



Instructions and Maintenance Manual

Process pump
Series 56-PA3000/5000



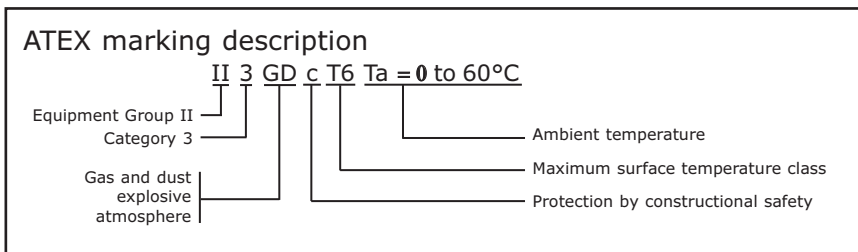
II 3GD c T6 Ta = 0°C to 60°C

Read this manual before using this product.

For future reference, please keep this manual in a safe place.

The information within this document is to be used by pneumatically trained personnel only.

This manual should be read in conjunction with the current catalogue.



1 SAFETY RECOMMENDATION

1.1 General recommendation

These safety instructions are intended to prevent a hazardous situation and/or equipment damage. These instructions indicate the level of potential hazard by label of "Caution", "Warning" or "Danger". To ensure safety, be sure to observe ISO4414 (Note1), JIS B 8370 (Note2) and other safety practices.

Note 1: ISO 4414: Pneumatic fluid power - Recommendations for the application of equipment to transmission and control systems. Note 2: JIS B 8370: Pneumatic system axiom.



CAUTION: Operator error could result in injury or equipment damage.



WARNING: Operator error could result in injury or loss of life.



DANGER: In extreme conditions, there is possible result of serious injury or loss of life.



WARNING

1. The compatibility of pneumatic equipment is the responsibility of the person who designs the decides its specifications.

Since the products specified here are used in various operating conditions, their compatibility for the specific pneumatic system must be based on specifications or after analysis and/or tests to meet your specific requirements.

2. 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 operators.

3. Do not service machinery/equipment or attempt to remove component 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. (Bleed air into the system gradually to create backpressure, i.e. incorporate a soft-start valve).

4. Contact SMC if the product is to be used in any of the following conditions:

- 1) Conditions and environments beyond the given specifications, or if product is 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) Applications, which have the possibility of having negative effects on people, properties or animals, requiring special safety analysis.



WARNING: Clean only with a damp cloth!



WARNING: Avoid hitting the product with metallic objects!



WARNING: Avoid using this product in non-explosive environment which can become explosive due to air leakage!



CAUTION: Ensure that the air supply system is filtered to 5 micron.

1.2 Conformity to standard

This product is certified to and complies with the following standards:

- Directive 94/9/EC
- EN 13463-1:2001
Non-electrical equipment for potentially explosive atmospheres
Part 1: Basic method and requirements
- prEN 13463-5:2003
Non-electrical equipment for potentially explosive atmospheres
Part 5: Protection by constructional safety "c"

2 INTENDED CONDITIONS OF USE



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 faulty operation.

Fluid temperature

Use each model within its respective fluid temperature range.

Fluid quality

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

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 and slow the valve's closing speed.
2. Absorb impact pressure by using elastic piping material such as rubber, or an accumulator, etc.

Liquid seals

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

Quality of operating air

1. 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 damage or malfunction.
2. Install an air filter.
Install an air filter near valves on their upstream side. Choose a filtration degree of 5µm or finer. A mist separator (AM) is suitable.
3. Compressed air that includes a large amount of drainage can cause malfunction of valves and other pneumatic equipment. As a counter measure, install an air dryer or after cooler, etc.
4. In situations where a large amount of carbon dust is generated, install a mist separator at the upstream side of valves to remove it. When a lot of carbon dust is generated from a compressor, it can adhere to the interior of valves and cause malfunction.

Refer to the SMC "Air Cleaning Equipment" catalog for details on air quality.

Ensure space for maintenance.

Be sure to allow the space required for maintenance activities.

Fluid properties

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

3 SPECIFICATIONS

Model		Automatically operated type				Air operated type			
		56-PA31□0	56-PA32□0	56-PA51□0	56-PA52□0	56-PA3113	56-PA3213	56-PA5113	56-PA5213
Port sizes	Main fluid suction / discharge port	Rc 3/8		Rc 1/2, 3/4		Rc 3/8		Rc 1/2, 3/4	
	Pilot air supply / exhaust port	Rc 1/4				Rc 1/4			
Material	Liquid contact areas	ADC12	SCS14	ADC12	SCS14	ADC12	SCS14	ADC12	SCS14
	Diaphragm	PTFE, NBR				PTFE			
	Check valve	PTFE, PFA				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 200L/min (ANR)		Maximum 300L/min (ANR)		Maximum 150L/min (ANR)		Maximum 200L/min (ANR)	
Suction lifting range <small>Note 1</small>	Dry	1m (interior of pump dry)		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)				Up to 6m (liquid inside pump)			
Fluid temperature		0 to 60°C (no freezing)				0 to 60°C (no freezing)			
Ambient temperature		0 to 60°C				0 to 60°C			
Pilot air pressure		0.2 to 0.7 MPa				0.1 to 0.5 MPa			
Withstand pressure		1.05MPa				0.75MPa			
Mounting position		1.05MPa				0.75MPa			
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 <small>Note2</small>)			
Pilot air solenoid valve recommended Cv factor		-				0.20		0.45	

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

Note 1) With cycles at 2Hz or more.

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

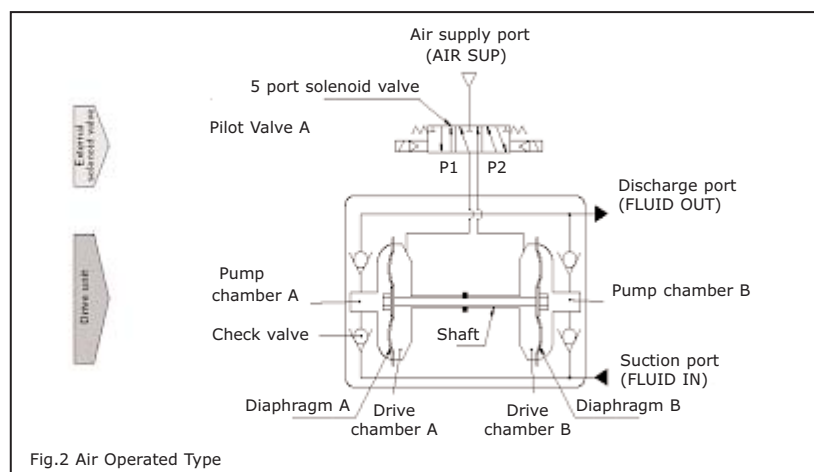
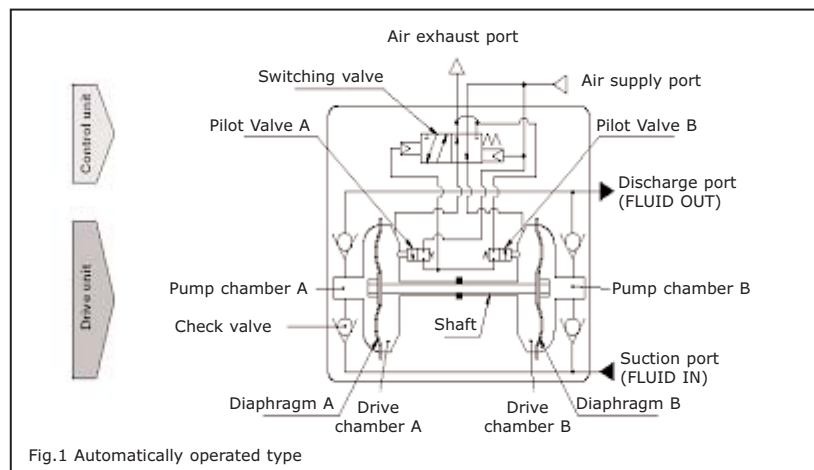
Note 3) With a low number of operating cycles, even a valve with a small Cv factor can be operated.

Production batch code

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

Production batch codes									
Month	Year	2003	2004	2005	...	2021	2022	2023	...
		H	I	J	...	Z	A	B	...
Jan	O	HO	IO	JO	...	ZO	AO	BO	...
Feb	P	HP	IP	JP	...	ZP	AP	BP	...
Mar	Q	HQ	IQ	JQ	...	ZQ	AQ	BQ	...
Apr	R	HR	IR	JR	...	ZR	AR	BR	...
May	S	HS	IS	JS	...	ZS	AS	BS	...
Jun	T	HT	IT	JT	...	ZT	AT	BT	...
Jul	U	HU	IU	JU	...	ZU	AU	BU	...
Aug	V	HV	IV	JV	...	ZV	AV	BV	...
Sep	W	HW	IW	JW	...	ZW	AW	BW	...
Oct	X	HX	IX	JX	...	ZX	AX	BX	...
Nov	Y	HY	IY	JY	...	ZY	AY	BY	...
Dec	Z	HZ	IZ	JZ	...	ZZ	AZ	BZ	...

4 CONSTRUCTION



5 INSTALLATION

WARNING:

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

5.1 Piping

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.

Automatically Operated Type (Fig. 3)

<Starting and Stopping>

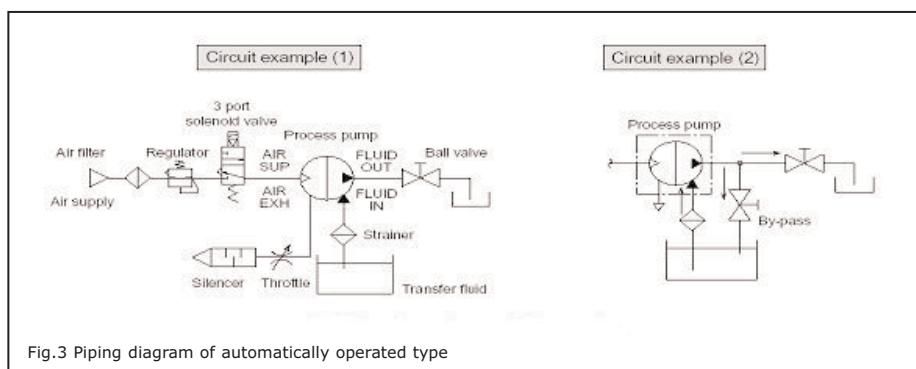
1. Connect air piping to the air supply port <AIR SUP> and connect piping for the fluid to be transferred to the suction port <FLUID IN> and the discharge port <FLUID OUT>.
2. Using a regulator, set the pilot air pressure within the range of 0.2 to 0.7MPa. Then, the pump operates when power is applied 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>. 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: 56-PA3000 1L/min, 56-PA5000 5L/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.



Air Operated Type (Fig. 4)

<Starting and Stopping>

1. Connect air piping (Note 1) to the pilot air supply ports <P1>, <P2> and connect piping for the fluid to be transferred to the suction port <FLUID IN> and the discharge port <FLUID OUT>.
2. Using a regulator, set the pilot air pressure within the range of 0.1 to 0.5MPa. Then, the pump operates when power is applied to the solenoid valve (Note 2) of the pilot air supply port and fluid flows from the suction port <FLUID IN> to the discharge port <FLUID OUT>. At this time, the ball valve on the discharge side is in an open state. The pump performs suction with its own power even without priming. (Note 3) Dry state suction lifting range: 56-PA3 1 m, 56-PA5 up to 0.5m) To restrict exhaust noise, attach a silencer to the solenoid valve air exhaust port.
3. To stop the pump, exhaust the air pressure being supplied to the pump with the solenoid valve of the air supply port.

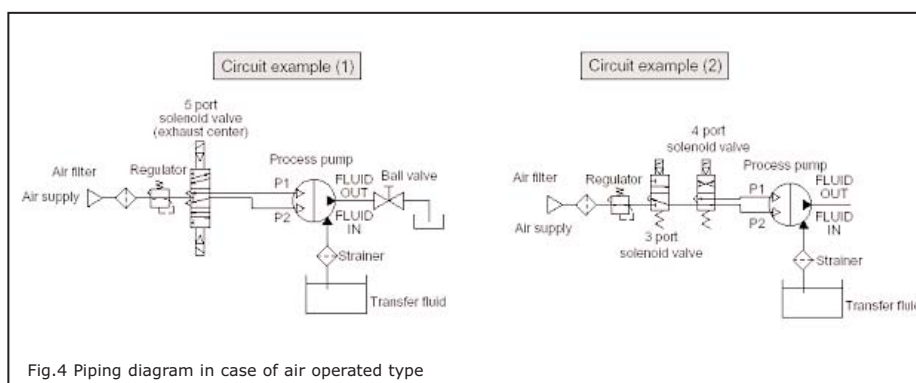
Note 1) When used for highly permeable fluids, the solenoid valve may malfunction due to the gas contained in the exhaust. Implement measures to keep the exhaust from going to the solenoid valve side.

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

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

<Discharge Flow Rate Adjustment>

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



Preparation before piping

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

Wrapping of pipe tape

When installing piping or fitting into a port, ensure that sealant material does not enter the port inside. When using seal tape, leave 1.5 to 2 threads exposed on the end of pipe/fitting.

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 proper tightening torque

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

5.2 Air supply

WARNING:

Do not use compressed air that contains chemicals, organic solvents or corrosive gases.

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

Use within the operating pressure range.

The operating pressure range is determined by the equipment being used. Operation beyond this range can cause damage, failure or malfunction, etc.

5.3 Operating Environment

WARNING:

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 that receive direct sunlight. (Sunlight should be blocked to prevent deterioration of resin from ultra violet rays and over heating, etc.)
4. Locations near heat sources with poor ventilation. (Heat sources should be blocked off, because radiated heat may cause damage due to softening of materials.)
5. Locations with impact or vibration.
6. Locations with high moisture and dust.

Adhere to the fluid and ambient temperature ranges.

The fluid and ambient temperatures are determined by the equipment being used. Operation beyond this range can cause damage, failure or malfunction, etc. **Employ suitable protective measures in locations where there is contact with water droplets, oil or welding spatter, etc.**

CAUTION:

Operating environment

- Do not allow corrosive fluids or solvents, etc., to come into contact with the outer surfaces of the pump.
- Do not use in water (or other liquid). Fluid may leak into the pilot switching valve and there may be corrosion of external parts, etc.

Low temperature operation

Do not allow freezing. Operation is possible down to an ambient temperature of 0°C, but do not allow solidification or freezing of drainage and moisture etc.

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. 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 misoperation.

5.4 Operating Environment

CAUTION:

The pump does not require lubrication.

In the event that it is lubricated, use class 1 turbine oil (without additives), ISO VG32.

Do not lubricate the air operated type.

Filters and strainers

Be careful regarding clogging of filters and strainers. Replace filter elements after one year of use, or earlier if the amount of pressure drop reaches 0.1MPa. Replace strainers when the amount of pressure drop reaches 0.1MPa. Flush drainage from air filters regularly.

Lubrication

If operated with lubrication, be sure to continue the lubrication.

Storage

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

6 MOUNTING

WARNING:

Installation and Maintenance Manual

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

Confirm the mounting position.

- Since the mounting position is different for each piece of equipment, this point should be confirmed either in the product catalog or in the Installation and Maintenance Manual.
- The mounting orientation is limited. Mount with the bottom (foot hole or mounting hole side) facing down.
- Since the reciprocal motion of the diaphragm propagates, the mounting bolts should be tightened securely. Furthermore, in cases where the propagation of vibration is not acceptable, insert vibro isolating rubber when mounting.

Ensure sufficient maintenance space.

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

Do not drop or bump.

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

7 MAINTENANCE

WARNING:

Shut off the compressed air if an abnormality occurs.

Stop the inflow of compressed air if there are abnormalities such as an unusual odor or sound.

Set the compressed air pressure to zero when performing maintenance.

In case of disassembly, first confirm that the pressure inside the pump is zero.

CAUTION:

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

The equipment may be deformed or damaged, and if balance is lost, a fall may cause injury.

Discharge drainage regularly.

If drainage accumulates in equipment, in piping or other areas, this can cause malfunction of the equipment or unexpected trouble 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 maintenance in accordance with the procedures in the Maintenance Manual specific to each model.

If handled improperly, this can cause damage or malfunction in machines and equipment, etc.

Contact SMC for the specific Maintenance Manual.

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

- Shut off the fluid supply and release the fluid pressure in the system.
- In the case of the automatically operated type, shut off the air supply and exhaust the compressed air in the pilot piping.
- 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.

Service life and replacement of consumable parts

When the pump exceeds the number of service life cycles (*), the diaphragm deteriorates and malfunction may occur. Furthermore, when the diaphragm is damaged by aging, the fluid escapes to the pilot air side, and it may become impossible to start the pump again. Using the number of service life cycles for reference, replace parts as soon as possible. Request maintenance parts (see the Maintenance parts list) and replace them in accordance with the specific Maintenance manual.

*Service life cycles/Discharge per cycle (reference)

Series	Diaphragm Material		Discharge per cycle
	PTFE	NBR	
56-PA3000 automatically operated type	100 million cycles	50 million cycles	Approx. 40ml
56-PA5000 automatically operated type	50 million cycles	50 million cycles	Approx. 100ml
56-PA3000 air operated type	50 million cycles	-	Approx. 22ml
56-PA5000 air operated type	50 million cycles	-	Approx. 90ml

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

• Calculation of diaphragm life

Example

Discharge rate 5L/min, when operating 8h/D (for 56-PA3000 automatically operated type)

$$\frac{\text{Discharge rate}}{\text{Discharge per cycle}} = \frac{5}{0.040} = 125 \text{ cycles/min}$$

$$\text{Service life} = \frac{\text{Reference life cycles}}{\text{Cycles per minute}} \times \frac{1}{60} \times \frac{1}{8(\text{daily operating time})} = \frac{100,000,000}{125} \times \frac{1}{60} \times \frac{1}{8} = 1666 \text{ days}$$

56-PA3000 / Automatically operated type

Diaphragm kit (PTFE)	KT-PA3-31
Diaphragm kit (NBR)	KT-PA3-32
Check valve kit	KT-PA3-36
Switching valve assembly kit	KT-PA3-37
Pilot valve kit	KT-PA3-38

56-PA3000 / Air operated type

Diaphragm kit (PTFE)	KT-PA3-31
Check valve kit	KT-PA3-36

56- PA5000 / Automatically operated type

Diaphragm kit (PTFE)	KT-PA5-31
Diaphragm kit (NBR)	KT-PA5-32
Check valve kit	KT-PA5-36
Switching valve assembly kit	KT-PA5-37
Pilot valve kit	KT-PA5-38

56-PA5000 / Air operated type

Diaphragm kit (PTFE)	KT-PA5-31
Check valve kit	KT-PA5-36

8 FLUID COMPATIBILITY

WARNING

Fluid properties

- Select models by choosing liquid contact materials suitable for the liquids to be transferred.
 - In liquid contact areas, aluminum is suitable for use with oils, and stainless steel is suitable for solvents and industrial water.
 - For the diaphragm material, nitrile rubber is suitable with inert liquids, and fluororesin is suitable with non permeating liquids.
 - Use fluids that will not corrode the liquid contact materials.
- Transfer examples are shown below. Since the possible applications will change depending on operating conditions, be sure to confirm by means of experimentation.
- 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 with foreign substances removed.
- When transferring liquids subject to coagulation, take measures to prevent coagulation inside the pump.

Fluid compatibility/Series 56-PA3000/5000

Model	56-PA3110 / 3113	56-PA3120	56-PA3210 / 3213	56-PA3220
	56-PA5110 / 5113	56-PA5120	56-PA5210 / 5213	56-PA5220
Body material	Aluminum (ADC12)		Stainless steel (SCS14)	
Diaphragm material	Fluororesin	Nitrile rubber	Fluororesin	Nitrile rubber
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 permeation liquids Corrosive liquids	Cleaning solvents Water, Solvents, Acids, Bases High permeation liquids High permeation liquids Corrosive liquids	Corrosive liquids Acids, Bases High permeation liquids High permeation liquids	Solvents Acids, Bases High permeation liquids High permeation liquids Corrosive liquids

* 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 EUROPEAN CONTACT LIST

SMC Corporation

Country	Telephone	Country	Telephone
Austria	(43) 2262-62 280	Italy	(39) 02-92711
Belgium	(32) 3-355 1464	Netherlands	(31) 20-531 8888
Czech Republic	(420) 5-414 24611	Norway	(47) 67 12 90 20
Denmark	(45) 70 25 29 00	Poland	(48) 22-548 50 85
Finland	(358) 9-859 580	Portugal	(351) 22 610 89 22
France	(33) 1-64 76 1000	Spain	(34) 945-18 4100
Germany	(49) 6103 4020	Sweden	(46) 8-603 0700
Greece	(30) 1- 342 6076	Switzerland	(41) 52-396 3131
Hungary	(36) 1-371 1343	Turkey	(90) 212 221 1512
Ireland	(351) 1-403 9000	United Kingdom	(44) 1908-56 3888

Websites

SMC Corporation	www.smcworld.com
SMC Europe	www.smceu.com