



Operation Manual

Process pump

PAF5410

SMC

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Safety instructions

This operation manual indicates the precautions for safety use of process pump with the level of potential hazard as follows. Those precautions contain the content essential to keep safety.



Warning

Operator error could result in serious injury and loss of life.



Caution

Operator error could result in injury or equipment damage.

1. Precautions for handling

Warning

1) Operating environment

- When dangerous fluid or fluid possibly harmful to human is used, take measure to isolate human from the pump. Should the external leakage of transported fluid come out, the serious damage to human could be caused.
- When flammable or highly corrosive fluid is transported, keep the fire source away from the pump. Otherwise, the fire and explosion could be caused.
- Prevent splash of corrosive fluid or other solvents to the external face of the pump.
- If attachment of unknown liquid is found on the external face of the pump, do not touch it without care.

2) External leakage of transported fluid

- When flammable or dangerous fluid is transported, keep the fire source and corrosive material away from the pump. For this purpose, prepare the vessel for possible leakage and take other measures to prevent contact with the fire source and corrosive material. Otherwise, the fire and explosion could be caused.
- During operation of pump, the transported fluid could leak due to life out of the diaphragm. In this case, take prevention for the leakage to avoid adverse effect to human or facility.
- Do not touch the leakage of fluid without care. If the fluid has high temperature or is chemical, the contact could result in burn and other injuries.

3) Disassembly

- Do not disassemble the pump.

Caution

1) Quality of supplied air

- Mount the filter with filtration of approx. 0.01 μ . For the quality of air to be used, refer to Compressed Air Cleaning Equipments Catalog No. 5*

*Typical circuit shown on No.5

Compressor → HAW(after cooler) → AT(air tank) → AFF(main line filter) → IDF(refrigerating air dryer) → AM(mist separator) → AMD(micro mist separator) → PAF

- If the amount of foreign materials generated from air supply (carbon powder etc.) is large, mount super mist separator etc. to reinforce prevention for attachment of dust. Deposit of foreign materials could increase resistance and prevent smooth operation.

2) Quality of transported fluid

- If it is known solid materials enter the transported fluid, mount the filter with filtration of 0.2mm at least on fluid in.

3) Life and replacement

- Suspend operation and replace the diaphragm before it reaches the end of life. If the diaphragm breaks, the transported fluid leaks inside the pump and exhaust port, and the internal parts of the pump are damaged and the air blows FLUID OUT port.
Calculation of life of diaphragm (depending on operating conditions)

$$\text{Referential life date} = \frac{0.130 \ell (\text{discharge amount per one cycle}) \times 50 \text{ million cycles (referential life cycles)}}{\text{Discharge per 1min. } (\ell) \times \text{operating time per day (hour)} \times 60 (\text{min.})}$$

- The pump internal capacity is about 600 m ℓ .

4) Pilot air

- Confirm the supplied pilot air is within specified range from 0.2 to 0.5MPa. The air out of this range could cause malfunction, stop of operation, damage of internal parts and external leakage.

5) Discharge amount and suction head

- Given discharge rate and suction head are for the condition with fresh water, room temperature, atmospheric pressure and no piping. Thus, they are varied by physical characteristic of transported fluid, and in some cases, enough suction head can't be obtained.

6) Max. Discharge amount

- Given max. discharge rate is for the condition with supplied pressure of 0.5MPa, no suction head, piping I.D. of 5/8", piping length of 0.5m.

7) Operating temperature

- The pump is available from 0 to 90 °C, but should be cared not to freeze.(Avoid exposure to heat cycle)

2. Precaution for installation

Caution

1) Mounting

- Only horizontal mounting is available. When the pump is not mounted horizontally with its bottom faced down, it may cause sucking failure.
- Use four M8 bolts to mount the pump. If the bolts are not tightened firmly, the pump could be exposed to the vibration and eventually damage.

2) Piping

- Perform flushing enough for piping to avoid intrusion of cutting chips and sealant debris created by screwing the piping and fitting. If the tape is used for sealing, leave two threads exposed.

3) Material of fitting

- The threaded part is made of resin. Thus, do not tighten the metal fitting to avoid collapse of the thread.

4) Tightening torque

- Insufficient tightening torque could cause external leakage and excessive one could damage threaded part and parts. Keep adequate value for tightening.

Thread size	Adequate tightening torque (N·m)
Rc1/8	0.4 to 0.5
Rc1/4	0.8 to 1
Rc3/4	4 to 5

3. Description and function of individual port

- Suction port (FLUID IN) --- To suck transported fluid. Connect suction piping.
- Discharge port (FLUID OUT) --- To discharge fluid sucked inside the pump. Connect discharge piping.
- Air supply port (AIR SUP) --- Supply compressed air set by regulator etc.
- Air exhaust port (AIR EXH) --- Exhaust pilot air.

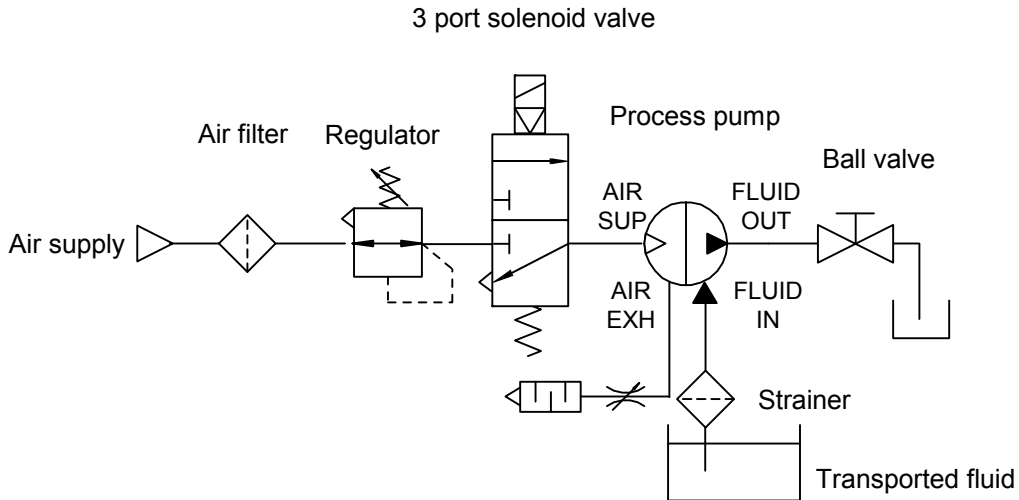
4. How to use

Caution

1) Start and stop

- a; Press manual pin.(Only at first operation)
- b; Connect air piping to air supply port "AIR SUP", and fluid transfer piping to suction port "FLUID IN" discharge port "FLUID OUT".
- c; Set pilot air pressure within 0.2 to 0.5MPa by regulator. Pump operates when 3-way valve on air supply port "AIR SUP" is energized, exhausting noise generated from air exhaust port "AIR EXH", and fluid flows from suction port "FLUID IN" to "FLUID OUT".
At this time, ball valve on discharge side is open. It sucks by itself without priming. To restrict exhausting noise, mount silencer (AN200-02 option) on air exhaust port "AIR EXH".
- d; Exhaust air supplied from 3-way valve on supply port "AIR SUP" to stop pump.

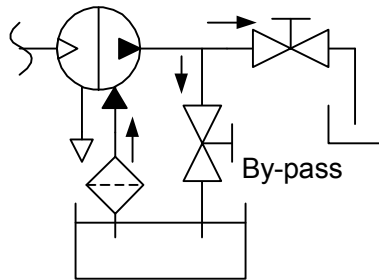
- Typical circuit



2) Adjustment of discharged flow rate

- Use ball valve connected to discharge side to adjust discharge flow. Do not close valve suddenly, as it generates surge and remarkably shortens pump life.
- When discharge flow is under range of specifications, keep minimum flow for process pump by installing bypass circuit from discharge side to suction side. Discharge flow under minimum flow may stop pump due to unstable operation.

- Typical circuit



5. Maintenance and check

1) During operation

- During operation of pump, it is necessary to check leakage of fluid and air and operating condition periodically. If any abnormality or concern is seen, stop the pump immediately and contact local supplier or SMC.
- When touching the pump for maintenance, put the protective tool such as glove which isn't affected by transported fluid to prevent burn.

2) During stop

- If the pump is stopped for a few hours, exhaust the air at supply side.
- If the pump is left unused for extended period, clean inside of the pump to prevent adherence and sticking of transported fluid over the time which could cause abnormal operation.

3) Check and repair

- Replace the diaphragm before it reaches referential life cycles (specified cycles). If the pump is continued after the life of diaphragm, the check valves of wetted part as well as the diaphragm are deteriorated and operating failure could be caused.

6. Specifications and how to order

• Specifications

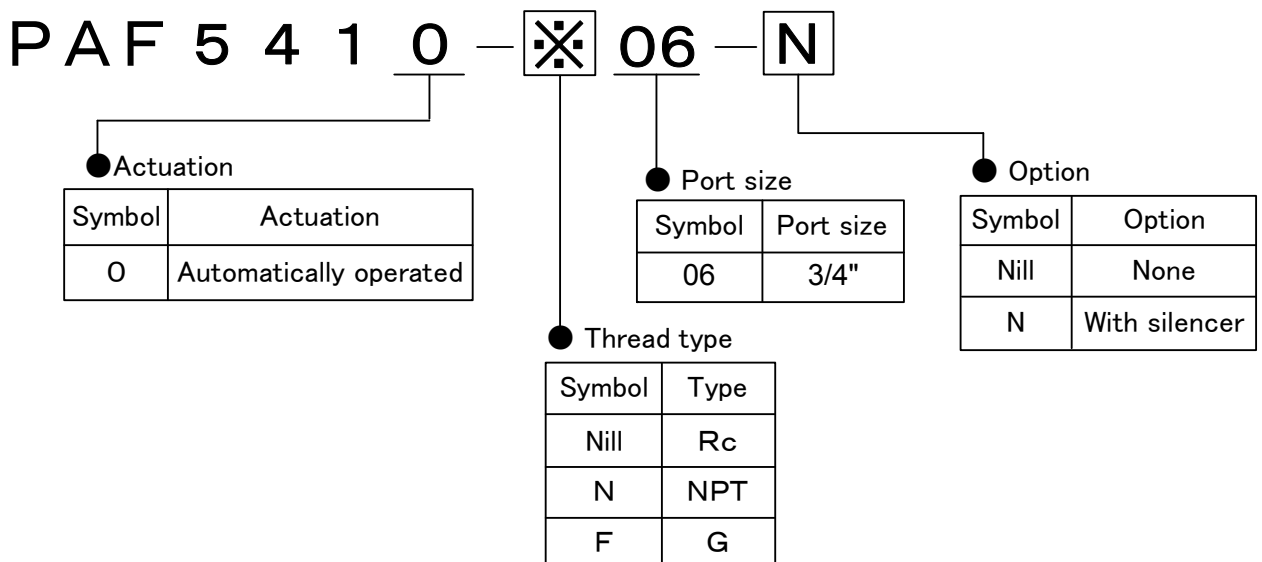
Model		PAF5410
Port size	Main fluid suction / discharge port	Rc, G, NPT 3/4, 3/4 tube piping, With nut
	Driving air Supply / Exhaust port	Rc, G, NPT 1/4
Material of wetted part	Body	New PFA
	Diaphragm / Packing	PTFE
	Check valve	New PFA, PTFE
Discharge amount		5 to 45L/min
Average discharge pressure		0 to 0.4MPa
Pilot air consumption		Max. 300L/min (ANR) ^{Note 2)}
Suction head	Dry	Max. 1m (Inside of the pump is dry.)
	Wet	Max. 4m (The pump contains the fluid.)
Transported fluid temperature		0 to 90 °C (No freezing or temperature fluctuation.)
Ambient temperature		0 to 70 °C (No freezing or temperature fluctuation.)
Pilot air pressure		0.2 to 0.5MPa
Proof pressure		0.75MPa
Mounting direction		Horizontal (mounting hole at bottom)
Weight		6kg

Note 1) Above values are at room temperature and with fresh water.

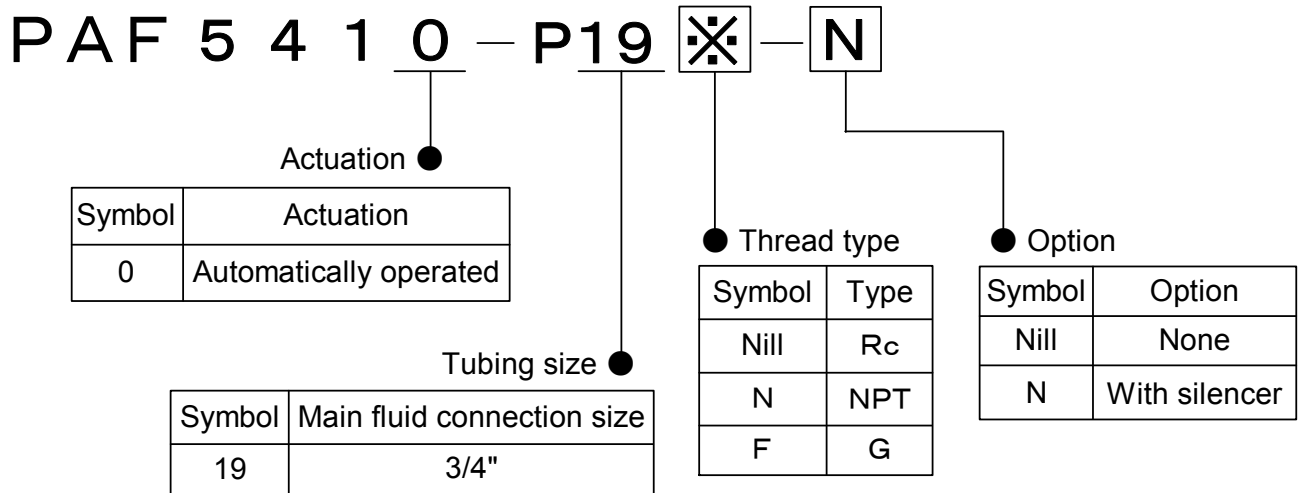
Note 2) Calculated for atmospheric condition, 20 °C (ANR)

• How to order

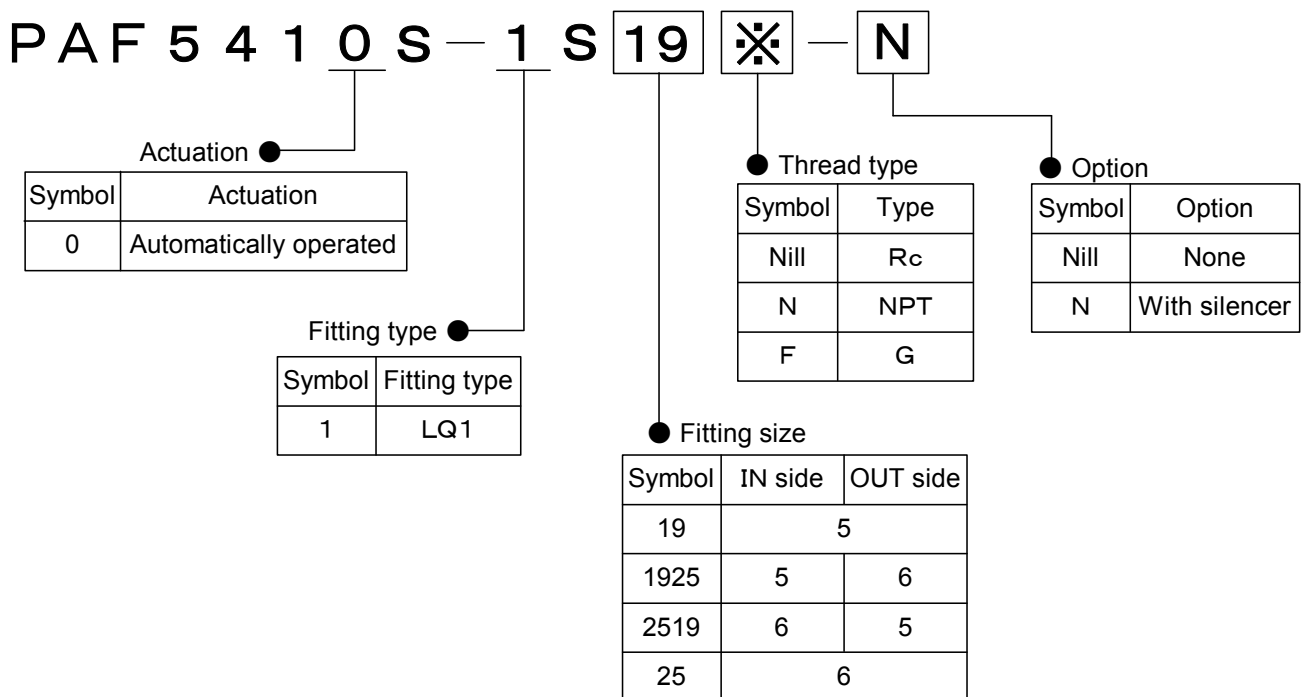
Female thread



Tube extension



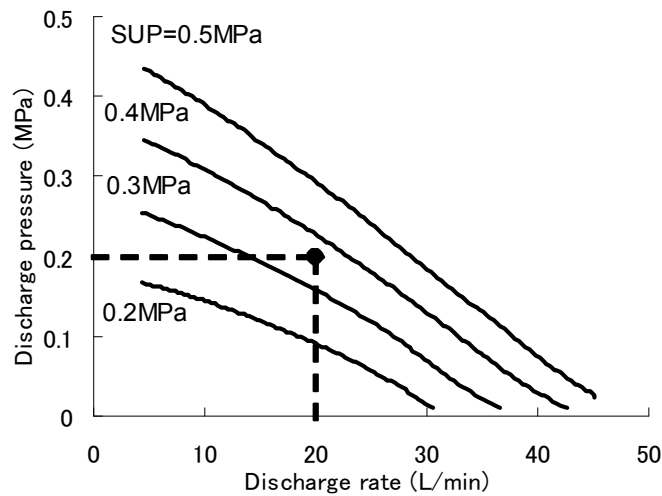
With nut



7. Discharge capability

1) Flow characteristic

With reference to flow characteristic graph (shown below), operating condition of the pump can be set.



Recommended typical condition A:

Obtain pilot air pressure when discharge rate is 20L/min and discharge pressure is 0.2MPa.

<Assumption; Fresh water (viscosity 1mPa·s , specific gravity1.0) is used as transported fluid>

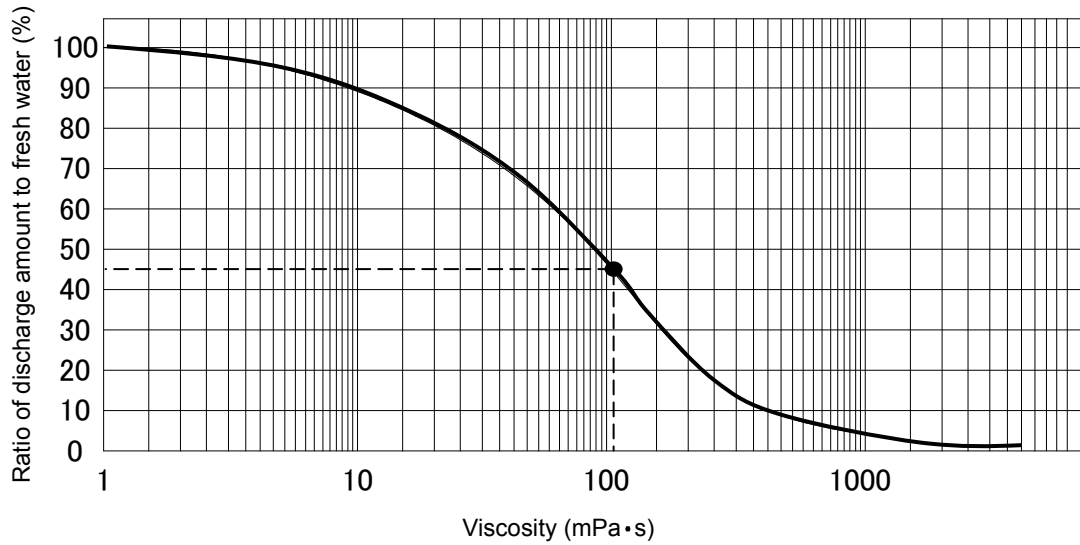
1. Plot the cross point between line with discharge rate 20L/min and line with pressure 0.2MPa.
2. Calculate pressure of transported fluid based on the point. In this example, the point is located between discharge curves (full line) with 0.3MPa and 0.4MPa and it can be found required air pressure at this point is approx. 0.37MPa in proportional relation.

Caution

- The above flow characteristic graph is for fresh water(viscosity 1mPa·s , specific gravity 1.0). Thus, if the fluid with higher viscosity such as oil is used, convert the fluid to fresh water with reference to viscosity characteristic graph.
- The discharge rate is affected by characteristic of transported fluid (viscosity, specific gravity, concentration of slurry) and operating conditions (temperature, pump head, transporting distance) etc. and should be confirmed before use.
- In the application where the back pressure is applied from discharge port “FLUID OUT”, the result of (pilot air pressure - back pressure, i.e. pressure difference) is pilot air pressure on the graph. Also, it should be noted discharge rate decreases compared with normal condition.
- If required output of compressor is calculated from air consumption, consider the output is 0.75 kW per air consumption of 100L/min (ANR) for reference.

2) Viscosity characteristic

With reference to viscosity characteristic graph (shown below), discharge amount of transported fluid with higher viscosity can be calculated.

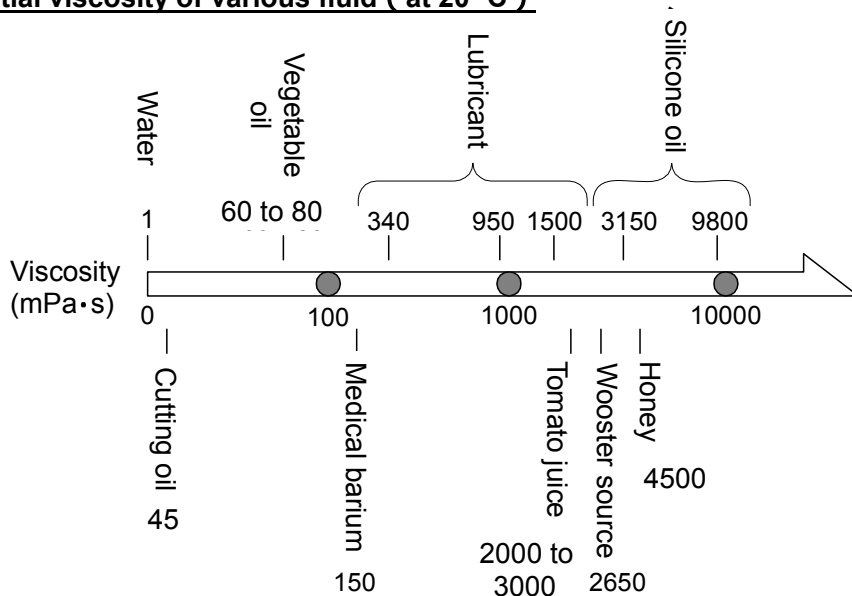


Recommended typical condition B:

Calculate discharge amount of fluid with viscosity 100mPa·s in case of discharge rate 9L/min and discharge pressure 0.2MPa.

- Find ratio of discharge rate to fresh water for the fluid with viscosity 100mPa·s from the graph. Then, it is found to be 45%.
- After that, convert it to discharge rate of fresh water. Since discharge rate 45% of fresh water is equal to 9L/min of the fluid, with the following calculation;
 $9\text{L/min} \div 0.45 = 20\text{L/min}$
 it is found discharge rate 10L/min is necessary for fresh water.
- Then, refer to flow characteristic graph and calculated air pilot pressure.

Referential viscosity of various fluid (at 20 °C)



⚠ Caution

- The viscosity of fluid is affected by operating conditions (temperature, transporting distance etc.) and fluctuation of ambient temperature.
- Viscosities up to 1000 mPa·s can be used.

8. Troubleshooting

If any abnormality is found, perform check along with the following list. If the abnormality can't be eliminated, return the pump to SMC.



Warning

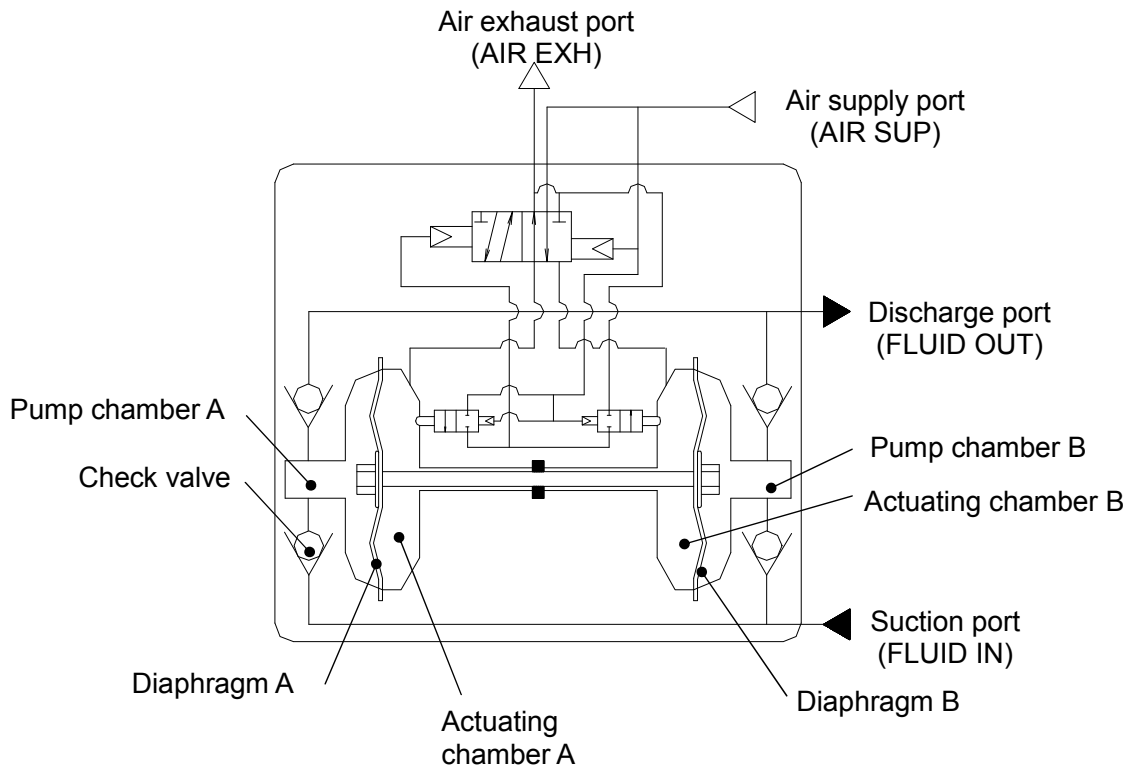
Exhaust dangerous fluid out of the pump before check.

- Do not return the pump with dangerous fluid left. Be sure to substitute it with DI water. Otherwise, the fluid could cause burn and other damages on human during transportation.

Trouble		Possible cause	Remedy
1) Supply of air can't move the pump.		<ul style="list-style-type: none"> - Internal air piping is clogged with dust. - Suction side (FLUID IN) or discharge side (FLUID OUT) is closed or has large resistance. - Defect inside the body. - Insufficient supplied air pressure. - Intrusion of foreign materials into pump chamber. - Damaged diaphragm. 	<ul style="list-style-type: none"> - Cleaning or replacement of pilot air switching part. - Review of piping at suction or discharge side and removal of restrictor. - Replacement of pump. - Supply of air at adequate pressure. - Cleaning. - Replacement of pump.
2) The pump starts, but doesn't discharge.	The pump doesn't suck.	<ul style="list-style-type: none"> - Check valve is clogged. - Check valve is damaged or worn. - The filter at suction side (FLUID IN) is clogged. - Excessive required suction head. - Incorrect mounting direction. - The diaphragm is damaged or comes off. - Sealing failure of fitting at suction side (FLUID IN). - Excessive viscosity of transported fluid. - Incorrect insertion of check valve. 	<ul style="list-style-type: none"> - Cleaning. - Replacement of pump. - Cleaning of filter. - Reduction to suction head covered by the pump. - Remounting in normal direction. - Replacement of pump. - Secure mounting of seal. - Use of fluid with lower viscosity. - Remounting in correct direction.
	The pump sucks, but doesn't discharge	<ul style="list-style-type: none"> - Check valve or fitting at discharge side (FLUID OUT) is clogged. 	<ul style="list-style-type: none"> - Cleaning.

<p>3) The discharge rate is insufficient.</p>	<ul style="list-style-type: none"> - Check valve at suction side (FLUID IN) or discharge side (FLUID OUT) is clogged. - Excessive viscosity of transported fluid. - Excessive required suction or discharge pressure. - The filter of suction side (FLUID IN) is clogged. - The filter of discharge side (FLUID OUT) is clogged. - Insufficient air supply. - Too small port size of transported fluid piping. - Application of back pressure from discharge side (FLUID OUT). 	<ul style="list-style-type: none"> - Cleaning. - Non-conformance. - Reduction of required head. - Cleaning or replacement. - Cleaning or replacement. - Supply of air at adequate pressure. - Increase of air supply. - Removal of back pressure or increase of supplied air pressure.
<p>4) A lot of air bubble come out from discharge side (FLUID OUT).</p>	<ul style="list-style-type: none"> - Air is sucked by suction side (FLUID IN). - Sealing failure of fitting at suction side (FLUID IN). - Damaged diaphragm. 	<ul style="list-style-type: none"> - Prevention of suction. - Secure mounting of seal. - Replacement of pump.
<p>5) Transferred fluid is flowed out from exhaust port. (AIR EXH)</p>	<ul style="list-style-type: none"> - Damaged diaphragm 	<ul style="list-style-type: none"> - Replacement of pump.
<p>6) Transported fluid or air leaks from jointed part to outside.</p>	<ul style="list-style-type: none"> - The diaphragm is damage or comes off. - Looseness of bolts which fix the parts at each port. 	<ul style="list-style-type: none"> - Replacement of pump. - Retightening.

9. Operating principle



When compressed air is supplied to air supply port within 0.2 to 0.5MPa, internal directional control valve operates and diaphragm starts reciprocation.

Air is supplied in actuating chamber shown in Fig.1, fluid in pump chamber is flowed out. Meanwhile, pump chamber B sucks fluid.

When pilot valve is pushed out at stroke end, built-in directional control valve is shifted, and starts reverse operation (Fig.2). This repeated operation realizes continuous suction and discharge.

