

# INSTRUCTION MANUAL

## Electro-Pneumatic Positioner

### SP520



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**SEG** Shin Hwa Eng. Co., Ltd

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# 1. Introduction

## 1-1 General Information for users

- For the protection and safety of the operator, the product, and the system in which this products is installed, the safety instructions mentioned in this manual must be observed.  
Safety cannot be guaranteed if the safety instructions in this manual are not properly followed.
- Installation commissioning and maintenance of the products should be performed by trained specialist personnel who have been authorized accordingly.
- The manual should be provided to the end-user.
- SP520 Series hardware can be upgraded without any prior notice.
- For additional information or if there occur problems that are not stimulated on these manual, please contact to Shin Hwa Eng. Co., Ltd. immediately.

## 1-2 Warranty

- Manufacturer will not take responsible for the personal and physical damage caused by user's negligence and products modifying or repairing randomly.  
If any alternations or modifications are required, please contact to Shin Hwa Eng. Co., Ltd.
- Quality warranty is valid during the warranty period stimulated in products warranty and shall be free cost during this period only.
- Even though it is within quality warranty period, following conditions must be paid.
  - In case that customer shall maintain or repair products improper randomly.
  - In case of happening problems caused by improper movement and storage or dealing which has exceeded over design condition.
  - In case that products shall be used over the specification range.
  - In case that problems shall be caused by improper installation.
  - In case that it happens on fires, earthquakes, storms, floods, thunder, lightening other natural disasters, riot, war, radiation exposure, force of majeure situation.

## 1-3 Safety on Installation

- When installing or replacing positioner equipped with actuator, following safety is required.
  - Stop completely valve, actuator and relative surrounding input signal, air pressure.
  - Separate by-pass valve or control valve so that overall system may not shut down.
  - Make sure that there is no remaining air pressure in actuator.
  - In case of enclosures covered with non-conductive material, brush discharge must be avoided.

## 1-4 Safety on pipe connection

- Be care to select facility so that moisture, oil, other materials may not be mixed in pipe of air

compressor and system.

- Prevent to penetrate on moisture, oil and different material with air regulator which is equipped filter or separated filter device in front of air port on SP520 series.

### 1-5 Supply pressure condition

- Use drying air with dew point of at least 10°C lower than ambient temperature.
- Avoid extra material using filters less than 5 micron. and avoid oil or lubrication oil.
- SP 520 series supply pressure range is 1.4 ~7 kgf/cm<sup>2</sup> (140 - 700 kPa).

And do not use over usage range

### 1-6 Supply pipe condition

- Check that different materials inside pipe must be erased before installing pipe.
- Do not use pipe which is squeezed or damaged.
- Pipeline should have more than 6 mm of inner diameter to maintain SP520 series flow rate.

### 1-7 Safety contents on electrical connection

- Check that electric power is off before connecting terminal.  
SP520 series(except feedback signal internal type) uses 4-20mA DC and in order to operate positioner, minimum supplying current is 3.2mA, but maximum supplying current must not exceed into 24mA.
- In case there is feedback option in SP520 series, separated power must be supplied to feed back signal and supplying voltage must be 9-28V and not exceed into maximum 30V.
- In order to protect products, positioner internal grounding block should be grounded.  
Please do not install the cable near high noise equipments such as high-capacity transformer or motor.
- Cable or Cable gland should be products which can be used over min. 90°C
- When equipping cable gland or blanking element, please use explosive proof items which is over IP66 grade.

### 1-8 Safety contents to use Flame Explosion Proof SP520 in danger area.

- Check that explosion proof certification is valid in usage condition and must meet with condition.
- SP520 positioner is using Flame Explosion Proof (Ex db mb IIB/IIC T6/T5 Gb, Ex tb IIIC T80°C /T100°C Db IP66) code. and It can be used in Zone 1,2 area.
- In danger area which is exiting explosive gas, explosion proof type of cables or flame explosion proof packing type cable must be used. In case of using explosive proof cable, it must be used by gasket and sealed completely.
- Intrinsic safe version must be supplied by certified power supply.
- For Ex-mb type a fuse corresponding to the device's rating current (max. 3 x I<sub>N</sub> or, resp. IB

according to IEC/EN 60127-2) shall be used in supply circuit.

- Enclosure with viewing window must be protected from high impact energy.
- Flameproof type junction box must be equipped with certified Ex-d cable glands. Ex-i and Ex-tb type junction box must be equipped with min IP64 rated Ex certified cable glands.
- The layout uses Annex F, of EN 60079-11. Therefore the installation environment shall comply with EN 60664 pollution degree 2 requirements.
- While the power is connected, make sure that do not open SP520 power terminal box.  
Before opening terminal box, make sure that power is off completely and after erasing current and voltage completely, it must be opened.
- SP520 series positioner have 2 ports for power connection. If one side of connection must be used when using explosive cable or flame explosion proof to packing plug in the other side should be used explosive blind plug in order to protect. (In case that the other items shall be required to use except our company's supplying plug blind approved resistance to explosion proof type structure shielding fitting or flame explosion proof type cable gland must be used when connecting power on.)
- Ring terminal with surface area of more that  $0.195 \text{ mm}^2$  with should be used and also M4 spring washer should be used to prevent falling out.
- For external ground terminal, ring terminal with surface area of more than  $5.5 \text{ mm}^2$  should be used.
- There will be risk of explosion due to electro-static charge. Static electricity charge may develop when cleaning the products with a dry cloth. It is imperative to avoid static electricity charge in the hazard area. If cleaning the surface of the products is required, please use wet clothes.

### 1-9 Safety to maintain intrinsic safety (Ex i) Proof (SP520) in danger area.

- Check that explosion proof certification is valid in usage condition and must meet with condition.
- SP520 positioner is using Intrinsic safety proof (EX ia IIC T6/T5 Gb) code. and It can be used in Zone 1,2 area.
- Barrier must be installed in safety area.
- SP520 positioner's intrinsic safety's parameter is as followings.

Main power :  $U_i=DC28V$ ,  $I_i=93mA$ ,  $P_i=0.65W$ ,  $C_i=0.5nF$ ,  $L_i=10\mu H$

Feedback signal power :  $U_i=DC28V$ ,  $I_i=93mA$ ,  $P_i=0.65W$ ,  $C_i=57.5nF$ ,  $L_i=10\mu H$

Limit switch :  $U_i=DC28V$ ,  $I_i=100mA$ ,  $P_i=0.65W$ ,  $C_i=0nF$ ,  $L_i=0\mu H$

(See Table in Sections 2-6)

- Do not open the power terminal box cover of the SP520 product while there is potential explosive atmosphere.
- SP520 has two power inlets. When using an explosion-proof cable or pressure-resistant packing conduit, if only one power inlet is used, the other must be blocked with an explosion-proof plug.

## 1-10 Safety Requirements



### Caution

Failure to observe the notice may result in damage to the device or may degrade performance.



### Warning

Failure to observe the is caution may result in damage to the device or personal injury.



### Danger

Failure to observe the warning may result in serious injuries or death.



## CAUTION

- ▶ Operating the products incorrectly may be degraded the safety.  
The well trained person who has proper knowledge and full experience on assembling and machinery operation should handle this products.
- ▶ Change or modification without permission may be exempt from the manufacturer's liability.
- ▶ Do not try to handle or disassemble the machine until the safety is firmly secured.
  1. Before maintenance or inspection of the machine, make sure that no moving objects fall or move.
  2. Before removing the products, check the safety such as taking safety action and cutting off the relative electric power and be well aware of the caution of products.
  3. When re-operating the machine, make sure that necessary safety action was taken and operated with safety.



## DANGER

- ▶ Please observe the rule relative to safety regulation (National safety regulation) construction supervision rules and general rules of operation techniques.
- ▶ Please check whether the smart positioner is in proper area or not.
- ▶ Please check whether positioner specification is allowable and range of positioner is approved in explosion area or not.
- ▶ Please close unnecessary cable gland with approved locking screw in explosive parts

## 2. Products Description

### 2-1 General Information

- SP520 Electro-Pneumatic Positioner is a control valve system device that precisely controls the valve opening by adjusting the pressure supplied to the valve actuator proportionally by receiving 4-20mA DC input current from the calibrator, central control room(DCS), and control room. It is a control device.

### 2-2 Main Features and Functions

- (1) With Precise and fast response, it can be available in several type of control valve.
- (2) Zero and Span adjustment are easy and convenient.
- (3) For intrinsically safe explosion-proof products, a position transmitter and limit switch can be built into the positioner.
- (4) Explosion-proof products can be externally equipped with position transmitters and limit switches certified for explosion protection.
- (5) It has excellent IP66 enclosure grade.
- (6) Air consumption quantity is very small , so in scale plant , the cost can be much saved
- (7) Inside structure is Module type and simple to maintain and repair.

### 2-3 Options

- (1) Internal position transmitter (4-20mA DC feedback signal)
- (2) External limit switch
- (3) External position transmitter

### 2-4 Label Description

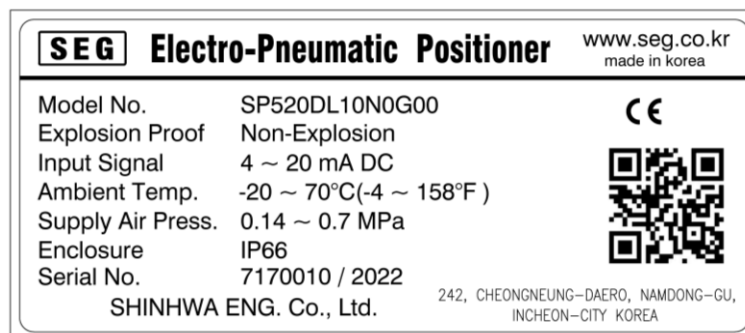



Fig 2-1 : SP520 Sticker name plate


### **\* Caution**

Please care not to touch volatile solvent hardener of instant adhesive, acetone WD-40 etc. because it can be erased sticker label's print contents.




<b>SEG Electro-Pneumatic Positioner</b>		www.seg.co.kr made in korea
Model No.	SP520DL10D2G00	Supply Air Press. 0.14 ~ 0.7 MPa
Explosion Proof	Ex ia IIC T6/T5 Gb Ex ia IIIC T80°C/T100°C Db	Enclosure IP66
Ui, li, Pi, Ci, Li	See manual or certificate	
Input Signal	4 ~ 20 mA DC	IECEX : EPS 21.0063X
Ambient Temp.	T5, T100°C:-20 ~ 60°C(-4 ~ 140°F) T6, T80°C:-20 ~ 40°C(-4 ~ 104°F)	ATEX : EPS 21 ATEX 1 085 X KCs : 22-KA2BO-0405X, 06X CCC : 2022122307115729
Serial No.	7170010 / 2022 SHINHWA ENG. Co., Ltd.	242, CHEONGNEUNG-DAERO, NAMDONG-GU, INCHEON-CITY KOREA

(KCs, IECEX, CCC)


<b>SEG Electro-Pneumatic Positioner</b>		www.seg.co.kr made in korea
Model No.	SP520DL10D2G00	Supply Air Press. 0.14 ~ 0.7 MPa
Explosion Proof	II 2 G Ex ia IIC T6/T5 Gb II 2 D Ex ia IIIC T80°C/T100°C Db	Enclosure IP66
Ui, li, Pi, Ci, Li	See manual or certificate	
Input Signal	4 ~ 20 mA DC	IECEX : EPS 21.0063X
Ambient Temp.	T5, T100°C:-20 ~ 60°C(-4 ~ 140°F) T6, T80°C:-20 ~ 40°C(-4 ~ 104°F)	ATEX : EPS 21 ATEX 1 085 X KCs : 22-KA2BO-0405X, 06X CCC : 2022122307115729
Serial No.	7170010 / 2022 SHINHWA ENG. Co., Ltd.	242, CHEONGNEUNG-DAERO, NAMDONG-GU, INCHEON-CITY KOREA

(ATEX)

Fig 2-2 : SP520 Explosion proof nameplate(Ex i)

<b>SEG Electro-Pneumatic Positioner</b>		www.seg.co.kr made in korea
Model No.	SP520DL10D2G00	Supply Air Press. 0.14 ~ 0.7 MPa
Explosion Proof	Ex db mb IIB/IIC T6/T5 Gb Ex tb IIIC T80°C/T100°C Db IP66	Enclosure IP66
Input Signal	4 ~ 20 mA DC	
Ambient Temp.	T5, T100°C:-20 ~ 60°C(-4 ~ 140°F) T6, T80°C:-20 ~ 40°C(-4 ~ 104°F)	IECEX : EPS 21.0063X ATEX : EPS 21 ATEX 1 085 X KCs : 22-KA2BO-0404X, 07X CCC : 2022122307115730
Serial No.	7170010 / 2022 SHINHWA ENG. Co., Ltd.	242, CHEONGNEUNG-DAERO, NAMDONG-GU, INCHEON-CITY KOREA

(IECEX, CCC)

<b>SEG Electro-Pneumatic Positioner</b>		www.seg.co.kr made in korea
Model No.	SP520DL10D2G00	Supply Air Press. 0.14 ~ 0.7 MPa
Explosion Proof	II 2 G Ex db mb IIB/IIC T6/T5 Gb II 2 D Ex tb IIIC T80°C/T100°C Db IP66	Enclosure IP66
Input Signal	4 ~ 20 mA DC	
Ambient Temp.	T5, T100°C:-20 ~ 60°C(-4 ~ 140°F) T6, T80°C:-20 ~ 40°C(-4 ~ 104°F)	IECEX : EPS 21.0063X ATEX : EPS 21 ATEX 1 085 X KCs : 22-KA2BO-0404X, 07X CCC : 2022122307115730
Serial No.	7170010 / 2022 SHINHWA ENG. Co., Ltd.	242, CHEONGNEUNG-DAERO, NAMDONG-GU, INCHEON-CITY KOREA

(ATEX)

Fig 2-3 : SP520 Explosion proof nameplate(Ex db mb)

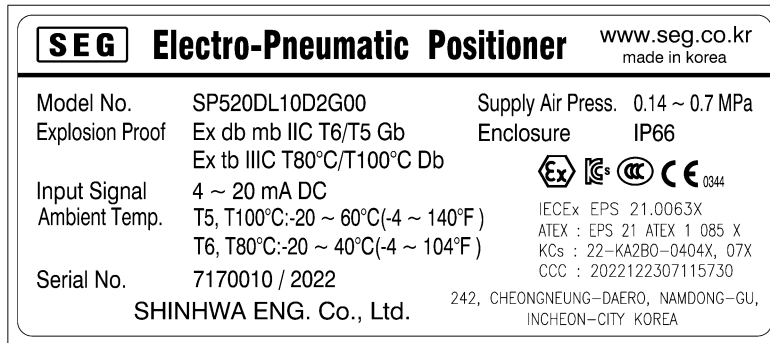


Fig 2-4 : SP520 Explosion proof nameplate(Ex db mb)  
(KCs)

Items of Label	Description
Model No.	Indicate model No according to specification including option.
Ambient Temp.	Indicate ambient temperature valid in explosion proof certification
Serial No.	Indicate products serial No.
Explosion Proof	Indicate products explosion proof grade.
Input Signal	Indicate the range of input electric signal
Supply Air Press.	Indicate pressure range supplying to positioner.
Enclosure	Indicate enclosure grade of water proof and dust proof.

## 2-5 Products Specification

Model	SP520S		SP520D	
Acting Type	Single		Double	
Motion Type	Linear	Rotary	Linear	Rotary
Input Signal	4~20mA DC			
Impedance	240 ± 15 Ω			
Air Connection	Rc(PT) 1/4, NPT 1/4			
Pres. Gauge Connection	Rc(PT) 1/8, NPT 1/8			
Conduit Entry	PF(G)1/2, NPT1/2, M20x1.5			
Stroke	10~150 mm	0~90°	10~150 mm	0~90°
Supply Pressure	0.14~0.7 MPa (1.4~7 bar)			
Explosion Proof Grade	Ex db mb IIB/IIC T6/T5 Gb Ex ia IIC T6/T5 Gb Ex tb IIIC T80°C /T100°C Db IP66 Ex ia IIIC T80°C /T100°C Db (IECEX), (ATEX), (KCs), (CCC)			
Enclosure	IP66			
Ambient Temperature	Non-explosion proof : -20~70°C (-4°F~158°F) Explosion proof : -20 ~ +60°C (T5,T100°C), -20 ~ +40°C (T6,T80°C)			
Linearity	±1% F.S.		±2% F.S.	
Hysteresis	±1% F.S.			
Sensitivity	±0.2% F.S		±0.5% F.S	
Repeatability	±0.5% F.S.			
Flow Capacity	70 LPM (Sup.=0.14 MPa)			
Air Consumption	2 LPM (sup.=0.14MPa), 3 LPM (sup.=0.7MPa)			
Humidity	5~95% RH at 40°C			
Feedback Signal (Option)	4~20mA (DC 10~30V )			
Material	Aluminum Diecasting			
Weight	3 kg (6.6 lb)			
Painting	Epoxy Polyestere Powder Coating			
Color	Black			

• Tested under ambient temperature of 20°C, absolute pressure of 760mmHg, and humidity of 65%.

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## 2-6 Explosion Proof Certificate

### ▶ KCs

(1) Type : Flame Proof Enclosure

Rating : Ex db mb IIC T6/T5 Gb

Certification No. : 22-KA2BO-0404X

Ambient Temperature : -20 ~ +60°C (T5), -20 ~ +40°C (T6)

(2) Type : Intrinsic Safety

Rating : Ex ia IIC T6/T5 Gb

Ex ia IIIC T80°C/T100°C Db

Certification No. : 22-KA2BO-0405X, 22-KA2BO-0406X

Ambient Temperature : -20 ~ +60°C (T5, T100°C), -20 ~ +40°C (T6, T80°C)

(3) Type : Dust explosion proof

Rating : Ex tb IIIC T80°C/T100°C Db

Certification No. : 22-KA2BO-0407X

Ambient Temperature : -20 ~ +60°C (T100°C), -20 ~ +40°C (T80°C)

### ▶ IECEx

(1) Type : Flame Proof Enclosure

Rating : Ex db mb IIB/IIC T6/T5 Gb

Certification No. : IECEx EPS 21.0063X

Ambient Temperature : -20 ~ +60°C (T5), -20 ~ +40°C (T6)

(2) Type : Intrinsic Safety

Rating : Ex ia IIC T6/T5 Gb,

Ex ia IIIC T80°C/T100°C Db

Certification No. : IECEx EPS 21.0063X

Ambient Temperature : -20 ~ +60°C (T5, T100°C), -20 ~ +40°C (T6, T80°C)

(3) Type : Dust explosion proof

Rating : Ex tb IIIC T80°C/T100°C Db IP66

Certification No. : IECEx EPS 21.0063X

Ambient Temperature : -20 ~ +60°C (T100°C), -20 ~ +40°C (T80°C)

**▶ ATEX**

(1) Type : Flame Proof Enclosure

Rating : II 2G Ex db mb IIB/IIC T6/T5 Gb

Certification No. : EPS 21 ATEX 1 085 X

Ambient Temperature : -20 ~ +60°C (T5), -20 ~ +40°C (T6)

(2) Type : Intrinsic Safety

Rating : II 2G Ex ia IIC T6/T5 Gb,

II 2D Ex ia IIIC T80°C/T100°C Db

Certification No. : EPS 21 ATEX 1 085 X

Ambient Temperature : -20 ~ +60°C (T5, T100°C), -20 ~ +40°C (T6, T80°C)

(3) Type : Dust explosion proof

Rating : II 2D Ex tb IIIC T80°C/T100°C Db IP66

Certification No. : EPS 21 ATEX 1 085 X

Ambient Temperature : -20 ~ +60°C (T100°C), -20 ~ +40°C (T80°C)

**▶ CCC**

(1) Type : Flame Proof Enclosure

Rating : Ex db mb IIB/IIC T5/T6 Gb

Certification No. : 2022122307115730

Ambient Temperature : -20 ~ +60°C (T5), -20 ~ +40°C (T6)

(2) Type : Intrinsic Safety

Rating : Ex ia IIC T5/T6 Gb

Ex ia IIIC T80°C/T100°C Db

Certification No. : 2022122307115729

Ambient Temperature : -20 ~ +60°C (T5, T100°C), -20 ~ +40°C (T6, T80°C)

(3) Type : Dust explosion proof

Rating : Ex tb IIIC T80°C/T100°C Db IP66

Certification No. : 2022122307115730

Ambient Temperature : -20 ~ +60°C (T100°C), -20 ~ +40°C (T80°C)

※ Above all certification can be checked in homepage( <http://www.seg.co.kr> )

### ► Flame Explosion Proof Specification

- IECEx : IEC 60079-0:2017, IEC 60079-1:2014, IEC 60079-11:2011, IEC 60079-18:2017,  
IEC 60079-31:2022
- ATEX : EN IEC 60079-0:2018, EN 60079-1:2014, EN 60079-11:2012, EN 60079-18:2015,  
EN 60079-31:2014
- KCs : Announcement No. 2021-22 of Ministry of Employment and Labor
- CCC : CQM10-C2301-2022 Implementation Rule for China Compulsory Certification  
CC22-001 20220429 Notification for transition of GB/T Series standards

### ► Intrinsic Safety Explosion Proof Specification

Intrinsic Safety Explosion Proof Specification	EC 60079-0 : 2017 EC 60079-11 : 2011				
Explosion Proof Class	Ex ia IIC T6/T5 Gb				
Barrier Specifications	Ui	li	Pi	Ci	Li
Main power	28VDC	93mA	0.65W	0.5nF	10μH
Feedback signal power	28VDC	93mA	0.65W	57.5nF	10μH
Limit switch (Dry contact type)	28VDC	100mA	0.65W	0nF	0μH

Remark) Please refer to the certificate for further information.

**2-7 Products Code**

(1) LINEAR TYPE

MODEL		SP520							
<b>Acting Type</b>	Single Double	<b>S</b> <b>D</b>							
<b>Motion Type</b>	Linear 10~40mm 40~90mm 90~150mm	<b>L1</b> <b>L2</b> <b>L3</b>							
<b>Feedback</b>	None Position transmitter (4~20mA DC)	<b>0</b> <b>1</b>							
<b>Explosion Proof Type</b>	Non explosion type (IP66) Ex db mb IIB/IIC T6/T5 Gb Ex ia IIC T6/T5 Gb (Ex ia IIIC T80°C/T100°C Db) Ex tb IIIC T80°C/T100°C Db IP66	<b>N</b> <b>D</b> <b>A</b> <b>T</b>							
<b>Explosion Proof type Specification</b>	None(IP66) KCs IECEX ATEX CCC	<b>0</b> <b>1</b> <b>2</b> <b>3</b> <b>4</b>							
<b>Connection</b>	Air – Rc(PF)1/4, Conduit – G(PF)1/2 Air – NPT1/4, Conduit – NPT1/2 Air – NPT1/4, Conduit – M20x1.5	<b>G</b> <b>N</b> <b>M</b>							
<b>Position L/S</b>	None	<b>0</b>							
<b>Orifice</b>	None ø1 ø2	<b>0</b> <b>1</b> <b>2</b>							
<p><b>※ Optionable items</b></p> <p>1. Non-Explosion Proof : Feedback option</p> <p>2. Ex db mb : Option not applicable.</p> <p>3. Ex ia : Feedback option</p>									

(2) ROTARY TYPE

MODEL	SP520								
<b>Acting Type</b>	Single Double	<b>S</b> <b>D</b>							
<b>Motion Type</b>	Rotary Fork Lever Namur	<b>R1</b> <b>R2</b>							
<b>Feedback</b>	None Position transmitter (4~20mA DC)	<b>0</b> <b>1</b>							
<b>Explosion Proof Type</b>	Non explosion type (IP66) Ex db mb IIB/IIC T6/T5 Gb Ex ia IIC T6/T5 Gb (Ex ia IIIC T80°C/T100°C Db) Ex tb IIIC T80°C/T100°C Db IP66	<b>N</b> <b>D</b> <b>A</b> <b>T</b>							
<b>Explosion Proof type Specification</b>	None(IP66) KCs IECEX ATEX CCC	<b>0</b> <b>1</b> <b>2</b> <b>3</b> <b>4</b>							
<b>Connection</b>	Air – Rc(PF)1/4, Conduit – G(PF)1/2 Air – NPT1/4, Conduit – NPT1/2 Air – NPT1/4, Conduit – M20x1.5	<b>G</b> <b>N</b> <b>M</b>							
<b>Position L/S</b>	None 2xSPDT External Type	<b>0</b> <b>1</b> <b>2</b>							
<b>Orifice</b>	None Ø1 Ø2	<b>0</b> <b>1</b> <b>2</b>							
<p><b>※ Optionable items</b></p> <ol style="list-style-type: none"> <li>1. Non-Explosion Proof : Feedback, L/S, Feedback+L/S, External L/S, External (L/S+Feedback)</li> <li>2. Ex db mb : External L/S, External (L/S+Feedback)</li> <li>3. Ex ia : Feedback, L/S, Feedback+L/S</li> <li>4. Ex tb: External L/S, External L/S+Feedback(External equipment can be used by third-party products)</li> </ol>									



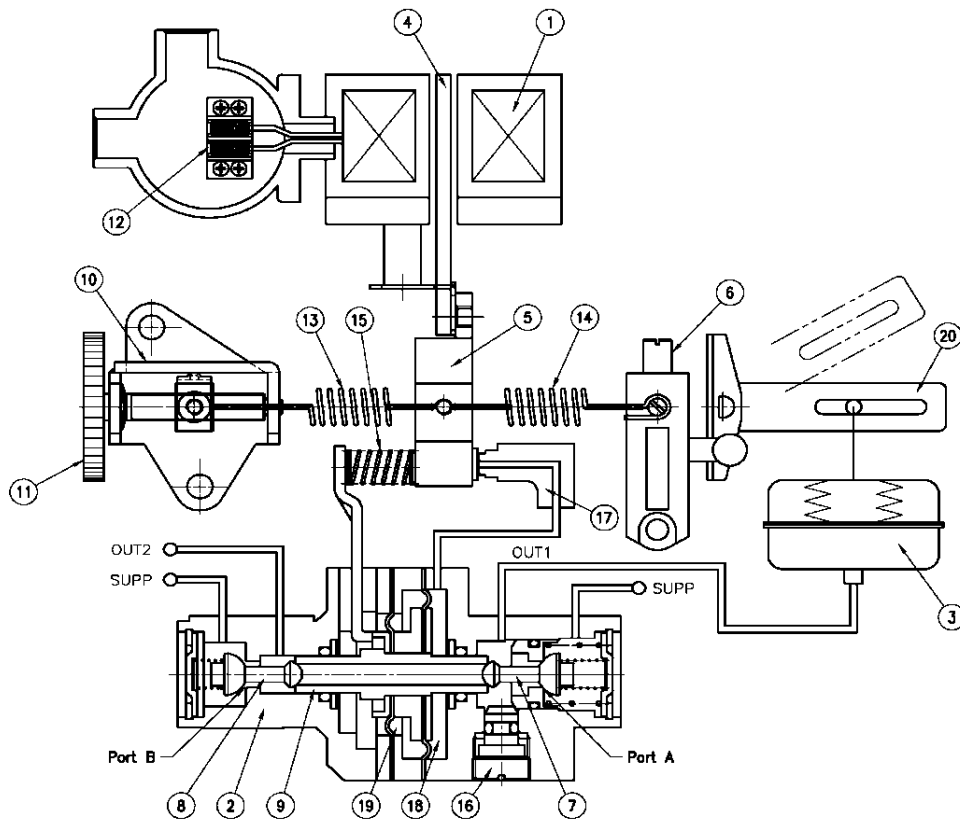
## 2-8 Principle of Operation

### (1) LINEAR TYPE

When the input signal (4~20mA) is input, the input current is transmitted to the coil of the Torque Motor (1) and magnetic force is generated in the core. Move to the left. As a result of the action, the gap between the nozzle (17) and the spring support (5) is opened, and the pressure in the nozzle pressure chamber (18) drops, resulting in a pressure difference with the pressure chamber (19).

Accordingly, Spool (9) pushes Poppet A (12) to open port A, and the output of OUT1 raises the diaphragm valve (3) valve to the top.

In accordance with this movement, the Feedback Lever (20) moves upward and transmits it to the Output Shaft, and the port A closes and the output of out1 stops and the diaphragm valve (3) is stopped until the pressure reaches the desired position by repeating the action.



1	Torque Motor	8	Poppet B	15	Gain suppression spring
2	Pilot Valve	9	Spool	16	Sensitivity adjust valve
3	Diaphragm valve	10	Zero control ass'y	17	Nozzle
4	Flapper	11	Zero control screw	18	Pressure(A)
5	Spring support	12	Input current terminal	19	Pressure(B)
6	Span lever	13	Zero control spring	20	Feedback lever
7	Poppet A	14	Span lever spring	21	*

Fig 2-5 : LINEAR TYPE operation principle

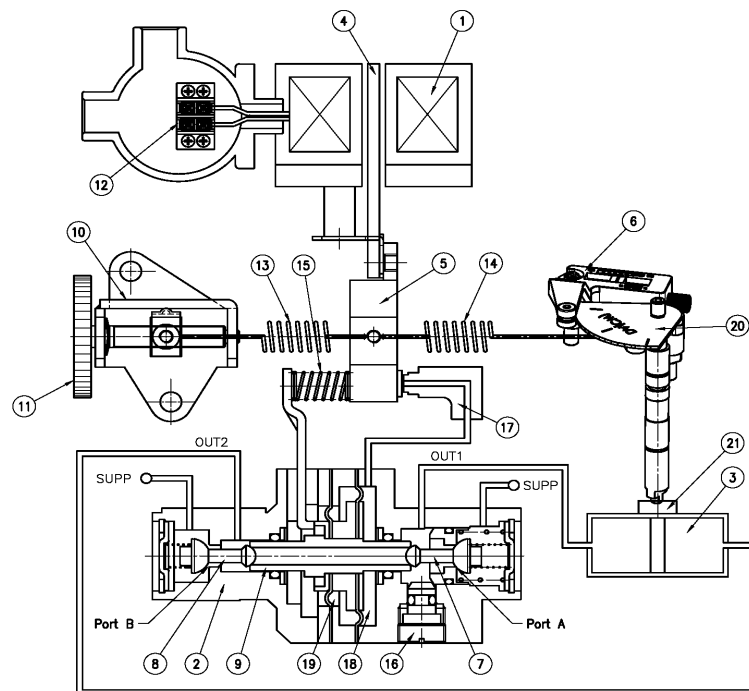
(2) ROTARY TYPE

When the input signal (4~20mA) is input, the input current is transmitted to the coil of the Torque Motor (1), and magnetic force is generated in the core. With this magnetic force, the flapper (4) receives the force to the right and the spring support (5) is Move to the left. As a result of the action, the gap between the nozzle (17) and the spring support (5) is widened and the pressure in the nozzle pressure chamber (18) drops, resulting in a pressure difference with the pressure chamber (19).

Accordingly, Spool(9) pushes Poppet A(12) to open port A, and the output of OUT1 pushes Actuator(3) to the right, rotates actuator stem(21), and is transferred to Cam(20).

According to this movement, the Span Lever(6) is moved and the spring support(5) is pulled through the Span lever spring(14), and the gap between the nozzle(17) and the spring support(5) becomes narrow again, and port A is closed and the output of out1 This stopping and stopping the actuator (3) is repeated until the pressure is equalized to reach the desired position.

Conversely, if the input current is small, the nozzle flapper (9) blocks the nozzle (8) and the pressure in the nozzle pressure chamber (18) increases, and the spool (9) becomes Poppet B (8) according to the pressure difference with the pressure chamber (19). Push to open port B and the output of OUT2 is connected to the actuator (3), and the actuator stem (21) rotates.



1	Torque Motor	8	Poppet B	15	Gain suppression spring
2	Pilot Valve	9	Spool	16	Sensitivity adjust valve
3	Actuator(double action)	10	Zero control ass'y	17	Nozzle
4	Flapper	11	Zero control screw	18	Pressure(A)
5	Spring support	12	Input current terminal	19	Pressure(B)
6	Span lever	13	Zero control spring	20	Cam
7	Poppet A	14	Span lever spring	21	Actuator stem

Fig 2-6 : Rotary TYPE operation principle

## 2-9 Structure

### (1) LINEAR TYPE

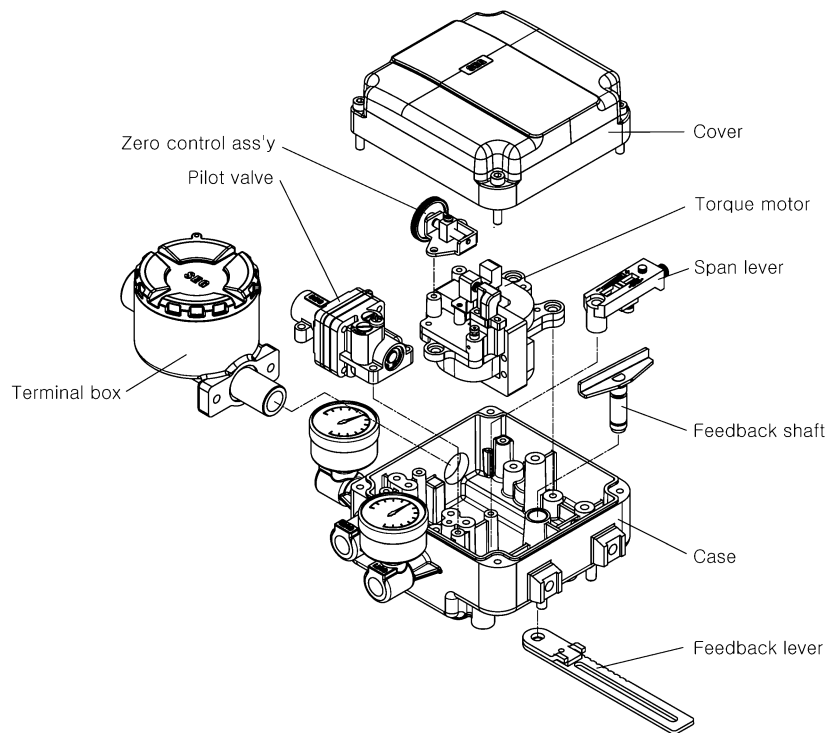


Fig 2-7 : LINEAR TYPE Schematic

### (2) ROTARY TYPE

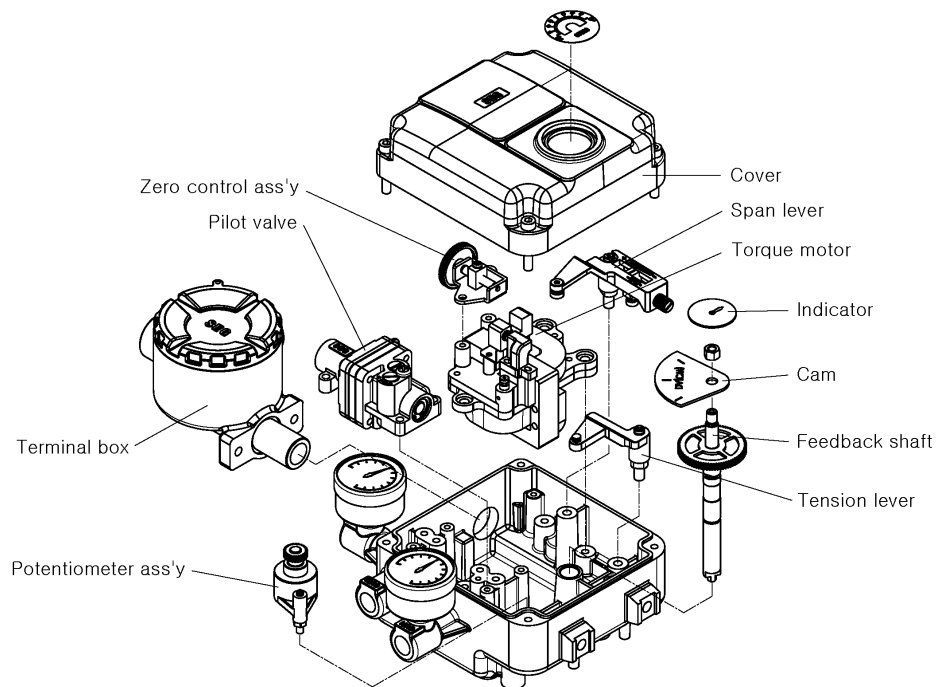


Fig 2-8 : ROTARY TYPE Schematic

2-10 Products Dimension

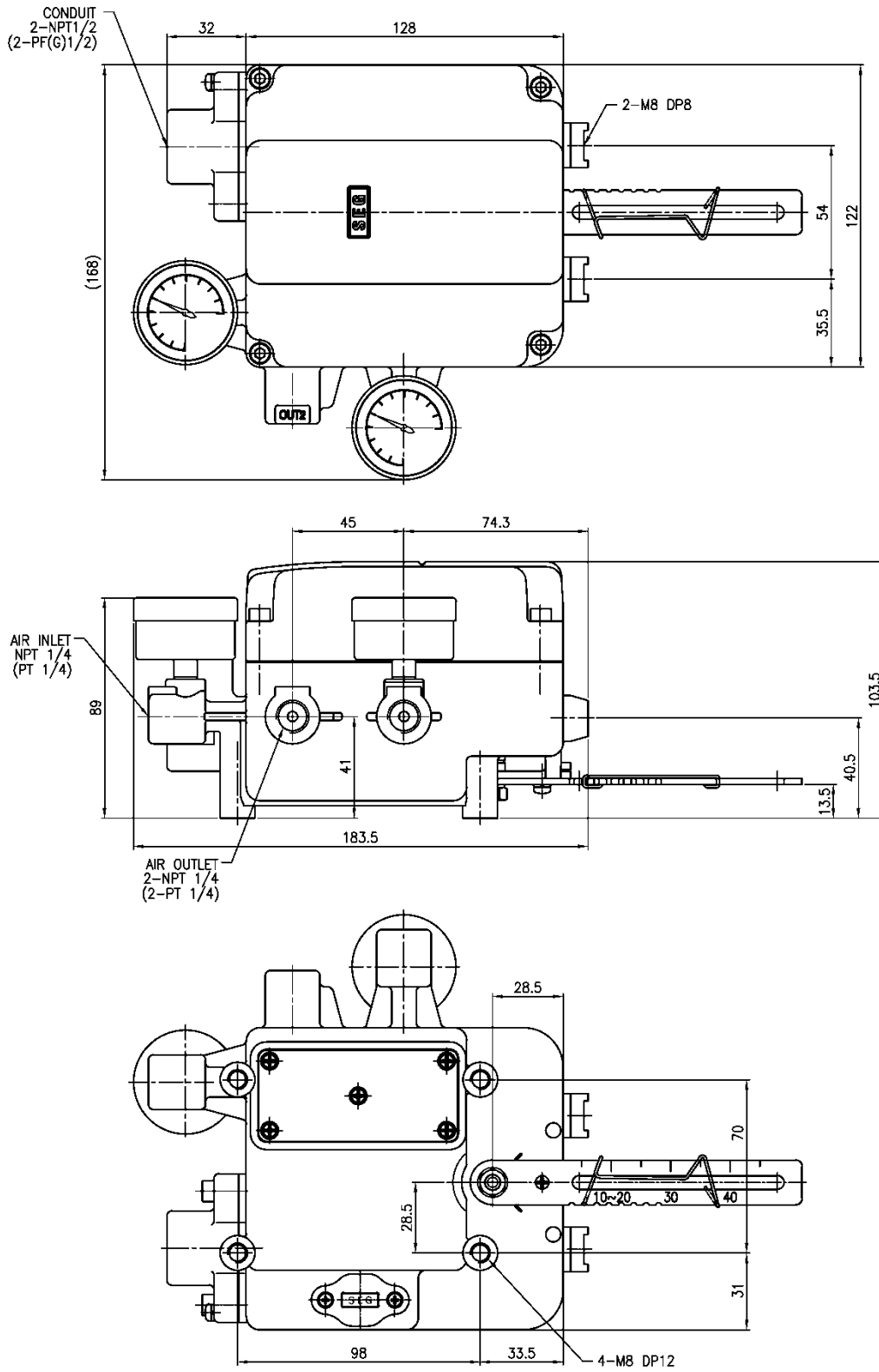


Fig 2-9 : SP520 LINEAR TYPE (Non Explosive Proof Type)

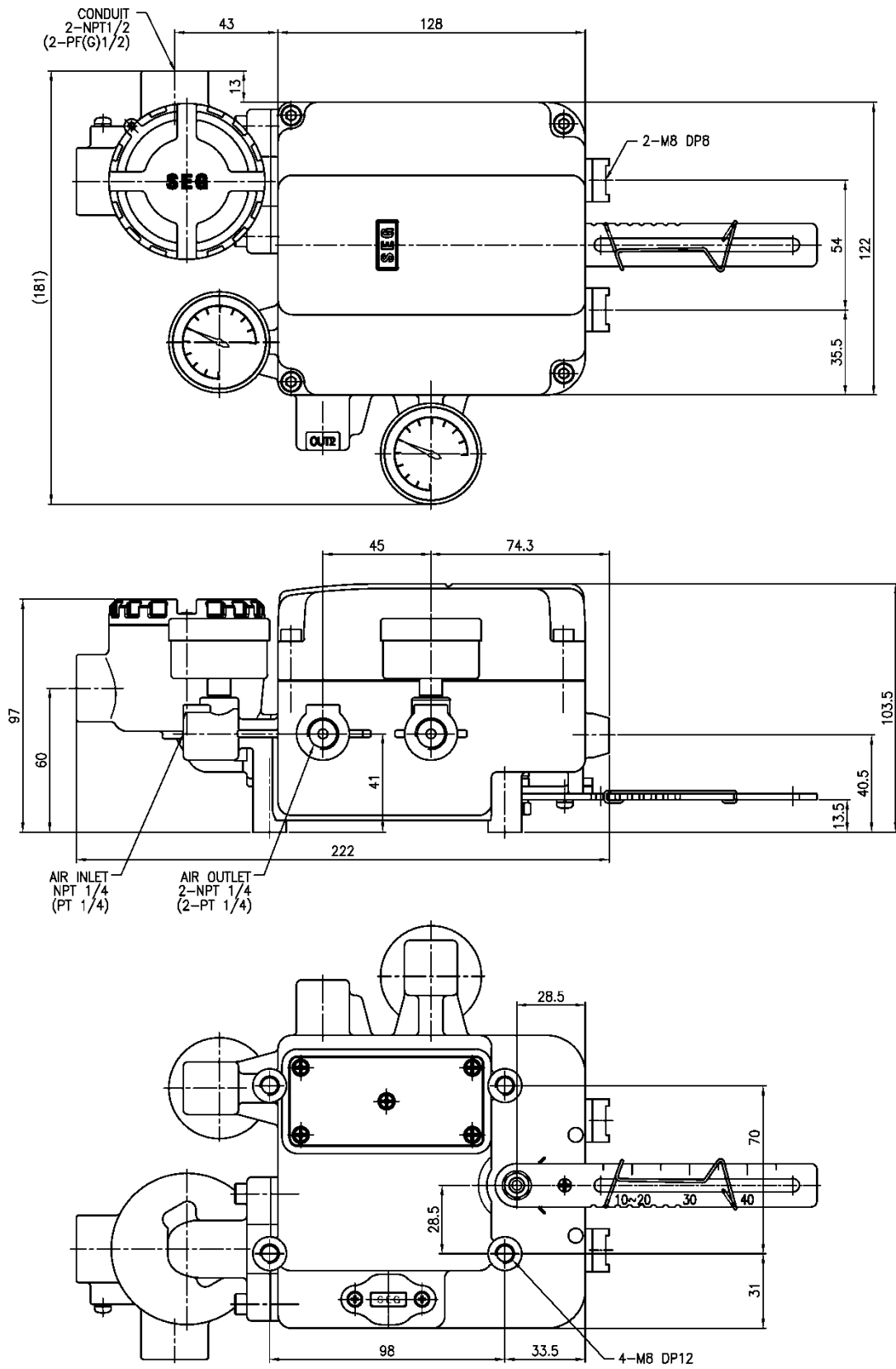


Fig 2-10 : SP520 LINEAR TYPE (Explosive Proof Type)

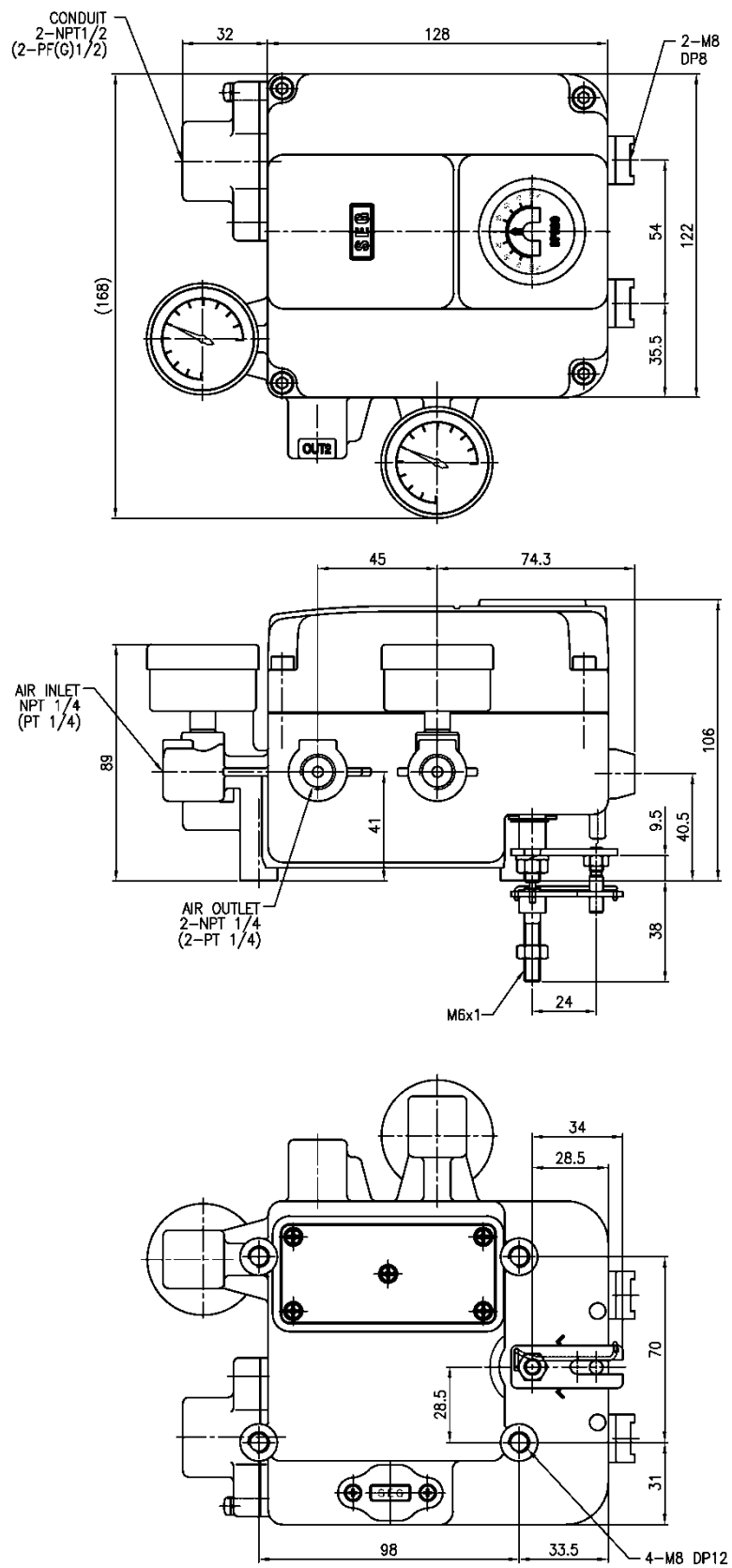


Fig 2-11 : SP520 Rotary TYPE (Non-Explosive Proof Type)

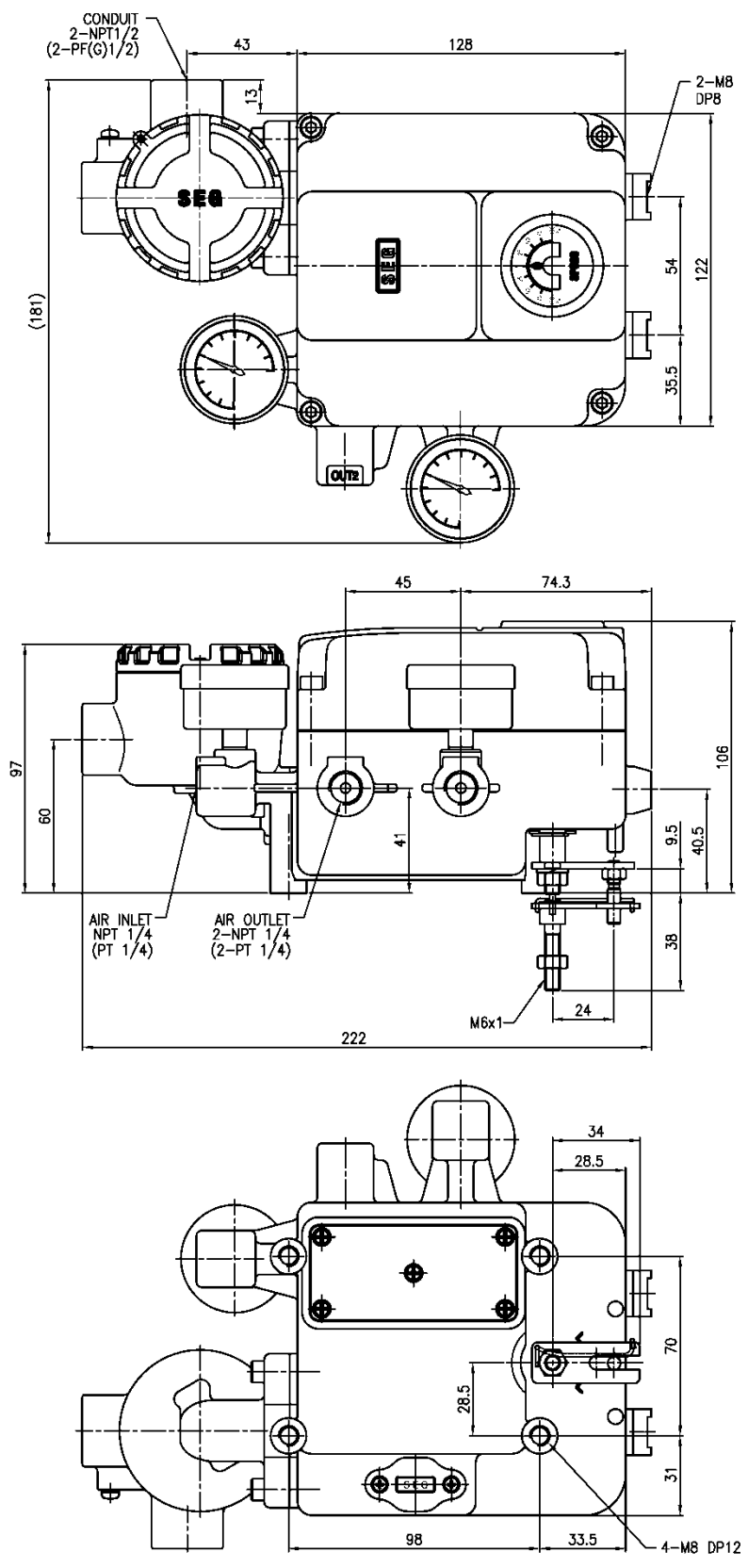


Fig 2-12 : SP520 Rotary TYPE (FORK LEVER Type)

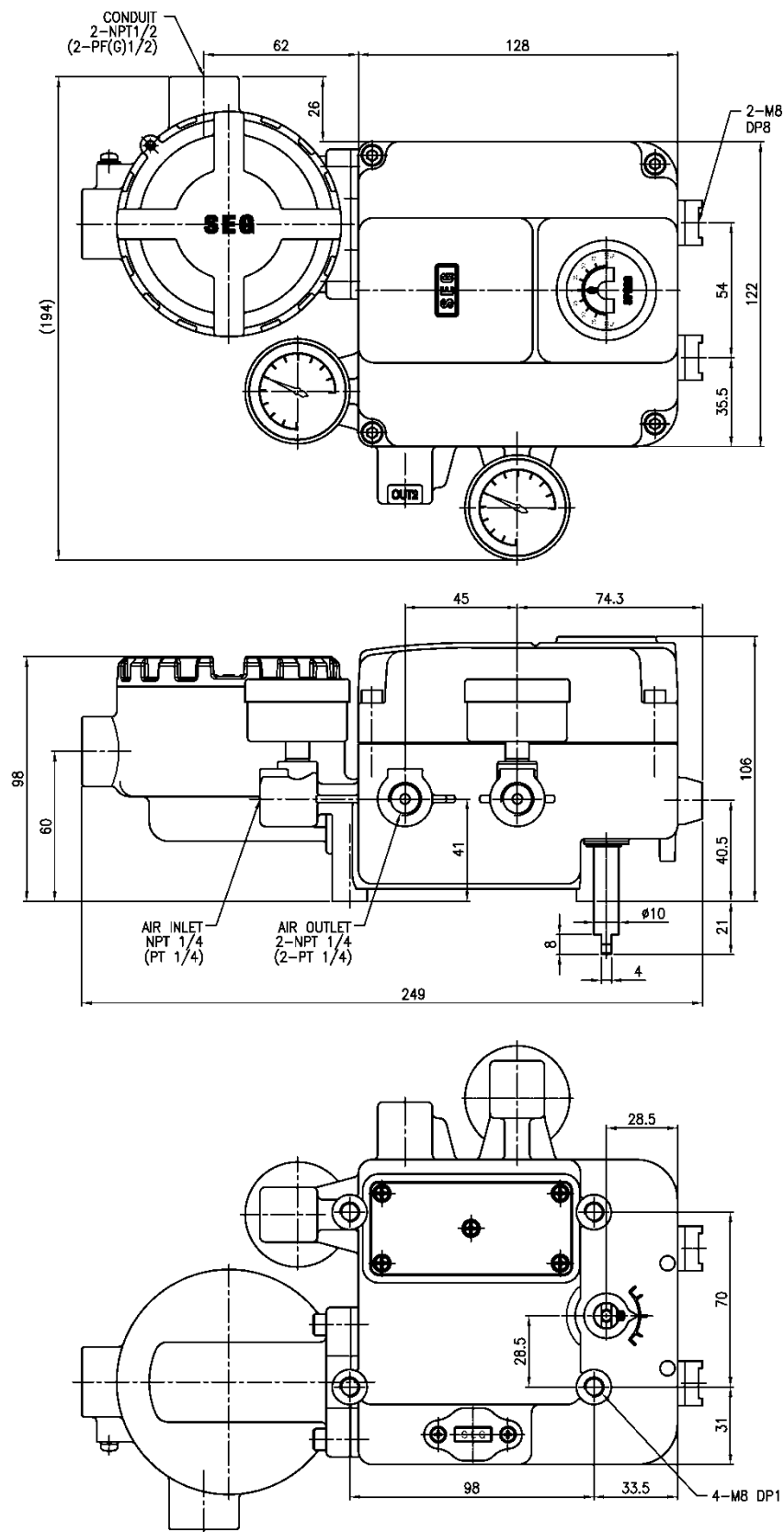


Fig 2-13 : SP520 Rotary TYPE (Namur Type)



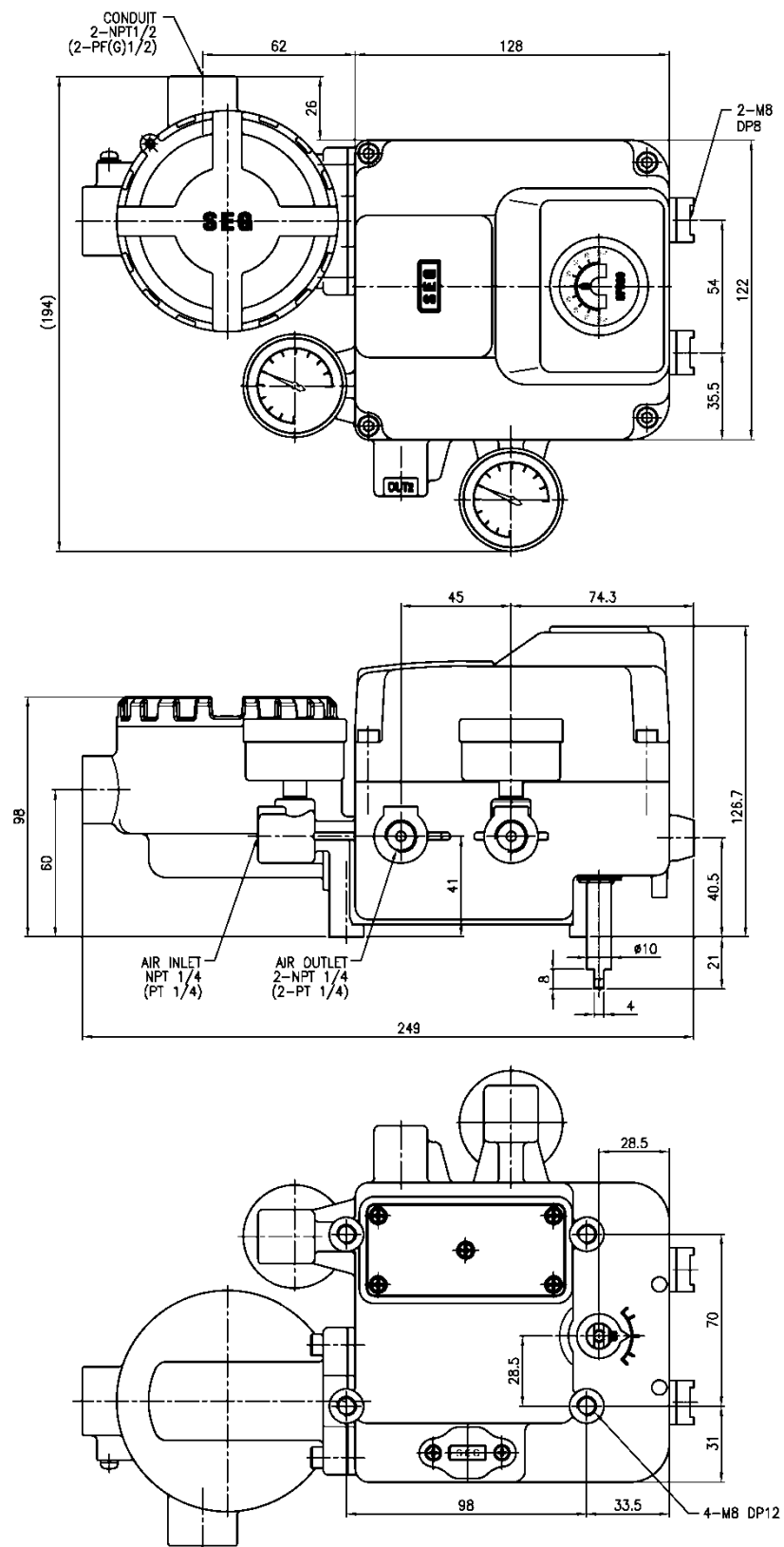


Fig 2-14 : SP520 Rotary TYPE (Limit Switch Option)



## 3. Installation

### 3-1 Caution before Installation

When installing or replacing positioner equipped in actuator, please follow safety instructions.



- Any input or supply pressure to valve, actuator and /or to other related devices must be turned off.
- Separate by-pass valve or other device from control valve so that total system may not be shut down.
- Make sure that there is no remaining pressure in actuator.
- Install filter regulator in positioner air supply line so that air pressure may be maintained properly and different material may not be inserted.
- Be alert that supplying air may not be mixed with oil, water and different material.
- When installing positioner, safety work is required after input signal and air pressure are shutdown.

### 3-2 Tools for Installation

- Hex Wrench set
- (+) & (-) screw drivers
- Spanners for hexagonal-head bolts

### 3-3 Linear Positioner Installation

Linear positioner shall be installed and used on linear motion valves such as glove or gate valve type which uses spring return type diaphragm or piston actuators.

#### 3-3-1 Caution on Installation

- When fabricating bracket and connecting to connection bar, following 2 kind of contents must be regulated.
- If following condition shall not be kept during the installation, it may be affected the performance of the products such as linearity function



### Caution

- ▶ When the valve opening is 50%, the feedback lever should be horizontal.
- ▶ When valve opening is 50%, the stem connection pin should be located at the numeric position marked on the feedback lever that is corresponding to the valve stroke.

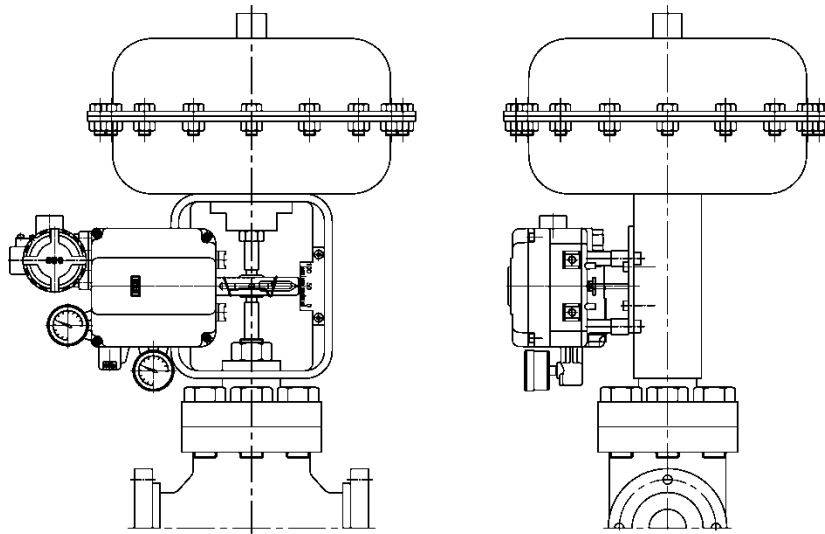


Fig 3-1 : SP520 Installation example

### 3-3-2 Standard lever type positioner installation steps

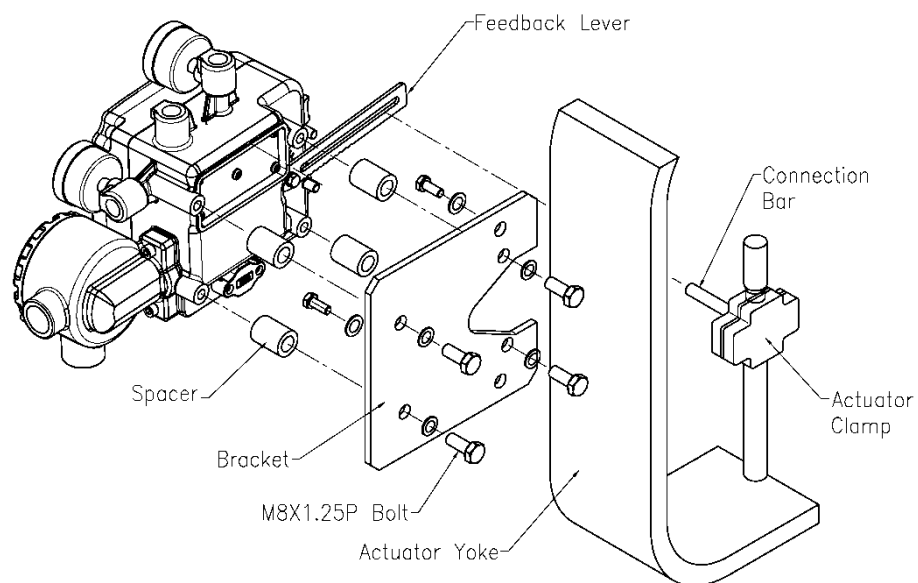


Fig 3-2 :SP520 Positioner Installation on actuator

- ① Assemble with the enclosed bracket and bolts.
- ② Connect a bracket onto actuator yoke with bolts.  
Tighten bolts loosely so that they may be modified location easily.
- ③ Connect air filter regulator to an actuator temporarily.

And then decrease slowly supplying air pressure and valve stroke shall be reached into 50% position in overall stroke.

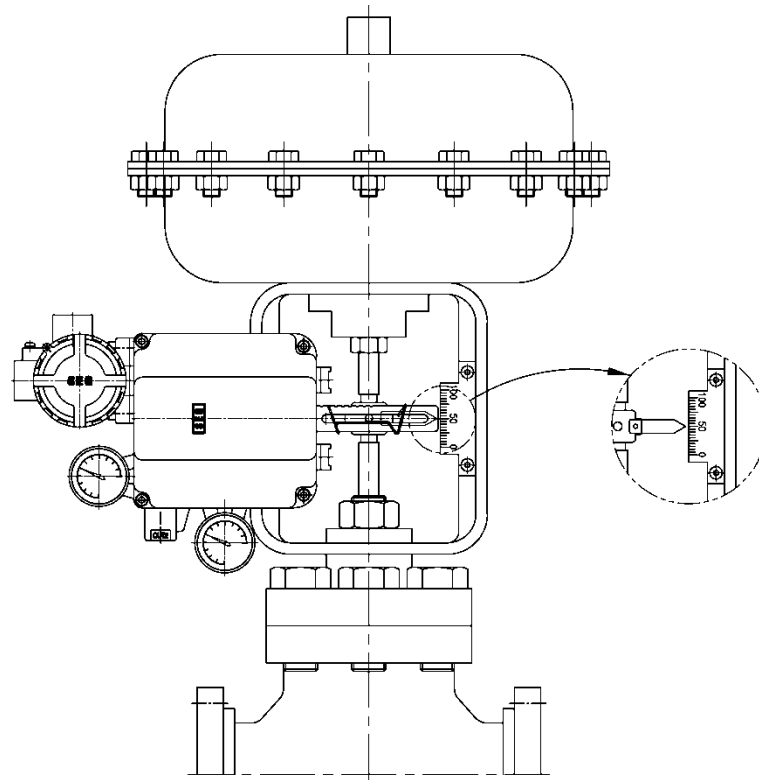


Fig 3-3 : SP520 positioner installation on actuator

- ④ Connection bar located on actuator clamp should be inserted into spring position on feedback lever's hole as seen as figure.

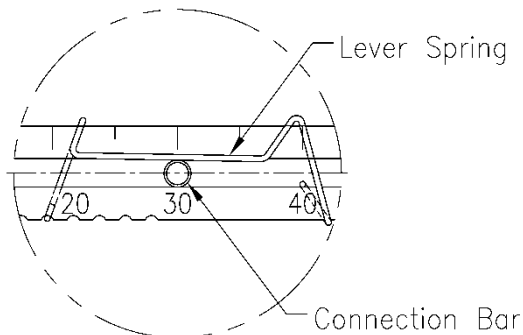


Fig 3-4 : connection bar Insert method between lever and spring  
(Stroke 30mm)

- ⑤ Check whether positioner feedback lever is levelled at valve 50% stroke.  
Unless it is levelled, adjust it horizontally after moving a bracket or positioner body.

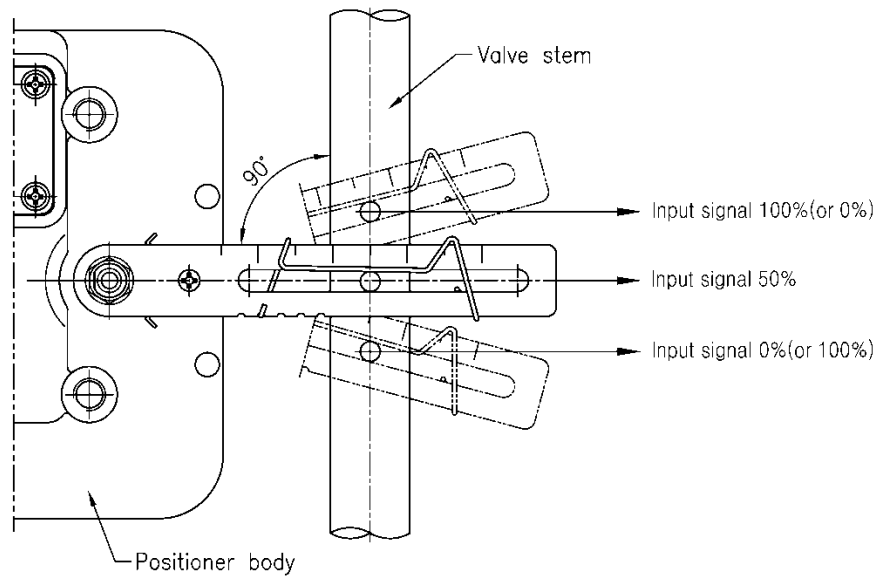


Fig 3-5 : When valve position is 50%, it shows installed lever vertically

- Check valve's full stroke.
- Make to correspondence connection bar in overall stroke value and feedback value's equal point.
- If positioner lever and actuator connection bar has not consistent, move and reset positioner bracket or connection bar.

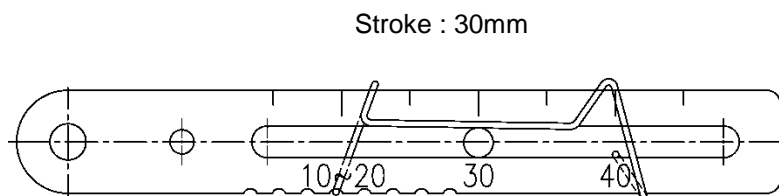


Fig 3-6 : Connection bar position when valve stroke is 60mm

- ⑥ After checking above caution contents and drawing, and fabricate bracket so that it may be fixed actuator as following figure.

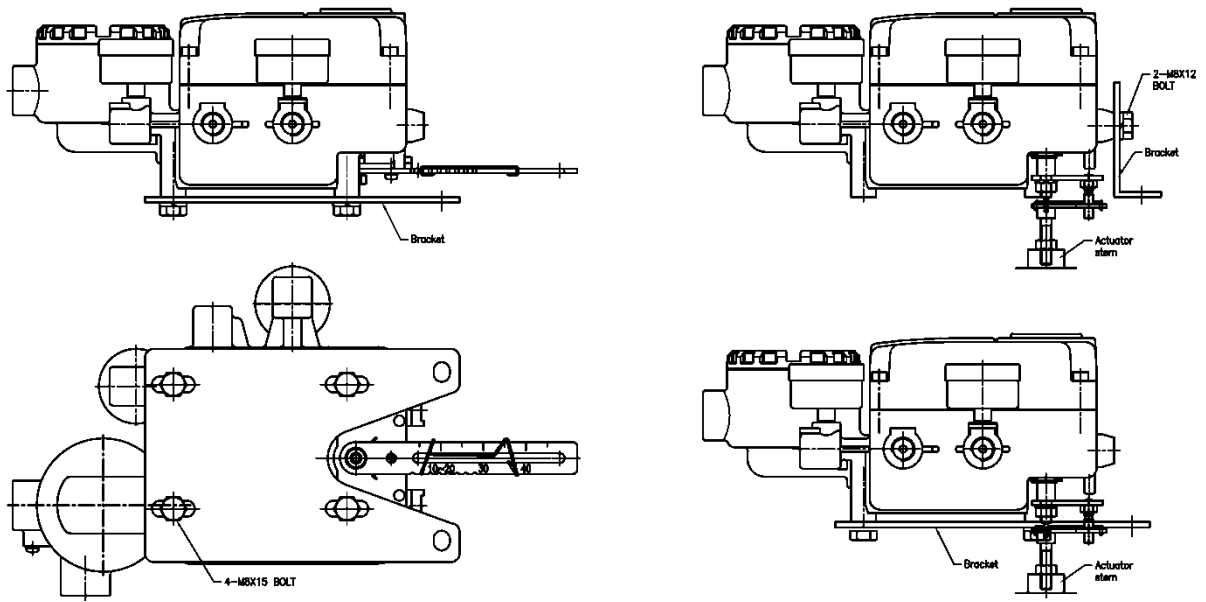


Fig 3-7 : SP520 Bracket insert method

- ⑦ In case that positioner was installed in bracket normally lever should not be touched in positioner stopper on full close and full open position. When lever shall be touched on positioner stopper, it may be malfunction, so after installing please check installation status.

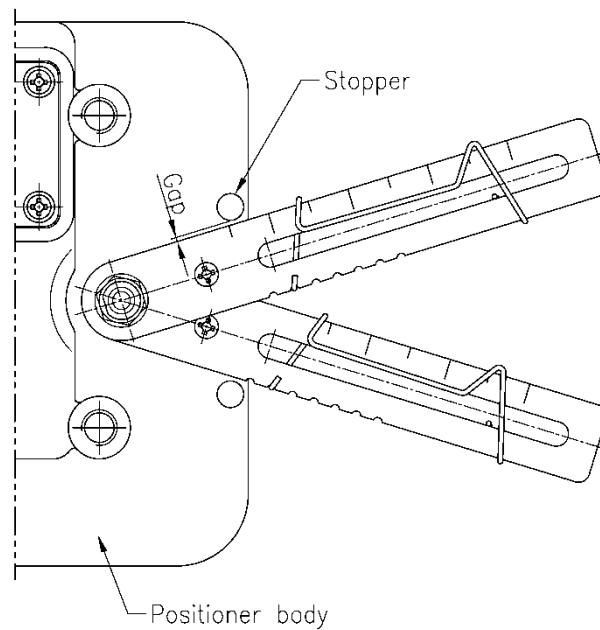


Fig 3-8 : SP520 lever and stopper's gap

### 3-4 Rotary Positioner Installation

Rotary positioner should be installed on 90degree rotary motion valve such as rack pinion, scotch yoke type, ball valve or butterfly valve. There are Fork lever type and Namur type.

#### 3-4-1 Fork Lever type Installation

Please attach lever set enclosed on packing to positioner main axis and shaft, and install so that positioner shaft and actuator axis may be concentric

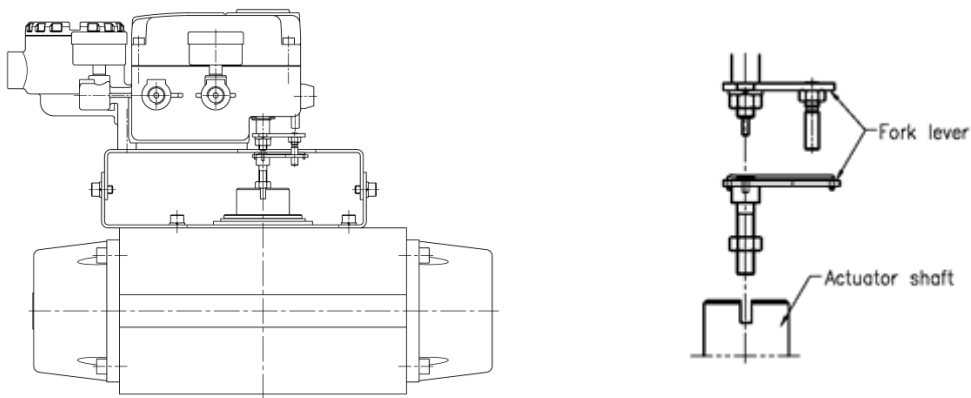


Fig 3-9 : Fork Lever Type Installation

#### 3-4-2 Namur Type Installation

Please Install the positioner on the upper part of the positioner mounting bracket, align the groove of the actuator main shaft with the protrusion of the positioner shaft, adjust the main shaft and the positioner shaft so that they are concentric, and install on the lower bracket.

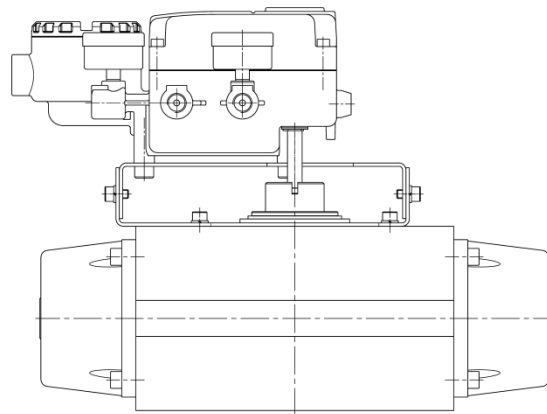


Fig 3-10 : Namur Type Installation



## 4. Air Pipe Connection

### 4-1. Air Pressure Condition



## CAUTION

- ▶ Make sure that air filter regulator should be installed on the front of positioner.
- ▶ Supplying air should not be mixed with oil, moisture or impurities.
- ▶ Filter regulator pressure should be set 10% higher than actuator operation pressure or actuator spring operation pressure.

### 4-2 Connection-Piping with actuator

#### 4-2-1 Single Acting actuator

Single acting positioner should use OUT 1 port only.

Therefore, in case of using a single type spring return actuator, make sure to connect positioner's OUT1 port and actuator's supply pressure port.

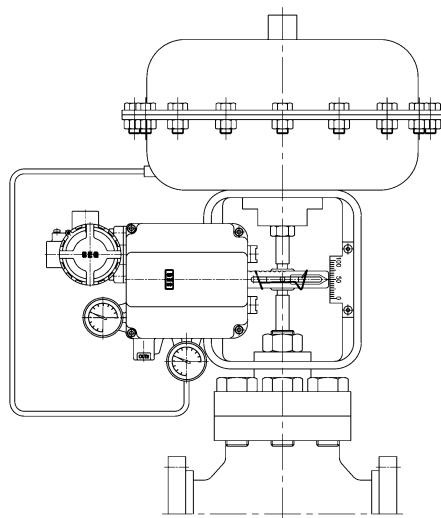


Fig 4-1 : Single Acting Linear Actuator

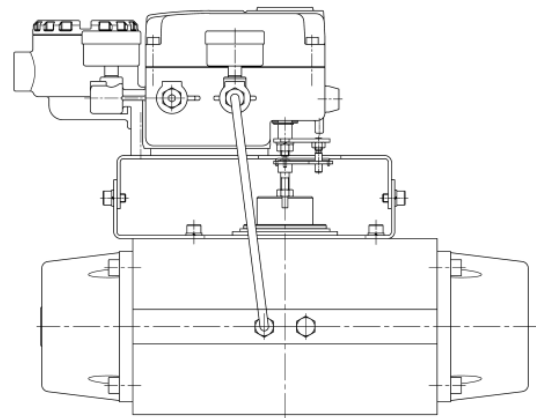


Fig 4-2 : Single Acting Rotary Actuator

#### 4-2-2 Double Acting actuator

Double acting positioner uses both OUT1 and OUT2 ports.

If electric input signal shall be increased, air pressure is supplied from OUT1 port.

So after checking this point, please note this when installing pipe.

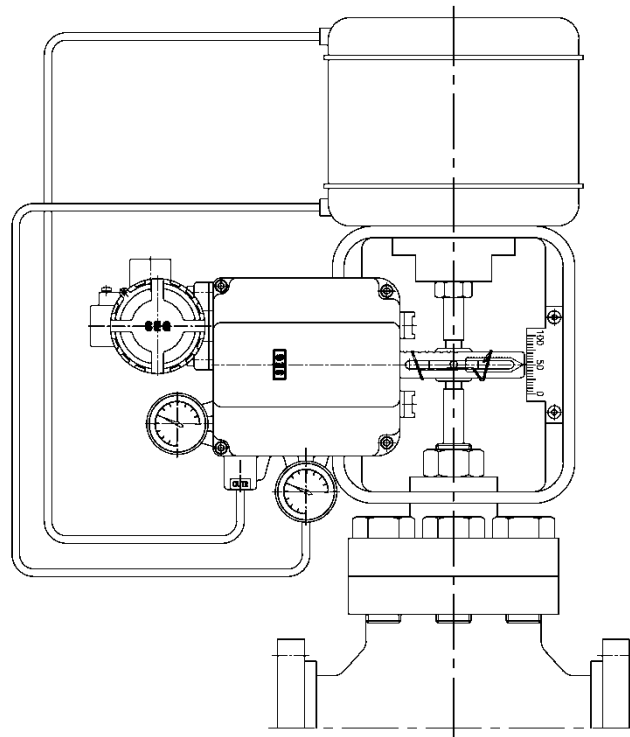


Fig 4-3 : Double Acting Linear Actuator

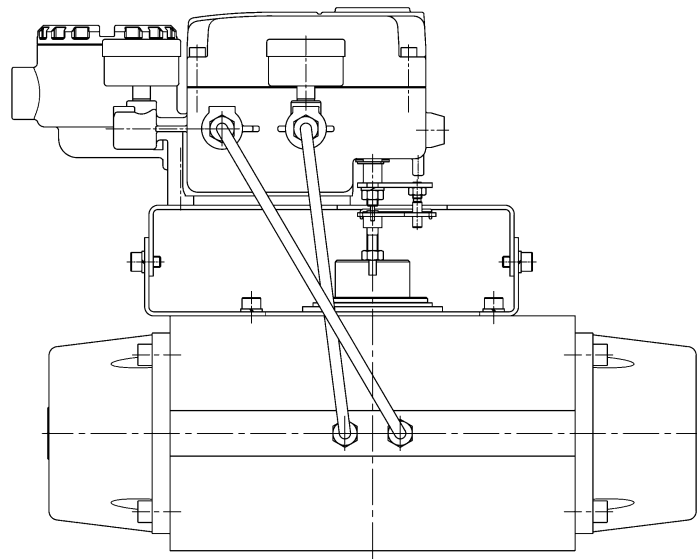
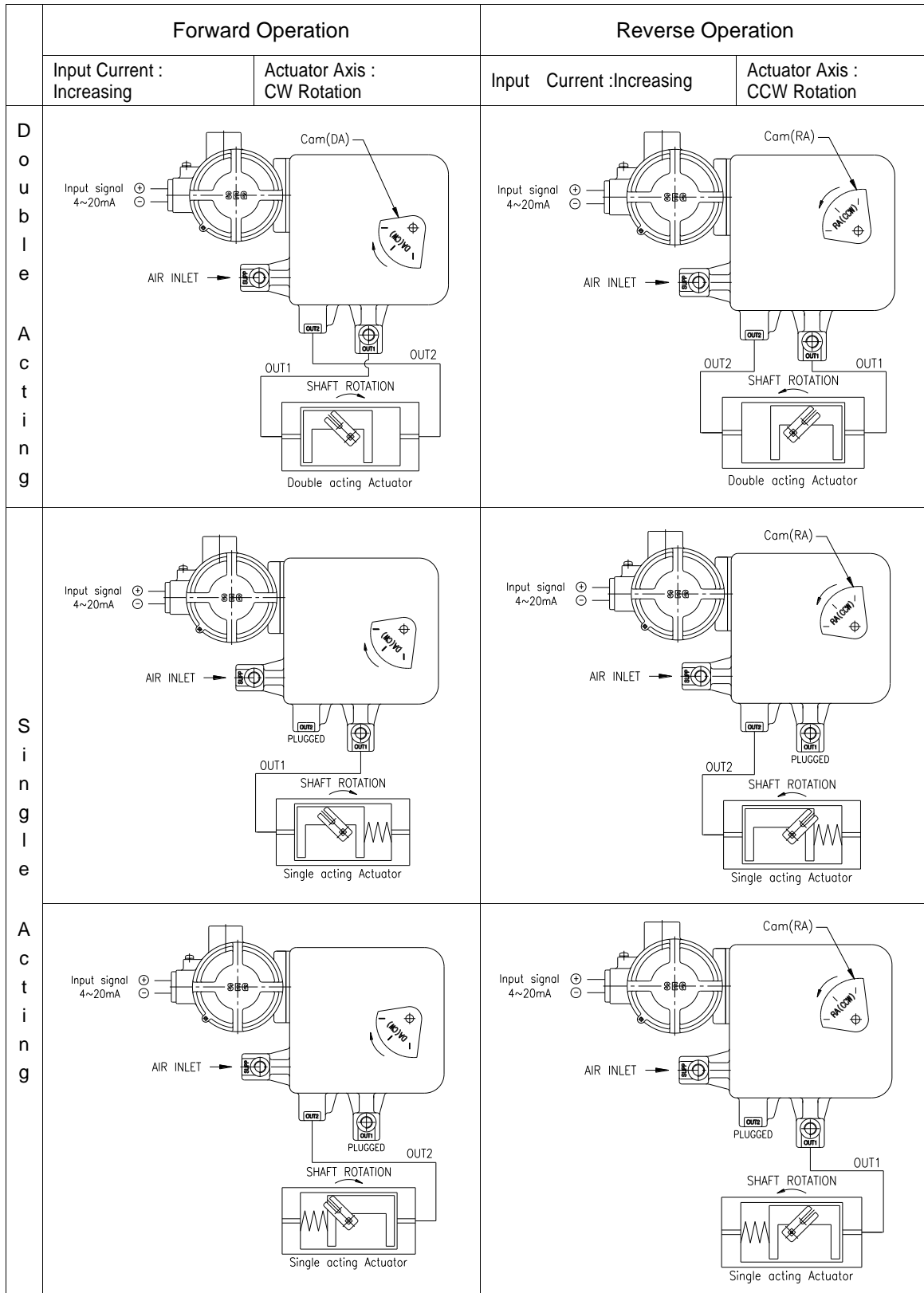


Fig 4-4 : Double Acting Rotary Actuator

### 4-3 Air Connection per each actuator type

#### 4-3-1 ROTARY TYPE



4-3-2 LINEAR TYPE

	Forward Operation		Reverse Operation	
	Input Current : Increasing	Cylinder rod : Arrow Direction	Input Current : Increasing	Cylinder rod : Arrow Direction
D o u b l e  A c t i n g				
	S i n g l e  A c t i n g			
A c t i n g				

## 5. Connection – Power

### 5-1 Safety



- ▶ Please check whether power is off before connecting terminal.
- ▶ Supply the lower than regulated current and voltage.
- ▶ Do not install cable on near equipments incurred by noises such as high capacity transformer or motor.
- ▶ Please discriminate intrinsic safety and non-intrinsic wire, and separate intrinsic wire from other electronic wire.
- ▶ It should be proper protection device so that static and electromagnetic may not be taken influenced
- ▶ Please do grounding so that it may be met regulation in relative explosion area

- Flame Explosion proof type cable and packing union must be used in danger area such as explosive gas zone and in case of using electric cable, gasket and shield should be used and they must be sealed completely. In case of using flame explosion proof packing union, it is required to select inside rubber packing size properly which meets on cable outside size.
- While power is on, do not open cover which is connected with parts such as PCB etc.
- Before opening cover, make sure that power is shut down and voltage must not be remained completely and after checking it, open the cover.

### 5-2 Cable grand terminal connection for Flame Explosion proof .

- When connecting to power supply with using cable grand for flame explosion proof (Ex db mb), Please use items only which obtained approval for flame explosion proof (Ex db mb) suitable to explosion proof condition in site .
  
- The inner rubber packing size must be selected according to the outer diameter of the cable.

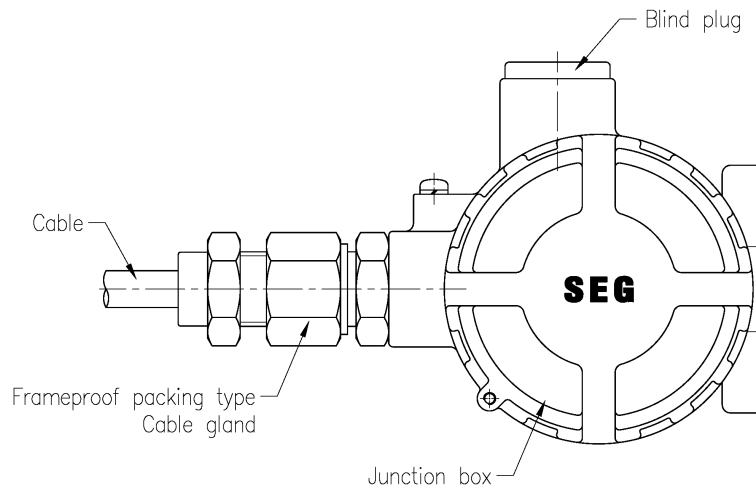


Fig 5-1 : Flame Proof Explosion type

### 5-3 Compound recharge type Flame Explosion Proof 's cable wire

- Please Install fitting for sealing in wire pipe inlet and keep the closure after complete sealing with full of compound method .

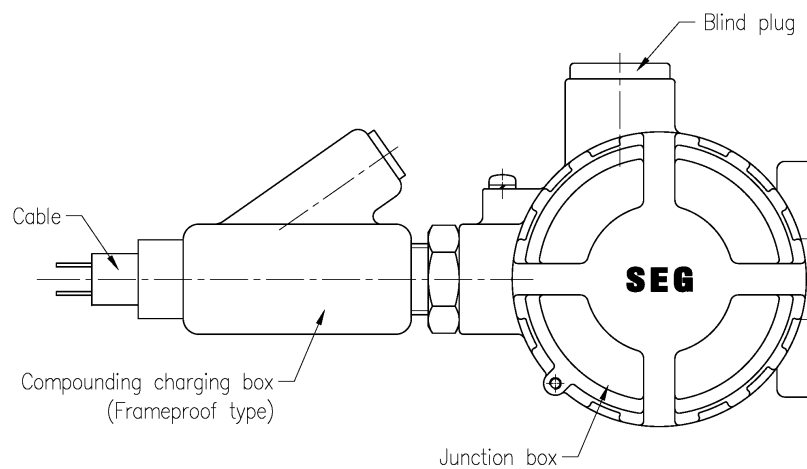


Fig 5-2 : Compound recharge type Flame Explosion Proof 's cable wire

- The installation of compound-filled internal pressure-explosion-proof wires shall conform to the requirements of IEC 60079-14 14.4 conduit systems.

### 5-4 Terminal connection for non-explosion proof (Non-option)

- Open the upper cover and connect correctly outside inlet wire (+), (-) on terminal block (+), (-)

position.

- Connect to grounding wire. (In case of grounding outside, please use nut for outside grounding and ground.)
- Please use cable grand and insert cable and fix, close upper cover.

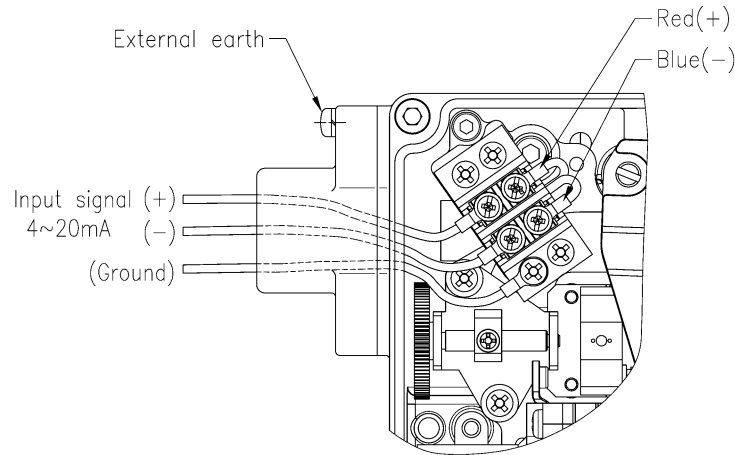


Fig 5-3 : Terminal connection for non-explosion proof (Non-option)

### 5-5 Terminal connection for non-explosion proof (Feedback option)

- Unscrew the set screw of the terminal box, open the terminal box cover, and connect it to the (+), (-) position of the terminal block in the terminal box according to the external input line (+) and (-).
- Connect the FEEDBACK SIGNAL line to (+), (-).
- Connect the ground wire to the ground wire.
- Close the terminal box cover and tighten the set screw again to fix the terminal cover.

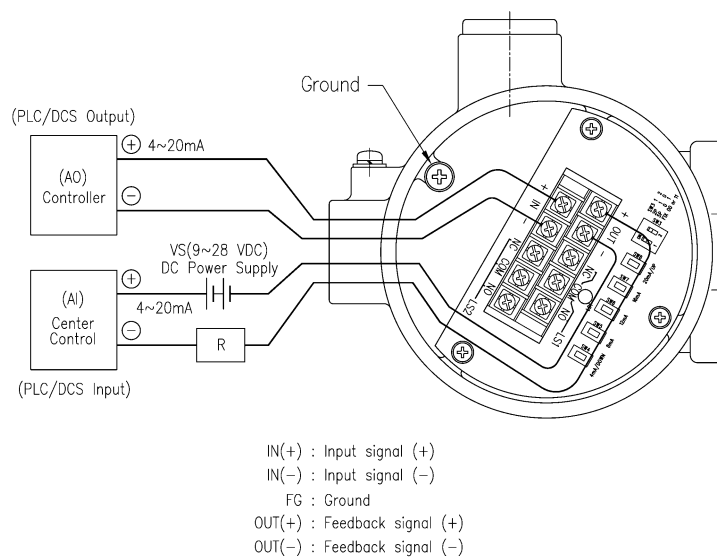


Fig 5-4 : Terminal Connection for non-explosion proof type (Feedback option)

### 5-6 Terminal connection for non-explosion proof (Feedback option + Limit Switch option)

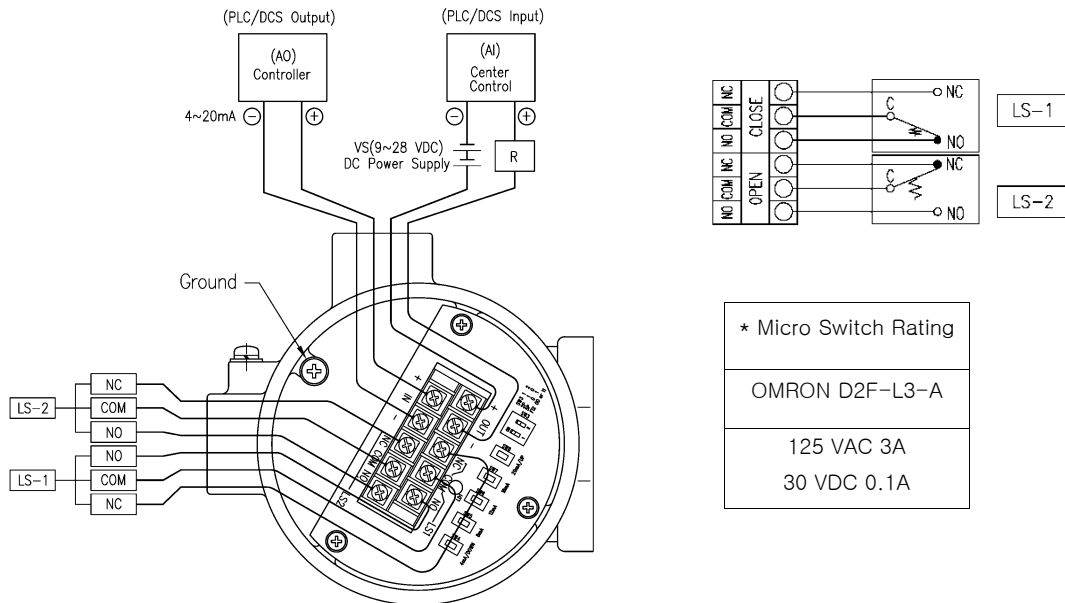


Fig 5-5 : Terminal Connection for Intrinsic Safety Proof type (Feedback option + Limit Switch option)

### 5-7 Terminal block connection for Flame explosion proof & Intrinsic Safety (non-option)

- Open the terminal box cover by loosening the set screw of the terminal box, and connect the external input wires (+) and (-) to the (+) and (-) positions of the terminal block in the terminal box.
- Connect the ground wire.
- Close terminal box cover and tighten set screw again and fix terminal cover.

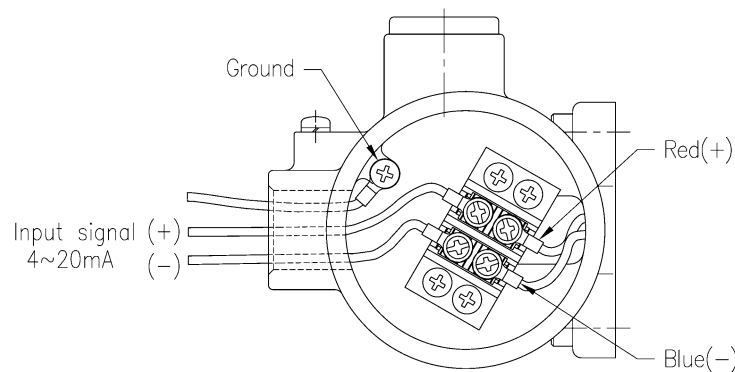


Fig 5-6 : Terminal block connection for Flame explosion proof & Intrinsic Safety (non-option)



## 5-8 Terminal Connection for Intrinsic Safety Proof type (Feedback option)

- The circuit of the intrinsically safe device must be separated from the general circuit.
- Keep the current parameter below the specified value indicated on the explosion-proof certification.
- Conduct appropriate grounding for the installation site, and maintain the ground resistance of the product and barrier with an equal potential.
- Unscrew the set screw of the terminal box, open the terminal box cover, and connect it to the (+), (-) position of the terminal block in the terminal box according to the external input line (+) and (-).
- Connect the FEEDBACK SIGNAL line to (+), (-).
- Connect the ground wire to the ground wire.
- Close the terminal box cover and tighten the set screw again to fix the terminal cover.

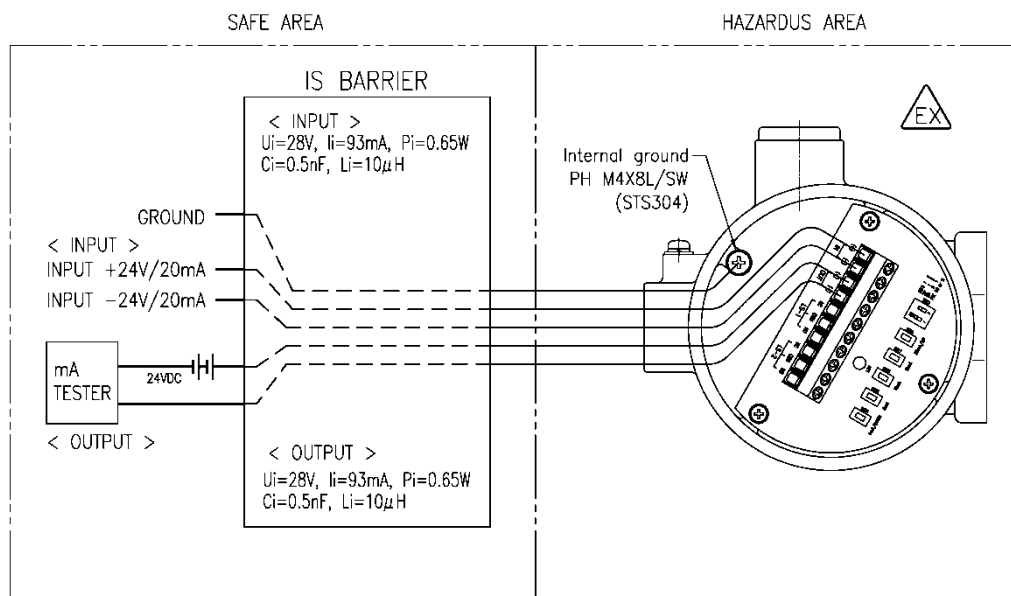


Fig 5-7 : Terminal Connection for Intrinsic Safety Proof type (Feedback option)

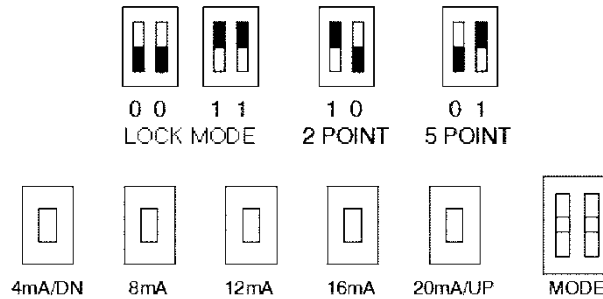
## 5-9 Position transmitter calibration for Intrinsic Safety (Feedback Option)

### 5-9-1 Mode Setting

Modify Mode according to the DIP Switch of TERMINAL BOX inside PCB Board.

- ① 2 POINT setting : DIP SWITCH location is 1,0 and both valve starting point (0%) and end point (100 %) shall be calibrated and remaining middle point will be set automatically .
- ② 5 POINT setting : DIP SWITCH location is 0,1 and valve starting point (0%), 25%, 50%, 75%, End point (100%), total 5 POINT shall be calibrated.

③ LOCK MODE : If completing calibration, DIP Switch shall be changed into 0,0 or 1,1 , and it must not be changed even though the button is pushed with mistakes.



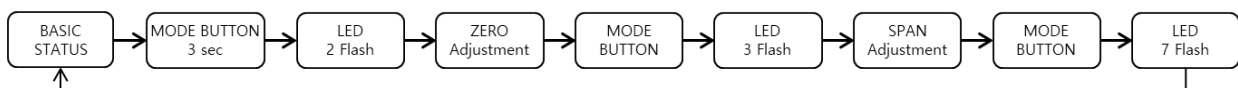
- 4mA/DN : 4mA setting and in calibration mode DOWN button
- 8mA : 8mA setting button
- 12mA : 12mA setting button
- 16mA : 16mA setting button
- 20mA/UP : 20mA setting and in calibration mode UP button
- 4mA/DN + 20mA/UP : calibration mode
- 4mA/DN + 12mA + 20mA/UP : Initial mode

Fig 5-8 : MODE and setting switch

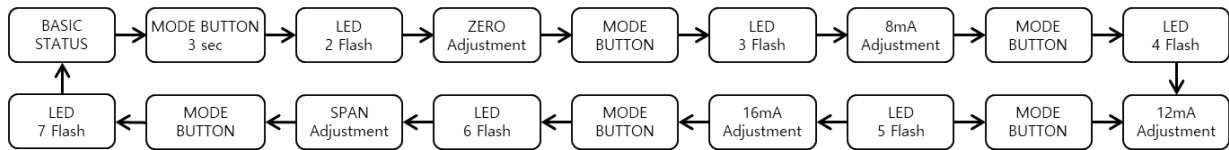
5-9-2 Calibration Method

- ① In Power On, POWER LED should be “ON” status basically.
- ② In case that LED extinguish fast, POTENTIOMETER status pass off range value than ZERO/SPAN Setting value .
- ③ First set LOCK / 2POINT / 5POINT’s MODE.
- ④ 4mA/8mA/12mA/16mA/20mA setting : Position the valve at 0%, 25%, 50%, 75%, 100%, respectively, and press each switch for 3 seconds to set. At this time, the LED flashes 3 times and then the default State.
- ⑤ when setting 2POINT, ZERO/SPAN’s value adjustment can be switched into adjustment mode if pushing calibration mode button (DN+UP) for 3 second, in this case, the adjustment processing is as followings.

Since the current fluctuates while the LED is blinking, the setting is proceeded with the blinking stopped.



- ⑥ When setting 5POINT, the value adjustment can be switched into adjustment mode if pushing calibration mode for three second. In this time, the adjustment process is as followings.



⑦ POTENTIOMETER Range

- Min Value : 50Ω, Max Value : 950Ω, Min Range value : 200Ω

⑧ Input voltage : DC10 ~ 28V (Max. Ui 28V)

**5-10 Terminal Connection for Intrinsic Safety Proof type (Feedback + Limit Switch option)**

- The circuit of the intrinsically safe device must be separated from the general circuit.
- Keep the current parameter below the specified value indicated on the explosion-proof certification.
- Conduct appropriate grounding for the installation site, and maintain the ground resistance of the product and barrier with an equal potential.

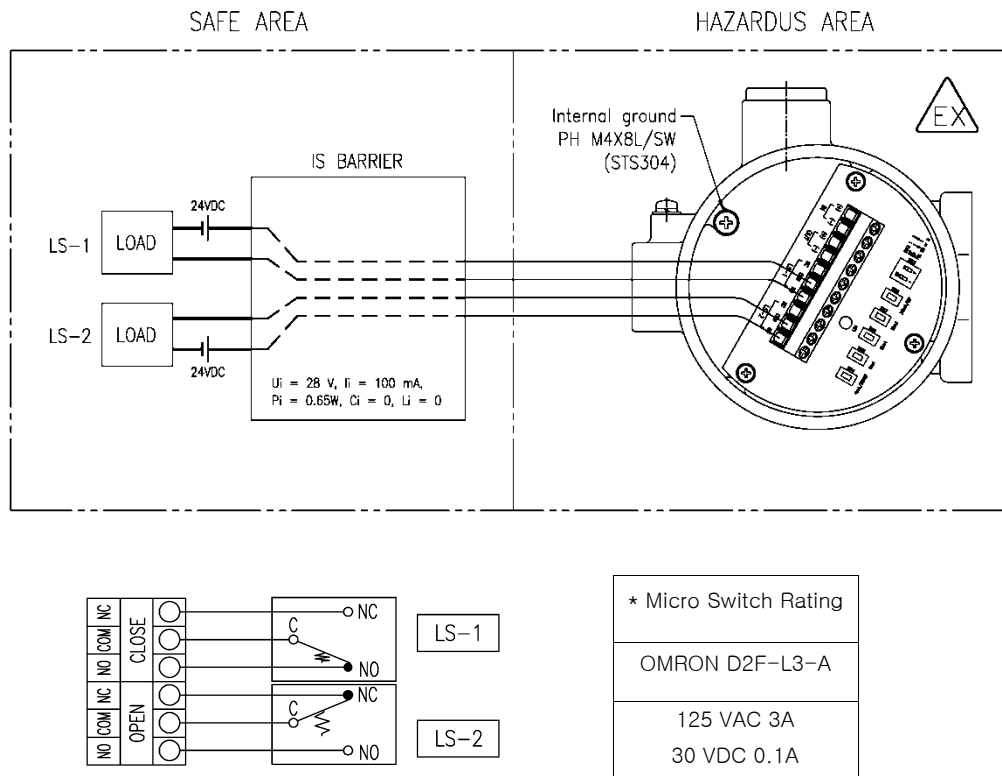


Fig 5-9 : Terminal Connection for Intrinsic Safety Proof type (Feedback option + Limit Switch option)

## 5-11 Grounding

- For the safety of the positioner and system, it must be grounded.
- There is 1 ground terminal inside and 1 outside the positioner. M4 round head + bolt is assembled.
- Any grounding terminal can be used and the resistance should be less than 100Ω.

## 6. Adjustment

### 6-1 SPAN adjustment and ZERO setting method

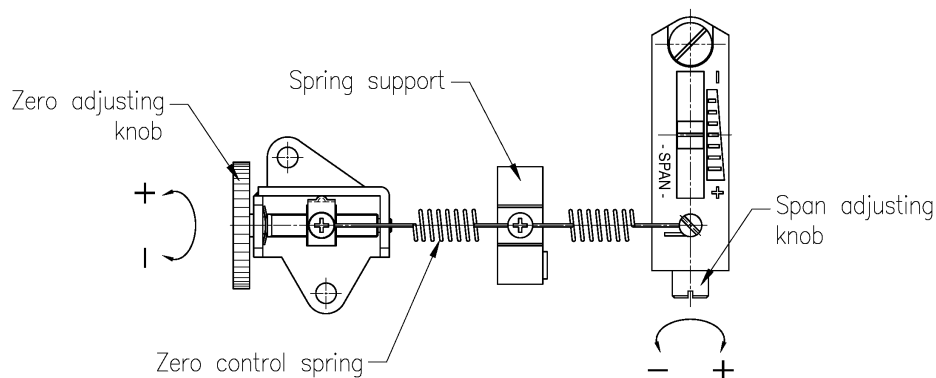


Fig 6-1 : SPAN Adjustment and ZERO structure

- ① From Calibrator, input 4mA current, rotate ZERO adjustment screw and adjust so that that valve position may be in 0%.
- ② From Calibrator, input 20mA current, rotate ZERO adjustment screw and adjust so that that valve position may be in 100%.
- ③ When adjusting by turning the SPAN adjusting screw, the position of 0% adjusted in the above step ① changes, so repeat the step ① once again.
- ④ When adjusting by turning the SPAN adjusting screw, the position of 100% adjusted in the above step ② changes, so repeat the step ② once again.
- ⑤ If you repeat the steps ① and ② above 2~3 times, you can set the correct position of OPEN and CLOSE.

## ! CAUTION

- ▶ In order that actuator shall be operated normally the ZERO and SPAN adjustments must be set correctly.
- ▶ If the ZERO and SPAN control is not set correctly, normal performance such as linearity may have an effect on.

### 6-2 Limit Switch Adjustment

To adjust the operating position of the limit switch, loosen the cam fixing screw and adjust the cam position. After rotating it to the position, tighten the screw again to fix it.

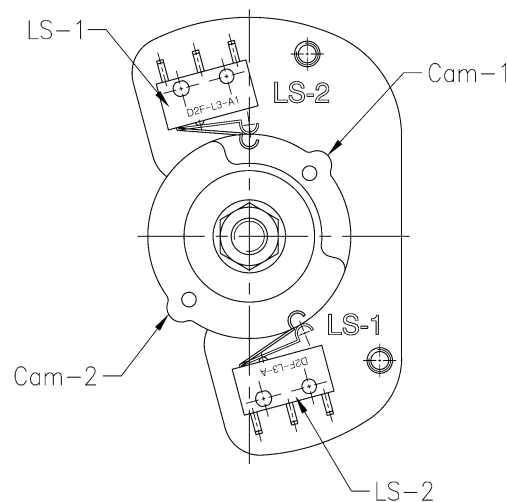


Fig 6-2 : Mechanical type limit switch operation position control

### 6-3 AUTO/MANUAL conversion screw setting method

- The auto/manual switching screw is located on the upper part of the pilot valve and serves to bypass the positioner.
- If you loosen the lock screw on the upper part of the pilot valve and turn the auto/manual switch screw in the "M" direction (counterclockwise), the supply pressure supplied to the positioner enters the actuator as it is regardless of the input signal.
- Conversely, if the auto/manual switch screw is turned in the "A" direction (clockwise), the supply pressure supplied to the positioner enters the actuator according to the input signal.
- Before loosening the auto/manual conversion screw, the supply pressure supplied to the positioner must not be excessive.

- After using the auto/manual conversion function, switch back to the auto state.

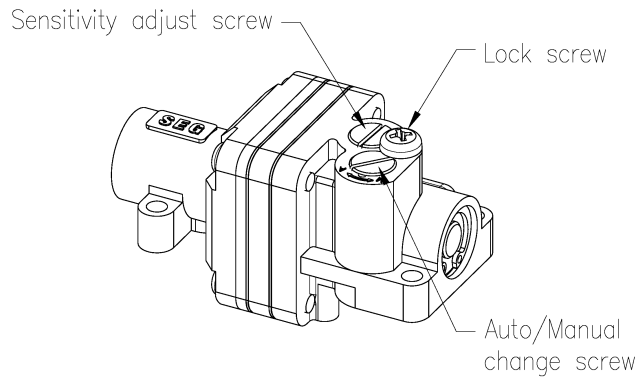


Fig 6-3 : Auto/Manual change screw

 **Caution**

▶ The sensitivity adjusting screw is adjusted to the optimum state when shipped from the factory. So do not arbitrarily adjust

**6-4 Orifice setting method**

- If the actuator capacity is very small compared to the flow rate of the positioner (capacity less than 180cm<sup>3</sup>), hunting may occur, so an orifice can be installed on the pilot valve.
- Remove the O-ring from OUT1 and OUT2 located under the pilot valve, insert the orifice (1mm, or 2mm), and then assemble the O-ring again. (If you select orifice mounting when ordering, it will be installed on the pilot valve and shipped.)

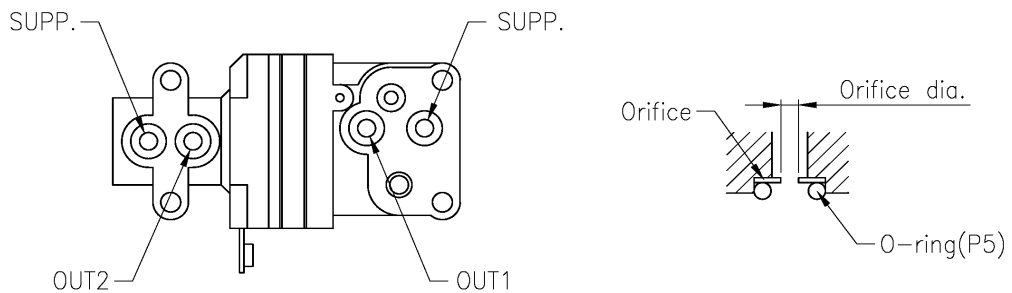


Fig 6-4 : Orifice Installation method

## 6-5 AUTO/MANUAL conversion screw's cleaning

- If the air pressure value of the regulator is output as OUT1 regardless of the supply pressure input signal, the hole of the auto/manual switching screw located on the pilot valve is clogged by foreign substances such as dirt and oil, so it must be cleaned.
- Loosen the lock screw on the upper part of the pilot valve, remove the auto/manual switching screw, make a hole with a steel wire of 0.3mm or less, wash it, and assemble it again.

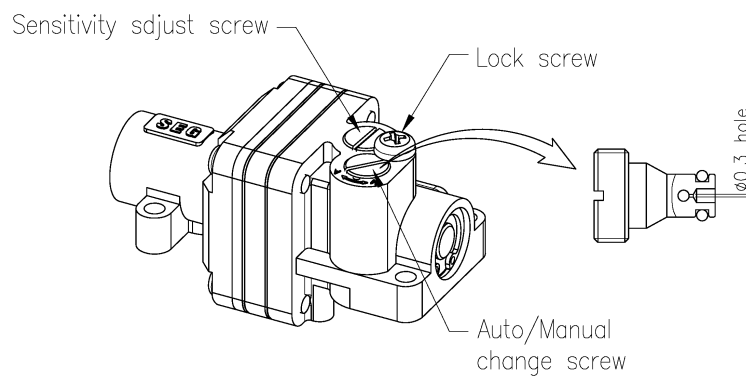


Fig 6-5 : AUTO/MANUAL conversion screw's cleaning

## 7. Error Check and solution method

### 7-1 Basic check point when positioner does not operate

- Supply pressure check point : Over Min  $1.4 \text{ kgf/cm}^2$
- Input signal check : 4~20mA
- Check ZERO, SPAN adjustment status.
- Check whether air comes out well from the nozzle of the torque motor
- Check Feedback lever installation status.

### 7-2 When positioner does not operate

Check point	- Move the flapper left and right by hand and it works ,	- Move the flapper left and right by hand and it does not work
	↓	↓
Cause	- Input signal (+), (-) connection error	- Auto/manual conversion screw loosening      - Nozzle block
	↓	↓      ↓
Solution method	- Check signal connection wire status	- Auto/manual conversion screw fixing      - Nozzle check and washing

### 7-3 Hunting happening in actuator

Check point	- When hunting works in a short cycle	- When hunting works in a long cycle
	↓	↓
Cause	- Actuator capacity is small	- On actuator , and valve , Friction is happening greatly.
	↓	↓
Solution method	- Equip orifice on Pilot valve OUT1, OUT2 outlet	- Action on friction decreasing - Increasing actuator capacity

### 7-4 When actuator does not act intermediate control but operate ON/OFF only .

Check point	Check if the direction of SPAN and CAM is installed correctly	- Check OUT1, OUT2 's pipe condition
	↓	↓
Cause	-SPAN, CAM's direction is wrong installed (Opposite direction)	- OUT1, OUT2 's pipe direction modification
	↓	↓
Solution method	- SPAN, CAM's correct installation	- OUT1, OUT2's pipe direction modification



### 7-5 When Linearity does not good

Check point	- Check linear positioner lever installation condition	- ZERO, SPAN setting - Check supplying pressure
	↓	↓
Cause	- Lever status is not horizontal in 50% . .	- ZERO, SPAN setting non-correct - Supplying pressure does not constant
	↓	↓
Solution method	- Lever's horizontal installation	- ZERO, SPAN Re-adjustment - Check supplying pressure such As regulator

### 7-6 When Hysteresis does not good .

Check point	- Check. FEEDBACK lever and connection bar installation's condition
	↓
Cause	- Happening on FEEDBACK lever and connection bar's fix parts gap
	↓
Solution method	- Lever and connection bar shall be modified tightly and equipped



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