



Intelligent Valve Positioner 1500 Series User's Manual

(Please read the instruction manual carefully before installation and use)



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1. Overview

1.1. Product structure

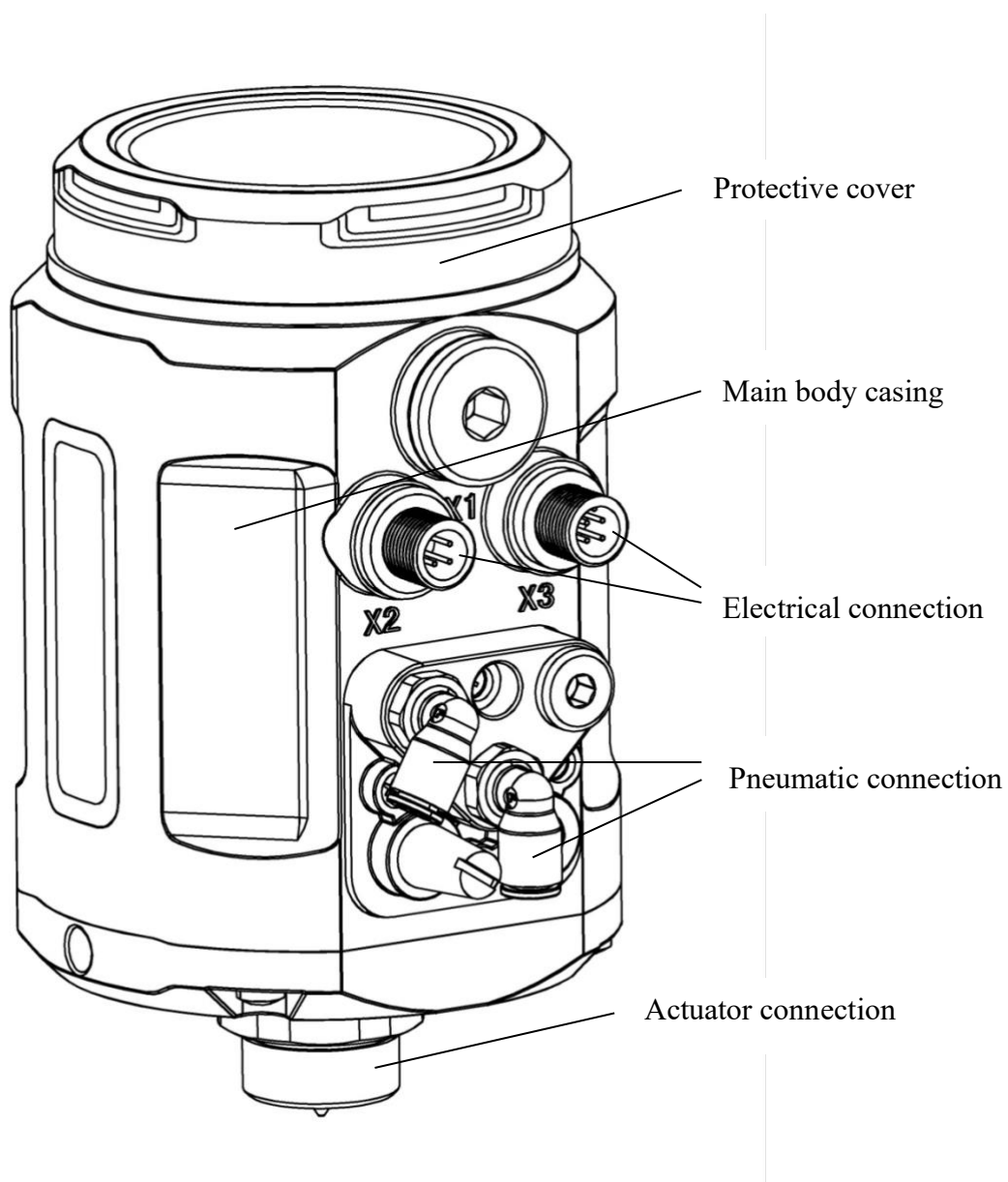


Figure 1. Positioner structure

1.2. Product description and application

1500 series intelligent valve positioner is a valve stroke controller based on microprocessor. The valve stroke can be set by external input signal. The positioner can adjust valve stroke quickly and accurately by using automatic control algorithm and PWM control technology. The product can be used in sealed space and controlled automatically and remotely. It is easy to install, operate, maintain and has low failure rate.

The positioner can combine with different pneumatically actuated valves for using. As shown in Figure 2.



with diaphragm valve

with angle seat valve

Figure 2. Combinations of positioner and pneumatically actuated valves

2. Installation

2.1. Mechanical dimensions

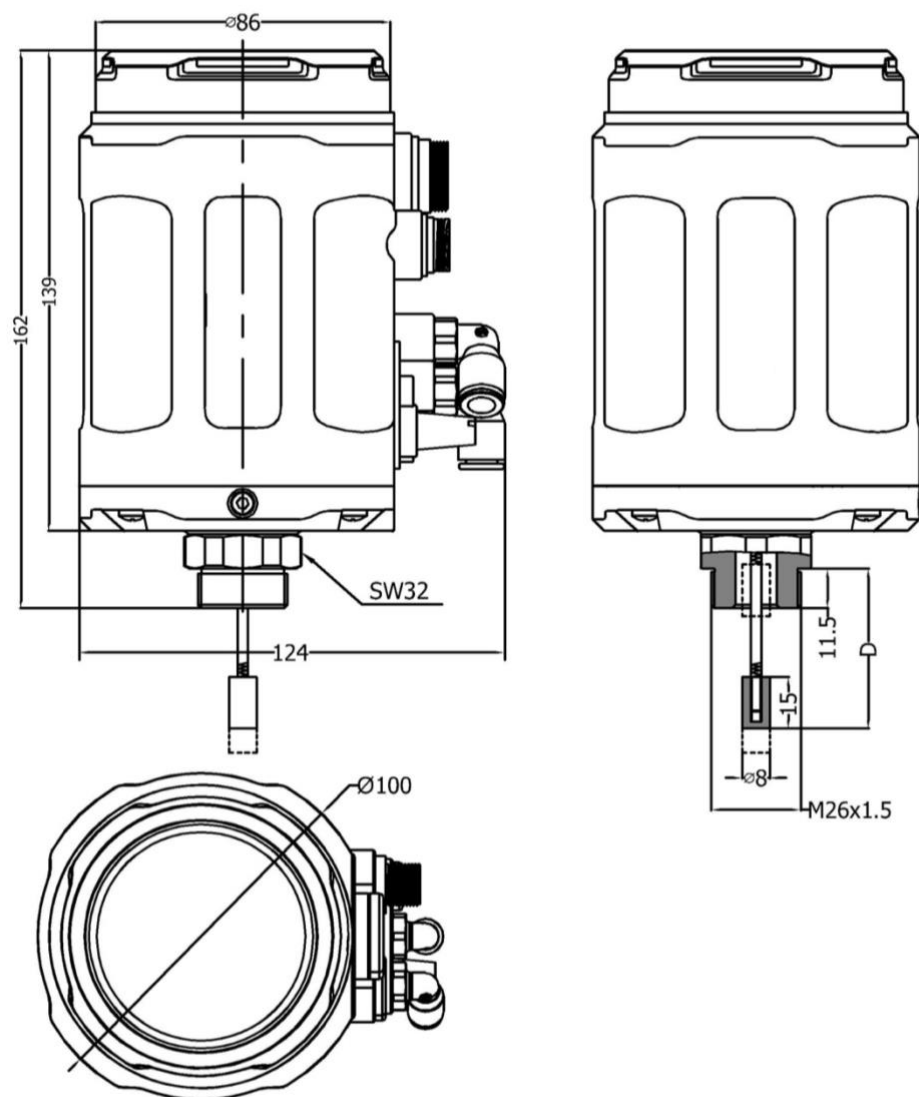


Figure 3. Mechanical dimensions for line stroke

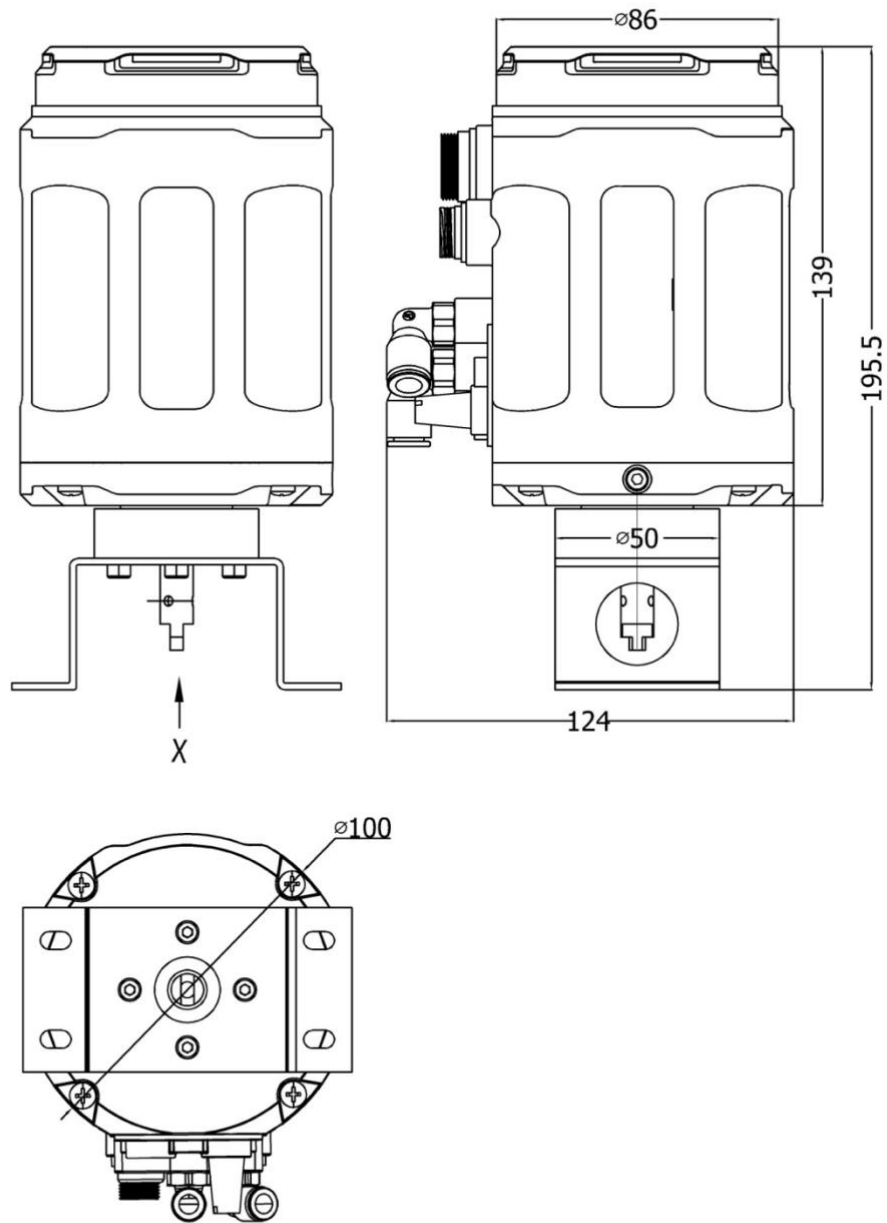


Figure 4. Mechanical dimensions for angle stroke

2.2. Actuator combination

2.2.1. Actuator of line stroke

1. Make sure that the stroke range and the screw thread size of the actuator which needs to combine meet the requirements.
2. Separately measure the C1 value when the valve is fully closed and C2 value when the valve is fully open by **the depth ruler**. The values are the distance between the stem top and the datum clamp face of the actuator. As shown in Figure 5.

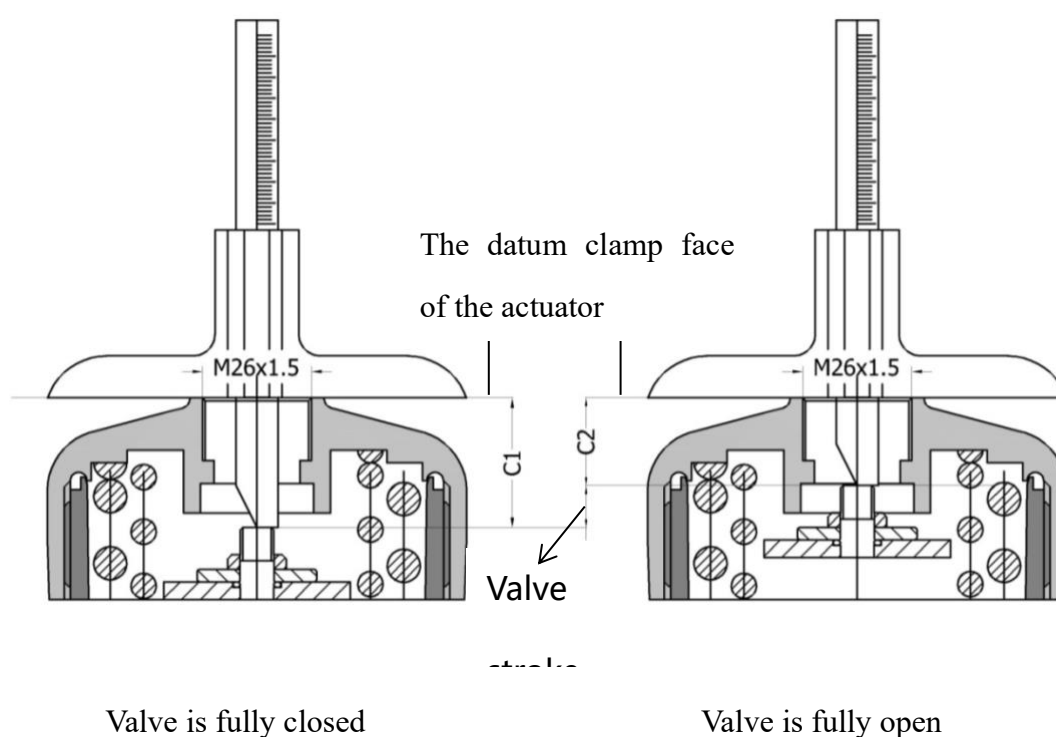


Figure 5. Actuator measurement

3. Adjust the adjusting nut of the displacement sensor. Then measure the D value (as shown in Figure 6) by **the depth ruler** in the state of the displacement sensor being completely loosened. Calculate the compression value $L1 = D - C1$, $L2 = D - C2$. It is recommended that the compression value L1 and L2 are both in the reference range which is showed in Table 1. If L1 value or L2 value is unable to meet the reference range, adjust the D value according to the actual situation.

NOTE !

The adjusted D value must ensure that $L1 > 0$, $L2 < \text{the maximum compression value of the displacement sensor}$. Otherwise, the positioner cannot match the actuator.

Maximum valve stroke	D range	L1, L2 reference range
5~25 mm	45~51 mm	3~28 mm
25~50 mm	65~71 mm	3.5~53.5 mm

Table 1. The reference range of the compression value

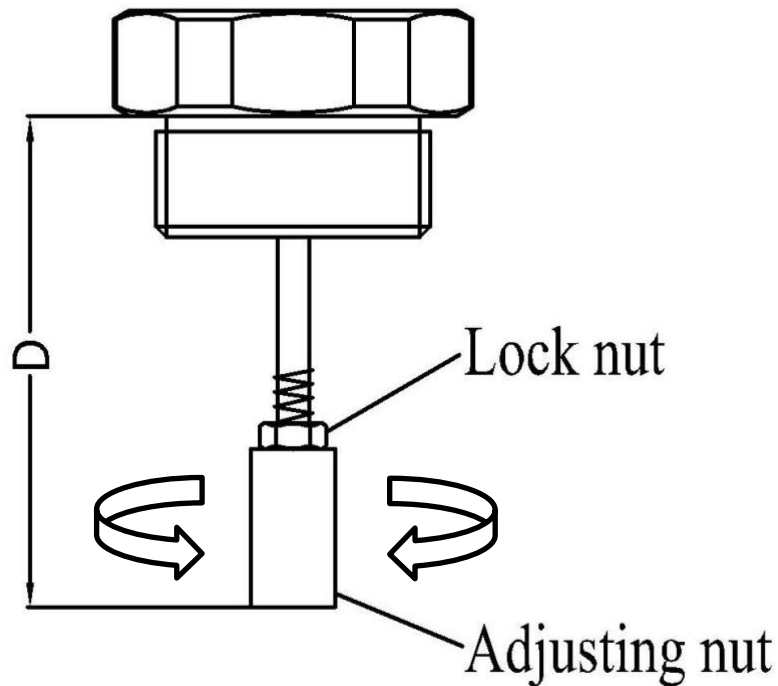


Figure 6. Travel sensor adjustment and measurement

4. Raise the internal valve stem of the actuator to the highest position. Make the actuator connection of the positioner entering into the thread connection of the actuator by **NO.32 wrench**. As shown in Figure 7.

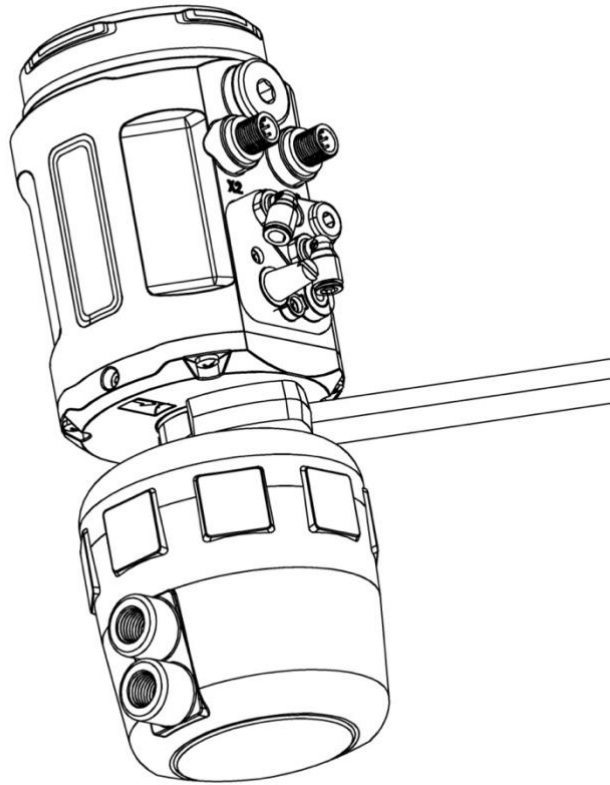


Figure 7. Actuator Combination

5. Power up the positioner, adjust the valve position manually and run the auto-tuning function in the initial mode. Check that whether the whole valve stroke range is in the effective range of the displacement sensor (Refer to the Chapter 5 Section 5.2.1 and Section 5.3.1 for details.). If not, repeat step 3.

2.2.2. Actuator of angle stroke

1. Fix the mounting body under the positioner. As shown in Figure 8.
2. Connect the feedback pole of the positioner with the axis of the actuator. As shown in Figure 8.

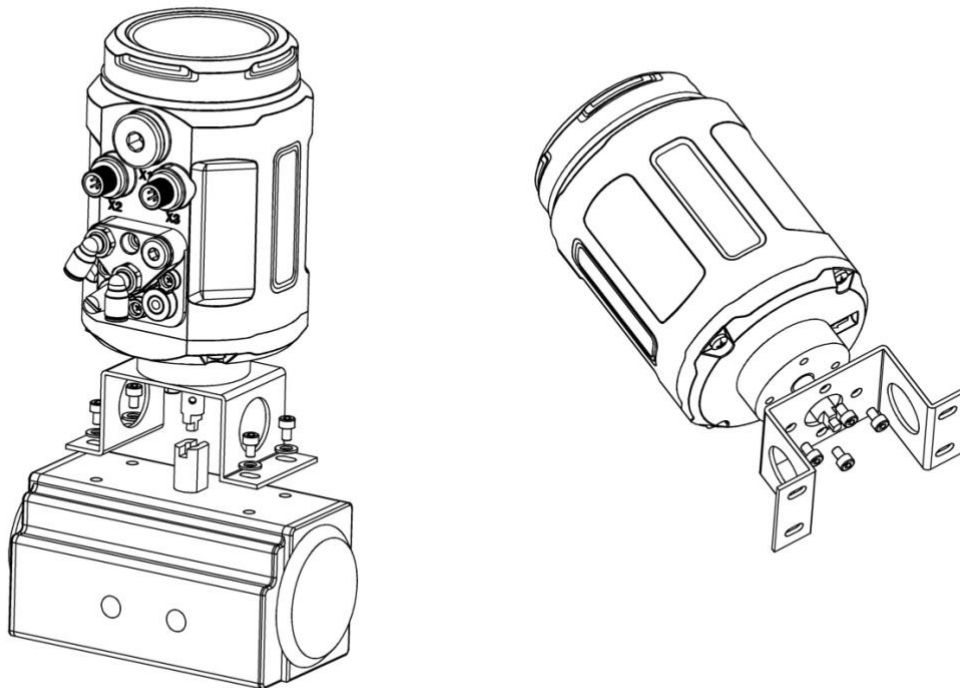
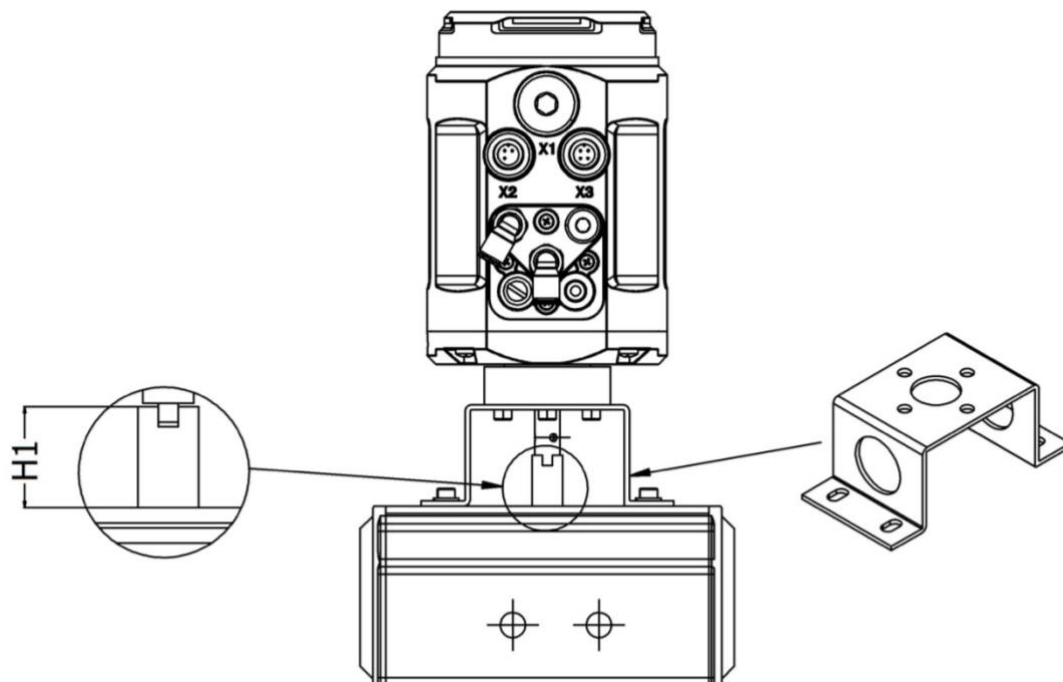
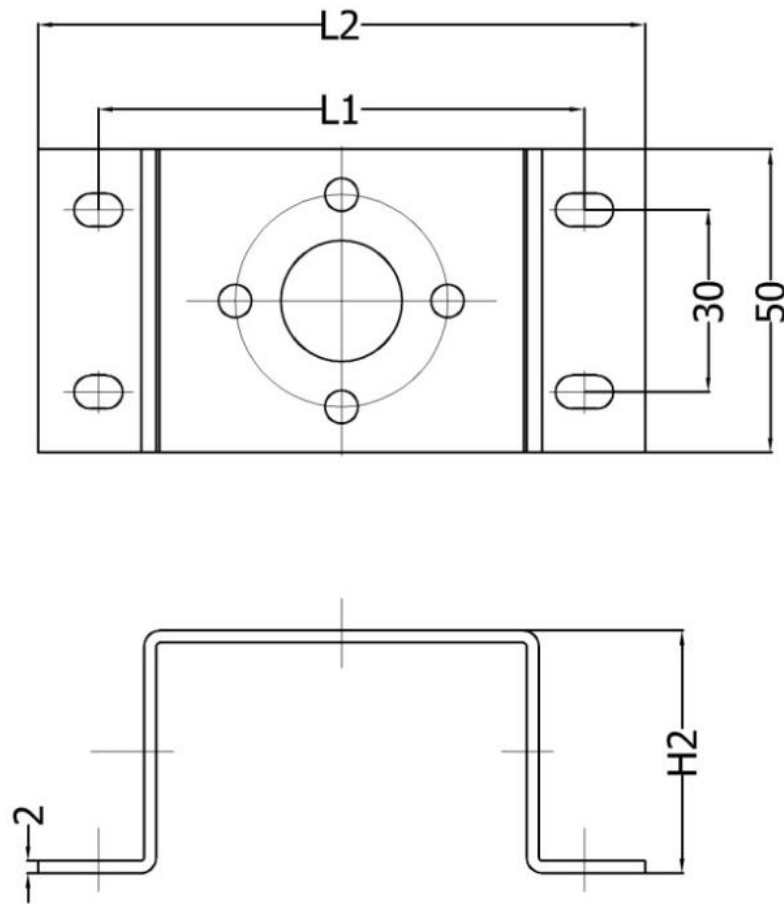


Figure 8. Graph Installation





Type	H1	H2	L1	L2
PF-1 (Default)	20	40	80	100
PF-2	30	50	80/130	100/150

Figure 9. Mechanical dimensions of the mounting body

2.3. Interface angle adjustment

If you need to adjust the interface angle, relax the hexagon screw in place A (As shown in Figure 7) first. Then adjust the angle clockwise or counter- clockwise in 180°range. After adjusting the angle, lock the angle by the hexagon screw.

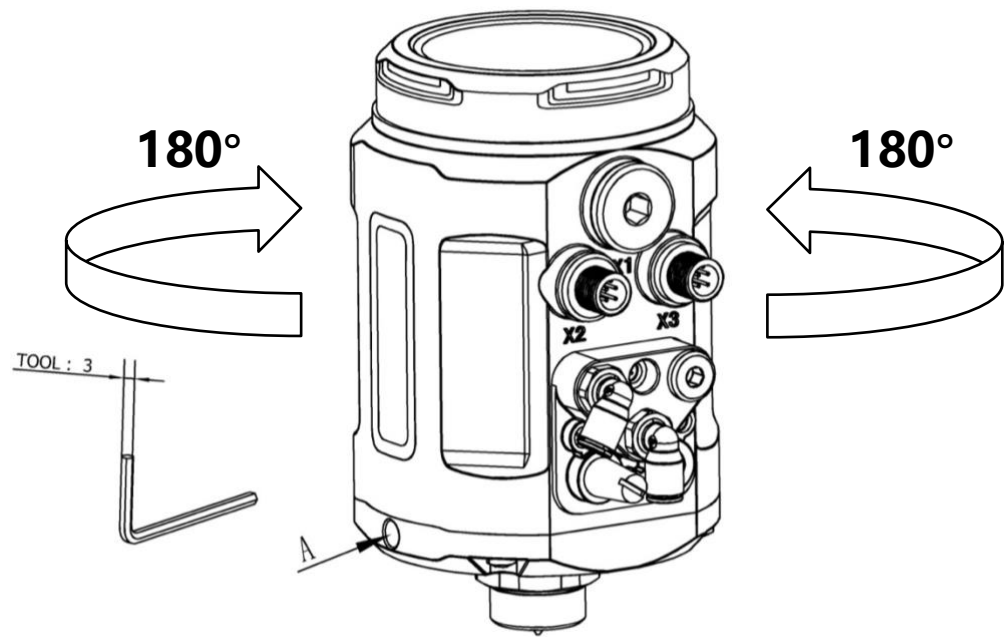


Figure 10. Graph operation

NOTE !

The positioner has rotation stopper mechanism. If it is restricted to rotate in one direction, please do not force to rotate continuously.

3. Connection description

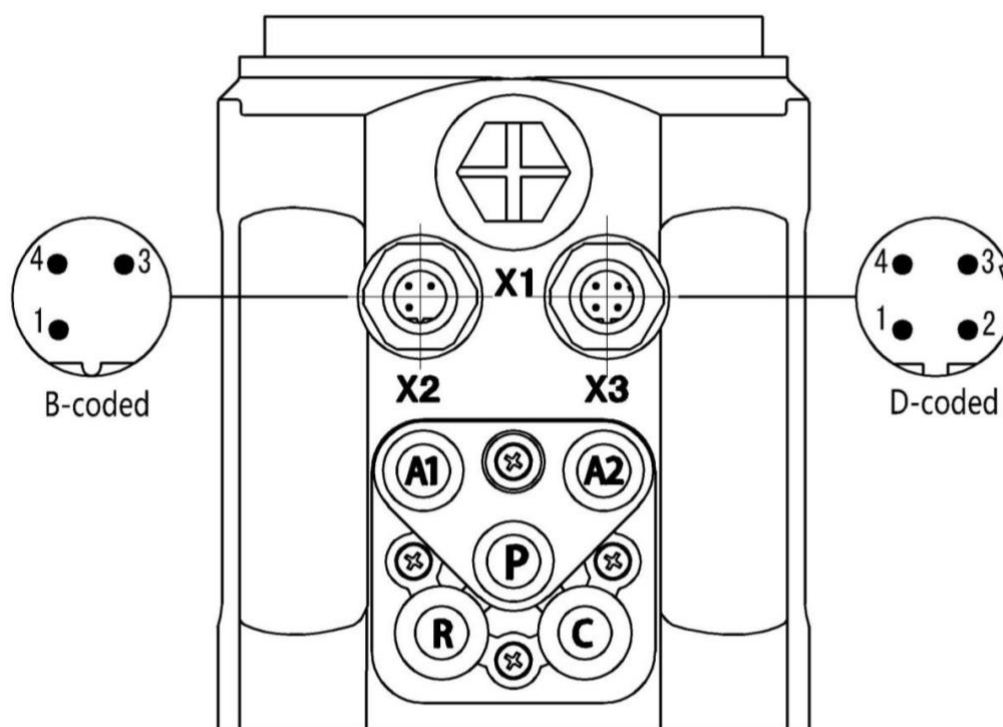


Figure 11. Connection

Connection	Pin	Description	Signal Type
X2	1	Analogue signal output +	4 – 20 mA
	3	Analogue signal output GND	GND
	4	NC	NULL

Table 2. Electrical connection description – X2 (optional)

Connection	Pin	Description	Signal Type
X3	1	Power supply +	+24 V
	2	Power supply GND	GND
	3	Set signal input +	4 – 20 mA
	4	Set signal input GND	GND

Table 3. Electrical connection description – X3

NOTE !

Error connection of the electrical pin may cause the positioner damage.

Connection	Description
P	Air supply enter (built-in filter, filter size 20 μm)
R	Air exhaust
C	Check valve
A1	Pilot air outlet 1
A2	Pilot air outlet 2

Table 4. Pneumatic connection description

NOTE !

The air source pressure bigger than 7 bar may cause positioner damage.

4. Technical data

4.1. Working data

Ambient temperature: 0~60°C

Protection class: IP67

Vibration resistance parameter: 100Hz

4.2. Electrical data

Connections: cable gland

Supply voltage:

24 V DC $\pm 10\%$, $\geq 1\text{A}$. Recommend switching-mode power supply.

Power input: $< 5\text{W}$

Input resistance for set-point signal: 140 Ω

4.3. Mechanical data

Cover material: Polycarbonate (PC)

Sealing material: Silicone rubber (SI)

Main body material: Polyamide Resin (PA6-GF30)

Control stroke range: 5-50 mm

4.4. Pneumatic data

Air pressure range: 3~7 bar, specific values depending on the actuator

Connections: Plug-in hose connector G1/4

Air quality:

ISO 8573-1

Solid particle size and density Class 3

Dew point Class 3

Oil content Class 3

Air flow rate:

17L/min (input pressure of 0.6Mpa)

95L/min (input pressure of 0.6Mpa, only single-acting)

5. Operation

5.1. Interface description

The positioner has a 4-key and 12-led control panel. User can set parameters and functions by pressing the four keys. 10 blue led lights are used to indicate the position percent zone of the displacement sensor or the position percent zone of the valve. They indicate the percent zones of 0-10%, 10-20%, 20-30%, 30-40%, 40-50%, 50-60%, 60-70%, 70-80%, 80-90%, 90-100%. The “MANUAL” led is used to indicate the operating mode. Led off indicates automatic mode. Led on indicates manual mode. Led flash indicates initial mode. “STATUS” led is used to indicate some system running states, such as system error alarms.



Figure 12. Operating interface

5.2. Operating mode

5.2.1. Initial mode

The positioner is default in the initial mode when it starts up after leaving factory. In the initial mode, the “MANUAL” led is flash, 10 blue led lights indicate the position percent zone of the displacement sensor effective stroke. User can operate   keys to open and close the valve. Press  key continuously, the actuator is aerated. Press  key continuously, the actuator is deaerated. Check out and make sure that valve position can move in the effective range of the displacement sensor and the whole valve stroke range is in the effective range of the displacement sensor according to 10 blue led and “STATUS” led.

If the whole valve stroke range is out of the effective range of the displacement sensor, valve position is held. If the minimum value of the whole valve stroke range is smaller than the minimum value of the effective range of the displacement sensor, the “STATUS” led is flash quickly. If the maximum value of the whole valve stroke range is larger than the maximum value of the effective range of the displacement sensor, the “STATUS” led is flash slowly. After system reporting the error, user can't operate keys.

5.2.2. Automatic mode

After the positioner completes the auto-tuning in the initial mode, system is in the automatic mode by pressing  key to exit. And if the positioner restarts up, system is default in the automatic mode. In this mode, the positioner accepts the input signal for set-point value and adjusts the valve stroke automatically, “MANUAL” led is turned off, 10 blue led lights are used to indicate the valve position percent zone. If the cut off function is enabled, the valve is fully close when the percent of set-point value $\leq 1\%$, and is fully open when the percent of set-point value $\geq 99\%$.

5.2.3. Manual mode

Short press  key to switch between the automatic mode and the manual mode. In the manual mode, “MANUAL” led is turned on, 10 blue led lights are used to indicate the valve position percent zone. User can operate   keys to open and close the valve manually. User also can operate combination keys to increase the adjustment speed. If after pressing  key continuously first, press  key continuously, the valve is quickly open. If after pressing  key continuously first, press  key continuously, the valve is quickly close.

5.3. Function instruction

5.3.1. Auto-tuning

The auto-tuning function can test the related control parameters including the direction between the aeration state of the actuator and the actual position, the total valve scale, PWM parameters etc.

Under the any operating mode interface, press  key for about 3 seconds to run the function. During the process of the function running, blue led lights are scrolling to display the step of the auto-tuning.

After finishing the auto-tuning, all 10 blue led lights are flash. If error appears during the auto-tuning, “STATUS” led is turned on, and valve position is held.

System will check whether the whole valve stroke range is in the effective range of

the displacement sensor during the auto-tuning process. If the whole valve stroke range is out of the effective range of the displacement sensor, valve position is held. If the minimum value of the whole valve stroke range is smaller than the minimum value of the effective range of the displacement sensor, the "STATUS" led is flash quickly. If the maximum value of the whole valve stroke range is larger than the maximum value of the effective range of the displacement sensor, the "STATUS" led is flash slowly.

During the auto-tuning, the actuator will be detected for air leakage. When the air leakage of the actuator is detected, the valve position is held, and the "STATUS" led flashes twice every 2 seconds.

During the auto-tuning, user can press  key to exit and turn back to the previous operating mode.

After finishing the auto-tuning, press  key to exit and turn to the specific operating mode according to the previous operating mode. If the previous operating mode is automatic mode or manual mode, system turns back to the previous operating mode. If the previous operating mode is initial mode, system turns to the automatic mode.

NOTE !

- Although the positioner has ran the auto-tuning function in the factory. In order to get the control parameters of the actual work environment, the positioner must run the function again in the actual work environment.
- Make sure that the air supply pressure is in the working range of the actuator and has no big wave. Otherwise the auto-tuning may fail or the test parameters may be error.

5.3.2. Dead band setting

The function is used to adjust the valve position control accuracy. The system does not adjust the valve position when the gap between the current position value and the position set-point value is not bigger than the dead band value.

The minimum value of the dead band is 0.2%, and the maximum value of the dead

band is 5%. Nine blue led lights separately indicate nine dead band values of 0.2%, 0.4%, 0.6%, 0.8%, 1%, 2%, 3%, 4%, 5% from left to right. In the automatic mode, press  key for about 3 seconds to enter the dead band setting interface. One led light is flash in order to display the current dead band value. Press   keys to change the dead band value. And the value is displayed by the blue led flashing. Press  key to confirm and exit back to automatic mode interface. Press  key to exit back to automatic mode interface without change.

NOTE !

The smaller the dead band setting, the higher the control accuracy getting. Please set the dead band value in reason. Because the too small value may cause the solenoid valve in the body to act frequently and lead to long adjustment time and unstable working state.

5.3.3. Cut off function switch setting

The function is used to enable and disable the cut off function. In the initial or automatic mode, press  key for about 3 seconds to enter the setting interface. The blue led on the far left flashes to indicate that the cut off function is enabled, and the blue led on the far right flashes to indicate that the cut off function is disabled. Press  key to change. Press  key to confirm the change and exit. Press  key to exit without change.

5.3.4. Factory setting

The function is used to recovery the system to factory state. In the automatic mode, press  +  key for about 3 seconds to run the function. After finishing the function, system is in the initial mode, the dead band value is 1%, and the cut off function is enabled. Before matching between the positioner and the actuator, please make sure that the positioner is in the initial mode after starting up.

5.3.5. Input signal error detection

The function is used to detect the error of 4-20mA input signal. The error condition is the value of 4-20mA input signal $\leq 3.5\text{mA}$. Once detecting the error signal, "STATUS" led is flash. The single-acting power-off safe positioner will exhaust the actuator cylinder's air. The single-acting power-off freeze positioner will keep the valve (default) or close the valve position (according to customer needs). The double-acting positioner will leave the valve position in a free state.

5.3.6. Analogue signal output (optional)

The positioner outputs 4-20mA analogue signal in the automatic mode and the manual mode, and dose not output in the initial mode and the running state of the auto-tuning.

6. Trouble shooting

1. LED does not light after the positioner starting up.

Make sure that the 24V DC power supply is normal.

Make sure that the power cables are connected correctly.

2. The positioner is unable to locate position. The valve cannot be fully opened or fully closed for a long time.

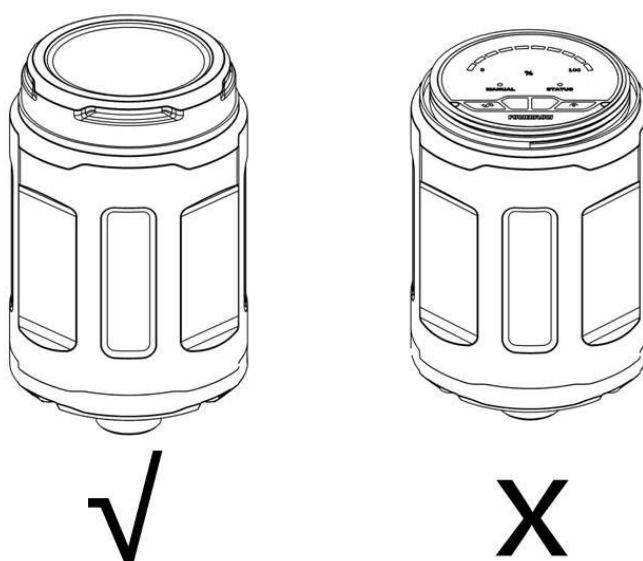
Make sure that the pressure of air supply meets the requirement.

Make sure that the dead band value meets the situation that the valve position adjustment is stable and has no fluctuation.

Make sure that the pneumatic connections of the positioner and actuator are not leaking.

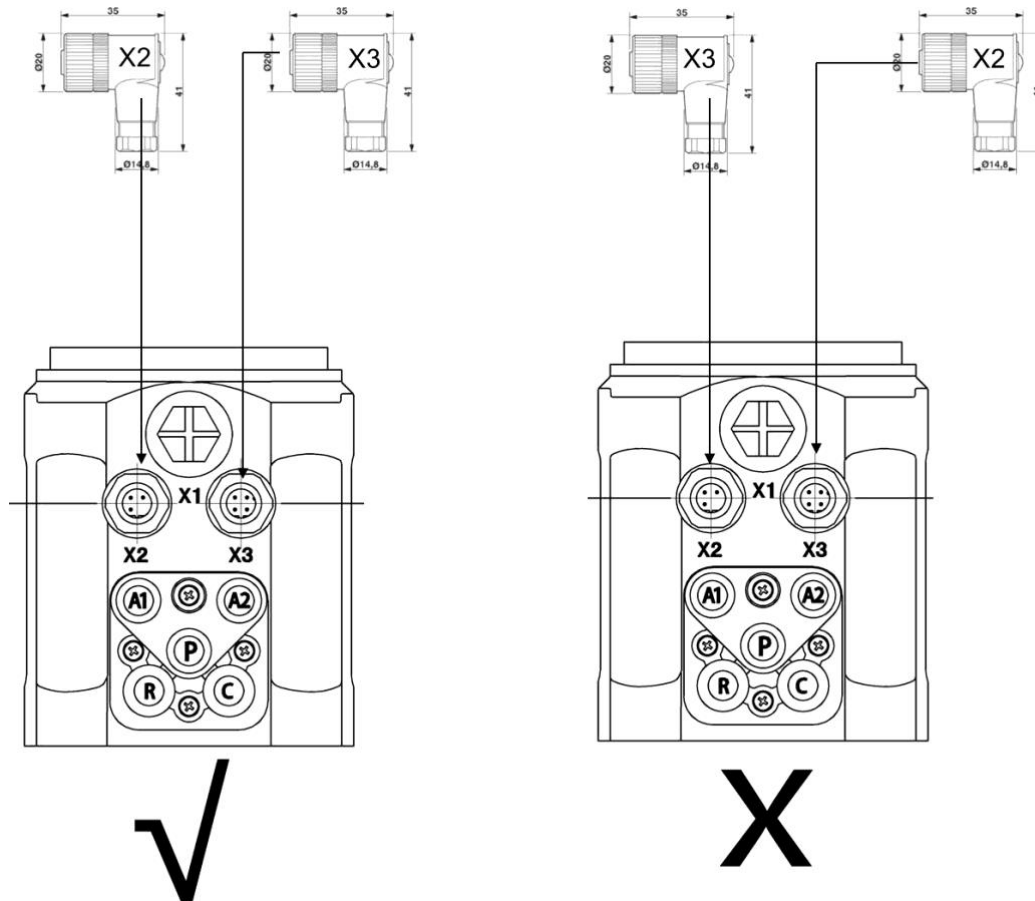
7. Attention

1. The power supply voltage of the positioner is 24V DC $\pm 10\%$. Please check the power supply before connecting the power cable to the electrical terminal. Make sure that the power supply is cut off before connecting the power cable. If the product is damaged by high voltage, it will lose warranty.
2. **Air supply use specification**
 - 1> The air pressure should be less than 0.7MPa.
 - 2> Install the filter pressure reducer (5 μ m filtration accuracy) in front of the air supply inlet of the positioner to prevent moisture or oil from infiltrating. In the situation of much oil in the air, it is suggested to additionally install the oil separator (3 μ m filtration accuracy) in front of the air supply inlet of the positioner. It is suggested to use the combination of SMC brand filter pressure reducer and SMC brand oil separator. Its model is AC20D-01CG-A. If the product is damaged due to the oil entering the product without oil separator or filter pressure reducer being installed, it will lose warranty.
3. After adjustment, the protective cover must be rotated tightly to ensure IP66 protection class. If the product is damaged by losing the protective cover or not rotating the protective cover tightly, it will lose warranty.



4. **Waterproof electrical connectors use specification**

- 1> The electrical connectors have foolproof design. Please connect the electrical female connector with the electrical male connector of the positioner according to the sign X2 and sign X3. Error connecting by strong force will destroy the electrical male connector.

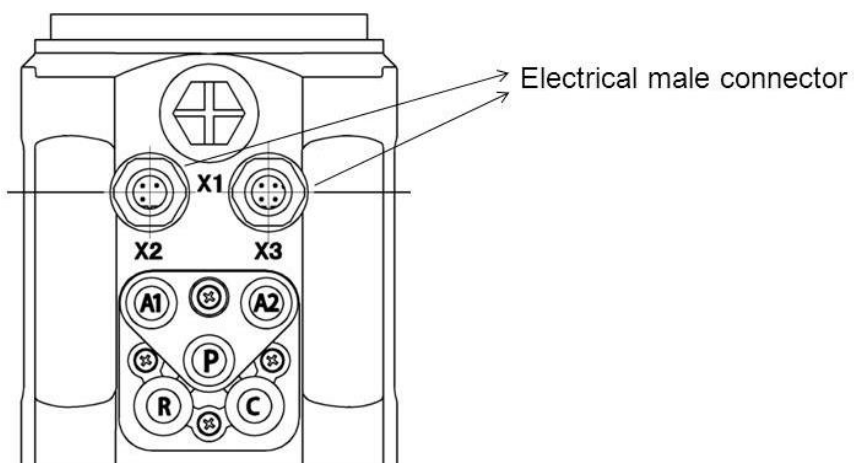


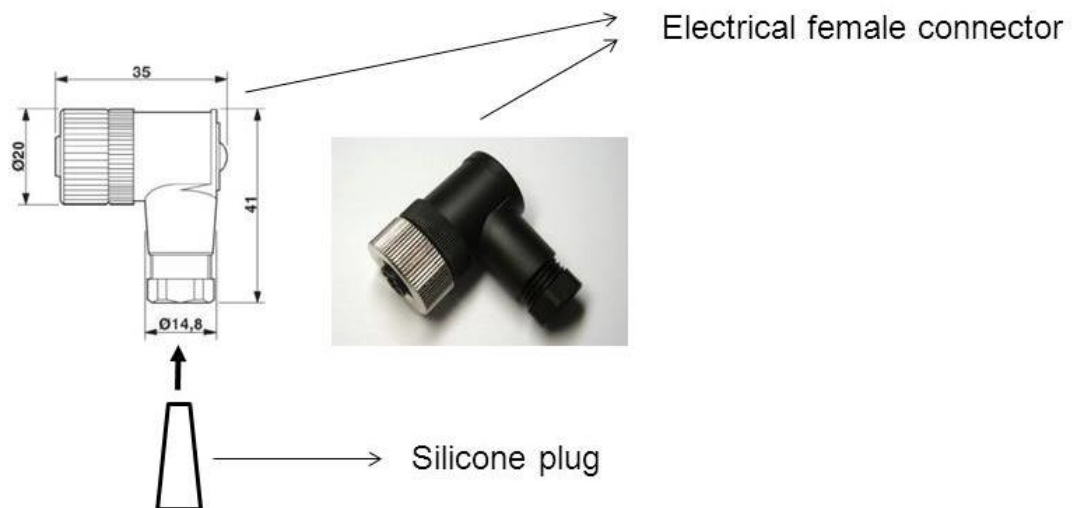
- 2> The cable diameter which is compatible with the waterproof electrical connectors is PG7 (4mm-6mm). Please use the multi - core cable with external insulation protection skin, otherwise the electrical connectors cannot achieve IP66 protection class.

Correct and error wiring ways are showing in the following pictures.



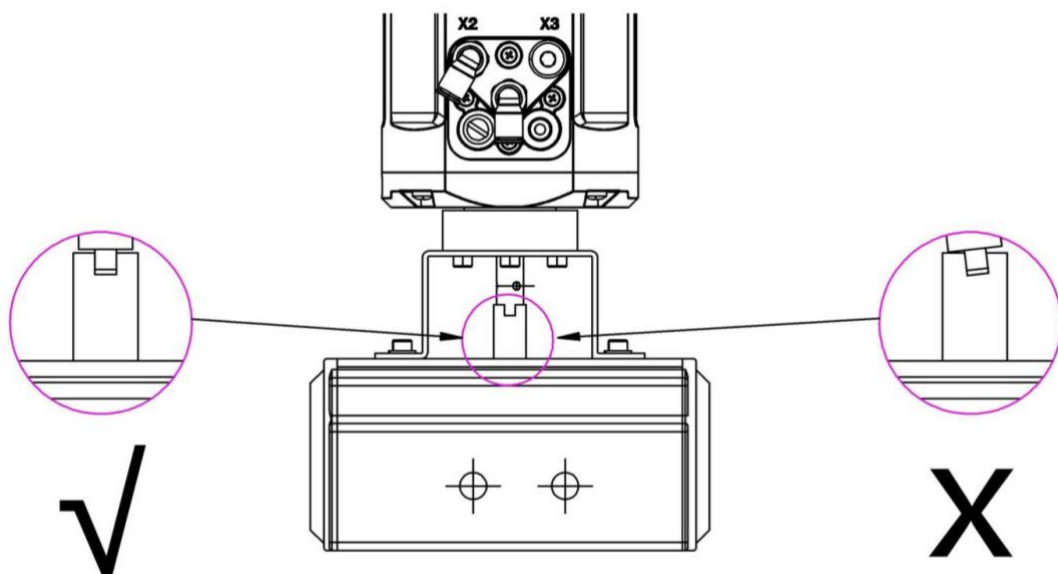
- 3> If the electrical male connectors are not used for a long time, to prevent water vapor or corrosive gases corroding the connector pins or entering the positioner inside, please screw on the electrical female connectors and block another side of the electrical female connectors with the silicone plugs. As shown below.





If the product is damaged by error operations for the waterproof electrical connectors, it will lose warranty.

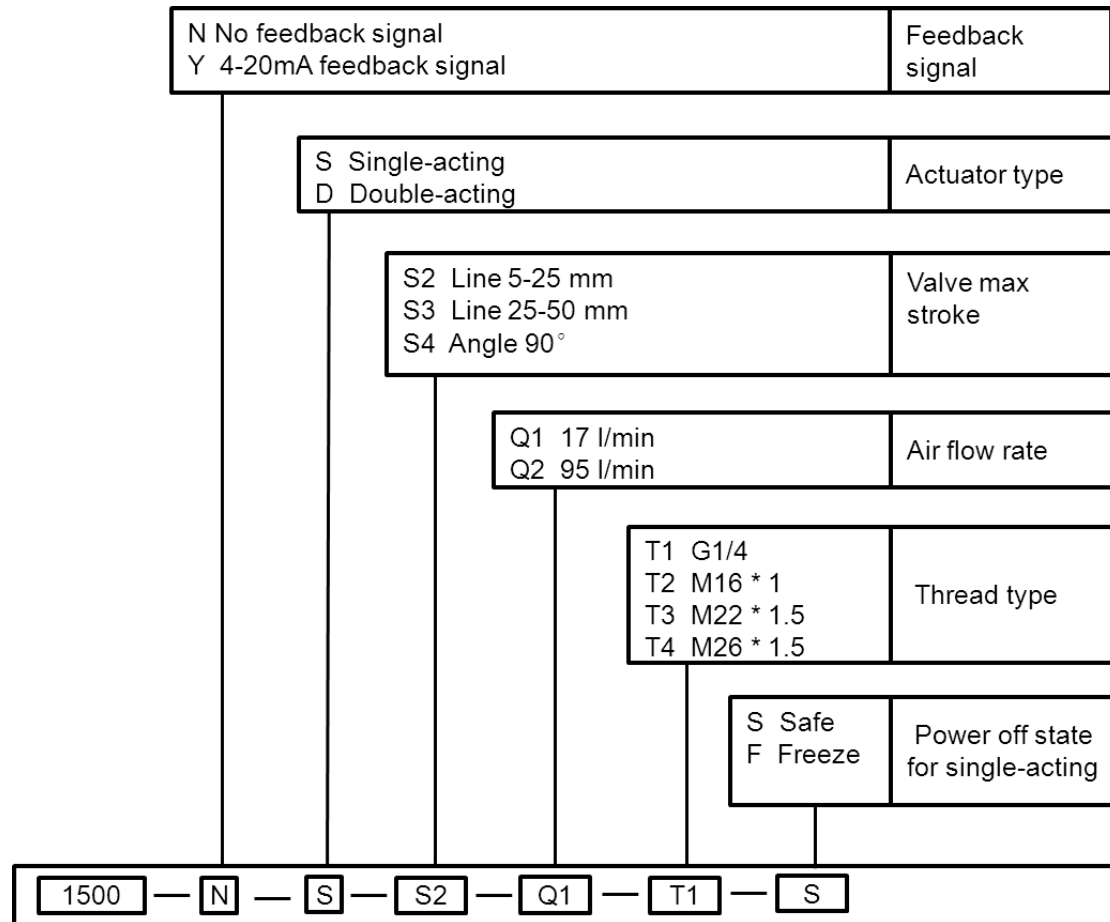
5. If the product is damaged by the user removing the pneumatic connectors or the filter elements near the pneumatic connectors, it will lose warranty.
6. For matching the angle stroke actuator, make sure that the groove of the actuator axis is vertical, so that the connection between the actuator axis and the positioner sensor is suitable. Otherwise the radial load force will destroy the sensor. If the product is damaged by the above reason, it will lose warranty.



8. Warranty terms

1. If the product is found to have quality problems which are confirmed by our company staff, customers have after-sale services for product maintenance or free replacement in the warranty period. Service response time is 24 hours (excluding non-working days).
2. The warranty period of the product is based on the company's latest warranty policy, which is no less than 12 months after the sale.
3. The following situations for repaired product do not belong to the warranty range:
 - (1) The date is not in the warranty period.
 - (2) The product is disassembled without authorization and permit by the product company.
 - (3) The damage causes from the operation which is not according to the product instruction manual or other human factors. Including but not limited to:
 - 1> The product surface has collision scars.
 - 2> Error wiring or error power supply makes the product damaged.
 - 3> Parts and accessories are lost.
 - 4> The product is damaged due to the oil entering the product without oil separator or filter pressure reducer being installed.
 - 5> Losing the protective cover or not rotating the protective cover tightly makes the product damaged.
 - 6> Error using the waterproof electrical connectors makes the product damaged.
 - (4) Force majeure (natural disasters) causes product failure or damage.
4. According to the actual situation, the product company offers the free or fee-based maintenance services outside the warranty range.
5. The terms become effective since the two sides signed a supply contract.

9. Selection and ordering data



Remark:

In the **air flow rate** option, code Q1 is suggested to match the actuator of 40-100 mm internal gas chamber diameter, code Q2 is suggested to match the actuator of 125-160 mm internal gas chamber diameter. Code Q2 is only used for single-acting actuator, and only in **Freeze** state when power-off. The air flow rates for code Q1 and Q2 are under the condition of 0.6Mpa input pressure.

In the **valve max stroke** option, AT actuator range for code S4 is AT50~AT125. For other actuator models, please consult our company. It is no need to select the **thread type** option for code S4.

Power off state for single-acting option is **Safe** by default.

V251127

The changed contents of this manual are not noticed.

The Company reserves the final interpretation for related technical updating.

Attachment

Air Supply Requirements for Intelligent Valve Positioner

All Series Products

In accordance with technical specifications, all series of intelligent valve positioners require Class 3 quality compressed air supply. Supplying compressed air that meets the air source standards ensures stable normal operation of the positioners.

Class 3 Dew Point: Dew point shall be -20°C . (If the actual operating ambient temperature of the positioner is lower than -20°C , the dew point of the supplied compressed air shall be 10°C lower than the actual operating ambient temperature of the positioner accordingly.)

Class 3 Solid Particle Size & concentration: 5.0 mg/m^3 (corresponding particle size: $5.0\text{ }\mu\text{m}$). Particles larger than $5.0\text{ }\mu\text{m}$ are prohibited from entering the equipment.

Class 3 Oil Content: 1.0 mg/m^3 , the cumulative oil content per cubic meter of air shall not exceed 1.0 mg .

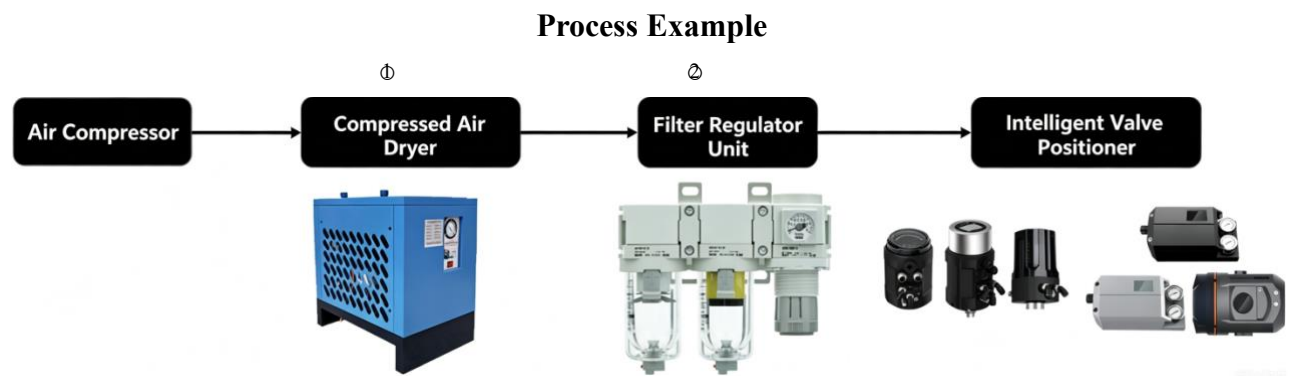


Figure 1. Process Flow Diagram

- ① Install a compressed air dryer on the main pipeline to remove most moisture contained in compressed air; the pressure dew point after filtration can reach -20°C .
- ② Select one of the air preparation assemblies shown in Figure 2 and install it upstream of the positioner. Depending on the selected configuration, install the filter regulator or air filter upstream, followed by the mist separator downstream. The filtration system shall remove particles larger than $5.0\text{ }\mu\text{m}$ and reduce the residual oil concentration to no more than 1.0 mg/m^3 .

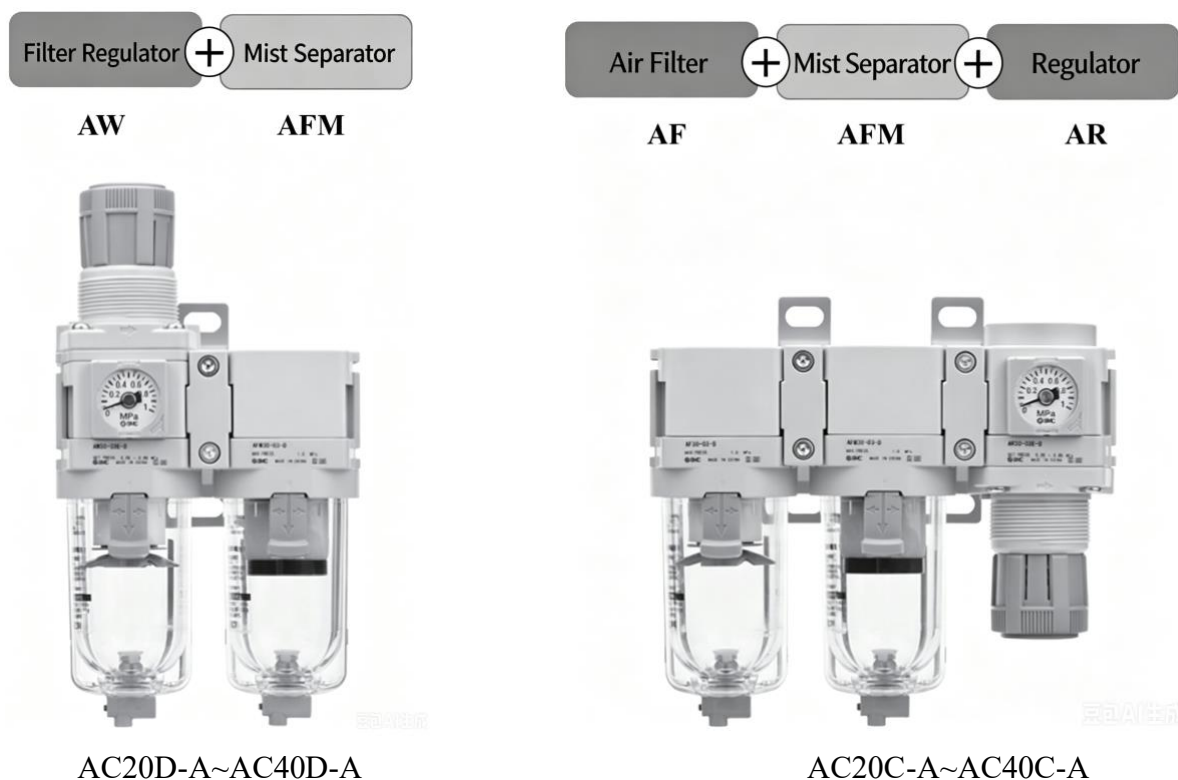


Figure 2. Filter Regulator Assembly

Filter Regulator Selection Recommendations

Selection Combination	Air Filter + Mist Separator + Regulator AF AFM AR 		Filter Regulator + Mist Separator AW AFM 
	AC 30 C- 03 DG - - A 1 2 3 4 5 6		AC 30 D- 03 DG - - A 1 2 3 4 5 6
Selection Model No.	SMC AC20C-02G-A		SMC AC20D-02G-A SMC AC30D-02G-A
	When the quality of compressed air at the inlet side is slightly lower than the operating requirements of the positioner		When the compressed air quality at the inlet meets the operating requirements of the positioner

Basic Parameters	Fluid: Air Ambient & Operating Temperature: -5~60°C (no freezing) Proof Pressure: 1.5 MPa Operating Pressure Range: 0.05~1.0 MPa Adjustable Pressure Range: 0.05~0.7 MPa Filtration Rating: AW: 5 µm, AFM: 0.3 µm (99.9% collection efficiency) Bowl Material: Polycarbonate Structure: Relieving type		
Selection Parameters	① Main Body Size: 20 Rated Flow Rate: 200 L/min Bowl Guard: Standard (Steel Band) Weight: 0.39 kg ② Thread Type (No Mark): Rc ③ Port Size Code 02: 1/4 ④ No Mark: Manual Drain Pressure Gauge G: Round Pressure Gauge with Limit Indicator ⑤ No Mark: No Accessories ⑥ No Mark: No Special Options	① Main Body Size: 20 Rated Flow Rate: 150 L/min Bowl Guard: Standard (Steel Band) Weight: 0.33 kg ③ Thread Type (No Mark): Rc ④ Port Size Code 02: 1/4 ⑤ No Mark: Manual Drain Pressure Gauge G: Round pressure gauge with limit indicator ⑥ No Mark: No accessories ⑥ No Mark: No special options	① Main Body Size: 30 Rated Flow Rate: 330 L/min Bowl Guard: Standard Equipment (Polycarbonate) Weight: 0.66 kg
1Series Positioner*	●	●	/
IP Series Positioner*	●	/	●

*●Recommended selection

Note: The rated air handling flow rate of the filter shall be higher than the maximum operating flow rate of the positioner. If multiple positioners are installed on the same air supply line, the total maximum operating flow rate shall be the sum of each unit. (1 Series Max Flow: 1500 / 1600: Q1-17 L/min, Q2-95 L/min 1880S: 17 L/min IP Series Max Flow: IP5500: 155 L/min IP6000 / IP6500: 187 L/min IP6000d: 150 L/min All above data are measured under 0.6 MPa supply pressure.)

Important Notes

1. Select filter regulators with suitable performance based on site working conditions to avoid equipment failure caused by high temperature, low temperature, high pressure, corrosive atmosphere and other harsh environments. Refer to the selection table at the end of this appendix.
2. Regularly inspect the condition and performance of the filter. Increase inspection frequency under high-frequency operating conditions to prevent malfunctions caused by clogged filter elements. (Typical failures include: ① Loss of filtration performance, allowing foreign matter to enter and damage the positioner; ② Clogging of the filter elements, resulting in an abnormal air supply and preventing the positioner from operating normally.)
3. For filter regulators with an auto-drain function, blockage of drain holes shall be prevented. Regular inspections can avert excessive water accumulation in the filter bowl caused by filter malfunctions. Manually drained filter regulators shall be drained manually on a regular schedule according to the water accumulation rate under actual working conditions.
4. Carry out regular maintenance or replace any nonconforming filter/regulator units in accordance with the operating instructions of the filter regulator to avoid unnecessary failures.