with the external solenoid valve’s ON/OFF cycle.
- Easy to operate, even for minute flow, low press operation or operation involving air.
- Can be used for operation with repetitive stopping.

Application Example
- Transferring liquid by suction
- Atomizing liquid
- Transferring liquid by pressure
- Stirring liquid

High abrasion resistance and low particle generation
No sliding parts in wetted areas.
Self-priming makes priming unnecessary
Exhausts the air inside the suction pipe to suck up liquid.

Courtesy of Steven Engineering, Inc.-230 Ryan Way, South San Francisco, CA 94080-6370-Main Office: (650) 588-9200-Outside Local Area: (800) 258-9200-www.stevenengineering.com
Process Pump
Automatically Operated Type (Internal Switching Type)
Air Operated Type (External Switching Type)
Series PA3000

How to Order

Material of body wetted areas

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Material of body wetted areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Body only</td>
</tr>
<tr>
<td>1</td>
<td>With silencer</td>
</tr>
</tbody>
</table>

Port size

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Port size</th>
</tr>
</thead>
<tbody>
<tr>
<td>03</td>
<td>3/8&quot;</td>
</tr>
</tbody>
</table>

Diaphragm material

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Diaphragm material</th>
<th>Applicable actuation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Nil</td>
<td>Automatically operated</td>
</tr>
<tr>
<td>1</td>
<td>PTFE</td>
<td>Air operated</td>
</tr>
<tr>
<td>2</td>
<td>NBR</td>
<td></td>
</tr>
</tbody>
</table>

Thread type

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Rc</td>
</tr>
<tr>
<td>1</td>
<td>NPT</td>
</tr>
<tr>
<td>2</td>
<td>G</td>
</tr>
<tr>
<td>3</td>
<td>NPTF</td>
</tr>
</tbody>
</table>

Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>Actuation</th>
<th>Port size</th>
<th>Material</th>
<th>Diaphragm</th>
<th>Check valve</th>
<th>Discharge rate</th>
<th>Average discharge pressure</th>
<th>Pilot air pressure</th>
<th>Air consumption</th>
<th>Suction lifting range</th>
<th>Noise</th>
<th>Withstand pressure</th>
<th>Diaphragm life</th>
<th>Fluid temperature</th>
<th>Ambient temperature</th>
<th>Recommended operating cycle</th>
<th>Pilot air solenoid valve recommended Cv factor</th>
<th>Mass</th>
<th>Mounting orientation</th>
<th>Packaging</th>
</tr>
</thead>
</table>
| PA3110    | Automatically operated | Rc, NPT, G, NPTF 3/8" Female thread | ADC12 | PTFE | PTFE | 1 to 20 l/min | 0 to 0.6 MPa | 0.2 to 0.7 MPa | Max. 200 l/min (ANR) or less | 72 dB (A) or less (excluding the noise from the quick exhaust and solenoid valve) | 1.05 MPa | 100 million times | 0 to 60°C (No freezing) | 0 to 60°C (No freezing) | 1 to 7 Hz (0.2 to 1 Hz also possible depending on conditions) | 0.05 | General environment
| PA3120    | Automatically operated | Rc, NPT, G, NPTF 3/8" Female thread | SCS14 | PTFE | PTFE | 1 to 20 l/min | 0 to 0.6 MPa | 0.2 to 0.7 MPa | Max. 200 l/min (ANR) or less | 72 dB (A) or less (excluding the noise from the quick exhaust and solenoid valve) | 1.05 MPa | 100 million times | 0 to 60°C (No freezing) | 0 to 60°C (No freezing) | 1 to 7 Hz (0.2 to 1 Hz also possible depending on conditions) | 0.05 | General environment
| PA3210    | Air operated | Rc, NPT, G, NPTF 1/4" Female thread | ADC12 | NBR | NBR | 0.1 to 12 l/min | 0 to 0.4 MPa | 0.1 to 0.5 MPa | Max. 150 l/min (ANR) or less | 72 dB (A) or less (excluding the noise from the quick exhaust and solenoid valve) | 0.75 MPa | 50 million times | 0 to 60°C (No freezing) | 0 to 60°C (No freezing) | 1 to 7 Hz (0.2 to 1 Hz also possible depending on conditions) | 0.05 | General environment
| PA3220    | Air operated | Rc, NPT, G, NPTF 1/4" Female thread | SCS14 | PTFE | PTFE | 0.1 to 12 l/min | 0 to 0.4 MPa | 0.1 to 0.5 MPa | Max. 150 l/min (ANR) or less | 72 dB (A) or less (excluding the noise from the quick exhaust and solenoid valve) | 0.75 MPa | 50 million times | 0 to 60°C (No freezing) | 0 to 60°C (No freezing) | 1 to 7 Hz (0.2 to 1 Hz also possible depending on conditions) | 0.05 | General environment
| PA3113    | Air operated | Rc, NPT, G, NPTF 1/4" Female thread | ADC12 | NBR | NBR | 0.1 to 12 l/min | 0 to 0.4 MPa | 0.1 to 0.5 MPa | Max. 150 l/min (ANR) or less | 72 dB (A) or less (excluding the noise from the quick exhaust and solenoid valve) | 0.75 MPa | 50 million times | 0 to 60°C (No freezing) | 0 to 60°C (No freezing) | 1 to 7 Hz (0.2 to 1 Hz also possible depending on conditions) | 0.05 | General environment
| PA3213    | Air operated | Rc, NPT, G, NPTF 1/4" Female thread | SCS14 | PTFE | PTFE | 0.1 to 12 l/min | 0 to 0.4 MPa | 0.1 to 0.5 MPa | Max. 150 l/min (ANR) or less | 72 dB (A) or less (excluding the noise from the quick exhaust and solenoid valve) | 0.75 MPa | 50 million times | 0 to 60°C (No freezing) | 0 to 60°C (No freezing) | 1 to 7 Hz (0.2 to 1 Hz also possible depending on conditions) | 0.05 | General environment

Note 1) With cycles at 2 Hz or more
Note 2) After initial suction of liquid operating at 1 to 7 Hz, it can be used with operation at lower cycles.
Since a large quantity of liquid will be pumped out, use a suitable throttle in the discharge port if problems occur.
Note 3) With a low number of operating cycles, even a valve with a small Cv factor can be operated.
Process Pump
Automatically Operated Type (Internal Switching Type)
Air Operated Type (External Switching Type)
Series PA5000

How to Order

<table>
<thead>
<tr>
<th>Model</th>
<th>PA5110</th>
<th>PA5120</th>
<th>PA5210</th>
<th>PA5220</th>
<th>PA5113</th>
<th>PA5213</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actuation</td>
<td>Automatically operated</td>
<td>Air operated</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Port size</td>
<td>Rc, NPT, G, NPTF 1/2&quot;, 3/4&quot; Female thread</td>
<td>Rc, NPT, G, NPTF 1/4&quot; Female thread</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body wetted areas</td>
<td>ADC12</td>
<td>SCS14</td>
<td>ADC12</td>
<td>SCS14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diaphragm material</td>
<td>PTFE</td>
<td>NBR</td>
<td>PTFE</td>
<td>NBR</td>
<td>PTFE</td>
<td></td>
</tr>
<tr>
<td>Check valve</td>
<td>PTFE, PFA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discharge rate</td>
<td>5 to 45 c/min</td>
<td>1 to 24 c/min</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average discharge pressure</td>
<td>0 to 0.6 MPa</td>
<td>0 to 0.4 MPa</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pilot air pressure</td>
<td>0.2 to 0.7 MPa</td>
<td>0.1 to 0.5 MPa</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air consumption</td>
<td>Max. 300 c/min (ANR) or less</td>
<td>Max. 250 c/min (ANR) or less</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suction lift range</td>
<td>Up to 2 m (Interior of pump dry)</td>
<td>Up to 0.5 m (Interior of pump dry)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noise</td>
<td>78 dB(A) or less (excluding the noise from the quick exhaust and solenoid valve)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Withstand pressure</td>
<td>1.05 MPa</td>
<td>0.75 MPa</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diaphragm life</td>
<td>50 million times</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating fluid temperature</td>
<td>0 to 60°C (No freezing)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>0 to 60°C (No freezing)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recommended operating cycle</td>
<td>—</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pilot air solenoid valve</td>
<td>Note 3)</td>
<td>Note 3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>recommended Cv factor</td>
<td>—</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td>3.5 kg</td>
<td>6.5 kg</td>
<td>3.5 kg</td>
<td>6.5 kg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mounting orientation</td>
<td>Horizontal (with mounting foot at bottom)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Packaging</td>
<td>General environment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>PA5110</th>
<th>PA5120</th>
<th>PA5210</th>
<th>PA5220</th>
<th>PA5113</th>
<th>PA5213</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actuation</td>
<td>Automatically operated</td>
<td>Air operated</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Port size</td>
<td>Rc, NPT, G, NPTF 1/2&quot;, 3/4&quot; Female thread</td>
<td>Rc, NPT, G, NPTF 1/4&quot; Female thread</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body wetted areas</td>
<td>ADC12</td>
<td>SCS14</td>
<td>ADC12</td>
<td>SCS14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diaphragm material</td>
<td>PTFE</td>
<td>NBR</td>
<td>PTFE</td>
<td>NBR</td>
<td>PTFE</td>
<td></td>
</tr>
<tr>
<td>Check valve</td>
<td>PTFE, PFA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discharge rate</td>
<td>5 to 45 c/min</td>
<td>1 to 24 c/min</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average discharge pressure</td>
<td>0 to 0.6 MPa</td>
<td>0 to 0.4 MPa</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pilot air pressure</td>
<td>0.2 to 0.7 MPa</td>
<td>0.1 to 0.5 MPa</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air consumption</td>
<td>Max. 300 c/min (ANR) or less</td>
<td>Max. 250 c/min (ANR) or less</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suction lift range</td>
<td>Up to 2 m (Interior of pump dry)</td>
<td>Up to 0.5 m (Interior of pump dry)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noise</td>
<td>78 dB(A) or less (excluding the noise from the quick exhaust and solenoid valve)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Withstand pressure</td>
<td>1.05 MPa</td>
<td>0.75 MPa</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diaphragm life</td>
<td>50 million times</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating fluid temperature</td>
<td>0 to 60°C (No freezing)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>0 to 60°C (No freezing)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recommended operating cycle</td>
<td>—</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pilot air solenoid valve</td>
<td>Note 3)</td>
<td>Note 3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>recommended Cv factor</td>
<td>—</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td>3.5 kg</td>
<td>6.5 kg</td>
<td>3.5 kg</td>
<td>6.5 kg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mounting orientation</td>
<td>Horizontal (with mounting foot at bottom)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Packaging</td>
<td>General environment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

- For automatically operated type only.

Note: Each of the values above are for normal temperatures and when the transferred fluid is fresh water.
- Refer to page 727 for maintenance parts.
- For related products, refer to page 728 and 729.

Note 1) With cycles at 2 Hz or more
Note 2) After initial suction of liquid operating at 1 to 7 Hz, it can be used with operation at lower cycles.
- Since a large quantity of liquid will be pumped out, use a suitable throttle in the discharge port if problems occur.
Note 3) With a low number of operating cycles, even a valve with a small Cv factor can be operated.

Courtesy of Steven Engineering, Inc.-230 Ryan Way, South San Francisco, CA 94080-6370-Main Office: (650) 588-9200-Outside Local Area: (800) 258-9200-www.stevenengineering.com
Performance Curve: Automatically Operated Type

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

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

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

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

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

Viscosity Characteristics (Flow rate correction for viscous fluids)

Selection from Viscosity Characteristic Graph
Required specifications example:
Find the pilot air pressure and pilot air consumption for a discharge rate of 2.7 l/min, and a viscosity of 100 mPa·s.

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

Caution
Viscosities up to 1000 mPa·s can be used.
Dynamic viscosity \( \nu = \text{Viscosity} \cdot \text{Density} \cdot \rho \)
\[ \nu = \frac{\mu}{\rho} \]
\[ \nu(10^{-3} \text{ m}^2/\text{s}) = \mu(\text{mPa-s})/\rho(\text{kg/m}^3) \]
Performance Curve: Air Operated Type

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.

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 100 mPa·s and the discharge rate is 2.7 l/min. Since this is equivalent to 45% of the discharge rate for fresh water, 2.7 l/min ÷ 0.45 = 6 l/min, indicating that a discharge rate of 6 l/min is required for fresh water.
3. Finally, find the pilot air pressure and pilot air consumption based on selection from the flow characteristic graphs.

Selection from Flow Characteristic Graph (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).

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 100 mPa·s and the discharge rate is 2.7 l/min. Since this is equivalent to 45% of the discharge rate for fresh water, 2.7 l/min ÷ 0.45 = 6 l/min, indicating that a discharge rate of 6 l/min is required for fresh water.
3. Finally, find the pilot air pressure and pilot air consumption based on selection from the flow characteristic graphs.

Caution
Viscosities up to 1000 mPa·s can be used. Dynamic viscosity \( \nu = \text{Viscosity} \ \mu / \text{Density} \ \rho \).
\[
\nu = \frac{\mu}{\rho} \quad \nu(10^{-3} \text{ m}^2/\text{s}) = \mu/(\text{mPa·s})/\rho/(\text{kg/m}^3)
\]
**Working 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.

**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

**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)

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 diagram (1)](image1)

**Circuit example (2)**

![Circuit diagram (2)](image2)

For related products, refer to page 728 and 729.
Piping and Operation: Air Operated Type

**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 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 0.5 MPa. Then, the pump operates when power is applied to the solenoid valve Note 2) of the pilot air supply port and fluid flows from the suction port <FLUID IN> to the discharge port <FLUID OUT>. At this time, the ball valve on the discharge side is in an open state. The pump performs suction with its own power even without priming. (Dry state suction lifting range: PA3 1 m, PA5 up to 0.5 m Note 3)) To restrict exhaust noise, attach a silencer to the solenoid valve air exhaust port.

3. To stop the pump, exhaust the air pressure being supplied to the pump with the solenoid valve of the air supply port.

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

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

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

**Discharge Flow Rate Adjustment**

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

---

**Recommended Valve**

<table>
<thead>
<tr>
<th>Valve Type</th>
<th>Model Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA3 13</td>
<td>VQZ14C-0 (Exhaust center)</td>
</tr>
<tr>
<td>PA5 13</td>
<td>VQZ24C-0 (Exhaust center)</td>
</tr>
</tbody>
</table>

**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**

For related products, refer to page 728 and 729.

© 676

Courtesy of Steven Engineering, Inc.-230 Ryan Way, South San Francisco, CA 94080-6370-Main Office: (650) 588-9200-Outside Local Area: (800) 258-9200-www.stevenengineering.com
Process Pump
Automatically Operated Type Series PA

Dimensions

PA3□0/Automatically Operated Type

Silencer: AN200-02
(Option)

Reset button

AIR SUP
(Pilot air supply port)
Rc, NPT, G, NPTF 1/4"

AIR EXH
(Pilot air exhaust port)
Rc, NPT, G, NPTF 1/4"

FLUID IN
Rc, NPT, G, NPTF 3/8"

FLUID OUT
Rc, NPT, G, NPTF 3/8"

PA3□13/Air Operated Type

AIR SUP (P1)
Rc, NPT, G, NPTF 1/4"

AIR SUP (P2)
Rc, NPT, G, NPTF 1/4"

FLUID IN
Rc, NPT, G, NPTF 3/8"

FLUID OUT
Rc, NPT, G, NPTF 3/8"

Courtesy of Steven Engineering, Inc.-230 Ryan Way, South San Francisco, CA 94080-6370-Main Office: (650) 588-9200-Outside Local Area: (800) 258-9200-www.stevenengineering.com
Process Pump
Series PAP3000
Fluororesin Type

Body material made from New PFA for superior corrosion resistance.
With the use of New PFA for body material, high corrosion resistance is achieved!

Body material
New PFA

Diaphragm material
PTFE

Variations

<table>
<thead>
<tr>
<th>Model</th>
<th>Body material</th>
<th>Diaphragm material</th>
<th>Assembly environment</th>
<th>Discharge rate (l/min)</th>
<th>Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automatically operated type</td>
<td>New PFA</td>
<td>PTFE</td>
<td>Standard</td>
<td>1 to 13</td>
<td>-Foot, -Silencer</td>
</tr>
<tr>
<td>Air pilot operated type</td>
<td>PAP3310</td>
<td>-</td>
<td>Clean room</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air pilot operated type</td>
<td>PAP3313</td>
<td>-</td>
<td>Standard</td>
<td>0.1 to 9</td>
<td>-Foot</td>
</tr>
</tbody>
</table>

Air pilot actuation reset circuit

Air pilot actuation is standard.

External switching valve control makes constant cycling possible.
- Discharge rate is easily controlled.
- Stable operation is possible in spite of such conditions as a minimal flow rate, low pressure operation, or the entrainment of gasses.
- Can be used for operation with repetitive stopping.

Compact & Light weight (Without foot)

<table>
<thead>
<tr>
<th>Mass: 2.1 kg</th>
</tr>
</thead>
</table>

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

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

Air filter
Strainer
Regulator
Process pump
Air supply port
Air exhaust port
Discharge port
Suction port

Notation: \(\square\) indicates a new product code.
Process Pump Clean Room
Automatically Operated Type (Internal Switching Type)
Air Operated Type (External Switching Type)
Series PAP3000

How to Order

Female thread

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Actuation</th>
<th>Option</th>
<th>Applicable actuation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Automatically operated</td>
<td>Nil</td>
<td>Automatically operated</td>
</tr>
<tr>
<td>3</td>
<td>Air operated</td>
<td>N</td>
<td>Air operated</td>
</tr>
</tbody>
</table>

Thread type

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Actuation</th>
<th>Option</th>
<th>Applicable actuation</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>Rc</td>
<td>Nil</td>
<td>Automatically operated</td>
</tr>
<tr>
<td>F</td>
<td>G</td>
<td>N</td>
<td>Air operated</td>
</tr>
<tr>
<td>T</td>
<td>NPT</td>
<td>N</td>
<td>Air operated</td>
</tr>
</tbody>
</table>

Port size

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Port size</th>
<th>Option</th>
<th>Applicable actuation</th>
</tr>
</thead>
<tbody>
<tr>
<td>03</td>
<td>3/8&quot;</td>
<td>Nil</td>
<td>Automatically operated</td>
</tr>
</tbody>
</table>

Option

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Option</th>
<th>Applicable actuation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nil</td>
<td>None</td>
<td>Nil</td>
</tr>
<tr>
<td>B</td>
<td>With foot</td>
<td>Nil</td>
</tr>
<tr>
<td>N</td>
<td>With silencer</td>
<td>Nil</td>
</tr>
</tbody>
</table>

Assembly environment

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Assembly environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>Clean room</td>
</tr>
</tbody>
</table>

Tubing size

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Main fluid connection size</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>3/8&quot;</td>
</tr>
<tr>
<td>13</td>
<td>1/2&quot;</td>
</tr>
</tbody>
</table>

Approval

© 682

 Courtesy of Steven Engineering, Inc.-230 Ryan Way, South San Francisco, CA 94080-6370-Main Office: (650) 588-9200-Outside Local Area: (800) 258-9200-www.stevenengineering.com
Process Pump Clean Room
Automatically Operated Type/Air Operated Type Series PAP3000

With nut

PAP3310 S 1 S 13 -

Assembly environment
Symbol Assembly environment
P Clean room

Actuation
Symbol Actuation
0 Automatically operated
3 Air operated

Option
Symbol Option Applicable actuation
Nil None
B With foot
N With silencer

Note 1) When option is more than one, suffix in alphabetical order.

Fitting type
Symbol Fitting type
1 LQ1
2 LQ2

Fitting size
Symbol IN side OUT side
11 3 3
1113 3 4
1311 4 4
13 4 5
1319 4 5
1913 6 4
19 6 5

Thread type
Symbol Type
Nil Rc
N NPT
F G
T NPTF

Note 2)

Integral fitting type

PAP3310 S 13 -

Assembly environment
Symbol Assembly environment
P Clean room

Actuation
Symbol Actuation
0 Automatically operated
3 Air operated

Option
Symbol Option Applicable actuation
Nil None
B With foot
N With silencer

Note 1) When option is more than one, suffix in alphabetical order.

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

Thread type
Symbol Type
Nil Rc
N NPT
F G
T NPTF

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

| Port size | Model | Actuation | Main fluid suction discharge port | Pilot air supply/exhaust port | Material | Body wetted areas | Discharge rate | Average discharge pressure | Pilot air pressure | Pilot air consumption | Suction lifting range | Noise | Withstand pressure | Diaphragm life | Fluid temperature | Ambient temperature | Recommended operating cycle | Mass | Mounting orientation | Packaging | General environment | Clean double packaging | General environment | Clean double packaging |
|-----------|-------|-----------|-----------------------------------|-------------------------------|----------|-------------------|---------------|----------------------|-----------------|------------------------|-------------------|----------------|-------------------|--------------|----------------|----------------|----------------|-------------------|------------------|-------------------|------------------|
|           | PA3310 | Automatically operated | Rc, NPT, G, NPTF 3/8" Female thread 3/8", 1/2" Tube extension With nut (size 3, 4, 5) 3/8", 1/2" Integral fitting type | Rc, NPT, G, NPTF 1/4" Female thread | New PFA | PTFE | 1 to 13 l/min (Note 1) | 0 to 0.4 MPa | 0.2 to 0.5 MPa | 140 l/min (ANR) or less | 80 dB (A) or less (Option: with silencer, AN200) | 0.75 MPa | 50 million times | 0 to 100°C (No freezing, heat cycle not applied) | 0 to 100°C (No freezing, heat cycle not applied) | — | Horizontal (with mounting foot at bottom) | General environment | Clean double packaging | General environment | Clean double packaging |
|           | PAP3310 | Air operated | Rc, NPT, G, NPTF 3/8" Female thread 3/8", 1/2" Tube extension With nut (size 3, 4, 5) 3/8", 1/2" Integral fitting type | Rc, NPT, G, NPTF 1/4" Female thread | New PFA | PTFE, New PFA | 0.1 to 9 l/min | 0 to 0.4 MPa | 0.2 to 0.5 MPa | 140 l/min (ANR) or less | 75 dB (A) or less (excluding the noise from the quick exhaust and solenoid valve) | 0.75 MPa | 50 million times | 0 to 100°C (No freezing, heat cycle not applied) | 0 to 100°C (No freezing, heat cycle not applied) | 2 to 4 Hz | — | Horizontal (with mounting foot at bottom) | General environment | Clean double packaging | General environment | Clean double packaging |
|           | PA3313 | Automatically operated | Rc, NPT, G, NPTF 3/8" Female thread 3/8", 1/2" Tube extension With nut (size 3, 4, 5) 3/8", 1/2" Integral fitting type | Rc, NPT, G, NPTF 1/4" Female thread | PTFE, New PFA | PTFE, New PFA | 1 to 13 l/min (Note 1) | 0 to 0.4 MPa | 0.2 to 0.5 MPa | 140 l/min (ANR) or less | 80 dB (A) or less (Option: with silencer, AN200) | 0.75 MPa | 50 million times | 0 to 100°C (No freezing, heat cycle not applied) | 0 to 100°C (No freezing, heat cycle not applied) | — | Horizontal (with mounting foot at bottom) | General environment | Clean double packaging | General environment | Clean double packaging |
|           | PAP3313 | Air operated | Rc, NPT, G, NPTF 3/8" Female thread 3/8", 1/2" Tube extension With nut (size 3, 4, 5) 3/8", 1/2" Integral fitting type | Rc, NPT, G, NPTF 1/4" Female thread | PTFE, New PFA | PTFE, New PFA | 0.1 to 9 l/min | 0 to 0.4 MPa | 0.2 to 0.5 MPa | 140 l/min (ANR) or less | 75 dB (A) or less (excluding the noise from the quick exhaust and solenoid valve) | 0.75 MPa | 50 million times | 0 to 100°C (No freezing, heat cycle not applied) | 0 to 100°C (No freezing, heat cycle not applied) | 2 to 4 Hz | Horizontal (with mounting foot at bottom) | General environment | Clean double packaging | General environment | Clean double packaging |

* Each value of above represents at normal temperatures with fresh water.
* Refer to page 727 for maintenance parts.
* For related products, refer to page 728 and 729.

Note 1) The discharge rates for PA(P)3310-P11, PA(P)3310S-S11, PA(P)3310S-S113, PA(P)3310S-S1311, PA(P)3310-S11 are between 1 to 12 l/min.
Performance Curve: Automatically Operated Type

**PAP3310 Flow Characteristics**

<table>
<thead>
<tr>
<th>SUP for models other than those below</th>
<th>SUP = 0.5 MPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUP = 0.4 MPa</td>
<td>SUP = 0.3 MPa</td>
</tr>
<tr>
<td>SUP = 0.2 MPa</td>
<td>SUP = 0.1 MPa</td>
</tr>
</tbody>
</table>

**PAP3310 Air Consumption**

<table>
<thead>
<tr>
<th>SUP for models other than those below</th>
<th>SUP = 0.5 MPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUP = 0.4 MPa</td>
<td>SUP = 0.3 MPa</td>
</tr>
<tr>
<td>SUP = 0.2 MPa</td>
<td>SUP = 0.1 MPa</td>
</tr>
</tbody>
</table>

**Selection from Flow Characteristic Graph (PAP3310)**

**Required specifications example:**

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

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

**Selection procedures:**

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

**Caution**

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

**Viscosity Characteristics** (Flow rate correction for viscous fluids)

<table>
<thead>
<tr>
<th>Ratio of discharge rate against fresh water (%)</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity (mPa·s)</td>
<td>100</td>
</tr>
</tbody>
</table>

**Selection from Viscosity Characteristic Graph**

**Required specifications example:**

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

**Selection procedures:**

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

**Caution**

Viscosities up to 1000 mPa·s can be used.

Dynamic viscosity \( \nu = \frac{\nu}{\rho} \),

\[ \nu = \frac{\mu}{\rho} \]

\[ \nu(10^{-3} \text{ m}^2/\text{s}) = \mu(\text{mPa·s})/\rho(\text{kg/m}^3) \]
Performance Curve: Air Operated Type

PAP3313 Flow Characteristics

Selection from Flow Characteristic Graph (PAP3313)

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

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

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

PAP3313 Air Consumption (2 Hz)

Calculating Air Consumption (PAP3313)

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

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

PAP3313 Air Consumption (3 Hz)

Viscosity Characteristics (Flow rate correction for viscous fluids)

Selection from Viscosity Characteristic Graph

Required specification example: Find the pilot air pressure for a discharge rate of 6 l/min, a discharge pressure of 0.25 MPa and a viscosity of 100 mPa·s.

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

Caution
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).

Viscosities up to 1000 mPa·s can be used.
Dynamic viscosity \( \nu = \text{Viscosity} \times \text{Density} \frac{\mu}{\rho} \)
\( \nu(10^{-5} \text{m}^2/s) = \mu(\text{mPa·s})/\rho(\text{kg/m}^3) \)
### Dimensions

#### PAP3310/Automatically Operated Type

**Integral fitting type With nut**

**Tube extension**

#### PAP3313/Air Operated Type

**Integral fitting type**

**With nut**

**Foot (Option)**

**Air operated reset port**

---

**Courtesy of Steven Engineering, Inc.**

230 Ryan Way, South San Francisco, CA 94080-6370

Main Office: (650) 588-9200
Outside Local Area: (800) 258-9200

www.stevenengineering.com
Prevents spraying of discharge and foaming in tank

- Space-saving design eliminates separate piping with built-in pulsation attenuator
Process Pump
Automatically Operated Type, Built-in Pulsation Attenuator (Internal Switching Type)

Series PAX1000

How to Order

PAX1 1 1 2 - 02 -

Body material

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Body material</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ADC12 (Aluminum)</td>
</tr>
<tr>
<td>2</td>
<td>SCS14 (Stainless steel)</td>
</tr>
</tbody>
</table>

Actuation

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Actuation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Automatically operated type, built-in pulsation attenuator</td>
</tr>
</tbody>
</table>

Option

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nil</td>
<td>Body only</td>
</tr>
<tr>
<td>N</td>
<td>With silencer *</td>
</tr>
</tbody>
</table>

Port size

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Port size</th>
</tr>
</thead>
<tbody>
<tr>
<td>02</td>
<td>1/4&quot;</td>
</tr>
<tr>
<td>03</td>
<td>3/8&quot;</td>
</tr>
</tbody>
</table>

Thread type

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>Rc</td>
</tr>
<tr>
<td>F</td>
<td>G</td>
</tr>
<tr>
<td>T</td>
<td>NPTF</td>
</tr>
</tbody>
</table>

Specifications

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

* Each of the values above are for normal temperatures and when the transferred fluid is fresh water.
* Refer to page 727 for maintenance parts.
* Refer to pages 728 and 729 for related products.
Performance Curve: Automatically Operated Type, Built-in Pulsation Attenuator

PAX1000 Flow Characteristics

Selection from Flow Characteristic Graph

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

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.

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

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

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

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

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 discharge pressure of 0.25 MPa, and a viscosity of 100 mPa·s.

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

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

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

Caution
Viscosities up to 1000 mPa·s can be used.
Dynamic viscosity \( \nu = \text{Viscosity} \cdot \frac{\mu}{\rho} \)
\( \nu(10^{-3}\text{m}^2/\text{s}) = \mu(\text{mPa·s})/\rho(\text{kg/m}^3) \)
Working Principle: Automatically Operated Type, Built-in Pulsation Attenuator

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.

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

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

Pulsation 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.
**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. 2 m) To restrict exhaust noise, attach a silencer (AN200-02: option) to the air exhaust port <AIR EXH>.

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

**Discharge Flow Rate Adjustment**

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

2. When operating with a discharge flow rate below the specification range, provide a by-pass circuit from the discharge side to the suction side to ensure the minimum flow rate inside the process pump. With a discharge flow rate below the minimum flow rate, the process pump may stop due to unstable operation. Refer to circuit example (2). (Minimum flow rates: PAX1000 0.5 l/min)

**Reset Button**

1. When the pump stops during operation, press the reset button. This makes it possible to restore operation in case the switching valve becomes clogged due to foreign matter in the supply air. Maintenance is necessary if the reset button needs to be pressed frequently.

---

**Caution**

Mounting posture of the pump is set with the bottom surface at the bottom. Air to be supplied to the AIR SUP port should be cleaned and filtered through AF filter, etc. Air with foreign matter or drainage etc. will have negative effects on the built-in switching valve and will lead to malfunction. When air needs additional purification, use a filter (Series AF), and a mist separator (Series AM) together. Maintain the proper tightening torque for fittings and mounting bolts, etc. Loose can cause problems such as fluid and air leaks, while overtightening can cause damage to threads and parts, etc.
Series PAX1000

Dimensions

- **AIR SUP** (Pilot air supply port) Rc, NPT, G, NPTF 1/4"
- **AIR EXH** (Pilot air exhaust port) Rc, NPT, G, NPTF 1/4"
- **FLUID IN** Rc, NPT, G, NPTF 1/4", 3/8"
- **FLUID OUT** Rc, NPT, G, NPTF 1/4", 3/8"
- **Reset button**

- **Silencer : AN200-02 (Option)**

- **FLUID IN**
  - 4 x M6 (Hexagonal bolt M6 is insertable)

- **FLUID OUT**
  - 4 x M6 (Hexagonal bolt M6 is insertable)

- **PROCESS PUMP**

- **Bottom**

- **Silencer : AN200-02 (Option)**

- **Dimensions (mm):**
  - AIR SUP: 75 x 5 x 20
  - AIR EXH: 75 x 5 x 20
  - FLUID IN: 23 x 110 x 120
  - FLUID OUT: 32.5 x 45.5 x 33
  - PROCESS PUMP: 105 x 105 x 105
Caution on Design

⚠️ Warning

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

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

3. Water hammer
   If a valve is operated abruptly etc., a high pressure may be applied due to water hammer. Take measures to prevent pressures higher than specified from being applied.
   <Examples of measures>
   • Use a water hammer resistant valve to reduce the valve closing speed.
   • Use an elastic piping material such as rubber hose or an accumulator to absorb the impact pressure.

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

5. Fluid pressure
   Do not pressurize or decompress the fluid supplied.

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

7. Use a design which prevents reverse pressure and reverse flow.
   If reverse pressure or flow occurs, this can cause equipment damage or malfunction, etc. Take safety measures in designing the circuit.

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

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

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

⚠️ Caution

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

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

⚠️ **Caution**

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

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

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

Piping

⚠️ **Caution**

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

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

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

### PA3000, PA5000, PAX1000

<table>
<thead>
<tr>
<th>Connection thread</th>
<th>Proper tightening torque (N·m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rc, NPT, G, NPTF 1/4</td>
<td>12 to 14</td>
</tr>
<tr>
<td>Rc, NPT, G, NPTF 3/8</td>
<td>22 to 24</td>
</tr>
<tr>
<td>Rc, NPT, G, NPTF 1/2</td>
<td>28 to 30</td>
</tr>
<tr>
<td>Rc, NPT, G, NPTF 3/4</td>
<td>28 to 30</td>
</tr>
</tbody>
</table>

### PAX1000

<table>
<thead>
<tr>
<th>Connection thread</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, NPT, G, NPTF 1/8</td>
<td>2 to 3</td>
</tr>
</tbody>
</table>

### PA3300, PAP3300, PAF3000, PAF5000

<table>
<thead>
<tr>
<th>Connection thread</th>
<th>Proper tightening torque (N·m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rc, NPT, G, NPTF 1/8</td>
<td>0.4 to 0.5</td>
</tr>
<tr>
<td>Rc, NPT, G, NPTF 1/4 (PAF3000)</td>
<td>0.8 to 1</td>
</tr>
<tr>
<td>Rc, NPT, G, NPTF 1/4</td>
<td>1.5 to 2</td>
</tr>
<tr>
<td>Rc, NPT, G, NPTF 3/8</td>
<td>2 to 2.5</td>
</tr>
<tr>
<td>Rc, NPT, G, NPTF 3/4</td>
<td>4 to 5</td>
</tr>
</tbody>
</table>

Air Supply

⚠️ **Warning**

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

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

⚠️ **Caution**

1. **Quality of operating air**
   - Be sure to use only air filtrated by a micro mist separator (such as series AMD). Use of a super mist separator (such as series AME) is recommended to extend maintenance intervals.
   - If a pump is operated by dried air and N2 gas, etc., the deterioration of the gaskets inside the switching valve will be accelerated and may result in substantially shortening the life span of the product.

Operating Environment

⚠️ **Warning**

1. **Do not use in the following environments, as this can cause failure.**
   1) Locations with an atmosphere of corrosive gases, organic solvents or chemical solutions, and where there may be contact with the same.
   2) Locations where there is contact with sea spray, water or steam.
   3) Locations where ultraviolet deterioration or overheating of resin may occur due to direct sunlight.
   4) Locations near heat sources with poor ventilation (heat sources should be shielded by heat insulating material).
   5) Locations with impact or vibration.
   6) Locations with excessive moisture and dust.

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

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

---

© 2022 SMC Corporation of America
All rights reserved.
## Maintenance

### Warning

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

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

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

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

5. Caution when transferring a high-temperature fluid
   The product itself will become hot due to the high-temperature fluid. The measurement of the product temperature is recommended to confirm the safety of the system before performing work.

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

### Caution

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

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

### Calculation of reference service life (days) of diaphragm

- **<Automatically operated type>**
  \[
  \text{Reference service life (days)} = \frac{A (\text{amount of discharge per cycle}) \times B (\text{reference number of cycles in service life})}{\text{Flow (l/min)} \times \text{Operating time per day (hour)} \times 60 (\text{min})}
  \]

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

- **Reference service life (days) =**
  \[
  B (\text{reference number of cycles in service life})
  \]

### Reference number of cycles in service life

- **B =**
  \[
  \text{Operating frequency of solenoid valve (Hz) \times 60 (sec) \times Operating time per day (hour) \times 60 (min)}
  \]

<table>
<thead>
<tr>
<th>Model</th>
<th>Operating method</th>
<th>Diaphragm material</th>
<th>Amount of discharge per cycle A</th>
<th>Reference number of cycles in service life B</th>
<th>Volume inside pump (wetted part)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA3.10</td>
<td>Automatically operated type</td>
<td>PTFE</td>
<td>Approx. 0.04 l</td>
<td>100 million cycles</td>
<td>Approx. 75 ml</td>
</tr>
<tr>
<td>PA3.20</td>
<td>Automatically operated type</td>
<td>PTFE</td>
<td>Approx. 0.022 l</td>
<td>50 million cycles</td>
<td>Approx. 315 ml</td>
</tr>
<tr>
<td>PA3.13</td>
<td>Air operated type</td>
<td>PTFE</td>
<td>Approx. 0.022 l</td>
<td>50 million cycles</td>
<td></td>
</tr>
<tr>
<td>PA5.10</td>
<td>Automatically operated type</td>
<td>PTFE</td>
<td>Approx. 0.1 l</td>
<td>50 million cycles</td>
<td></td>
</tr>
<tr>
<td>PA5.20</td>
<td>Automatically operated type</td>
<td>NBR</td>
<td>Approx. 0.1 l</td>
<td>50 million cycles</td>
<td></td>
</tr>
<tr>
<td>PA5.13</td>
<td>Air operated type</td>
<td>PTFE</td>
<td>Approx. 0.09 l</td>
<td>50 million cycles</td>
<td></td>
</tr>
<tr>
<td>PA (P)3310</td>
<td>Automatically operated type</td>
<td>PTFE</td>
<td>Approx. 0.025 l</td>
<td>50 million cycles</td>
<td></td>
</tr>
<tr>
<td>PA (P)3313</td>
<td>Air operated type</td>
<td>PTFE</td>
<td>Approx. 0.037 l</td>
<td>50 million cycles</td>
<td></td>
</tr>
<tr>
<td>PAX1000</td>
<td>Automatically operated type</td>
<td>PTFE</td>
<td>Approx. 0.02 l</td>
<td>50 million cycles</td>
<td></td>
</tr>
<tr>
<td>PB1011</td>
<td>Solenoid valve driven</td>
<td>PTFE</td>
<td>Approx. 0.004 l</td>
<td>50 million cycles</td>
<td></td>
</tr>
<tr>
<td>PB1013</td>
<td>Air operated type</td>
<td>PTFE</td>
<td>Approx. 0.004 l</td>
<td>50 million cycles</td>
<td></td>
</tr>
<tr>
<td>PAF3410</td>
<td>Automatically operated type</td>
<td>PTFE</td>
<td>Approx. 0.054 l</td>
<td>Approx. 105 ml</td>
<td></td>
</tr>
<tr>
<td>PAF3413</td>
<td>Air operated type</td>
<td>PTFE</td>
<td>Approx. 0.054 l</td>
<td>Approx. 100 ml</td>
<td></td>
</tr>
<tr>
<td>PAF5410</td>
<td>Automatically operated type</td>
<td>PTFE</td>
<td>Approx. 0.130 l</td>
<td>Approx. 60 ml</td>
<td></td>
</tr>
<tr>
<td>PAF5413</td>
<td>Air operated type</td>
<td>PTFE</td>
<td>Approx. 0.190 l</td>
<td>Approx. 310 ml</td>
<td></td>
</tr>
</tbody>
</table>

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

⚠️ **Caution**

1. The pump can be used without lubrication.
   
2. If lubricating the pump, continue lubrication.
   
**Warning**

1. Test before using with the actual equipment.
   
2. Storage
   
3. After a long period of non-use, perform a trial run prior to operation.