

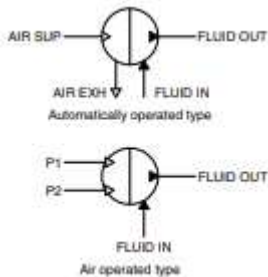


ORIGINAL INSTRUCTIONS

Instruction Manual  
55-PA3###/PA5###  
Process Pump



Refer to Declaration of  
Conformity for relevant  
Directives



ATEX classification

55-PA3##0	II 2 G Ex h IIB T6 Gb II 2 D Ex h IIB T68°C Db	0°C ≤ Ta ≤ +60°C
55-PA3##3	II 2 G Ex h IIB T5 Gb II 2 D Ex h IIB T89°C Db	
55-PA5##0	II 2 G Ex h IIB T6 Gb II 2 D Ex h IIB T68°C Db	
55-PA5##3	II 2 G Ex h IIB T6 Gb II 2 D Ex h IIB T78°C Db	

Certificate reference: SMC. 19.0007 X  
For special conditions of use see section 1.2

The intended use of this ATEX Category 2 process pump is to convert the potential energy provided by compressed air into a force which causes mechanical linear motion. The mechanical linear motion is then used to pump liquid through a system.

1 Safety Instructions

1.1 General Safety Instructions

These safety instructions are intended to prevent hazardous situations and/or equipment damage. These instructions indicate the level of potential hazard with the labels of “Caution,” “Warning” or “Danger.” They are all important notes for safety and must be followed in addition to International Standards (ISO/IEC) \*1), and other safety regulations.

\*1) ISO 4414: Pneumatic fluid power - General rules relating to systems.  
ISO 4413: Hydraulic fluid power - General rules relating to systems.  
IEC 60204-1: Safety of machinery - Electrical equipment of machines. (Part 1: General requirements)  
ISO 10218-1: Manipulating industrial robots - Safety. etc.

- Refer to product catalogue, Operation Manual and Handling Precautions for SMC Products for additional information.
- Keep this manual in a safe place for future reference.

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

**Warning**

- Always ensure compliance with relevant safety laws and standards.**
- All work must be carried out in a safe manner by a qualified person in compliance with applicable national regulations.

1.2 Special Conditions of Use.

- Clean only with damp cloth.**
- Do not run the pump without fluid.**
- Product must be earthed.**

2 Specifications

2.1 Specifications

55-PA Series Process Pump Specifications

Model		Automatically operated type				Air operated type			
		55-PA31#0	55-PA32#0	55-PA51#0	55-PA52#0	55-PA3113	55-PA3213	55-PA5113	55-PA5213
Port sizes	Main fluid suction / discharge port	Rc, NPT, G, NPTF 3/8"		Rc, NPT, G, NPTF 1/2", 3/4"		Rc, NPT, G, NPTF 3/8"		Rc, NPT, G, NPTF 1/2", 3/4"	
	Pilot air supply / exhaust port	Rc, NPT, G, NPTF 1/4"							
Material	Liquid contact areas	ADC12	SCS14	ADC12	SCS14	ADC12	SCS14	ADC12	SCS14
	Diaphragm	PTFE, NBR				PTFE			
	Check valve	PTFE, PFA							
Discharge rate		1 to 20L/min		5 to 45L/min		0.1 to 12L/min		1 to 24L/min	
Average discharge pressure		0 to 0.6MPa				0 to 0.4MPa			
Pilot air consumption		Maximum 200 L/min (ANR)		Maximum 300 L/min (ANR)		Maximum 150 L/min (ANR)		Maximum 250 L/min (ANR)	
Suction lifting range <sup>Note1</sup>	Dry	Up to 1m (interior of pump dry)		Up to 2m (interior of pump dry)		Up to 1m (interior of pump dry)		Up to 0.5m (interior of pump dry)	
	Wet	Up to 6m (liquid inside pump)							
Fluid temperature		0 to 60°C (no freezing)							
Ambient temperature		0 to 60°C (no freezing)							
Maximum viscosity		1000 mPa.s							
Pilot air pressure		0.2 to 0.7 MPa				0.1 to 0.5 MPa			
Withstand pressure		1.05 MPa				0.75 MPa			
Mounting position		Horizontal (with mounting foot at bottom)							
Weight		1.7kg	2.2kg	3.5kg	6.5kg	1.7kg	2.2kg	3.5kg	6.5kg
Recommended operating cycles		--				1 to 7Hz (0.2 to 1Hz also possible depending on conditions) <sup>Note2</sup>			
Pilot air solenoid valve recommended Cv factor <sup>Note3</sup>		--				0.20		0.45	

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

Note 1: With cycles at 2Hz or more

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

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

55-PA-X10 Process Pump Specifications

Model		Automatically operated type	
		55-PA31#0-X10	55-PA32#0-X10
Port sizes	Main fluid suction / discharge port	Rc, NPT, G, NPTF 3/8"	
	Pilot air supply / exhaust port	Rc, NPT, G, NPTF 1/4"	
Material	Liquid contact areas	ADC12	SCS14
	Diaphragm	PTFE, NBR	
	Check valve	Stainless steel, Ceramic	
Discharge rate		1 to 10L/min	
Average discharge pressure		0 to 0.3MPa	
Pilot air consumption		Maximum 200 L/min (ANR)	
Suction lifting range <sup>Note1</sup>	Dry	Up to 1m (interior of pump dry)	
	Wet	Up to 6m (liquid inside pump)	
Fluid temperature		0 to 60°C (no freezing)	
Ambient temperature		0 to 60°C (no freezing)	
Maximum viscosity		1000 mPa·s	
Pilot air pressure		0.2 to 0.7 MPa	
Withstand pressure		1.05 MPa	
Mounting position		Horizontal (with mounting foot at bottom)	
Weight		1.7kg	2.2kg

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

2.2 Performance Curves

Refer to the information in the standard PA3000-5000 web catalogue.

2.4 Production batch code

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

Construction	Production batch codes											
Year / Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2019	Xo	XP	XQ	XR	XS	XT	XU	XV	XW	XX	Xy	XZ
2020	yo	yP	yQ	yR	yS	yT	yU	yV	yW	yX	yY	yZ
...	...	...	...	...	...	...	...	...	...	...	...	...
2024	Co	CP	CQ	CR	CS	CT	CU	CV	CW	CX	Cy	CZ

3 Construction

Refer to the information in the standard PA3000-5000 web catalogue for construction details.

4 Installation

**Warning**

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

4.1 Operating Environment

**Warning**

- Do not use in the following environments, as this can cause failure.**
  - 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 and dust.
  - Do not use the product submersed 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.

**Caution**

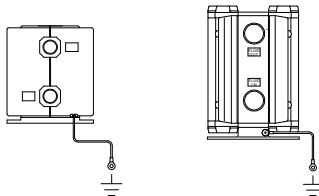
- Fluid leakage**
  - Take measures to deal with leakage. Fluid may leak when the pump is in operation due to aging of the diaphragm, etc. Take measures so that leakage in this type of situation will not have an adverse effect on equipment or personnel.
- Be careful not to touch fluid that has leaked. 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
- Perform periodic inspections to confirm normal operation.**

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

- Earth connection**

Product must be earthed using the earthing terminal provided.

Grounding the pump (Fig. 1). Ensure that the pump is electrically connected to a ground (earth) point.



55-PA3000 55-PA5000  
Fig.1 Method of Connecting Ground Cable

4.2 Mounting

**Warning**

- Mount the pump horizontally with the mounting foot at the bottom.
  - 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.**
    - When installing and mounting, be sure to allow the space required for maintenance and inspections.
    - Do not drop, bump or apply impact when handling.
    - Never mount in a place that will be used as a scaffold during piping work.
    - Damage can be caused if subjected to an excessive load.

4 Installation (continued)

4.3 Piping

Refer to the information in the standard PA3000-5000 web catalogue for circuit examples.

**Automatically operated type**  
**<Starting and Stopping>**

- 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>.
- Using a regulator set the pilot air pressure within the range of 0.2 to 0.7MPa. Then the pump operates when power is applied to the 3-port solenoid valve of the air supply port <AIR SUP>, the sound of exhaust begins from the air exhaust port <AIR EXH> and fluid flows from the suction port <FLUID IN> to the discharge port <FLUID OUT>. The ball valve on the discharge side should be open for the pump to operate. The pump performs suction even without priming (Dry state suction lifting range: max. 1 m). To restrict exhaust noise, attach a silencer (2504-002: option) to the air exhaust port <AIR EXH>.
- 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>**

- Adjustment of the flow rate from the discharge port <FLUID OUT> is performed with the needle valve connected on the discharge side or the throttle connected on the air exhaust side.
- 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: 55-PA3##0 1L/min, 55-PA5##0 5L/min).

**<Reset button>**

- 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.

**Air operated type**

**<Starting and Stopping >**

- Connect air piping <sup>Note 1</sup> to the pilot air supply ports <P1>, <P2> and connect piping for the fluid to be transferred to the suction port <FLUID IN> and the discharge port <FLUID OUT>.
- Using a regulator set the pilot air pressure within the range of 0.1 to 0.5MPa. Then, the pump operates when power is applied to the solenoid valve <sup>Note 2</sup> 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: 55-PA3##3 up to 1m, 55-PA5##3 up to 0.5m <sup>Note 3</sup>) To restrict exhaust noise, attach a silencer to the solenoid valve air exhaust port.
- 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 centre 5 port valve, or a combination of residual exhaust 3 port valve and a pump drive 4 port valve. If air in the drive chamber is not released when the pump is stopped, the diaphragm will be subjected to pressure and its life will be shortened.

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

**<Discharge flow rate adjustment>**

- 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.

4 Installation (Continued)

Caution

- 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.
- Exhaust: When using automatically operated type ensure that a metal silencer is used. If the silencer is not directly connected to the body, the silencer must be grounded.
- **Connection of piping to products**  
When connecting piping to a product, refer to catalogue or Installation and maintenance manual to avoid mistakes regarding the supply port, etc.

Always fasten threads with the correct tightening torque

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

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.
- Compressed air that includes a large amount of condensate water can cause malfunction of valves and other pneumatic equipment. As a counter measure install an air dryer upstream of the pump.
- In situations where a large amount of carbon dust is generated from the compressor, install a filter (5 microns) at the upstream side of valves to remove it otherwise, it can adhere to the interior of valves and cause malfunctions.
- Refer to the SMC "Air Cleaning Equipment" catalogue for further details on air quality.
- **Use within the operating pressure range.** The equipment being used

determines the operating pressure range. Operation beyond this range can cause damage, failure or malfunction, etc.

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

- **The pump can be used without lubrication.**  
Do not lubricate the air operated type.
- **If lubricating the pump, continue lubrication.**  
If lubricating the automatically operated type, use turbine oil Class 1 (with no additives) ISO VG 32, and, be sure to continue lubricating the pump.

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 (*See Section 8 for 'Applicable Fluids'*).
- **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 150-180µm should be used.
- **Fluid properties**
  - a) Do not use strong acids, strong bases or chemicals that can affect humans.
  - b) When flammable fluids are transferred, give consideration to leakage during operation, and strictly prohibit flames. There is a danger of fire or explosion due to accidental leakage of the fluid.

4 Installation (Continued)

- c) When flammable fluids are transferred, and the diaphragm is damaged due to ageing. The fluid can enter the air circuit and be exhausted by the pump. In this case the exhaust gas can contain flammable vapour, ensure that the exhaust is piped to a safe area.
- **Trapped fluid**  
When the system is stopped there may be cases where fluid can be trapped after the pump. Ensure a by-pass or safety valve is used to relieve a pressure increase.
  - **Be sure to observe the maximum operating pressure.**  
Operation above the maximum operating pressure can cause damage. In particular, avoid application of pressure above the specifications caused by water hammer.  
<Examples of Pressure Reduction Measures>
    1. Use a water hammer relief valve or reduce the valve's closing speed.
    2. Absorb impact pressure by using elastic piping material such as rubber, or an accumulator, etc.

5 How to Order

Refer to the information in the standard PA3000-5000 web catalogue for 'How to Order'.

6 Outline Dimensions

Refer to the information in the standard PA3000-5000 web catalogue for general dimensions.

7 Maintenance

7.1 General Maintenance

Warning

- If handled improperly, compressed air can be dangerous. Only qualified personnel should perform maintenance of pneumatic systems.
- Before performing maintenance, ensure the supply pressure is shut off and all residual air pressure is released from the system.

Caution

- **Perform maintenance in accordance with the procedures in the maintenance manual specific to each 'Process Pump' model. If handled improperly, this can cause damage or malfunction in machines and equipment, etc. (*Contact SMC for the specific maintenance manual.*)**
- 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, as disassembly will invalidate the product's warranty. When disassembly is necessary, please consult with SMC or our distributor.
- **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.**
  - a) Shut off the fluid supply and release the fluid pressure in the system.
  - b) In the case of the automatically operated type, shut off the air supply and exhaust the compressed air in the pilot piping.
  - c) Demount the product.
- **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.

7.2 Service life and replacement of consumable parts

- When the pump exceeds the number of service life cycles (\*), the diaphragm deteriorates, and malfunction may occur. Furthermore, when aging damages, the diaphragm, the fluid escapes to the pilot air side, and it may become impossible to start the pump again. Using the number of service life cycles for reference, replace parts as soon as possible.

7 Maintenance (Continued)

- Contact SMC for the special maintenance parts list and replace them in accordance with the maintenance manual.

Series	Diaphragm		Discharge per cycle
	PTFE	NBR	
55-PA3##0 automatically operated type	100 million cycles	50 million cycles	Approx. 0.04L
55-PA5##0 automatically operated type	50 million cycles	50 million cycles	Approx. 0.10L
55-PA3##3 air operated type	50 million cycles	--	Approx. 0.022L
55-PA5##3 air operated type	50 million cycles	--	Approx. 0.09L

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

**Calculation of reference service life (days) of diaphragm:**  
**Example 1:** 55-PA3##0 automatically operated type (PTFE diaphragm)

Discharge flow rate 5 L/min and operating 8 hours per day,  
Reference service life (days) =

$$\frac{A \text{ (amount of discharge per cycle)} \times B \text{ (reference number of cycles in service in service life)}}{\text{Flow(L / min)} \times \text{Operating time per day (hour)} \times 60 \text{ (min)}}$$

$$\begin{aligned} &= \frac{0.04 \times 100,000,000}{5 \times 8 \times 60} \\ &= 1666 \text{ days} \end{aligned}$$

**Example 2:** 55- PA5##3 air operated type (PTFE diaphragm)

Operating frequency of solenoid 5Hz and operating 8 hours per day,

Reference service life (days) =

$$\frac{B \text{ (reference number of cycles in service life)}}{\text{Operating frequency of solenoid (Hz)} \times 60 \text{ (sec)} \times \text{Operating time per day (hour)} \times 60 \text{ (min)}}$$

$$\begin{aligned} &= \frac{50,000,000}{5 \times 60 \times 8 \times 60} \\ &= 347 \text{ days} \end{aligned}$$

8 Applicable Fluids

Caution

- Select the wetted parts materials according to the transfer liquid you use to determine the model: -
  - a) For the liquid contact areas, aluminium is suitable for oils, and stainless steel is suitable for solvents and industrial water.
  - b) For the diaphragm material, NBR is suitable for inert liquids, and PTFE is suitable for non-permeating liquids.
  - c) 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 tests.
- 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.
- 

8 Applicable Fluids

Material and fluid compatibility for series 55-PA3##0/PA3##3/PA5##0/PA5##3					
Model		55-PA3110 / 3113	55-PA3120	55-PA3210 / 3213	55-PA3220
		55-PA5110 / 5113	55-PA5120	55-PA5210 / 5213	55-PA5220
Body material		Aluminium (ADC12)		Stainless steel (SCS14)	
Diaphragm material		PTFE	NBR	PTFE	NBR
Example of applicable liquids	Compatible liquids	Ethyl alcohol Toluene Cutting oil Brake fluid (High penetration liquids)*	Turbine oil	Methyl ethyl ketone Acetone, Flux Isopropyl alcohol Inert solvents (High penetration liquids)*	Industrial water Inert solvents
	Incompatible liquids	Cleaning solvents Water, Acids, Bases High permeation liquids High penetration liquids Corrosive liquids	Cleaning solvents Water, Solvents, Acids, Bases High permeation liquids High penetration liquids Corrosive liquids	Corrosive liquids Acids, Bases High permeation liquids High penetration liquids	Solvents Acids, Bases High permeation liquids High penetration liquids Corrosive liquids

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

9 Limitations of Use

**9.1 Limited warranty and Disclaimer/Compliance Requirements**  
Refer to Handling Precautions for SMC Products located on [www.smcworld.com](http://www.smcworld.com) .

Caution

9.2 Obligations of the end-user

- Ensure the product is used within the specification outlined.
- Ensure that the maintenance periods are suitable for the application.
- Ensure any cleaning processes to remove dust layers are made with the atmosphere in mind (e.g. using a damp cloth to avoid static build up).
- Ensure that the application does not introduce additional hazards by mounting, loading, impacts or other methods.
- Ensure that there is sufficient ventilation and air circulation around the product.
- If the product is subject to direct heat sources in the application, they should be shielded so that the pump temperature stays within the stated operating range.

Caution

- **SMC products are not intended for use as instruments for legal metrology.**  
Measurement instruments that SMC manufactures or sells have not been qualified by type approval tests relevant to the metrology (measurement) laws of each country.

Danger

- Do not exceed any of the specifications listed in Section 2 of this document as this will be deemed improper use.
- Air equipment has an air leakage during operation within certain limits. Do not use this equipment when the air itself introduces additional hazards and could lead to an explosion.
- Use only ATEX certified auto switches. These should be ordered separately.  
Do not use this product in the presence of strong magnetic fields that

could generate a surface temperature higher than the product specification.

- In the event of damage or failure of any parts located in the vicinity where this product has been installed, it is the responsibility of the user to determine whether or not this has compromised the safety and condition of this product and/or the application.
- External impact on the body could result in a spark and/or damage. Avoid any application where foreign objects can hit or impact the body. In such situations the application should install a suitable guard to prevent this occurrence.
- Do not use this equipment where vibration could lead to failure.

10 Contacts

Refer to Declaration of Conformity and [www.smcworld.com](http://www.smcworld.com) for contacts.

SMC Corporation

URL : [http// www.smcworld.com](http://www.smcworld.com) (Global) [http// www.smceu.com](http://www.smceu.com) (Europe)  
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