ORIGINAL INSTRUCTIONS

Instruction Manual

Pneumatic Positioner

*56-IP5*00 Series*

Refer to Declaration of Conformity for relevant Directives

II 3GD	Ex h IIC T6/T6 Gc	-20°C ≤ Ta ≤ +80°C
	Ex h IIIC T65°C/T85°C Dc	

Product marking shown above is for the standard product.

ATEX Marking Description:

Ex	Specific Marking for Explosion Protection
II	Equipment Group
3	Equipment Category
GD	Environment (Gas/Dust)
Ex h	General Protection Level Symbols
IIC	Gas Sub-Division
IIIC	Dust Sub-Division
T	Temp. Classification
Gc/Dc	Equipment Protection Level
X	Special Conditions of Use
Ta	Ambient Temperature Range

The intended use of this ATEX Category 3 Pneumatic Positioner is to convert potential energy provided by compressed air into a force which holds a cylinder piston rod in a controlled position.

Certifcate Number:	SMC. 19.0027 X

Note 1: The X at the end of the certificate number represents that this product is subject to “Special Conditions of Use”, please see Section 2.3.

1 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.

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

2 Specifications

This product is certified to ATEX Category 3GD and therefore is suitable for use in Zones 2 & 22 only.

2.1 Product Specifications:

Refer to the operation manual for this product;

2.1.1 Specifications:

		56-IP5000 [Lever type]		56-IP5100 [Rotary type]	
		Single Action	Double Action	Single Action	Double Action
Supply Pressure		0.14 ~ 0.7 MPa			
Input Pressure		0.02 ~ 0.1 MPa			
Standard Stroke		10 ~ 85mm		60° ~ 100°	
Linearity		Within ±1% F.S.	Within ±2% F.S.		
Sensitivity		Within 0.1% F.S.	Within 0.5% F.S.		
Hysteresis		Within 0.75% F.S.	Within 1% F.S.		
Repeatability		Within ±0.5% F.S.			
Output Flow Rate		80 l/min (ANR) @ 0.14MPa – See **Fig.1**			
Air Consumption		5 l/min (ANR) @ 0.14MPa – See **Fig.2**			
Thermal Coefficient		Within 0.1% F.S./°C			
Air Connection Port		Rc 1/4 (Standard)			
Mass		Approx. 1.4kg		Approx. 1.2kg	
Body Size [mm]		118 x 102 x 86		118 x 92 x 77.5	
Operating Temp.	Standard	-20°C to +80°C			
	Low Temp.	-30°C to +60°C			
	High Temp.	-5°C to +100°C			

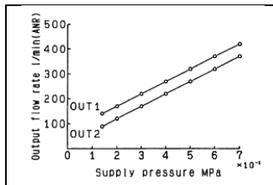


Fig.1: Output Flow Rate Characteristics

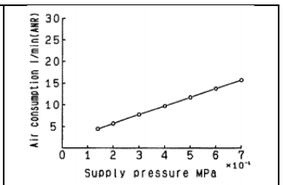


Fig.2: Air Consumption Characteristic

2.2 Production Batch Code:

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

Production Batch Codes

Month \ Year		2017	2018	2019	…	2021	2022	2023	…
		V	W	X	…	Z	A	B	…
Jan	o	Vo	Wo	Xo	…	Zo	Ao	Bo	…
Feb	P	VP	WP	XP	…	ZP	AP	BP	…
Mar	Q	VQ	WQ	XQ	…	ZQ	AQ	BQ	…
Apr	R	VR	WR	XR	…	ZR	AR	BR	…
May	S	VS	WS	XS	…	ZS	AS	BS	…
Jun	T	VT	WT	XT	…	ZT	AT	BT	…
Jul	U	VU	WU	XU	…	ZU	AU	BU	…
Aug	V	VV	WV	XV	…	ZV	AV	BV	…
Sep	W	VW	WW	XW	…	ZW	AW	BW	…
Oct	X	VX	WX	XX	…	ZX	AX	BX	…
Nov	y	Vy	Wy	Xy	…	Zy	Ay	By	…
Dec	Z	VZ	WZ	XZ	…	ZZ	AZ	BZ	…

2.3 Special Conditions of Use:

- Products are suitable for sub-divisions IIC & IIIC.
- Products are suitable for Zones 2 & 22 only.

2.3.1 Temperature Marking:

2.3.1.1 Standard Product:

- In the special ambient temperature range (-20°C to +60°C) the product is rated to temperature class T6 and has a maximum surface temperature of 65°C.
- In the special ambient temperature range (+60°C to +80°C) the product is rated to temperature class T6 and has a maximum surface temperature of 85°C.

2.3.1.2 High Temperature Variant:

- In the special ambient temperature range (-5°C to +60°C) the product is rated to temperature class T6 and has a maximum surface temperature of 65°C.
- In the special ambient temperature range (+60°C to +80°C) the product is rated to temperature class T6 and has a maximum surface temperature of 85°C.

2.3.1.3 Low Temperature (-30°C) Variant:

- In the special ambient temperature range (-30°C to +60°C) the product is rated to temperature class T6 and has a maximum surface temperature of 65°C.

2.3.1.4 Low Temperature (-40°C / -DIL00505) Variant:

- In the special ambient temperature range (-40°C to +60°C) the product is rated to temperature class T6 and has a maximum surface temperature of 65°C.

2.3.2 Protect from Impacts

- Protect the unit from impacts and avoid dropping the product during the transfer and mounting of the product as it may cause failure of the unit.

3 Installation

3.1 Installation

Warning

- Do not install the product unless the safety instructions have been read and understood.
- Since the zero-point varies depending on the mounting position, the zero point should be adjusted by the end-user after installation.
- Avoid hitting the product with metallic objects.
- Avoid using this product in non-explosive environments which can become explosive due to air leakage.
- Ensure that when this product is used in hazardous areas, ensure that the operational speed of the moving parts is less than 1m/s.
- Ensure that the product adjustment process is completed successfully as to avoid the actuator hunting.

3.2 Environment

Warning

- Do not use in an environment where corrosive gases, chemicals, water, salt water or steam are present.
- Do not use in an explosive atmosphere except within the specified rating.
- Do not expose to direct sunlight. Use a suitable protective cover.
- Do not install in a location subject to vibration or impact in excess of the product’s specifications.
- Do not use in a place subject to heavy vibration and/or shock.
- Do not use in wet environments, where water can remove the presence of the lubrication.
- Do not use in case of heavy dusty environments where dust can penetrate into the product and dry the grease.
- Do not allow dust layers to build up on the cylinder surface and insulate the product.
- Do not use or mount this product in a location where it is exposed to radiant heat.
- Allow sufficient space for maintenance and adjustment around the product when mounted.

3.3 Piping

Caution

- Before connecting 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 thread* exposed on the end of the pipe/fitting.
- Tighten fittings to the specified tightening torque.

Thread	Tightening Torque
Rc 1/8	7 ~ 9 Nm
Rc 1/4	12 ~ 14 Nm

3.4 Lubrication

Caution

- SMC products have been lubricated for life at manufacture, and do not require lubrication in service.
- If a lubricant is used in the system, refer to catalogue for details.
- The positioner has a fixed orifice and nozzle, which contains fine paths in them. Use filtered, dehydrated air and avoid the use of lubricators as this may cause malfunction of the positioner. Ensure that the air supply system is filtered to 5 microns.

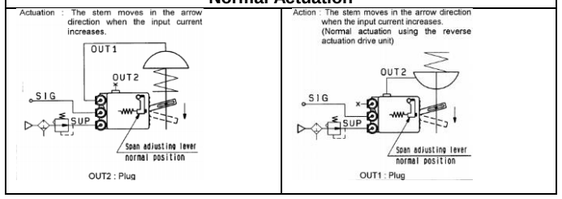
3.5 Basic Function

- Before laying the pipes, flush the pipe inside sufficiently so as to eliminate foreign matter in the piping.

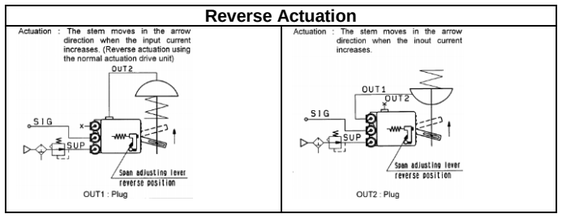
3.5.1 IP5000 (Lever Type)

3.5.1.1 Single Action

Normal Actuation

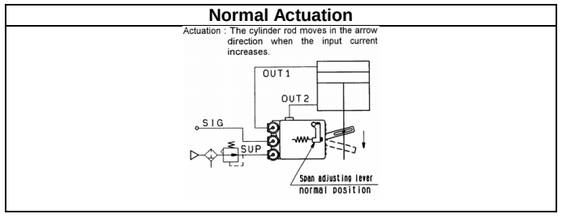


Reverse Actuation

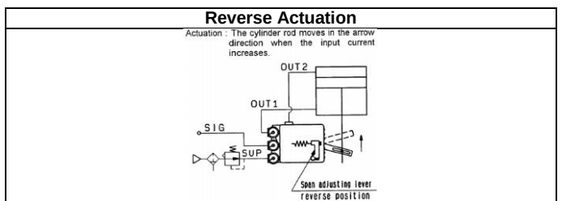


3.5.1.2 Double Action

Normal Actuation



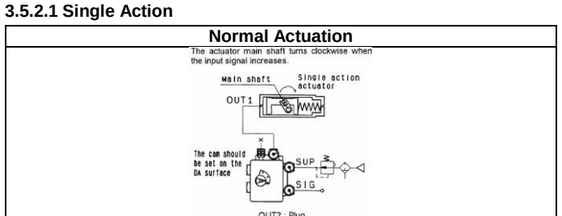
Reverse Actuation

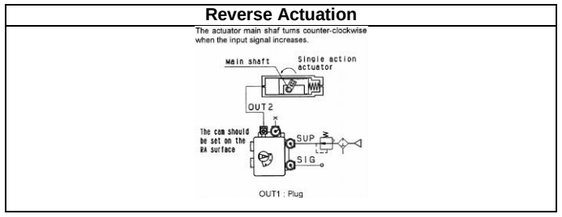


3.5.2 IP5100 (Rotary Type)

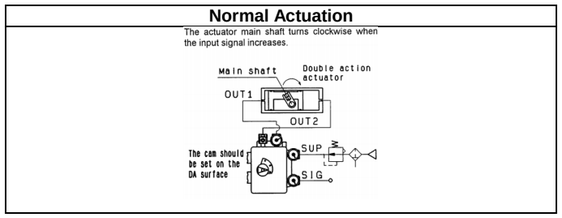
3.5.2.1 Single Action

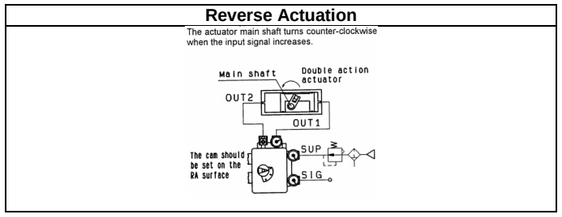
Normal Actuation





3.5.2.2 Double Action





3.6 Electrical Connection

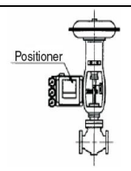
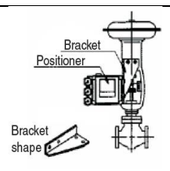
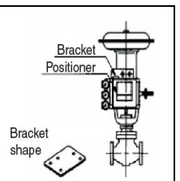
- Ground the product in accordance with applicable regulations.
- Do not pass an electrical current through the product.

3.7 Mounting

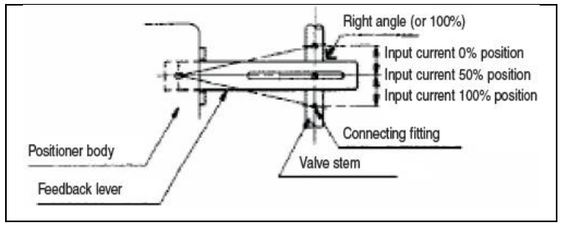
For positioner and diaphragm, brackets are to be manufactured according to the installation method. The unit should be attached using bolts securely fastened through the mounting holes on the side or back of the positioner.

3.7.1 Type IP5000 (Lever Type)

3.7.1.1 Actuator/Valve Installation

 **Fig.3:** Direct mounting to a diaphragm valve	 **Fig.4:** L-Type Bracket	 **Fig.5:** Front Bracket
Attach directly by using screw holes at the side of the positioner and that of the yoke side of the diaphragm	Attach by using a screw hole at the side of the positioner and that of the front mount of the diaphragm	Attach by using screw hole at the back of the positioner and that of the front mount of the diaphragm

3.7.1.2 External feedback lever installation



- Install the valve stem and feedback lever so that they cross at right angles when the input signal is 50%.
- Full scale should be at least 10% and at most 30%.

3.7.2 Type IP5100 (Rotary Type)

3.7.2.1 Actuator/Valve Installation

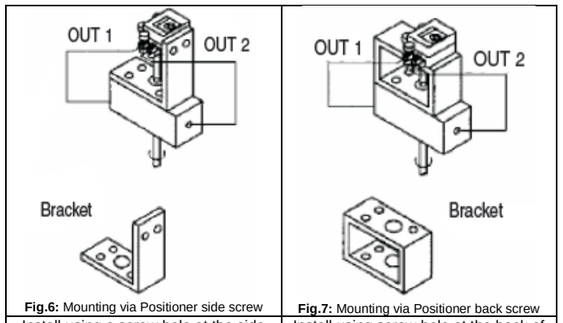


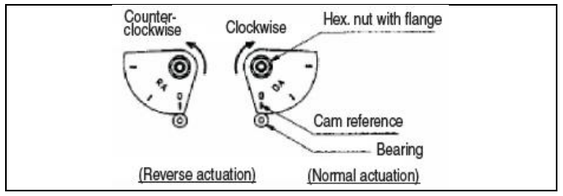
Fig.6: Mounting via Positioner side screw

Install using a screw hole at the side of the positioner and the screw hole on the actuator

Fig.7: Mounting via Positioner back screw

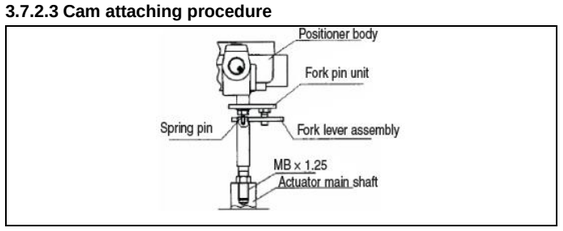
Install using screw hole at the back of the positioner and the screw hole on the top of the actuator

3.7.2.2 Feedback shaft connection



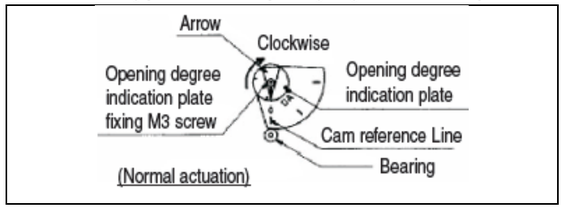
- See actuator from the side of positioner front cover, when input pressure increases. When the actuator main axis rotates clockwise use the DA surface of the cam. When it rotates counter-clockwise, use the RA surface.
- Mount the cam securely to the feedback shaft centering location.
- After loosening the hexagonal nut with flange, set the actuator in starting condition. Afterwards, mount the cam making sure that the connecting point of the cam and the bearing of the feedback arm unit meet at the zero-point of the cam.
- Since mounting the cam is dangerous, please ensure this is performed without air pressure supplied.
- Cam is tightened to the shaft temporarily when it is shipped from SMC. When it is operated ensure it secured firmly with the lock nut, to a tightening torque of 2.0 to 2.5 Nm.

3.7.2.3 Cam attaching procedure



- Install positioner feedback shaft and rotary actuator main axis so that they are concentric. Ensuring that the spring pin of the feedback shaft end can enter the end of the fork lever assembly axis.

3.7.2.4 Mounting procedure of opening degree indication plate



- Lock the cam and then adjust the zero-point and span (refer to section 4). Then, fix the opening degree indication plate to the shaft using the M3 screw. At that point, the end of the arrow of the opening degree indication plate is to be pointing at the centre of the bearing as shown in the image above. Please refer to **Fig.8.** (I) and (II) for starting at the 0-position in the opening degree indication window.
- Mounding conditions of the panel are shown in **Fig.8.** (III) and (IV), when the panel is displayed in the contrary way to previously explained. This panel should be used as a measure of valve lift.

4 Settings

4.1 Adjusting method

⚠ Caution

- For this positioner, span and zero point adjustment of each actuator is necessary. Adjustment shall be done based on each actuator size.
- Keep in mind that span and zero point adjustment interfere with each other.
- Secure the zero-span lock nut after adjustment.
- Characteristics change due to change of mounting position, ambient temperature and supply pressure.
- This positioner is force balanced type. Characteristics depend on the final mounting direction. If the direction of initial adjustment and the final adjustment differ, then please re-adjust it.
- If the product has sat idle for a long time after setup and before operation, please check and readjust if necessary.

Check the following prior to starting the adjustments;

- Check that the pipeline is correctly connected with the pressure supply port and OUT1 and OUT2 ports.
- Check that the actuator and positioner and securely connected.
- Check that the feedback arm of internal feedback (Type IP5000) is attached to the correct position (normal or reverse). [Refer to Section 3.5].
- Check for the correct use of the cam face (normal or reverse) in Type 5100 and that the flange nut is secured.

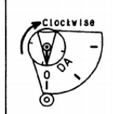
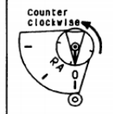
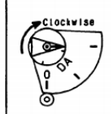
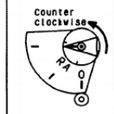
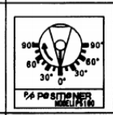
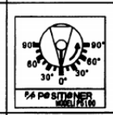
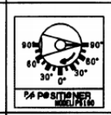
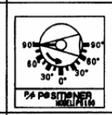
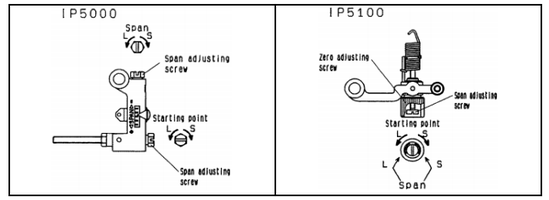
Indication method	0°→90°		90°→0°	
	Normal	Reverse	Normal	Reverse
Actuation form	A	A	B	C
Mounting cam and opening degree indication plate				
Opening degree indication window				
State	(Ⅰ)	(Ⅱ)	(Ⅲ)	(Ⅳ)

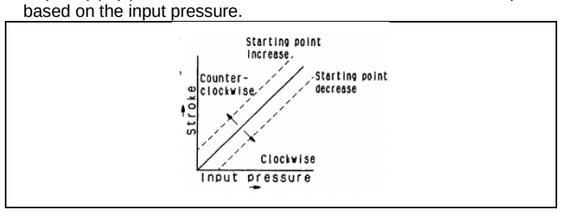
Fig.8: Indication Method

4.1 Zero-Point Adjustment and Span Adjustment

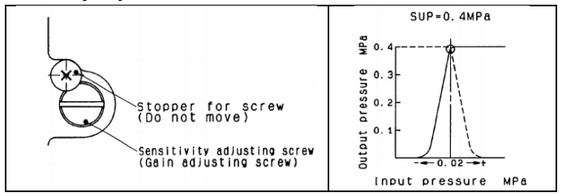


Adjusting Procedure:

- (1) Set input pressure 0%, then set the actuator starting point by turning zero-adjustment screw.
- (2) Secondly, vary the input pressure and see the stroke of the actuator. When the span is not enough or too long, adjust it according to the drawing.
- (3) Set input pressure 0%, and again at zero-point like point (1).
- Repeat (1)~(3) until the stroke of the actuator is correct and acceptable based on the input pressure.



Sensitivity Adjustment:



- Above shows the input current-output characteristics of OUT1 and OUT2 of the pilot valve. When the positioner is shipped out of our plant, the output pressure is set to the optimum state as shown in the graph, and this needs no further adjustment.

⚠ Caution

- The sensitivity adjustment of the pilot valve is effective to the actuator of double acting type only.
- If the sensitivity is poor because of the actuator type, turn the sensitivity adjusting screw counter-clockwise. (The number of turns varies depending on the number of actuators. Turn it by 1/16th to 1 turn. Do not loosen the stopper screw at this time since it is set to avoid the screw coming loose.

5 How to Order

Refer to the standard product catalogue or customer drawing for 'How to Order'.

6 Outline Dimensions (mm)

Refer to the standard product catalogue or customer drawing for general dimensions.

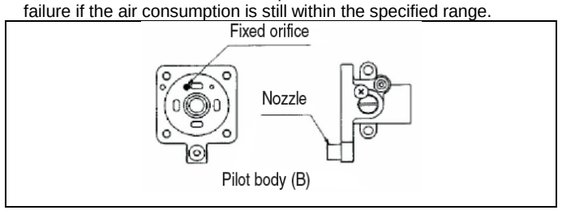
7 Maintenance

7.1 General Maintenance

⚠ Caution

- Not following proper maintenance procedures could cause the product to malfunction and lead to equipment damage.
- If handled improperly, compressed air can be dangerous.
- Maintenance of pneumatic systems should be performed only by qualified personnel.
- Before performing maintenance, turn off the power supply and be sure to cut off the supply pressure. Confirm that the air is released to atmosphere.
- After installation and maintenance, apply operating pressure and power to the equipment and perform appropriate functional and leakage tests to make sure the equipment is installed correctly.

- If any electrical connections are disturbed during maintenance, ensure they are reconnected correctly and safety checks are carried out as required to ensure continued compliance with applicable national regulations.
- Do not make any modification to the product.
- Do not disassemble the product, unless required by installation or maintenance instructions.
- Do not use a product which looks or contains damage, this will invalidate the certification. If damage is seen, please replace the product immediately.
- Check the positioner once a year, see required checks in Section 7.3. When an excessively warn diaphragm, o-ring or other seals has been found then these should be replaced immediately.
- Before removing the positioner for maintenance, or replacing unit parts after installation, ensure the supply pressure is shut off and all residual air pressure is released from the piping.
- When the fixed orifice is clogged with carbon particles or other material, remove the pilot valve auto/manual change over screw (built in fixed opening) and clean it by inserting a 0.3mm diameter wire into the hole.
- When you disassemble the pilot valve, coat the o-ring of the sliding section with (Toray Silcone SH45) grease.
- Check for air leaks from the compressed air piping. Air leaks could lower the performance characteristics of the positioner. Air is normally discharged from a bleed port, but this is necessary air consumption based on the construction of the positioner, and it is not considered a failure if the air consumption is still within the specified range.



- Do not make any modification to the product.
- Do not disassemble the product, unless required by installation or maintenance instructions.

7.2 Pilot Valve Unit Replacement Procedure

7.2.1 IP5000 Series

For IP5000 refer to **Fig.13.** below for position of parts.

- Pilot Valve Unit Part Number = P378010-11
- Loosen cover stopper thread (2) to remove the body cover (1).
- Loosen the zero adjusting screw (3) and remove the feedback spring (4) from the balance lever (5). Rotate feedback arm (11) to the counter direction of the feedback spring (4) and remove the feedback spring (4) from the top of the pilot valve unit (6).
- Loosen four [4] pilot valve unit mounting cross recessed pan head screws (7) and M3 hexagon nut (8) from the minor feedback joint (at the balance lever (5) side).
- Remove the minor feedback connecting screw (9) from the balance lever (5) and remove the pilot valve unit (6) from the body (10). Please do not loosen the minor feedback connecting balance lever (5) and the nut paint secured to the flapper (12).
- Mount new pilot valve unit (6). Insert minor feedback square nut (13) to the balance lever before tightening four [4] cross recessed pan head screws (7).
- Tightening minor feedback connecting M3 hexagon nut (8) (balance lever (5) side.). Attention should be taken on the following three points to settle the pilot valve unit (6).
  (1) Gap between the stopper and the balance lever is approximately 1mm (dimension a).

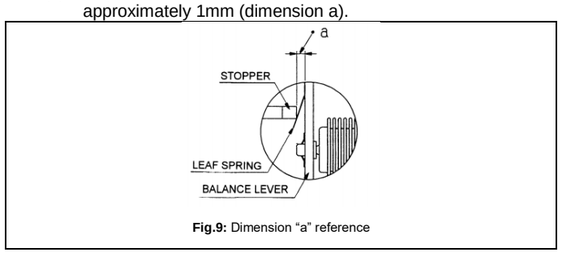


Fig.9: Dimension “a” reference

  (2) The nozzle and the flapper are slightly in contact with each other (highlighted area b).
  (3) Connect spring is straight (as much as possible) (highlighted area c).

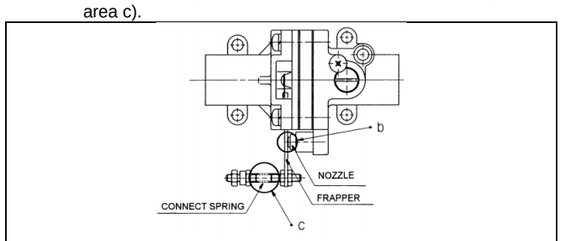


Fig.10: Dimension “b” and “c” references

- Connect the feedback spring (4) to the balance lever (5).
- Check the performance in the following order;
  (1) Apply supply pressure.
  (2) Check if the nozzle opens and closes and the output is switched by moving the balance lever (11) to the applicable open/close direction.
  (3) If no output, move the pilot valve unit mounting position towards the supply port (**Fig.11.)**. If the unit remains on the output, move the pilot valve unit mounting position towards the positioner mounting screw side **(Fig.12.)**
- If the operation test shows no problem, proceed to adjusting of the zero-point and the span.

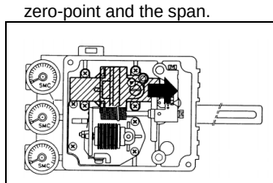


Fig.11: No Output – IP5000

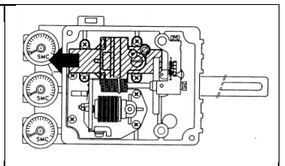


Fig.12: Constant Output – IP5000

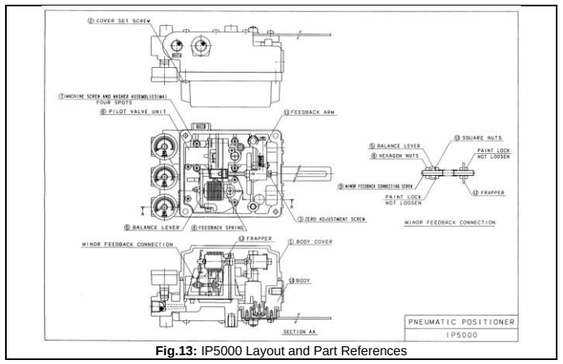


Fig.13: IP5000 Layout and Part References

7.2.2 IP5100 Series

For IP5100 refer to **Fig.16.** below for position of parts.

- Pilot Valve Unit Part Number = P378020-11
- Loosen cover stopper thread (2) to remove the body cover (1).
- Loosen the truss screw (M3) (3) and remove the open degree indicator (4) in case of the indicated equipped. Then loosen the hexagon nut with flange (5) and place cam (6) aside by rotating from the top of the pilot valve unit (7).
- Loosen four [4] pilot valve unit mounting cross recessed pan head screws (8), and M3 hexagon nut (9) of the minor feedback joint (at balance lever (11) side).
- Remove the minor feedback connecting screw (10) from the balance lever (11) and remove pilot valve unit (7) from the body (12). Please loosen the minor feedback connecting balance lever (11) and the nut paint settled to the flapper (13).
- Mount new pilot valve unit (7). Insert minor feedback square nut (14) to the balance lever before tightening four [4] cross recessed pan head screws.
- Tightening minor feedback connecting M3 hexagon nut (9) (balance lever (11) side.). Attention should be taken on the following three points to settle the pilot valve unit (7).
  (1) Gap between the stopper and the balance lever is approximately 1mm (dimension a). [See **Fig.9.**]
  (2) The nozzle and the flapper are slightly in contact with each other (highlighted area b). [See **Fig.10.**]
  (3) Connect spring is straight (as much as possible) (highlighted area c). [See **Fig.10.**]
- Set cam (6) at the specified position and settle it with the hexagon nut with flange (5).
- Set the open degree indicator (4) and secure it with the truss screw (3).
- Check the performance in the following order;
  (4) Apply supply pressure.
  (5) Check if the nozzle opens and closes and the output is switched by moving the balance lever (11) to the applicable open/close direction.
  (6) If no output, move the pilot valve unit mounting position towards the supply port (**Fig.14.)**. If the unit remains on the output, move the pilot valve unit mounting position towards the positioner mounting screw side **(Fig.15.)**
- If the operation test shows no problem, proceed to adjusting of the zero-point and the span.

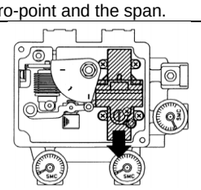


Fig.14: No Output – IP5100

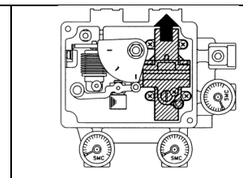


Fig.15: Constant Output – IP5100

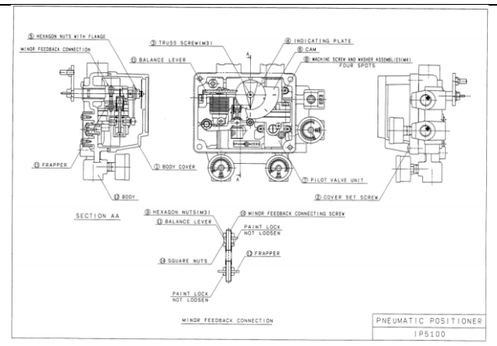


Fig.16: IP5100 Layout and Part References

7.3 Periodic Check Procedure

7.3.1 Positioner operation test

Mount the positioner to the actuator and supply pressure. Check that the operating time of extend/retract is almost the same and the movement is smooth when turning the signal ON and OFF by applying 0.02~0.1 MPa input pressure.

Check for the following:

- Foreign material may be trapped in the air passage, the supply port valve or the exhaust port of the pilot valve, if the extend and retract times are vastly different. To rectify flush and remove the material.
- Check the control valve in the case of knocking. If knocking is not solved, the replace the seals and pilot valve unit, readjust and check again.

7.3.2 Positioner air consumption test

Mount the positioner to the actuator and pipe a flow gauge to the supply pressure side. Apply pressure and measure the air consumption at 0.6 MPa input pressure.

Check for the following:

- If the measured value is outside of the allowable limits then foreign matter may be trapped in the supply port valve or the exhaust port valve of the pilot valve. To rectify flush and remove the material.
- If this does not fix the problem replace the seals and pilot valve unit, readjust and check again.

7.3.3 Positioner performance test

Mount the positioner to the actuator and supply pressure to check the linearity and the hysteresis.

Check for the following:

- If the value is outside of the specified values replace the seals and pilot valve unit, readjust and check again. If this does not solve the issue inspect the actuator part.

7.3.4 Pilot valve unit

It is recommended that the positioner pilot valve unit is replaced every 3 years, whether there is any irregularity or not. See the pilot valve replacement procedure in Section 7.2.

7.3.5 Feedback shaft

Ensure the shaft rotation is smooth and there is no play between the bearing and the shaft.

Check for the following:

- If the shaft has run out of grease, then the end-user should apply grease. If there is play then the product should be replaced.

7.3.6 Pilot valve air tightness test

Plug the output pressure connect port and apply maximum supply pressure. Ensure there is no “unnecessary leakage” to the outside.

Check for the following:

- If leakage occurs, re-tighten the pilot valve, and the base packing screw on the body.
- If this does not fix the problem, replace the seals and pilot valve unit, readjust and check again.

7.3.7 Feedback arm unit

Remove the feedback spring hook to ensure the feedback arm moves smoothly.

Check for the following:

- Apply grease if the operation is not satisfactory.
- If damage is found on the shaft or the feedback arm bearing then replace the product.

7.3.8 Positioner pressure gauge

Apply an input pressure into a controlled/calibrated gauge and the gauge being investigated and ensure the reading is correct.

Check for the following:

- If the difference between the two values is 3% or more than the maximum pressure gauge value, then this should be replaced.

8 Limitations of Use

8.1 Limited warranty and Disclaimer/Compliance Requirements

Refer to Handling Precautions for SMC Products located on www.smcworld.com .

8.2 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 actuator 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.
- Avoid applications where the shaft and the adjoining part in the application can create a possible ignition source.
- 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 cylinder damage. Avoid any application where foreign objects can hit or impact the cylinder. 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.

9 Contacts

Refer to Declaration of Conformity and www.smcworld.com for contacts.

SMC Corporation

URL : http// www.smcworld.com (Global) http// www.smceu.com (Europe)
'SMC Corporation, Akihabara UDX15F, 4-14-1, Sotokanda, Chiyoda-ku, Tokyo 101 0021

Template DKP50047-F-085H