



Installation and Maintenance Manual

Process Pump

PB1011A



1 Safety Instructions

This manual contains essential information for the protection of users and others from possible injury and/or equipment damage.

- Read this manual before using the product, to ensure correct handling, and read the manuals of related apparatus before use.
- Keep this manual in a safe place for future reference.
- These instructions indicate the level of potential hazard by label of "Caution", "Warning" or "Danger", followed by important safety information which must be carefully followed.
- To ensure safety of personnel and equipment the safety instructions in this manual and the product catalogue must be observed, along with other relevant safety practices.

Caution	Indicates a hazard with a low level of risk, which if not avoided, could result in minor or moderate injury.
Warning	Indicates a hazard with a medium level of risk, which if not avoided, could result in death or serious injury.
Danger	Indicates a hazard with a high level of risk, which if not avoided, will result in death or serious injury.

Warning

- The compatibility of pneumatic equipment is the responsibility of the person who designs the pneumatic system or decides its specifications. Since the products specified here can be used in various operating conditions, their compatibility with the specific pneumatic system must be based on specifications or after analysis and/or tests to meet specific requirements.
- **Only trained personnel should operate pneumatically operated machinery and equipment.**
Compressed air can be dangerous if an operator is unfamiliar with it. Assembly, handling or repair of pneumatic systems should be performed by trained and experienced personnel.
- **Do not service machinery/equipment or attempt to remove components until safety is confirmed.**
 - 1) Inspection and maintenance of machinery/equipment should only be performed after confirmation of safe locked-out control positions.
 - 2) When equipment is to be removed, confirm the safety process as mentioned above. Switch off air and electrical supplies and exhaust all residual compressed air in the system.
 - 3) Before machinery/equipment is re-started, ensure all safety measures to prevent sudden movement of cylinders etc. (Supply air into the system gradually to create back pressure, i.e. incorporate a soft-start valve).
- **Do not use this product outside of the specifications. Contact SMC if it is to be used in any of the following conditions:**
 - 1) Conditions and environments beyond the given specifications, or if the product is to be used outdoors.
 - 2) Installations in conjunction with atomic energy, railway, air navigation, vehicles, medical equipment, food and beverage, recreation equipment, emergency stop circuits, press applications, or safety equipment.
 - 3) An application which has the possibility of having negative effects on people, property, or animals, requiring special safety analysis.

Caution

- Ensure that the air supply system is filtered to 5 microns.

2 Specifications

2.1 Specification

PB1011A Process Pump Specification

Type	PB1011A	
Type of operation	Solenoid valve built-in type	
Port size	Main fluid	Rc, NPT, G 1/8 Female thread
	Suction/discharge port	Rc, NPT, G 1/8 Female thread
	Pilot air	Supply port: Rc, NPT, G 1/8 Female thread Exhaust port: M5 x 0.8 Female thread
Material	Body wetted areas	Polypropylene (PP), Stainless steel (SUS316)
	Diaphragm	PTFE
	Check valve	PTFE, Polypropylene (PP)
	Liquid contact seals	FKM
Maximum discharge rate	2000 mL/min	
Average discharge pressure	0 to 0.6 MPa	
Pilot Air Pressure	0.2 to 0.7 MPa	
Air consumption	40 L/min (ANR) or less	
Suction head	Up to 2.5 m (Interior of pump dry)	
Noise	64 dB (A) or less	
	(Option: Silencer / AN120-M5 Mounting)	
Withstand pressure	1.05MPa	
Diaphragm life (Reference)	30 million times (One time per cycle)	
Operating fluid temperature	0 to 50°C (No freezing, heat cycle is not applied)	
Ambient temperature	0 to 50°C (No freezing, heat cycle is not applied)	
Recommended operating cycle	1 to 10 Hz	
Weight	0.18 kg	
Mounting orientation	FLUID OUT port at top	
Maximum operating viscosity	100 mPa·s	
Power supply voltage	DC24 V	
Power consumption	0.35 W	
Packaging environment	General environment	

*The valves above are for tap water, atmospheric pressure, and normal temperature.

*Slurry cannot be transferred due to seating failure and wearing of the check valve and accumulation of particles causing operation failure.

Note 1: When the piping length of both the suction side and the discharge side is almost 0m. It may not be possible to obtain the discharge in the specification depending on the piping conditions. With the air operated type, it may not be possible to obtain the discharge in the specification depending on the piping conditions for the pilot air.

Note 2: Operation is possible with a small Cv value when the operation cycle is small.

2.2 Performance curves

2.2.1 Example of selection from the Flow Characteristic graph

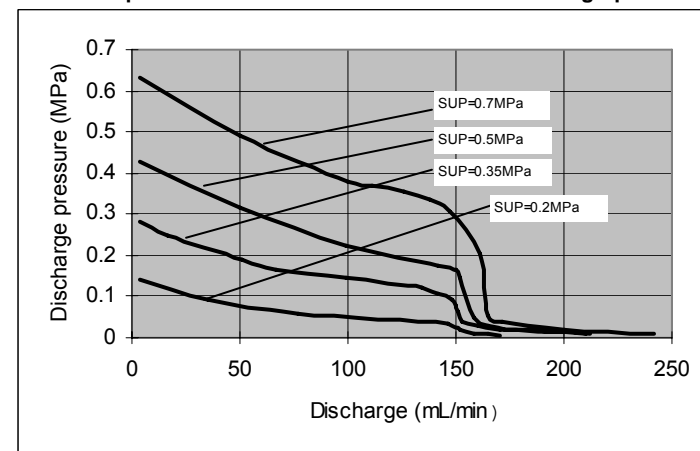
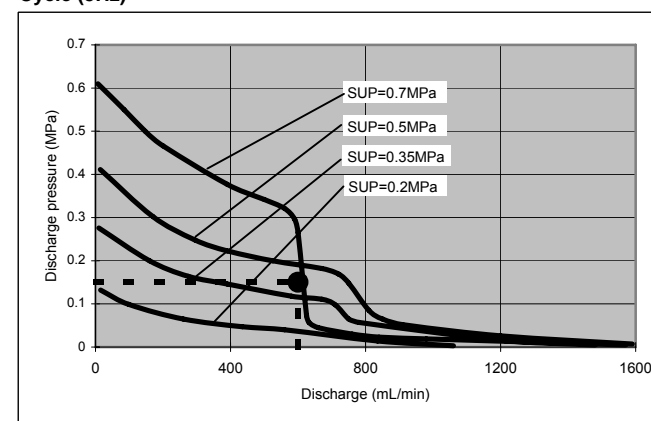


Fig.1a Flow rate characteristic graphs

Specifications (continue)

Cycle (5Hz)



Cycle (7Hz)

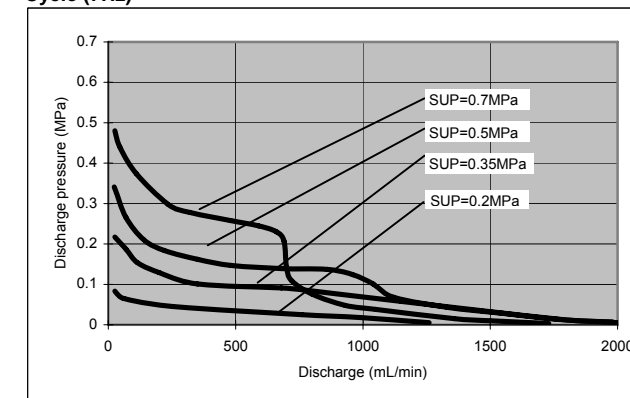


Fig.1b Flow rate characteristic graph

Required specification example (Ref. Fig.1b Cycle5 Hz)

Find the pilot air pressure for a discharge rate of 600 mL/min and a discharge pressure of 0.15 MPa for built in solenoid valve type.

<The transferred fluid is clear water (viscosity of 1 mPa·s, specific gravity of 1.0) and solenoid valve cycle is 5 Hz.>

* When the total pump head is required instead of the discharge pressure, a discharge pressure of 0.1 MPa corresponds to a total pump head of 10m.

1. First, mark the intersection point for a discharge rate of 600 mL/min and a discharge pressure of 0.15 MPa.
2. Find the pilot air pressure for the marked point. In this case, the point is between the discharge curves for 0.35 MPa and 0.5 MPa, and based on the proportional relationship to these lines, the pilot air pressure for this point is approximately 0.4 MPa.

Caution

- Flow-rate characteristics are for tap water (viscosity of 1 mPa·s, specific gravity of 1.0), no piping for suction and discharge.
- The amount of discharge differs greatly depending on properties (viscosity, specific gravity) of the fluid being transferred and operating conditions (pump head, transfer distance), etc.

2.1.2 Calculation of Air Consumption

Find the air consumption for operation with a 5 Hz switching cycle and pilot air pressure of 0.35 MPa from the Air consumption graph (Fig.2).

1. Look up from the 5 Hz switching cycle to find the intersection with SUP = 0.35 MPa.
2. From the point just found, draw a line to the Y-axis to find the air consumption. The result is approximately 10 L/min (ANR).

Specifications (continue)

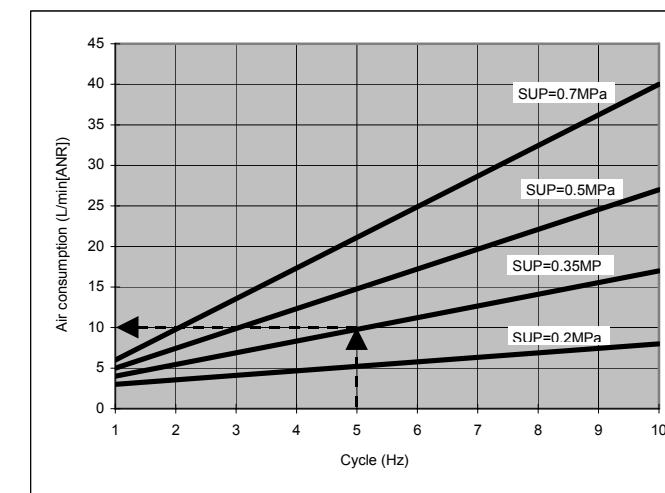


Fig.2 Air consumption characteristic graph

Caution

- The air consumption differs greatly depending on properties (viscosity, specific gravity) of the transferred fluid and operating conditions (pump head, transfer distance), etc.

2.1.3 Selection of Viscosity Characteristic graph

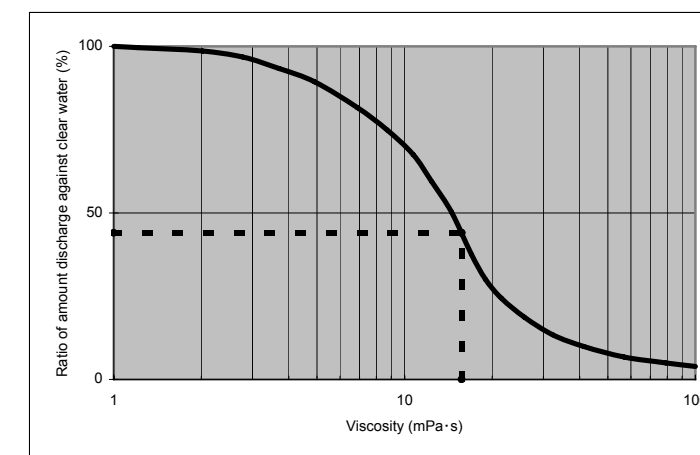


Fig.3 Viscosity characteristic graph

Required specification example

Find the pilot air pressure and pilot air consumption for a discharge rate of 270 mL/min, discharge pressure of 0.15 MPa, and a viscosity of 15 mPa·s.

1. First, find the ratio of the amount of discharge against clear water when viscosity is 15 mPa·s from the graph to the left. It is determined to be 45%.
2. Next, the viscosity of 15 mPa·s and the discharge rate of 270 mL/min in the required specification example are converted to the amount of discharge for clear water. Since 45% of the clear water discharge is equivalent to 270 mL/min in the required specifications, $270 \text{ mL/min} \div 0.45 = \text{approximately } 600 \text{ mL/min}$, indicating that a discharge rate of 600 mL/min is required for clear water.

Specifications (continue)

- Finally, find the pilot air pressure and pilot air consumption based on the flow-rate characteristic graphs.

Caution

- Transfer is possible up to about 100 mPa·s.

Kinematic viscosity $\nu = \text{Viscosity } \mu / \text{Density } \rho$

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

2.3 Production batch code

The production batch code printed on the label indicates the month and year of production as per the following table.

Year	2010	2011	2012	....	2021	2022	2023	....
Month	o	P	Q	....	Z	A	B	....
Jan	o	oo	Po	Qo	....	Zo	Ao	Bo
Feb	P	oP	PP	QP	....	ZP	AP	BP
Mar	Q	oQ	PQ	QQ	....	ZQ	AQ	BQ
Apr	R	oR	PR	QR	....	ZR	AR	BR
May	S	oS	PS	QS	....	ZS	AS	BS
Jun	T	oT	PT	QT	....	ZT	AT	BT
Jul	U	oU	PU	QU	....	ZU	AU	BU
Aug	V	oV	PV	QV	....	ZV	AV	BV
Sep	W	oW	PW	QW	....	ZW	AW	BW
Oct	X	oX	PX	QX	....	ZX	AX	BX
Nov	y	oy	Py	Qy	....	Zy	Ay	By
Dec	Z	oZ	PZ	QZ	....	ZZ	AZ	BZ

3 Construction

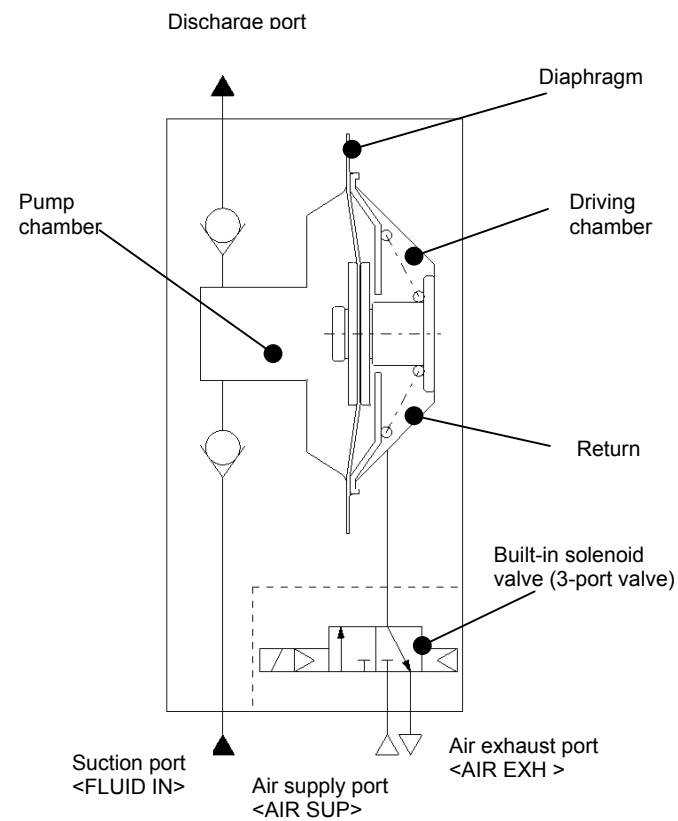


Fig.4 PB1011A (Built-in solenoid valve type)

Construction (continue)

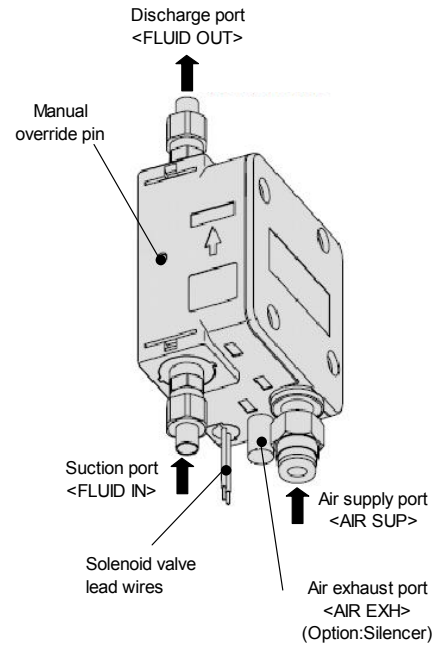


Fig.5 Name and function of parts (see Table 1)

Table 1

Description	Functions
Suction port (FLUID IN)	Sucks the fluid to be transferred.
Discharge port (FLUID OUT)	Discharges the fluid taken in the pump.
Air supply port (AIR SUP)	Supplies air of set pressure.
Air exhaust port (AIR EXH)	Exhausts pilot air
Manual override pin	The pump operates one time per push.
Lead wires	Solenoid lead wires

4 Installation

Warning

Do not install the product unless the safety instructions have been read and understood.

- Confirm the Specifications. Fully understand the applications, fluids, environment and other operating conditions to use this product within the specified range shown in this manual.

4.1 Operating Environment

Warning

- Do not use in the following environments, as this can cause failure.
 - Locations where flammable fumes are present or where flammable liquid may get stuck to the product.
 - Locations with an atmosphere of corrosive gases, organic solvents or chemical solutions.
 - Locations where there is contact with sea spray, water or steam.
 - Locations where ultraviolet deterioration or overheating of resin may occur due to direct sunlight.
 - Locations near heat sources with poor ventilation (heat sources should be shielded by heat insulating material).
 - Locations with impact or vibration.
 - Locations with excessive moisture or dust.

- Do not use the product submerged in water (liquid). Otherwise, liquid will enter the openings inside the product resulting in malfunction.
- Using very dry compressed air as the pilot air may affect the reliability (service life) of the equipment, because the lubrication characteristics inside the equipment will deteriorate. Please consult with SMC when using very dry compressed air as the pilot air.

4 Installation (continue)

Caution

- Fluid leakage
 - In some cases the circulation fluid may leak from the pump to the external environment (example: when the diaphragm reaches its end life cycle). Depending on the fluid take measures to collect the fluid (example: by installing a drain pan) to avoid any adverse effects to the operators or equipment.
 - Be careful not to touch fluid that has leaked. Depending on the operation conditions there is a danger of burns or other injury to the skin if hot fluids or chemicals, etc., are touched
 - When dangerous fluids are used, take safety measures to isolate the product from operators. There is a risk of serious injury due to leakage of the fumes or liquids.

- Perform periodic inspections to confirm normal operation.

It may otherwise become impossible to assure safety in the event of unexpected malfunction or miss operation.

4.2 Mounting

Warning

- Mount the pump is vertical only, so that the FLUID OUT port is at the top. Suction failure may occur if it is not mounted vertically.
- Fix the pump securely by inserting two screws into the two M4 threaded mounting holes. If using the foot (option B), fix the foot securely using the two $\phi 4.5$ mounting holes.
- Secure all specified mounting positions when using this product because the reciprocal motion of the diaphragm propagates.
- If the propagation of the vibration of the pump is not acceptable, insert vibrating-isolating rubber when mounting.

- Ensure sufficient maintenance space.

4.3 Piping

Caution

- Support the piping according to JIS B 8370 when piping the tube. Arrange the piping so that tension is not applied to the tube.
- Before piping make sure to clean up chips, cutting oil, dust etc.
- When installing piping or fittings, ensure sealant material does not enter inside the port. When using seal tape, leave 1.5 to 2 threads exposed on the end of the pipe/fitting.

Always fasten threads with the correct tightening torque

Connection thread	Tightening torque N·m
Rc 1/8	0.8 to 1.0

- If fittings with metal threads are used, it could break the female thread of the product. For piping the tube fitting, use fittings with resin threads.

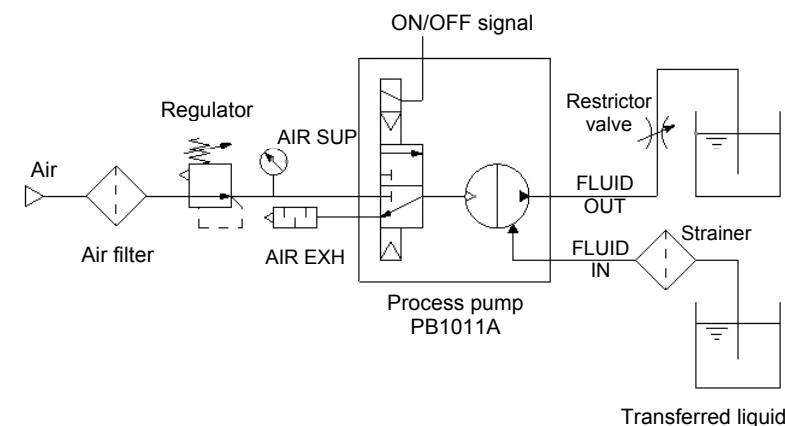


Fig.6 Piping example for PB1011A

4 Installation (continue)

4.4 Air supply

Warning

- Use clean air. Do not use compressed air that contains chemicals, synthetic oils containing organic solvents, salts or corrosive gases, etc., as these can cause malfunction or damage the equipment.
- The pilot air should be in the range of 0.2 to 0.7MPa with sufficient supply capacity. Operation outside of this range will cause failures, such as malfunction stopping, breakage of internal parts, external leakage etc.
- 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 with a membrane air dryer (such as IDG series).

Caution

- Use the supply air, which has been dried by an air dryer.
- Be sure to use only air filtrated by a micro mist separator (such as AMD series). Use of a super mist separator (such as AME series) is recommended to extend maintenance intervals.
- If a pump is operated by dried air and N2 gas, etc., the deterioration of the inner gaskets will be accelerated and may result in substantially shortening of the product life.

4.5 Storage

Caution

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

4.6 Lubrication

Caution

- Do not lubricate the compressed air supplied as pilot air.
- SMC products have been lubricated for life at manufacture, and do not require lubrication in service.

4.7 Fluid

Warning

- 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 problems during operation (Refer to SMC Best Pneumatics Book 7 page 730 or consult SMC)

- Fluid quality

If fluid is used which contains particles, problems 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 filtration of 150-180 μm is recommended.

- Fluid properties
 - Do not use the flammable liquids.
 - Do not use acids, bases or chemicals that can affect operators.

- Liquid seals

Provide a relief valve in the system to prevent it from becoming a liquid-sealed circuit. (see Fig 7).

4 Installation (continue)

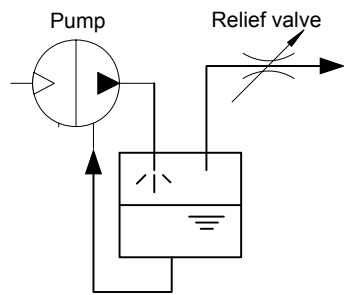


Fig.7 Countermeasure against liquid sealed circuit

- 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.
- Measures against static electricity**
 Take measures against static electricity as static electricity may occur depending on the fluid.
- Condensation and freeze of the pilot port**
 The built-in solenoid valve type air exhaust port can be cooled 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.

- Do not allow pump to be idle for a long time.**
 If the pump is operated for a long time without any fluid inside, The diaphragm may be damaged or the life may be shortened. Do not continue idling for 3 minutes or longer.

- The pump cannot transfer gas.**

4.8 How to use

1) Connect air piping to air supply port "AIR SUP", and fluid transfer piping to suction port "FLUID IN" and discharge port "FLUID OUT".

- Connect the solenoid valves lead wire to DC24V signal wire. Red is for (+), "Black is for (-)

2) Set pilot air pressure within the range 0.2 to 0.7MPa.

- The diaphragm starts moving by inputting DC24V by turning on and off. Exhaust noise can be heard from air exhaust AIR EXH.

- Start operation by applying ON/OFF signal repeatedly to the solenoid valve prepared separately. After a while, the fluid will flow from the suction port "FLUID IN" to the discharge port "FLUID OUT".

- It sucks by itself without priming (Suction pump head: 2.5m Normal temp / clean water)

3) How to stop the pump

Turn off the solenoid valve to exhaust the air from the pump. The air in the pump has to be exhausted.

Warning

- If the pump is to be stop for few hours, exhaust the from the "AIR SUP" port.

5 Outline Dimensions (mm)

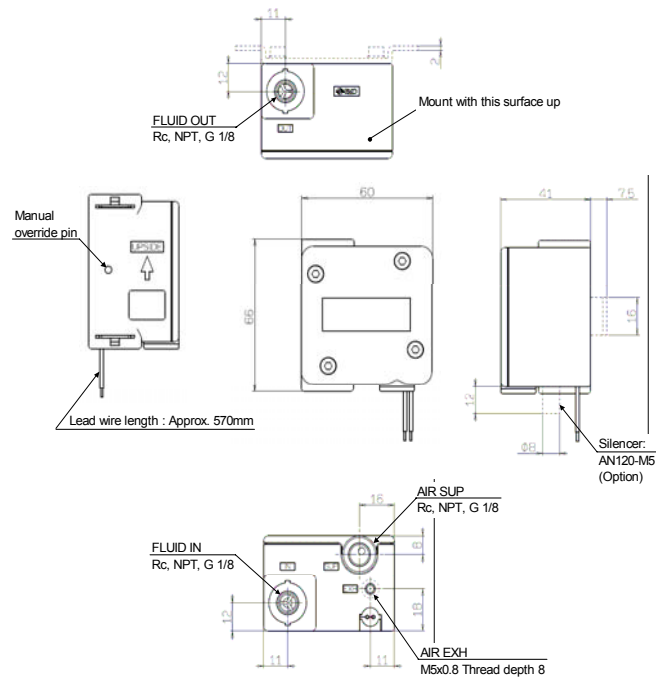


Fig.8a Process pump PB1011A

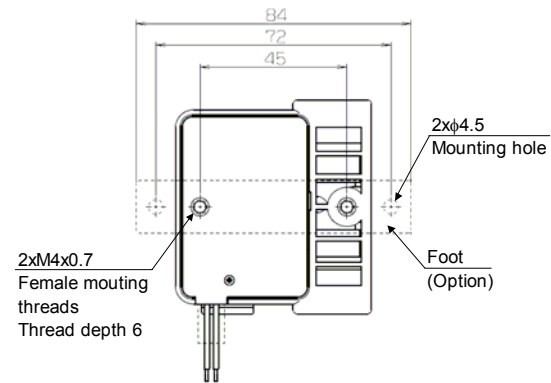


Fig.8b Process pump PB1011A

6 Maintenance

6.1 General Maintenance

Warning

- Use appropriate protective equipment.**
 When touching the pump for maintenance, wear protective equipment such as gloves that are compatible with the fluid used. There is a risk of chemical burns.
- Perform maintenance 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.

6 Maintenance (continue)

- Do not disassemble the product, as disassembly will invalidate the product's warranty.

When disassembly is necessary, please consult with SMC or our distributor.

- Transfer of dangerous fluids.**
 In case a dangerous fluid such as a strong acid or base is transferred by mistake, do not disassemble the product. There is a danger of serious injury if personnel come into contact with the remaining fluid.

- If handled improperly, compressed air can be dangerous. Only qualified personnel should perform maintenance of pneumatic systems.

Caution

- Perform maintenance after consulting the operation manual.**
 Please obtain the operation 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.

- After maintenance apply operating pressure and power to the equipment and check for proper operation and possible air leaks. If operation is abnormal, verify product set-up parameters.

- Do not make any modification to the product.

- Do not disassemble the product, unless required by the maintenance manual.

- Do not step on or place heavy objects on the unit.

The equipment may be deformed or damaged.

- Discharge drainage regularly.**
 If drainage accumulates in upstream filters, piping or other areas malfunction or unexpected trouble in the process pump can occur due to splash over into the downstream side, etc. Therefore, the amount of drainage and operation of auto drains should be checked every day.

- Perform demounting of the product in accordance with the procedures below.**

- Shut off the air supply and exhaust the compressed air in the pilot piping.
- Demount the product.
- When the equipment is to be started again after remounting or replacement, first confirm safety, and then confirm that the equipment can operate normally.

- Discharging condensate**

Operation with condensate caught in the equipment or the piping may lead to operation failure of the equipment, splashing from the outlet, and unexpected accidents. Remove condensate from air filters regularly.

- During operation of the pump, it is necessary to check leakage (air and liquid) and operating conditions regularly. If any abnormality is seen, stop operating the product contact your local supplier or SMC sales representative.

6.2 Service life and replacement of consumable parts

- If the operating cycle of the process pump exceeds the service life of 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 diaphragm, and replace the pump as early as possible.

- The product is not guaranteed once it has been disassembled. Customers are responsible for performing maintenance properly.

6 Maintenance (continue)

- Please obtain the maintenance procedure from SMC or our distributor, and read it carefully before carrying out maintenance.

Calculation of reference service life (days) of diaphragm:

Model	Diaphragm Material	Amount of discharge per cycle	Ref. Number of cycles in service life A	Volume inside of pump (wetted parts)
PB1011A	PTFE	4 mL	30 million cycles	Approx. 9 mL

Note: This is not a metering pump. The amount of discharge depends on the operating conditions.

Reference service life (days) =

$$\frac{A \text{ (Reference number of in service life)}}{\text{Operating frequency of solenoid valve (Hz) x Operating time per day (hour) x 60 (min) x 60 (sec)}}$$

Example 1:

Frequency solenoid valve 5 Hz and operating 8 hours per day.

$$\text{Reference service life (days)} = \frac{30,000,000}{5(\text{Hz}) \times 8(\text{hour}) \times 60(\text{min}) \times 60(\text{sec})} = 208 \text{ (days)}$$

6.3 Spare Parts

PB1011A Spare Parts List

Spare Part No.	Description
KT-PB1A-9	Diaphragm set
KT-PB1A-1	Check valve set
KT-PB1A-7	Port set (Rc screw)
KT-PB1A-7N	Port set (NPT screw)
KT-PB1A-7F	Port set (G screw)
KT-PB1A-4	Seal set
KT-PB1-3	Foot set
SYJ314M-5H-Q	Kit for integrated solenoid valve

Note1: Refer to the part number in the maintenance manual to check the parts.
 Note2: After performing maintenance confirm that the process pump is operating normally, and, ensure there is no leakage.

7 Applicable Fluids

Caution

Material and fluid compatibility for PB1011A

Model	PB1011A	
Body material	Polypropylene, Stainless steel (316)	
Diaphragm material	PTFE	
Example of applicable liquids	Compatible liquids	Municipal water, Neutral detergent
	Incompatible liquids	Ethyl alcohol, Isopropyl alcohol, Oils, Kerosene, Thinners, Toluene, Acetone, acids, bases, Flammable liquids, High penetration liquids, Corrosive liquids

7 Applicable Fluids (continue)

- Do not use flammable fluid. Fire or explosion can result due to fluid leakage.
- Selecting fluids the following must be considered: -
 - For the stainless steel parts solvents and industrial water are suitable.
 - For the diaphragm material (PTFE) is suitable for non-permeating liquids.
 - Use fluids that will not corrode the wetted parts materials.
- Since the possible applicability may vary depending on operating conditions, be sure to confirm by means of testing.
- These products are not suitable for use in medical applications or with food products.
- Possible applications will change depending on additive agents. Take note of additives.
- Possible applications will change depending on impurities. Take note of impurities.
- Mixing of foreign substances will shorten service life. Operate without foreign substances.
- When transferring liquids subject to coagulation, take measures to prevent coagulation inside the pump.
- When dangerous fluids are used, take safety measures to isolate the product from the operator. There is a risk of serious injury due to leakage of the fumes or liquids.
- Do not use liquids that will cause the wetted sealant to swell.

8 Limitation of Use

- To stop the pump, turn off the power supply to the built-in solenoid valve.
- Use caution so that the operating fluid does not adhere to the product outer surface. Never use the product with the operating fluid adhering to the product outer surface.
- Fluid pressure

Feeding the fluid from the suction side into the pump with pressure or drawing it with negative pressure will cause reverse pressure to be applied to the diaphragm, causing shortening of the product life.
- Use a design that 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. When installing a check valve, use the check valve whose cracking pressure is 0.02MPa or less. Using the check valve of higher cracking pressure, suction failure might be occurred.
- Refer to Best Pneumatics No. (1) (pages 3 ~ 7 and page 1369 ~ 1430) for precautions on the usage of the solenoid valve.
- Take measures that the circulation fluid does not come in contact with the external surface of the pump.

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9 Contacts

AUSTRIA	(43) 2262 62280-0	LATVIA	(371) 781 77 00
BELGIUM	(32) 3 355 1464	LITHUANIA	(370) 5 264 8126
BULGARIA	(359) 2 974 4492	NETHERLANDS	(31) 20 531 8888
CZECH REP.	(420) 541 424 611	NORWAY	(47) 67 12 90 20
DENMARK	(45) 7025 2900	POLAND	(48) 22 211 9600
ESTONIA	(372) 651 0370	PORTUGAL	(351) 21 471 1880
FINLAND	(358) 207 513513	ROMANIA	(40) 21 320 5111
FRANCE	(33) 1 6476 1000	SLOVAKIA	(421) 2 444 56725
GERMANY	(49) 6103 4020	SLOVENIA	(386) 73 885 412
GREECE	(30) 210 271 7265	SPAIN	(34) 945 184 100
HUNGARY	(36) 23 511 390	SWEDEN	(46) 8 603 1200
IRELAND	(353) 1 403 9000	SWITZERLAND	(41) 52 396 3131
ITALY	(39) 02 92711	UNITED KINGDOM	(44) 1908 563888

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