XE100

Electro Pneumatic Positioner Operating Manual

Linear motion / Side lever type

XE-S1

3S Co., Ltd.

(E)IM-XE1S1/00-R10

Safety precautions

Cautions and Warnings – read before operating

Warning! Indicates a situation where incorrect operation while failing to heed the warning could result in death or serious injury if not avoided.

- For mounting, air tubing, electric wiring, inspection, maintenance or dismantling of the product, follow the national legislation of the country to be used.
- Of the two conduit connection holes on the terminal box unit, be sure to insert a blind plug provided with the positioner tightly into the unused one. (Check the conduit connection hole size, please use the appropriate plug.)
- Turn off the power before removing the terminal box cover or blind plug.
- Before removing or disassembling component screws or pressure gauges etc. for inspection reduce, the output pressure to Zero and then disconnect the supply pressure.
- When operating the equipment during adjustment or inspection (see pages 1 and 2), do not touch moving parts such as cams, bearings, clamps or levers with your hands.

Caution! Indicates a situation where incorrect operation while failing to heed the caution could result in malfunction or physical damage.

- During the operation, ensure the supply pressure remains below limit of usage of XE100series Positioner, 0.7 MPa.

  The normal value during single acting and double acting is 0.14 – 0.28 MPa and 0.4 MPa respectively.
- Use the equipment with the XE100series Positioner cover Ass'y installed.
- If drainage or debris etc. accumulates in the pressure line on the supply side, the orifice will become stuck and cause a malfunction. Install an air filter (such as Pressure regulator with filter, manufactured by 3S Co., Ltd.) of 5 um or less and supply air cleansed by a dryer etc.
- When checking to see if debris or blockage is observed in the orifice or mesh filter, first shut off the supply pressure.
- When carrying out pipe work, always flush the pipes sufficiently.
- When screwing pipes and fittings, wrap with seal tape or apply liquid sealant left about 2 threads from the screw top for waterproofing.
- Using lubricator on the supply side will block the orifice or nozzle. Do not use any lubricator.
- Avoid impact on or application of excessive force to the positioner to avoid malfunction.
- During adjusting the range, take care not to place a screwdriver close to the unit. The actuator may move unexpectedly.
- During the installation of the body cover or the terminal box cover, or during removing them, take care not to place a screwdriver close to the units. The actuator may move unexpectedly.

- Index -

1. Introduction

This manual is intended for the Electro-pneumatic positioner of the side-lever type for linear motion single/double acting.

For other types, please refer to the relevant manual.

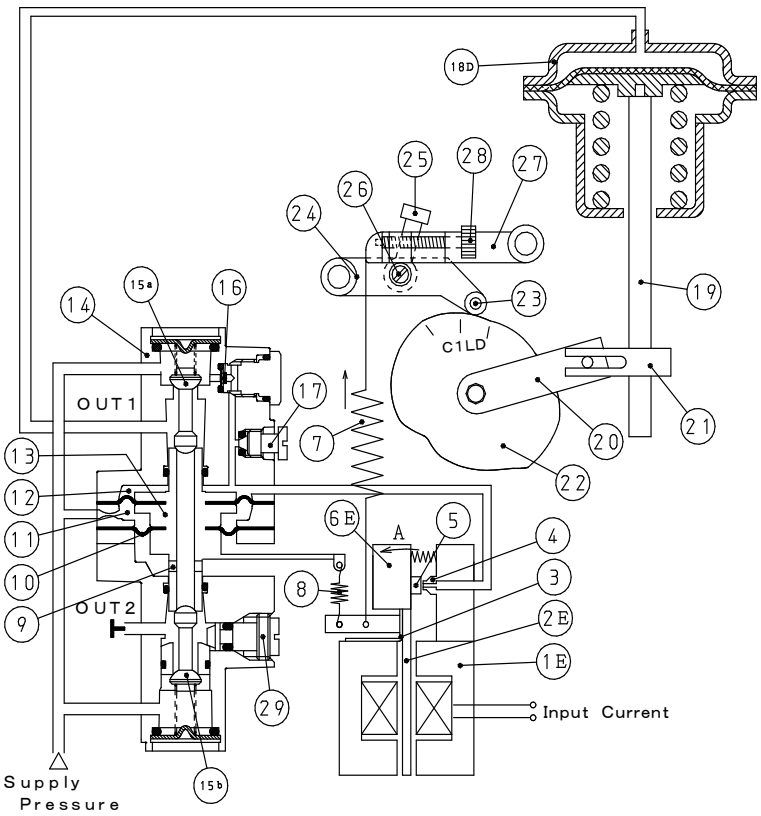
2. Operation principle

(1) Single acting

When input current is applied to the torque motor (1E), the armature (2E) moves in the direction of the arrow A by the flexure (3). This movement pull off the flapper (5) from the nozzle (4) to reduce pressure in the nozzle back pressure chamber (12).

As a result, the balance between this pressure and that in the pressure chamber (11) is lost and eventually the relay spool (13) opens the port (15) to introduce the output from OUT 1 to the diaphragm actuator (18), thereby lowering the stem (19).

This movement is transmitted to the feedback levers (20), (21), cam (22), range arm (24) and zero arm (27) to expand the feedback spring (7) until the tension of this spring and the attraction of the torque motor (1E) balance, obtaining a change in the stem (19) proportional to the input current.



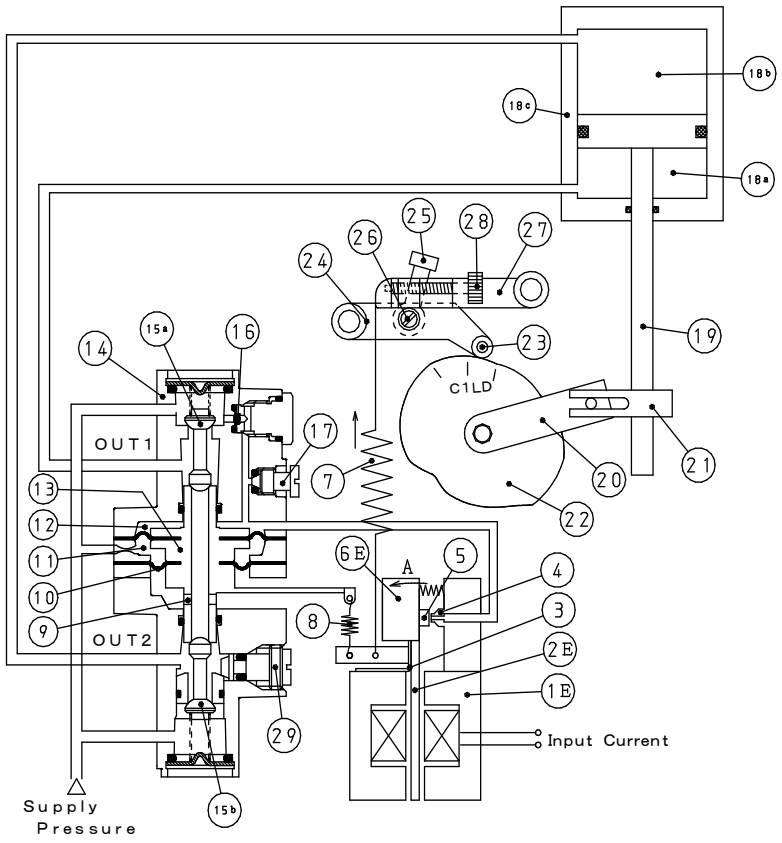
1E Torque motor
2E Armature
3 Flexure
4 Nozzle
5 Flapper
6E Counter Weight Block
7 Feedback Spring
8 Stabilizer Spring
9 Exhaust
10 Diaphragm
11 Pressure Chamber
12 Nozzle Back Pressure
13 Relay Spool
14 Pilot Relay Body
15a Port A
15b Port B
16 Fixed Orifice
17 A/M Selector
18D Diaphragm Actuator (Pressure Chamber)
19 Stem
20 Feedback Lever A
21 Feedback Lever B
22 Cam
23 Bearing
24 Range Arm
25 Range Adjuster
26 Roller Shaft
27 Zero Arm
28 Zero Adjustment Knob
29 Seat Adjuster

(2) Double acting

When input current is applied to the torque motor (1E), the armature (2E) moves in the direction of the arrow A by the flexure (3).

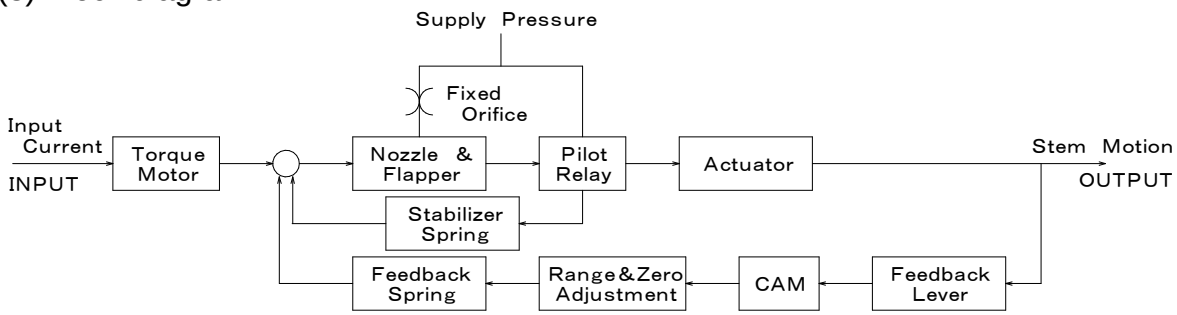
This movement pull off the flapper (5) from the nozzle (4) to reduce pressure in the nozzle back pressure chamber (12). As a result, the balance between the above pressure and that in the pressure chamber (11) is lost, and eventually the relay spool (13) opens port (15a) and port (15b) simultaneously separates from the end of the relay spool (13). In response to this movement, the output from OUT 1 flows into the lower cylinder chamber (18a) and the upper cylinder chamber (18b) connects to the vent to raise steam (19).

This movement is transmitted to the feedback levers (20), (21), cam (22), range arm (24) and zero arm (27) to expand the feedback spring (7) until the tension of this spring and the attraction of the torque motor (1E) balance, obtaining a change in the stem (19) proportional to the input current.



1E Torque motor
2E Armature
3 Flexure
4 Nozzle
5 Flapper
6E Counter Weight Block
7 Feedback Spring
8 Stabilizer Spring
9 Exhaust
10 Diaphragm
11 Pressure Chamber
12 Nozzle Back Pressure
13 Relay Spool
14 Pilot Relay Body
15a Port A
15b Port B
16 Fixed Orifice
17 A/M Selector
18a Lower Cylinder Chamber
18b Upper Cylinder Chamber
18c Cylinder
19 Stem
20 Feedback Lever A
21 Feedback Lever B
22 Cam
23 Bearing
24 Range Arm
25 Range Adjuster
26 Roller Shaft
27 Zero Arm
28 Zero Adjustment Knob
29 Seat Adjuster

(3) Block diagram



3. Specifications

Specifications	Single acting	Double acting
Input signal/Impedance	Standard : 4～20mA / 250Ω (1/2 split range adjustment is available)	
Supply air pressure	0.14～0.7MPa	
Stroke	10～100mm	
Air connector	Rc1/4 (pressure gauge Rc 1/8) Option : NPT1/4 (pressure gauge NPT1/8)	
Electric wire connector	G1/2 Option:NPT1/2, M20×1.5 (Not available for TIIS flame-proof)	
External Lead-in wire	Flameproof (Threaded conduit type / Flameproof packing type)	
Pressure gauge	Standard: 0～0.2MPa, 0～0.4MPa, 0～1.0MPa Option : kPa, psi, bar psi, bar only NPT	
Protection of enclosure	Protection dust & drip-proof IP65 (IEC529-1989)	
Types of protection	Flameproof construction: TIIS: Ex d IIB T6 Ex d IIB+H_2 T6 (corresponding to Hydrogen) ATEX: II 2G Ex d IIB T6 Gb II 2G Ex d IIB+H_2 T6 Gb (corresponding to Hydrogen) Standards: EN60079-0:2009 EN60079-1: 2007 IECEx: Ex d IIB T6 Gb Ex d IIB+H_2 T6 Gb (corresponding to Hydrogen) Standards: IEC60079-0:2007 IEC60079-1: 2007 KOSHA: Ex d IIB T6 Ex d IIB+H_2 T6 (corresponding to Hydrogen)	
Cam	Standard: Linear, Equal Option: non-linear characteristics	
Ambient temperature	Standard use (S): -20 to 83^{0}C Low temperature use (L): -50 to 60^{0}C High temperature use (H): 0 to 100^{0}C Flameproof use(S): -20 to 60^{0}C	
Weight	2.2kg	2.3kg
Material	Base: aluminum diecasting (Anodizing) Cover: PBT resin (containing glass fiber) /option: aluminum diecasting	

(*1) Characteristics	Single acting	Double acting
Linearity	(*2) ±1%F.S.	±2.0%F.S.
Hysteresis	1.0%F.S.	1.0%F.S.
Repeatability	0.3%F.S.	0.5%F.S.
Sensitivity	0.2%F.S.	0.5%F.S.
Supply pressure change	0.2%/0.01MPa	0.3%/0.01MPa
Vibration resistance	No resonance in the range of 20 to 200Hz at 2G	
Posture error	0.2%/10°, 4%/90°	
Air usage (Nl/min)	5 Nl/min /0.14 MPa	10 Nl/min /0.4 MPa
Max. Air treatment (Nl/min)	160 / 0.14 MPa Output side at max. open (orifice φ5)	370 / 0.4MPa Output side at max. open (orifice φ5)

*1: In case of different to actuator, each model has its own performance.

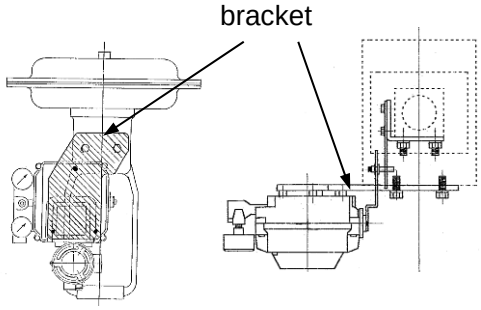
*2: Linearity is 1.5% F.S. for stroke under 10mm.

4. Installation

(1) Installation

1) Example of Installation

The diagram on the right shows an example of installing XE100 positioner with a one-sided bracket to a linear-motion control valve. (e.g., a globe valve combined with a diaphragm actuator or cylinder actuator)

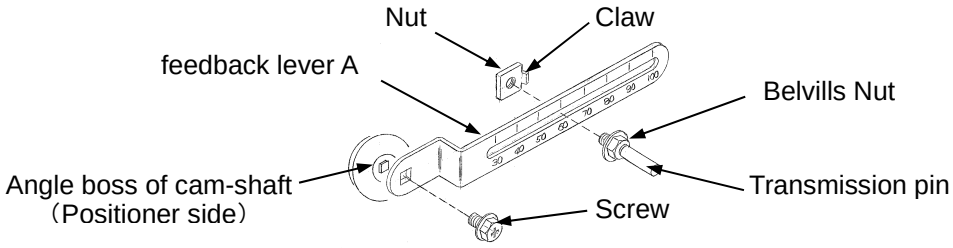


When using in a place with strong vibrations, take anti-vibration measures such as fixing both ends of the mounting bracket.

2) Assembling feedback lever A (positioner side)

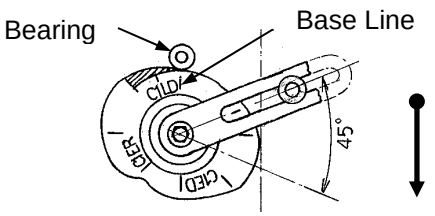
① Stroke measurement lines are etched into the feedback lever A, so it fixes to match with the prescribed stroke, completing the lever, so align the transmission pin with the specified stroke to complete the lever.

With max. and min. stroke, assemble by facing the nut's claw towards the lever's long hole.

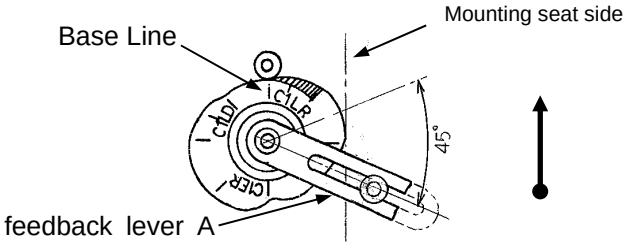


② Align the completed lever with the actuator action, and fix in place to the main body's cam shaft angle boss with a screw.

＊Unless otherwise specified, shipped with linear characteristics. When selecting Equal %, modified in accordance with 9-2 (3) Eq% Cam characteristics (P.14)



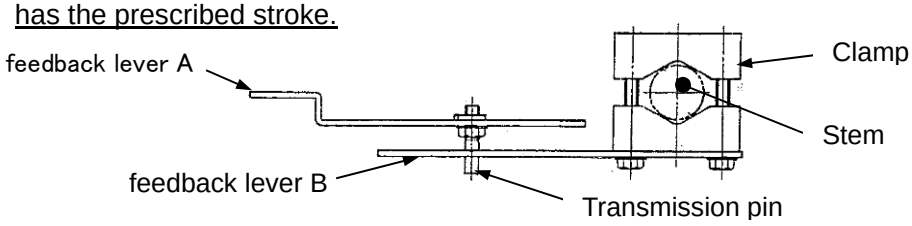
Direct action
(stem falls with increased input signal)



Reverse action
(stem rises with increased input signal)

3) Installing to actuator

While inserting the transmission pin of feedback lever A into the long hole in feedback lever B on the valve stem side, interpose the brackets and install on the valve actuator. At this point check that feedback levers A and B are level and that the transmission pin has the prescribed stroke.



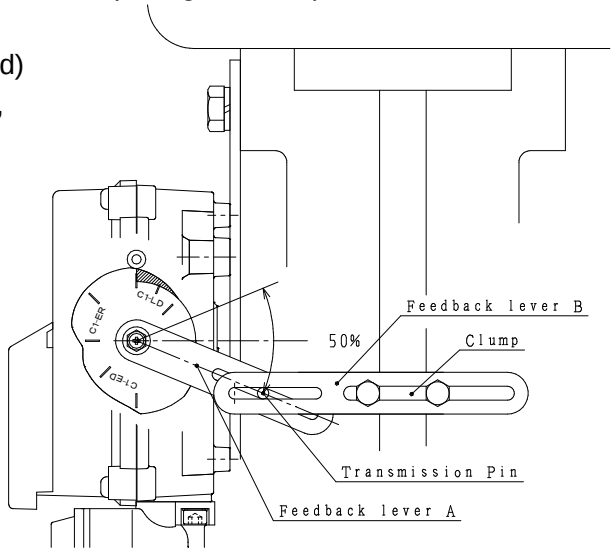
(2) Adjustment of posture

1) Valve closing function of Linear-characteristic cam

Adjustment of Valve closing function perform in accordance with the following.
First, adjust the positioner (cam) position, second, set zero and range point. After that check the valve closing function.

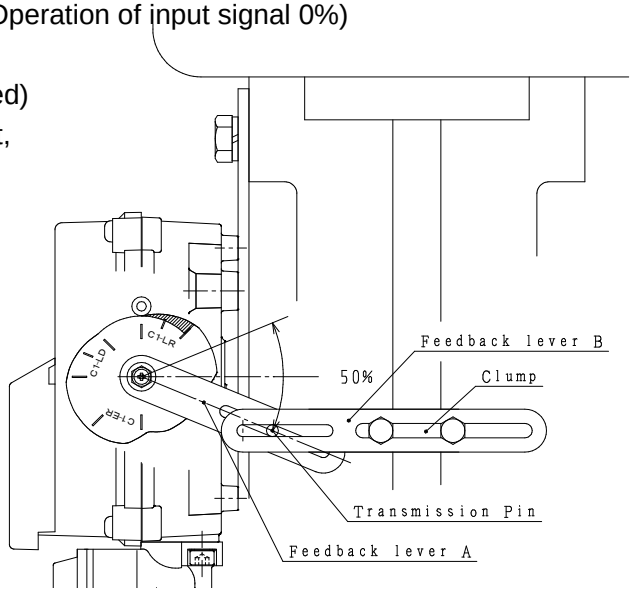
① Direct action of valve closing function (Operation of input signal 100%)

a. Select C1-LD for the Cam
b. Turn the actuator valve to 0% (valve closed)
c. Adjust upwards or downwards the bracket, clamp and stamp lever so that the top of the extension line for the baseline indicating maximum Cam displacement (100%) becomes on the center of the bearings.
(see the figure on right)



② Reverse action of valve closing function (Operation of input signal 0%)

a. Select C1-LR for the Cam
b. Turn the actuator valve to 0% (valve closed)
c. Adjust upwards or downwards the bracket, clamp and stamp lever so that the top of the extension line for the baseline indicating minimum Cam displacement (0%) becomes on the center of the bearings.
(see the figure on right)



③ Direct action /reverse valve of valve closing function

In this case, look at the Cam from the side of lever installation, and reinstall so that the Cam is reversed and the Cam code not visible, turning it to C1-LR. For assembly method see Converting to Near Eq% Cam Characteristics (P.14). For position alignment follow the same procedures as described in ② above.

2) Near Eq% characteristics

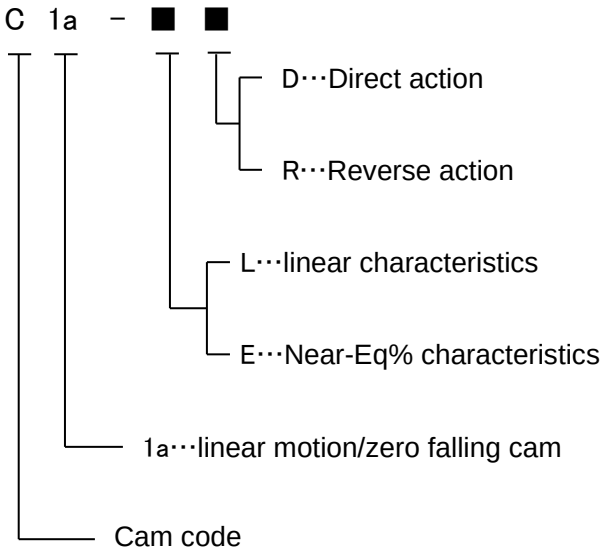
When approaching Near equal percentage (Eq%) characteristics, this model does not have valve closing function of cam, but for Cam adjustment follow the basic guidelines in above 1).

＊ When changing Cam from linear characteristic to Near Eq% characteristic, reassemble for Near Eq% characteristics side and reinstall. See Converting to Near Eq% Cam Characteristics (P.14).

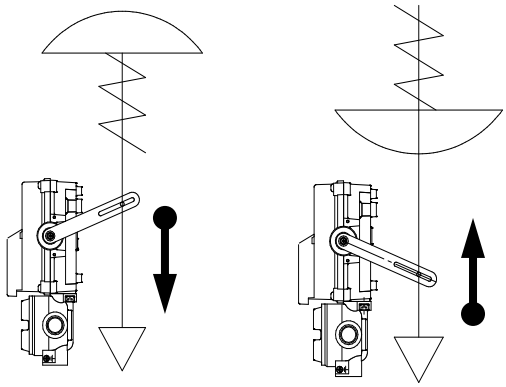
5. Cam

(1) Cam type and code

Standard Cam enables selection of linear and near-Eq% characteristics.
Characteristics of Cam can be selected to suit the valve characteristics.
Unless otherwise specified, the default shipping setting is standard linear motion.
When using as near-Eq%, see Converting to Near Eq% Cam characteristics (P.14).



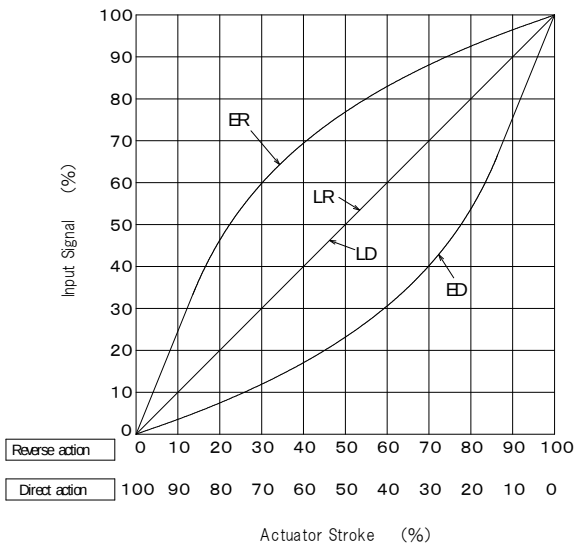
Linear motion



C1a－■D	C1a－■R
(direct action) Stem falls by input signal increase	(reverse action) Stem rises by input signal increase

(2) Cam characteristics and specifications

The valve Characteristics and Cam Characteristics can be selected to suit the objectives of use.
The input signal and actuator stroke are related as described in the diagrams below.



Cam characteristics/applications

Cam code	Cam characteristics/applications		
	Operation	Characteristics	Applicable actuator
C1-LD	Linear motion	Linear	Direct
C1-LR			Reverse
C1-ED		Near-Eq %	Direct
C1-ER			Reverse

Note: Direct action means the valve stem falls when input signal increases.
Reverse action means the valve stem rises when input signal increases

6. Piping and Wiring

(1) Pneumatic piping

1) The connection is selectable, either Rc1/4 or NPT1/4 as required.
Please use the appropriate connector.

2) Ensure no foreign objects or cutting chips are contained in the piping by purging appropriately.

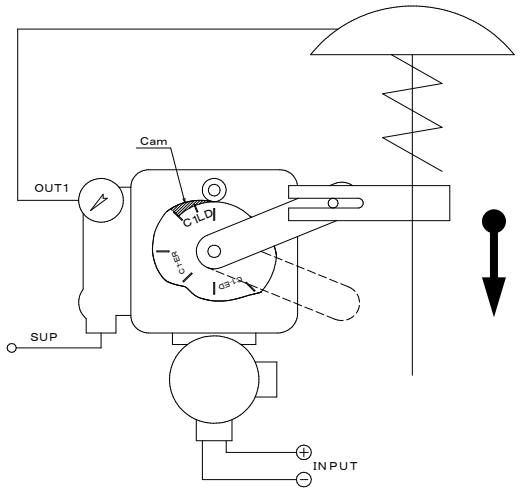
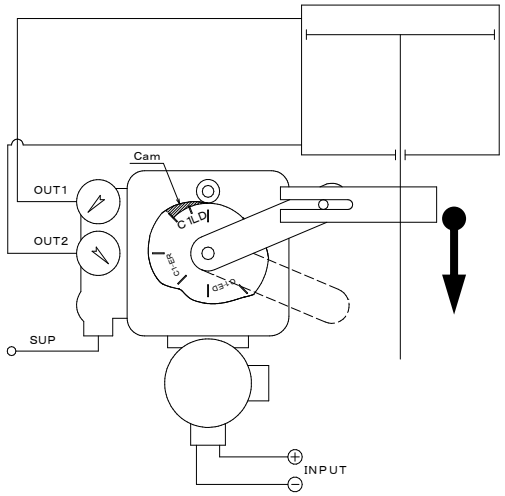
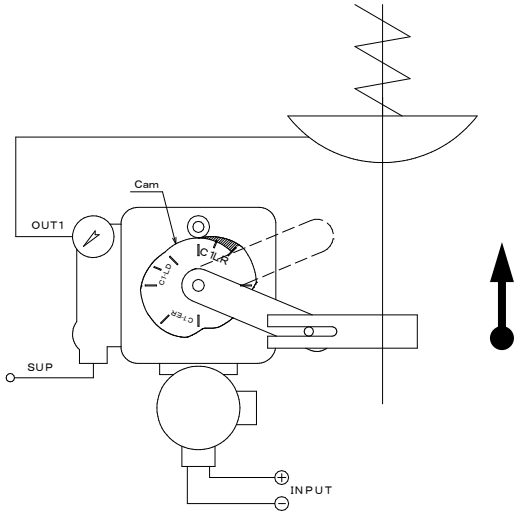
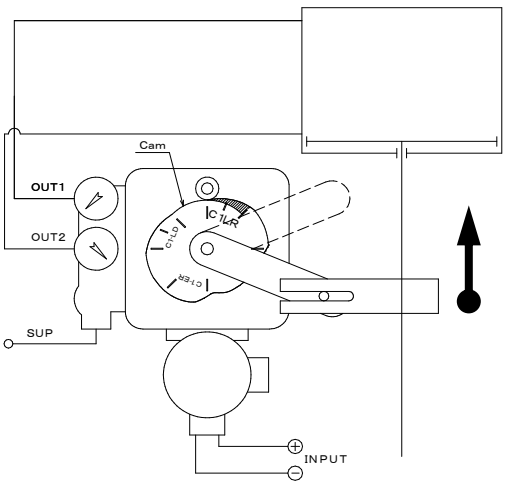
3) Use supply air that has been dried and filtered.

∗Use a filter around the supply air nozzle that has a filtration value of less than 5um.

∗Inappropriate supply air can cause malfunctioning and shorten the product's life-span.

4) Regulate the supply pressure to the required pressure, using for example air filter (pressure reduction valve with filter attached, provided by 3S).

5) When double acting type is used as a single acting type, blind OUT 2 connector nozzle (or OUT 1 when used as reverse action pilot), remove the pressure gauge and blind that port also.

Piping for single action	Piping for double action
Action: Stem falls by input signal increase	Action: Stem falls by input signal increase
	
Action: Stem rises by input signal increase	Action: Stem rises by input signal increase
	

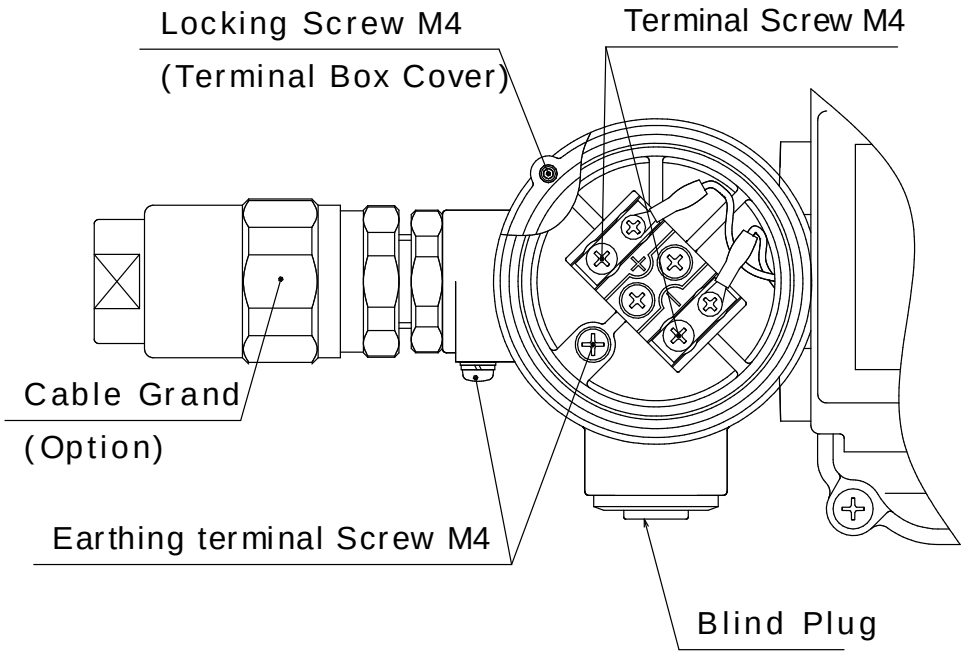
For single action/reverse action pilot (the method of using OUT2 with reduced output by input signal increase), see page 11.

(2) Electric Wiring

⚠ Warning

・When wiring, Please turn off the power.
・Please installing in accordance with local recommended.
・When using flame-proof equipment at hazardous areas, always wiring in accordance with 『ANNEX1 Instructions about Flame-proof type Equipment』.
・Be sure to close the unused connection port with a blind plug .

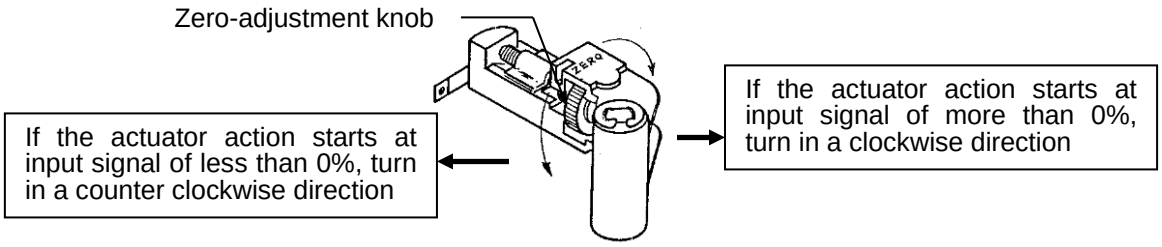
1) Remove Terminal Box Cover and connect wires to the terminal block with insulated terminals. Connect Input signal (+) and (-) wires to the (+) terminal [Red] and (-) terminal [Blue] respectively.
2) Choose one of the two connection ports to ensure the most suitable arrangement for the wires.
3) Impact on Positioner and use of excessive force during wiring works may result in deterioration in performance.
4) Apply a sealant to the threads of the connection port for waterproofing.
5) Please be sure to connect Earthing terminal with a cable lug surely.
6) The earth connection shall be mounted so that it is secured against loosening and twisting.



7. Adjustment

(1) Zero point adjustment

1) Set input signal to the stroke starting signal (4mA) then turn the zero adjustment knob clockwise or counter clockwise. (Because the Cam has valve closing function, adjust by the valve in closed position)



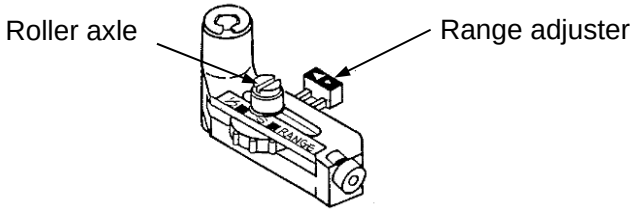
2) For Zero Point Adjustment, we recommend checking output pressure as well as the stroke. The table below shows output pressure when emphasizing tight-shut

Output pressure gauge	Double Acting		Single Acting	
	RA	DA	RA	DA
OUT1	O	MAX	O	(※1)0.12～0.14
OUT2	MAX	O	—	—

(Units: MPa) ※1When diaphragm actuator is SUP0.14MPa (a range of 0.02 – 0.1MPa)

(2) Range adjustment

Adjust Range Adjustment so that actuator stops at 0% position of the stroke by the 0% applied input signal and 100% position for 100% input signal respectively. (When Stopper or Valve Seat exists at the 100% or 0% position of the actuator, the adjustment is made between the 10% - 90% position or, otherwise, 25% - 75% position)



① At first Zero Adjustment is carried out.

② Check the actuator stroke is positioned at 100% when 100% input signal is applied. Checking for the input signal and stroke has to be done carefully because over-ranged adjustment causes over-traveling in the actuator stroke, before the input signal reaches 100%.

③ Use the controls on the range adjuster ◁ ▷ as marked. The large mark is to increase the range; the small mark is to decrease the range.

④ The Range Adjuster can be free to move by loosening the roller axle slightly using a screw driver.
Holding the roller axle in place with the screw driver used to loosen the axle, move and adjust the Range Adjuster and lock it again.
Do not loosen too much because the roller axle will be slanted and its adjustment will become unreliable due to the zero-shifted stroke.

⑤ Range adjustment and zero adjustment is carried out alternately.

⑥ If Range adjustment cannot be achieved by full range movement of the Adjuster, check the position of the transmission pin on the feedback lever.

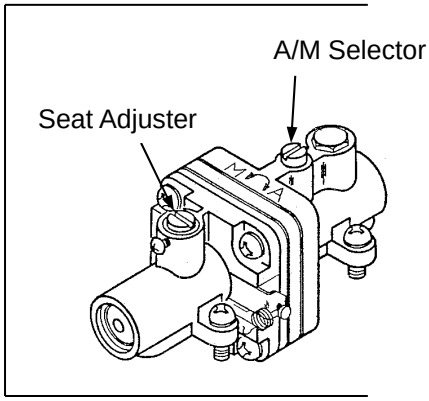
Caution! Actuator may move when the screw driver is close to the unit.

(3) Seat adjuster

1）The Seat adjuster has the function to adjust the pressure balance of the output pressures. At the time of shipment, the output pressure balance is adjusted to specified balance point (75% - 80% of the supply pressure).
Thus, do not adjust unless you have accidentally turned the seat adjuster.
Incorrect operation can result in malfunction.

2）Adjusting the balance pressure helps the following issues. When adjusting follow the directions detailed in 10.3, Troubleshooting/ Insufficient performance. Contact 3S before carrying out any adjustments.

① Alleviates 'hunting' phenomenon (High Pressure Balance)
② Reduction in Hysteresis. (shifting balance point)



(4) A/M Selector

A/M Selector is a valve for changing between Auto and Manual

1） When using in Auto mode, turn the Selector towards A (clockwise) until it stops.
(When shipped products are set to Auto)

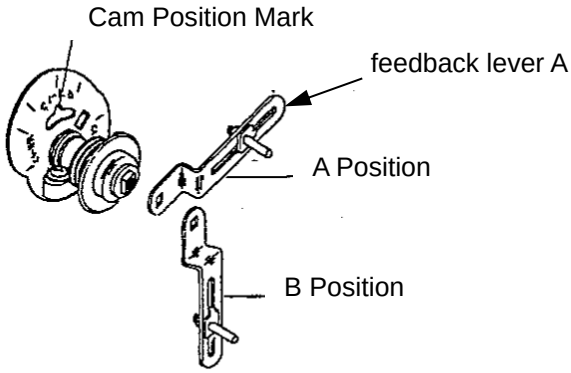
2） To use in manual mode turn the Selector to M .
(counter-clockwise, more than one quarter up to one and a half turns)
The actuator can be operated in manual mode adjusting the supply pressure reduction valve.
Not available for Single Acting-OUT2 and Double Acting.

(5) Linearity adjustment

Insufficient linearity can be caused by misalignment of Cam position (pointers position) when positioning the closed valve.
If this occurs, carry out readjustments on the bracket and/or clamp while checking the positioning of the pointers.
See page 5, Adjustment of Installation Position, for adjustment range.

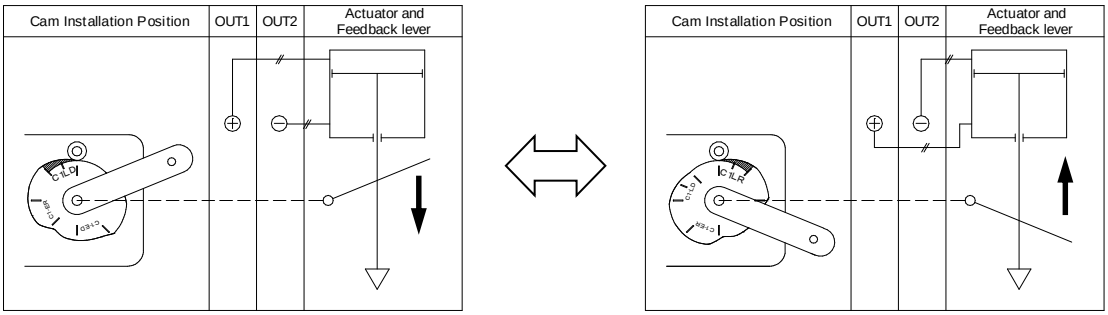
8. Change of operation

There is no need to turn the Cam over to change direct action of the actuator, instead change the installation position of the feedback lever.
For double-acting type, exchange OUT1 and OUT2 output piping.



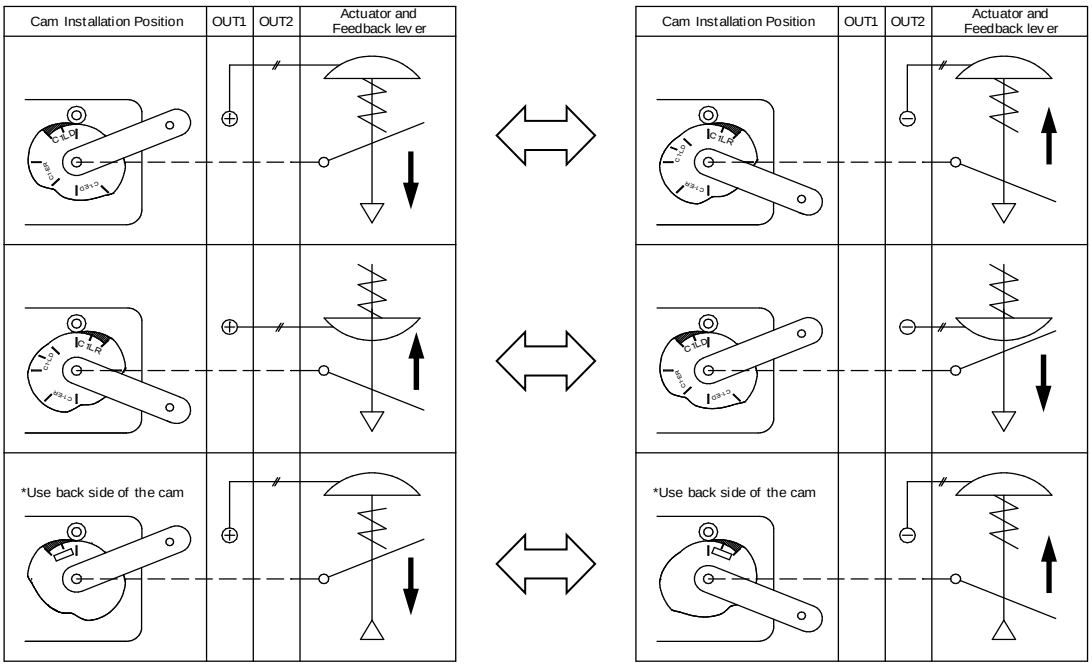
(1) Double acting

① Exchange OUT1 and OUT2 piping.
② Remove the screw from feedback lever A, and remove the lever from the Cam shaft.
③ Set feedback lever A in the direction as indicated on the Cam shaft
④ Adjust Zero and Span adjustments.



(2) Single acting

※For reverse action pilot



※ For reverse acting pilot (increase in signal input and decrease in output) follow the guidance below.

① Remove screw plug from OUT2
② Move piping and output gauge from OUT1 to OUT2.
③ Set the screw plug from OUT2 to OUT1.
④ Remove TP screw from feedback lever A and feedback lever from cam shaft.
⑤ Set the feedback lever in the direction appropriate.
⑥ Adjust Zero and Range Adjustments.

9. Maintenance

9-1 Regular inspection

Carry out regular inspections for maintenance.
Refer to the Regular Inspection Manual below.
Refer to pages 1, 2 and 18 for unit names and position of parts.
For maintenance of Flame-proof type Equipment, see “ANNEX1”.

- Table of Regular Inspection Manual-

○: Check (Replace defective parts) ◇: Cleaning ■: Replace △: Greasing※5

Unit	Check point	Checking period (Year)										Summary of checking contents
		0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	
Base & Cover	Supply pressure filter		◇				◇				◇	Foreign objects, dust
	Pressure gauge		○		○		○		○		■	Indication error
	Cover packing						○				■	Defects
Zero & Range Arm	Shaft holder		△				△				△	Greasing
	Bearing						○				○	Damage, wear
	Zero-adjustment plate										○	Wear
Cam & Lever	Cam Plate										○	Wear
	Cam Shaft/Spring						△				△	Wear/Greasing
	Transmission Pin		△				○				○	Wear
	Cam Shaft packing		○				○				■	Defects
Torque motor unit ※1	Magnet Yoke/etc		◇				◇				◇	Metal dust
	Flexure spring										○	Loose screws
	O-ring										○	Defects
	Nozzle, flapper		◇				◇				◇	Dirt / Wear&Tear
Pilot Relay unit ※3	Fixed Orifice ※4 Filter mesh (when cleaner attached)		○		○		○		○		○	Dirt, clogging
Terminal box ※2	Terminal, O-ring						○				○	Loose screws Greasing

Note1. Dismantling the Torque motor unit (※1) and Terminal box (※2) can harm the **performance of the flame-proof characteristics and is prohibited**.

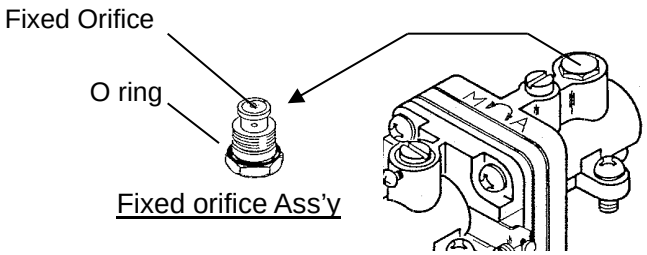
Note2. Dismantling the Pilot Relay Unit (※3) can harm the **performance of the flame-proof characteristics and is prohibited**.

Note3. Change the Pilot Relay Unit every five years using the units provided.
∗ Determine the exchange period based on the conditions of use (frequency, opening and closing speed) and ambient range of temperature.

Note4. Before cleaning the fixed orifice (※4), always cut off the supply air pressure and check that no residual pressure remains.

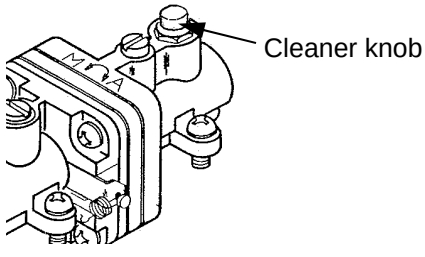
Note5. Perform the greasing in our factory. When it is necessary, place an order to us.

No-cleaner type



When Filter mesh is dirty or clogging, clean with cleaning air. Remove the orifice Ass’y from the pilot relay unit, and clean with 0.3 diameter piano wire and cleaning air.

Cleaner type



Push the cleaner knob (red), and dispose of rubbish

9-2 Replacing or changing unit parts

(1) Replacing pilot relay unit

Before replacing parts, always cut off the supply air pressure and check that no residual pressure remains.

【Removing】

① Remove the stabilizer spring from the hanger using tweezers .

＊Be careful not to bend or stretch the stabilizer spring.

② Remove the four installation screws (M4 Cross Recessed Head screws), and remove the Pilot Relay Unit.

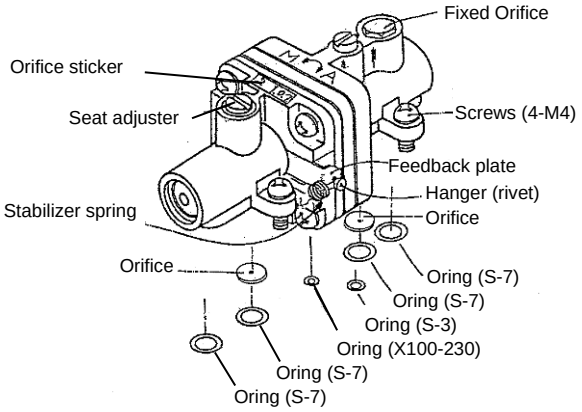
＊When removing, check to make sure that O-ring on the Pilot Relay side is not still attached to the base side.

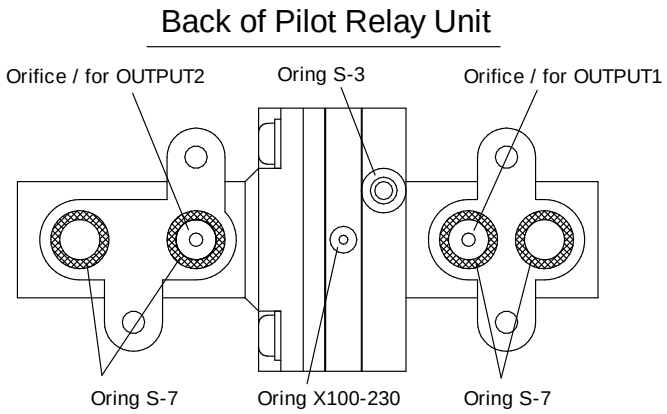
【Installation/checking】

① Before installing the new Pilot Relay Unit, check that all the O-rings on the install seating are attached.
Check particularly for S-3 and X100-230 O-rings, which are small and can get lost during removal of the unit.

② Set the new Pilot Relay Unit on the base, fix in place with the four installation screws and then hang the stabilizer spring to the hanger.

③ After finishing installation the Pilot Relay Unit, check the operation and hysteresis.
Check that there is no breathe sound to indicate air release from the base of the Pilot Relay Unit installation. A loud breathing sound could suggest major air release, in which case check that the 0-rings are attached correctly.





(2) Changing the orifice

When using small capacity actuator, hunting (or overshooting) may occur. If this happens, replace the orifice according to the capacity of the actuator (Pilot Relay attachment) in accordance with the guidelines below.

Actuator capacity (litres)	Orifice diameter (ϕ)
0.5～0.7	0.7
1.0	1.0
2.0＜V	2.0 5.0 (when increasing action speed)

① After removing the Pilot Relay Unit following the replacement guidelines in (1) above, remove O ring (S-7) and orifice of the unit back side, and the orifice to be replaced.

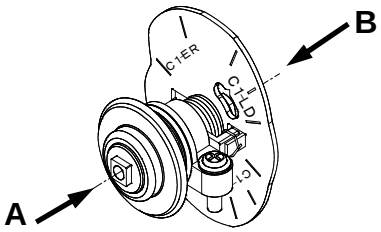
② After replacing with the specified orifice, attach the O-ring (S-7), and install the Pilot Relay Unit and Stabilizer Spring.

※Circle the appropriate figures for the diameter of the new orifice on the orifice diameter sticker.

③ After replacement, follow the guidelines above, and check activity and functionality.

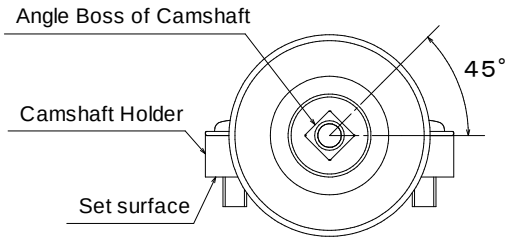
(3) Changing to Eq% Cam characteristics

When changing from linear-characteristic to equal percentage characteristic, it is necessary to remove the Cam from the base and reset the Cam & Shaft Unit.
The procedure is described below



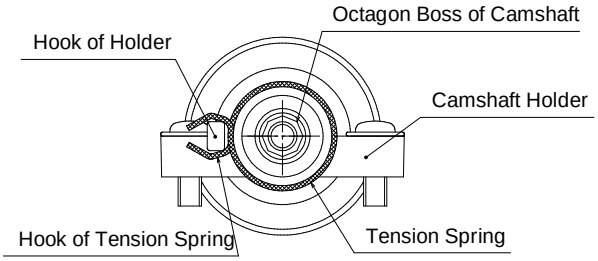
① Set the angle boss position

Look the cam shaft from the direction of arrow A (Fig.1). Turn the shaft's flat surface is slanted at a 45° angle as shown in the illustration on the right.



② Tension spring setting

Turn the Cam shaft holder and look from the direction of arrow B.
In this state set the tension spring in the spring holder so that the spring hooks are in a cross shape as shown in the illustration.

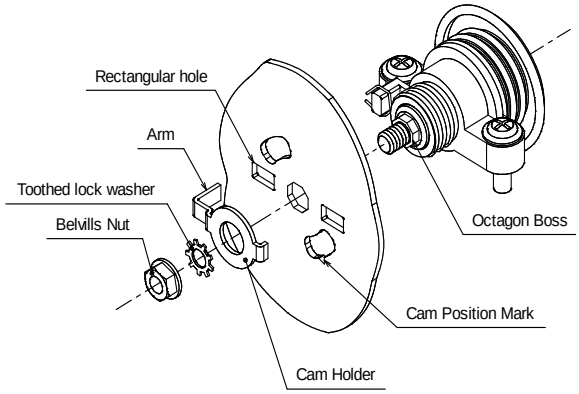


③ Inserting the cam into the cam shaft

When setting the cam's symbol side as the reverse side in the near-Eq% characteristic, move the cam position mark to the lower right and insert into the cam shaft octagon boss.
(For linear-characteristic rotate the can 180° , so that move the cam position mark locates the upper left)

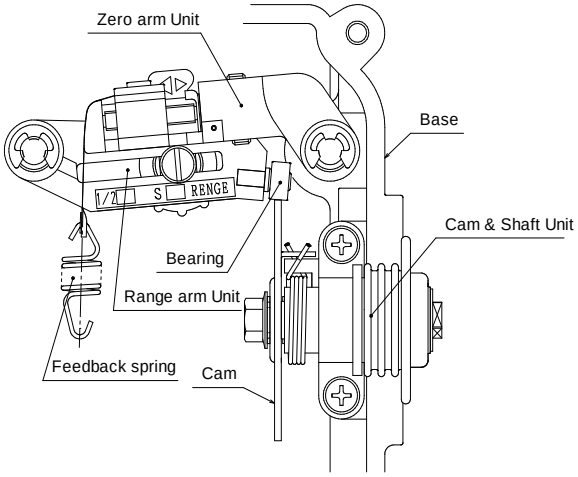
④ Cam holder installation

When the cam is inserted, the cam rectangular hole and the spring holder position are aligned.
In this state, pass the cam holder through the cam rectangular hole and insert it in where the tension spring hooks are crossed and then set the arm.
Next, insert the toothed lock washer and then screw on the belvills nut and tighten it firmly.
(At this time be careful that the tension spring does not come between the cam and the cam shaft holder).
Finally check that the Cam runs smoothly.



⑤ Cam shaft unit installation

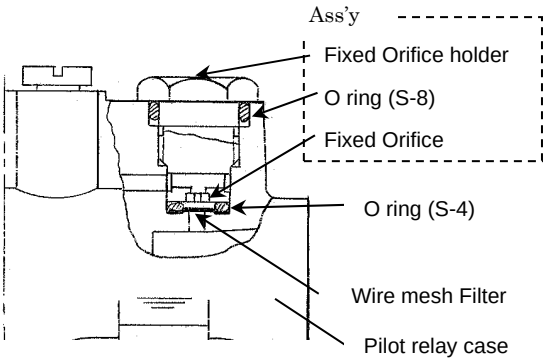
Fit the assembled Cam & shaft Unit to the positioner.
Lift up the arm using your finger to avoid damaging range-arm unit end bearings.
Also be careful not to install the unit in reverse.



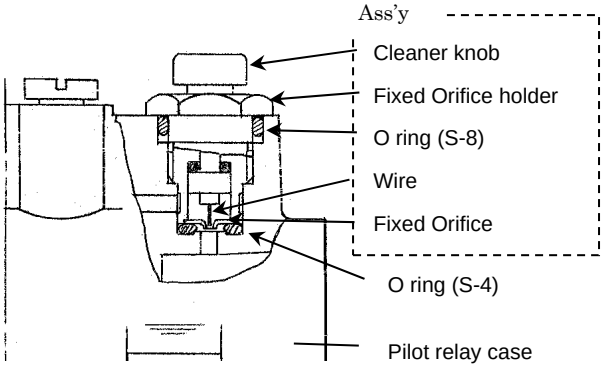
(4) Replacing Fixed orifice Ass'y

The fixed orifice ass'y comes in versions with cleaner attached and without cleaner.
(Internal construction differs. See figure below.)

Follow the guidelines below when converting from non-cleaner to cleaner-attached versions to avoid problems arising by quality of supply air. (When converting, always cut off the supply air pressure and check that no residual pressure remains).



Without cleaner



With cleaner

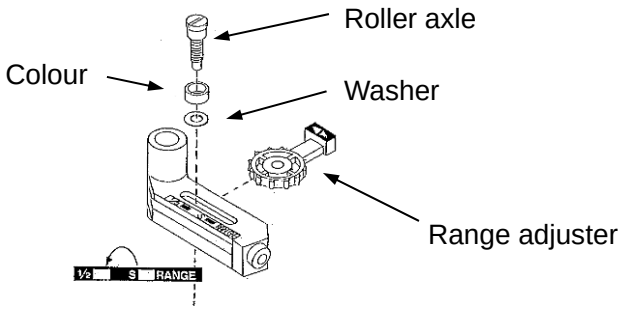
① Use an spanner and remove the fixed orifice ass'y from the Pilot Relay Unit.
② Using a tool such as tweezers, remove the O-ring and mesh filter from the fixed orifice ass'y installation holes. (Use new O-ring (S-4) for exchange)
③ If the fixed orifice ass'y installation holes are dirty, clean by method such as applying air pressure to the area.
④ Re-attach the O-rings (S-4) to the holes. (Do not use the mesh filter)
⑤ Install the new fixed orifice ass'y and check operations.
∗ At this point check that O-ring (S-8) is attached to the fixed orifice ass'y.

(5) Changing to split range

When converting to Split Range remove the roller shaft as shown below, then adjust as described above after repositioning the Range Adjuster gears to the 1/2 mark.

For 4-12mA range: Adjust to 4mA at 0% and 12mA at 100%.

For 12-20mA range: Adjust to 12mA at 0% and 20mA at 100%.



10. Troubleshooting

1) Not operating with Input Signal applied

Identification and assessment of problems can be done by gently moving the counter block (with flapper attached) by hand and attaching it to the nozzle and checking the output pressure.

Check at Counterblock	Cause	Action
When counterblock is moved, output pressure is activated/switched normally	Incorrect wiring (+/-)	Tighten or correct wiring
	Torque motor is open or short circuited	Replace Torque Motor Unit （※）
	Loose or incorrectly mounted feedback lever	Tighten or re-mount
When counterblock is moved, output pressure keeps high	Orifice or cleaner orifice is jammed	Clean or replace/press cleane knob
	Incorrect replacement of A/M selector	Tighten towards arrow A (clockwise)
	Incorrect flapper contact, broken flapper	Replace Torque Motor Unit （※）
When counterblock is moved, output pressure keeps low	Low or no supply pressure	Check Reducing Valve, or original pressure
	Jammed nozzle	Replace Torque Motor Unit （※）
	Faulty pilot relay unit	Replace pilot relay unit

2) Malfunction

Issue	Cause	Action
Incorrect zero position	Loose feedback lever connection	Tighten and readjust
	Metal material near cover	Remove materials and readjust
Wrong stroke	Transmission pin wrongly positioned	Tighten and readjust
	Cam wrongly positioned	
	Loose range adjuster roller shaft	
Operation is not smooth	Loose set or lock screws	Tighten and readjust
	Cam shaft worn out	Replace if backlash is too big
Wrong linearity	Feedback lever setting is wrongly positioned	Correct setting
	Cam is worn out	Replace cam and readjust
Response time is slow (both wasy)	Supply port screen is clogged	Clean
	Filter of reducing valve is clogged	Replace filter
Extremely slow response (one way, OUT1 pressure hard to raise	A/M selector not completely closed	Rotate to arrow A (clockwise)
	Clogged orifice	Clean or replace
	Incorrect contact between nozzle and flapper	Replace Torque Motor Unit （※）

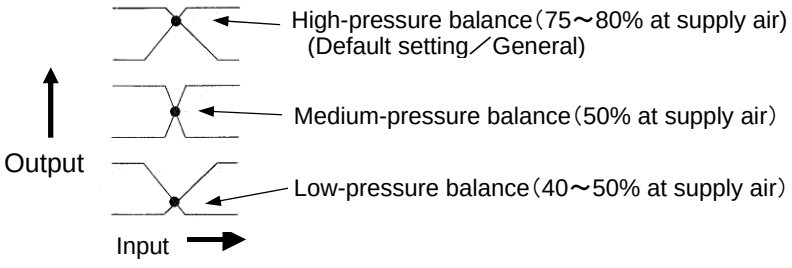
※Torque Motor Units shall be replaced in the 3S factory.

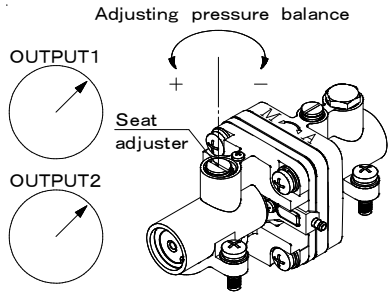
3) Insufficient Performance

Issue	Cause	Action
Fast Cycle Hunting	Fixed orifice becoming clogged	Clean or replace
Slow Cycle Hunting	Grand packing worn out	Increase the actuator size
	Insufficient actuator strength	Replace grand packing or increase actuator size
	Pilot relay balance pressure too low	Adjust seat adjuster (※)
Overshoot	Pilot relay balance pressure too low	Adjust seat adjuster (※)
	Delayed transmission of feedback circuit	Check wearing and backlash
Jumping	Insufficient actuator torque	Increase the actuator size
Knocking	Pilot relay balance pressure too low	Adjust seat adjuster (※)
	Actuator defect	Switch to manual mode, check and repair
	Lack of supply pressure capacity or clogged SUP filter	Increase reducing valve size and clean or replace
Large hysteresis	Feedback circuit is worn	Tighten loose screws/replace defective equipment
	Balance pressure not adjusted	Readjust seat adjuster (※)
Poor response	Problem with balance pressure	Readjust seat adjuster (※)
	Damaged, dirty or mispositioned nozzle/flapper	Replace torque motor (SSS will replace)

(※) Adjusting the Seat Adjuster

If the Seat Adjuster is turned in the wrong direction, and emergency recovery is required, follow the guidelines below.





① Plug output1 and output2 of positioner, change input signal so that output pressure balance, and check the output pressure at balancing point.

If the situation does not allow removing positioner from actuator, change input signal so that actuator balance at intermediate point, anywhere half close/half opened and check the pressure inside cylinder at balancing.

(Depending on the actuator model, it is difficult to adjust positioner properly with actuator connected.)

(Warning: When air escapes from between the positioner and actuator, the balance point becomes lower)

② When lowering the balance point, rotate the Seat Adjuster clockwise, and when raising the balance point rotate in an counter-clockwise direction. (After rotational adjustment (about 1/10 of a full rotation), change the input signal and check the output pressure balance point.

If the value falls outside the standard range for adjustment, rotate slightly in either direction as required.

■The maximum rotation range is 1/4 of a full rotation. Excessive rotation will damage the unit.

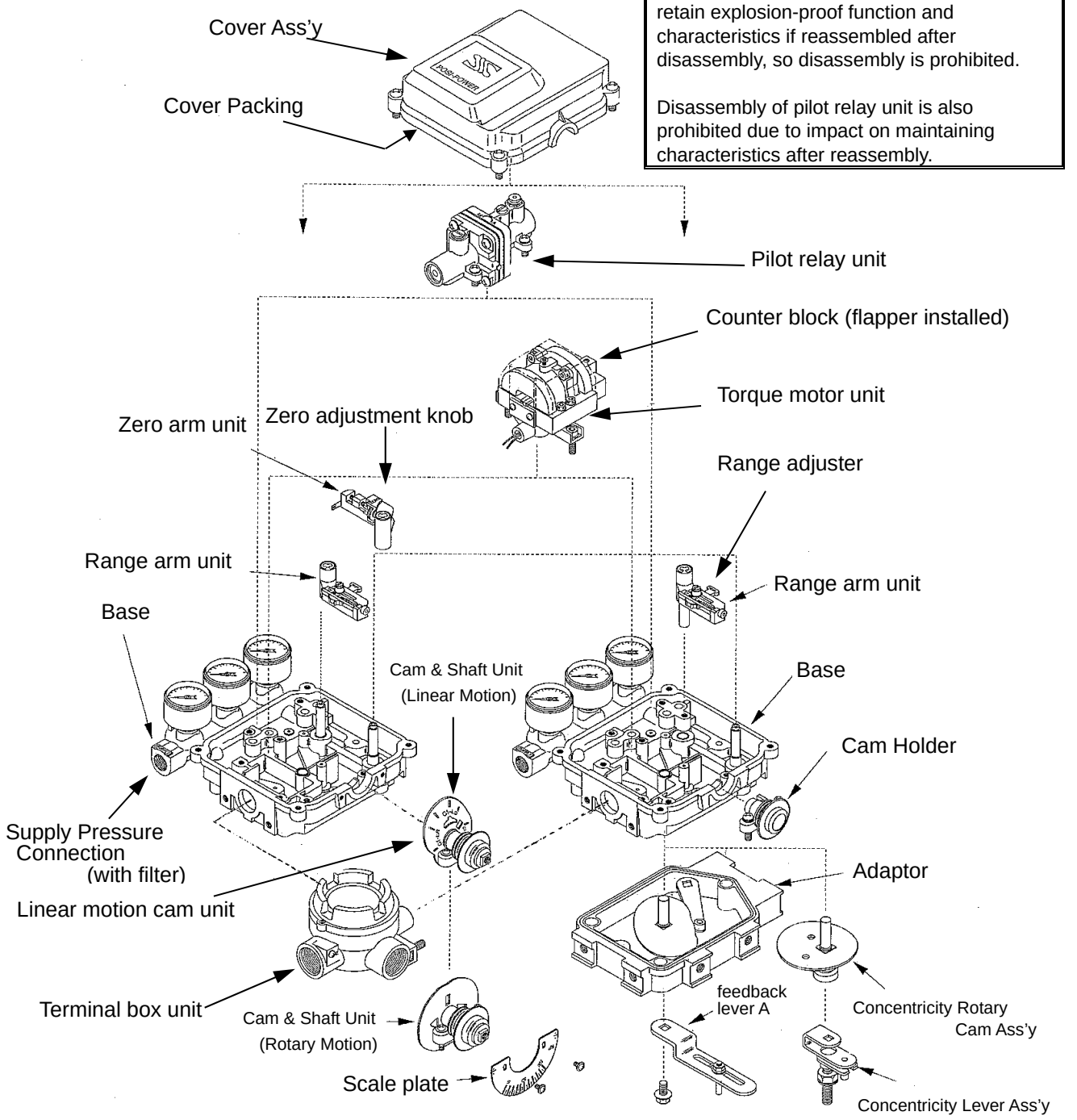
■A difference in the effective surface area of pistons on either side, a spring inserted from one side, heavy loading can all cause pressure difference between OUT1 and OUT2. In such cases, set the higher pressure as standard.

11. Part names (common to XE models)

－Disassembly prohibited－

The circuit box and torque motor may not retain explosion-proof function and characteristics if reassembled after disassembly, so disassembly is prohibited.

Disassembly of pilot relay unit is also prohibited due to impact on maintaining characteristics after reassembly.



Linear motion (Side lever type)	Rotary motion (Link lever type)	Linear motion (Back lever type)	Concentric motion (Back lever type)
S1	S3	B4	B7

12. Model notation

Basic Model

MODEL	Code	Description	
UNIT	**XE**	ElectroPneumatic	
Series	**1**	100Series	
Housing	**0**	Standard Type	
	5	Ex d IIB T6 II 2G Ex d IIB T6 Gb Ex d IIB T6 Gb Ex d IIB T6	(TIIS) (ATEX) (IECEx) (KOSHA)
	6	Ex d IIB+H_2 T6 II 2G Ex d IIB+H_2 T6 Gb Ex d IIB+H_2 T6 Gb Ex d IIB+H_2 T6	(TIIS) (ATEX) (IECEx) (KOSHA)
Function and connections	**1**	Rc(PT)1/4 Single acting	
	2	Rc(PT)1/4 Double acting	
	3	NPT1/4 Single acting	
	4	NPT1/4 Double acting	

Auxiliary Model

MODEL	Code	Description
(∗1) Ambient Temp. Range	**S**	Standard: −20～83℃ Flameproof: −20～60℃
	L	−50～60℃
	H	0～100℃
Mounting method	**S1**	Linear motion / Side lever type
	S3	Rotary motion / Link type
	B4	Linear motion / Back lever type
	B7	Concentric Rotary motion

∗1: The Flameproof type is only available for the standard product(s)

Additional model

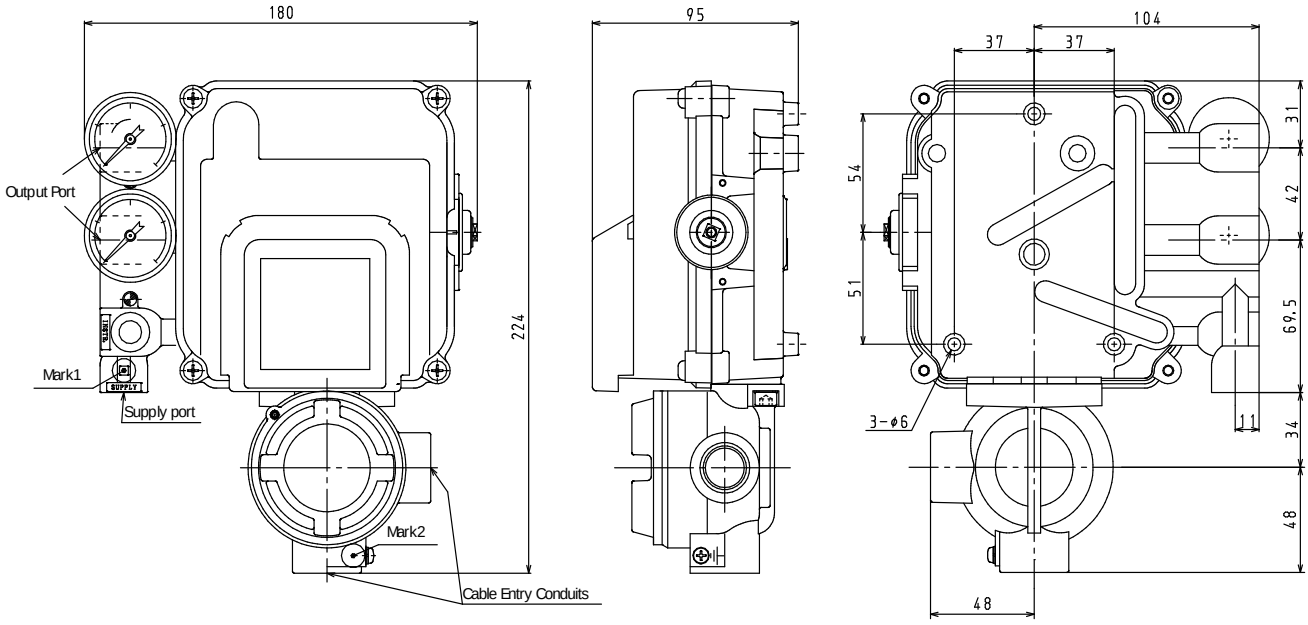
MODEL	Code	Description
(*2) Outlet Pressure gauge	**M2**	0.2MPa
	M4	0.4MPa
	M0	1.0MPa
	K2	200kPa
	K4	400kPa
	K0	1000kPa
	P2	30psi
	P4	60psi
	P0	150psi
	B2	2bar
	B4	4bar
	B0	10bar
Pilot Relay: Cleaner and Orifice	F1	Standard type : without cleaner / Orifice Dia φ5.0
	F2(STD)	Standard type : without cleaner / Orifice Dia φ2.0
	F4	Standard type : without cleaner / Orifice Dia φ1.0
	F5	Standard type : without cleaner / Orifice Dia φ0.7
	F6	Standard type : without cleaner / Orifice Dia φ0.45
	Q1	Standard type : with cleaner / Orifice Dia φ5.0
	Q2	Standard type : with cleaner / Orifice Dia φ2.0
	Q4	Standard type : with cleaner / Orifice Dia φ1.0
	Q5	Standard type : with cleaner / Orifice Dia φ0.7
	Q6	Standard type : with cleaner / Orifice Dia φ0.45
	G1	Stability type : without cleaner / Orifice Dia φ5.0
	G2	Stability type : without cleaner / Orifice Dia φ2.0
	G4	Stability type : without cleaner / Orifice Dia φ1.0
	G5	Stability type : without cleaner / Orifice Dia φ0.7
	G6	Stability type : without cleaner / Orifice Dia φ0.45
	J1	Stability type : with cleaner / Orifice Dia φ5.0
	J2	Stability type : with cleaner / Orifice Dia φ2.0
	J4	Stability type : with cleaner / Orifice Dia φ1.0
	J5	Stability type : with cleaner / Orifice Dia φ0.7
	J6	Stability type : with cleaner / Orifice Dia φ0.45
	R1	High Rangeability Type : without cleaner / Orifice Dia φ5.0
	T1	High Rangeability Type : with cleaner / Orifice Dia φ5.0
Input Signal (DC)	**M1**	4～20mA
	M2	4～12mA
	M3	12～20mA
Function and connections	**C1a**	Linear motion/45° 4Phase linear/Eq%
	C3L	Linear/rotary/90° 2Phase/linear
	C3E	Linear/rotary/90° 2Phase/Eq%
	C3B	Linear/rotary/90° 2Phase/square-law
	C3P	Linear/rotary/90° 2Phase/reverse Eq%
	C4La	Linear motion/45° 4Phase/linear
	C7L	Rotary/concentric/90° 2Phase/linear
Lever & Clamp	LOO	Linear motion/side lever type or Multi-stage lever combined with clamp
	lOO	Multi-stage lever combined without clamp
	DOO	Direct lever combines/with clamp
	dOO	Direct lever combines/without clamp
	KOO	Linkage lever type rotary motion or Linkage lever combined/with clamp
	kOO	Linkage lever combined/without clamp
	HOO	Linear motion/back lever type or L type lever combined/with clamp
	hOO	L type lever combined/without clamp
	VOO	Concentric rotary motion or Concentric rotary combined/M8 screw combin

Note) Model notation in bold type is for standard and in normal type for optimal specifications

*2: Contact 3S for psi, bar displays (only NPT)

13. Outline Dimension

[unit : mm]



Air Connection Port

Supply Port	Output Port	Gauge Port	Mark 1
Rc1/4	Rc1/4	Rc1/8	–
NPT1/4	NPT1/4	NPT1/8	N
Rc1/4	Rc1/4	NPT1/8	Z

Cable Entry Conduit

Cable Entry Conduit	Mark 2
G1/2	G
NPT1/2	N
M20×1.5	M

ANNEX1
Instructions about Flame-proof type Equipment

1. Introduction

When using flame-proof equipment, thoroughly review the notes on this clause, please use it correctly.

2. Electrical Equipment of Flame-proof Construction

The flame-proof construction is of completely enclosed type and its enclosure shall endure explosive pressures in cases where explosive gases or vapours entering the enclosure cause explosion.
In addition, the enclosure construction shall be such that flame caused by explosion does not ignite gases or vapours outside the enclosure.

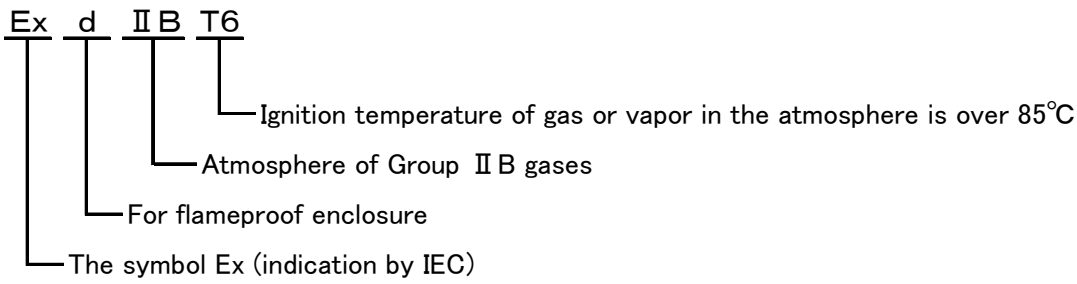
3. Installation of Flame-proof Equipment

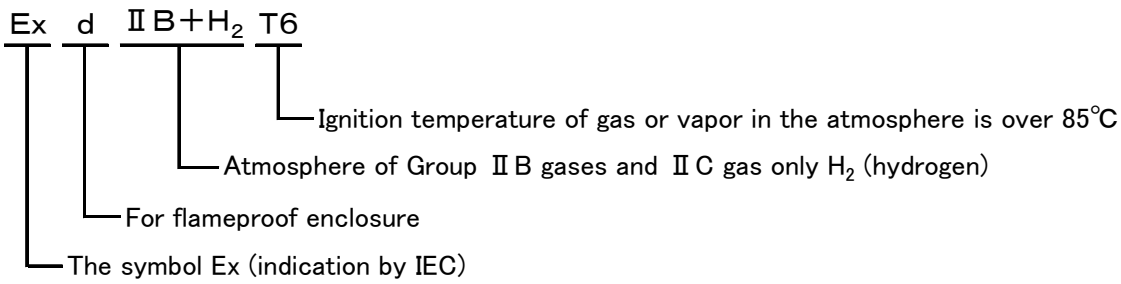
For installation, please select according to the following conditions.

（1）Installation Area

Hazardous area that can be installed in 3S flame-proof equipment is defined as follows.
Using flame-proof equipment is listed in the displayed nameplate.
Thoroughly review the specifications, please use it correctly.

【TIIS Flame-proof】

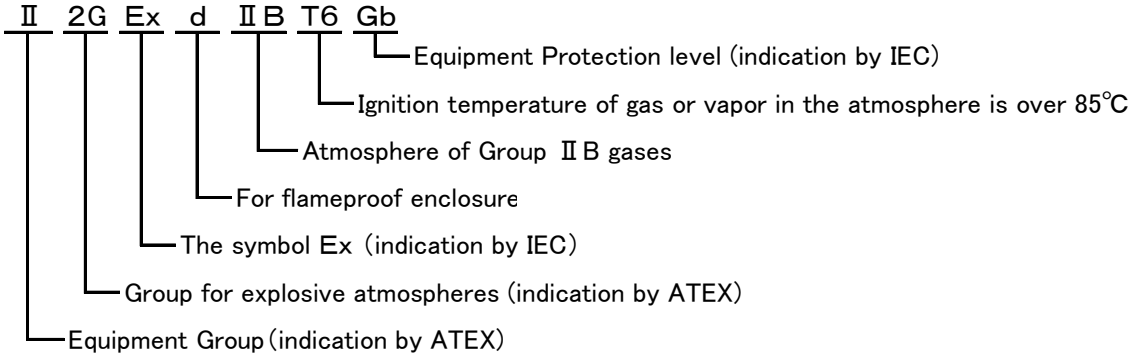


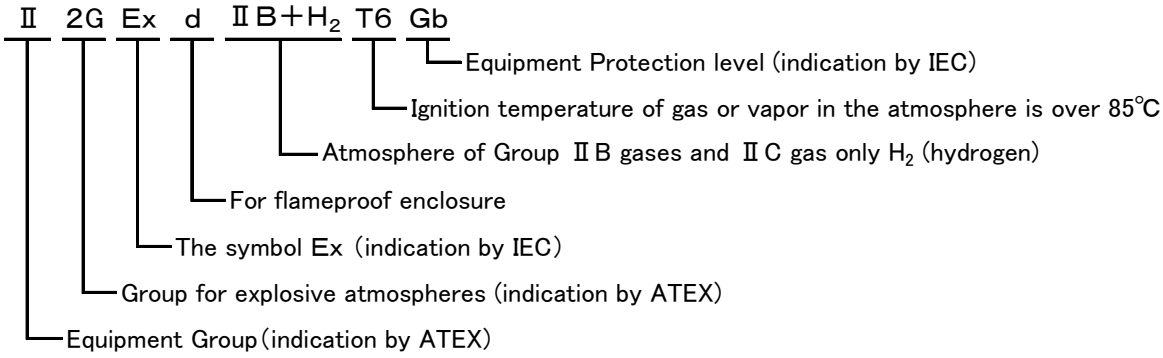


Flame-proof equipment may be installed, with targeted gases, in a hazardous area in Zone 1 or 2.

Flame-proof equipment shall not be installed in a hazardous area in Zone 0.

【ATEX Flame-proof】

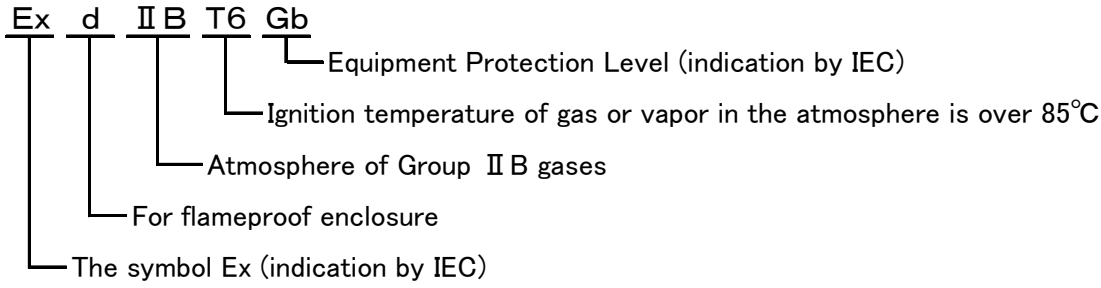


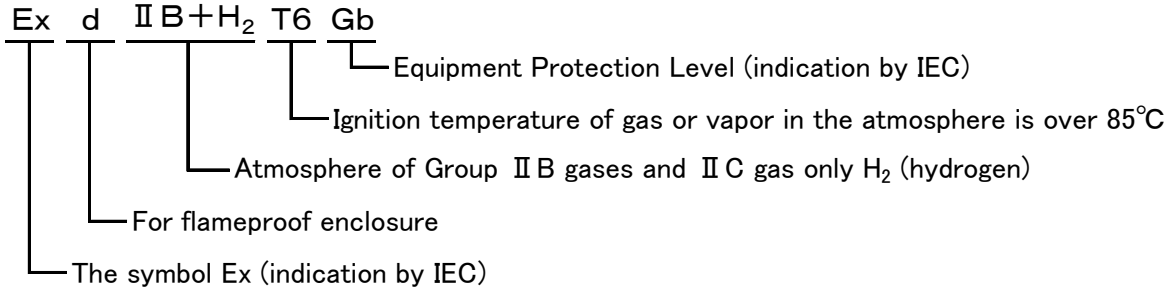


Flame-proof equipment may be installed, with targeted gases, in a hazardous area in Zone 1 or 2.

Flame-proof equipment shall not be installed in a hazardous area in Zone 0.

【IEC Flame-proof】

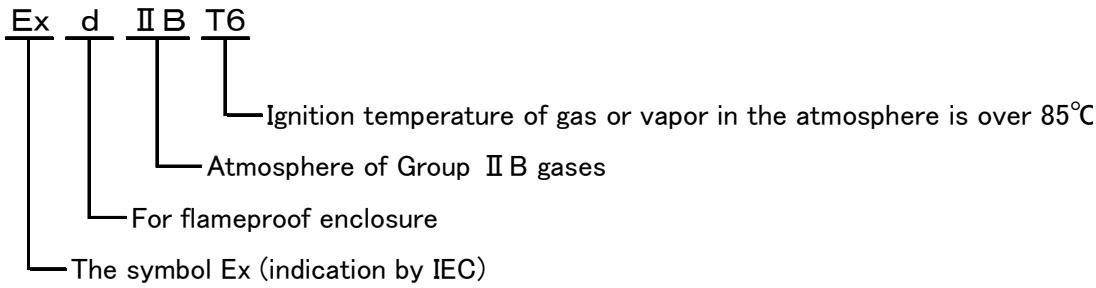


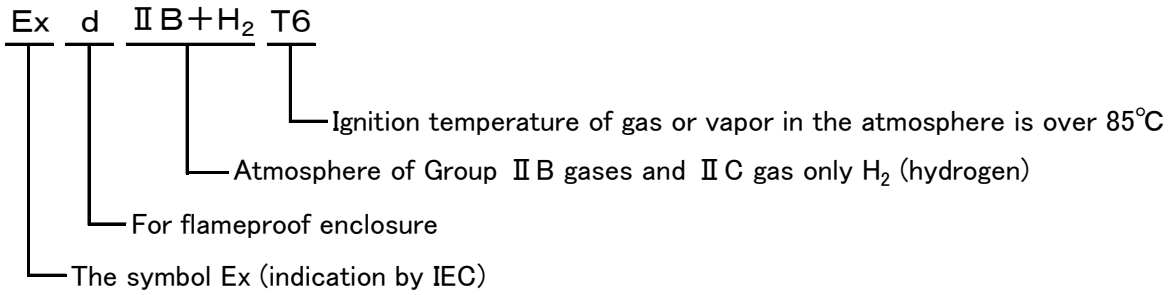


Flame-proof equipment may be installed, with targeted gases, in a hazardous area in Zone 1 or 2.

Flame-proof equipment shall not be installed in a hazardous area in Zone 0.

【KOSHA Flame-proof】





Flame-proof equipment may be installed, with targeted gases, in a hazardous area in Zone 1 or 2.

Flame-proof equipment shall not be installed in a hazardous area in Zone 0.

(2) Environmental Conditions

The temperature range for XE100 series positioner of flame-proof type is certified at an ambient temperature range from -20℃ to +60℃.

This is also indicated on the nameplate.

When using the equipment, please operate in the ambient temperature range.

4. Marking

【TIIS Flame-proof】

Following the Labor Safety and Health Laws of Japan, XE100 series positioner is certified by Technology Institution of Industrial Safety (TIIS), and approved to use in a hazardous area. Positioner is certainly installed certification label and equipment nameplate.

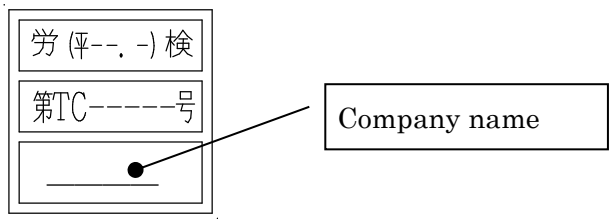
- Specification of Flameproof ⅡB -

ELECTRO-PNEUMATIC POSITIONER	B56
MODEL	XE15 - / -R1
SUPPLY	0.14~0.7MPa/140~700kPa
INPUT	~ mADC
AMBIENT TEMP	-20℃ ~ 60℃
EXPLOSION PROOF	ExdⅡBT6
SER. NO.	20

- Specification of Flameproof ⅡB+H_2 -

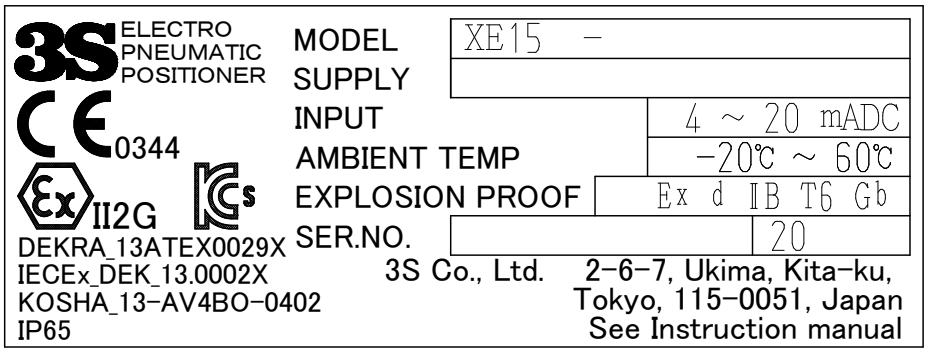
ELECTRO-PNEUMATIC POSITIONER	B55
MODEL	XE16 - / -R1
SUPPLY	0.14~0.7MPa/140~700kPa
INPUT	~ mADC
AMBIENT TEMP	-20℃ ~ 60℃
EXPLOSION PROOF	ExdⅡB+H_2T6
SER. NO.	20

- Certification Label -

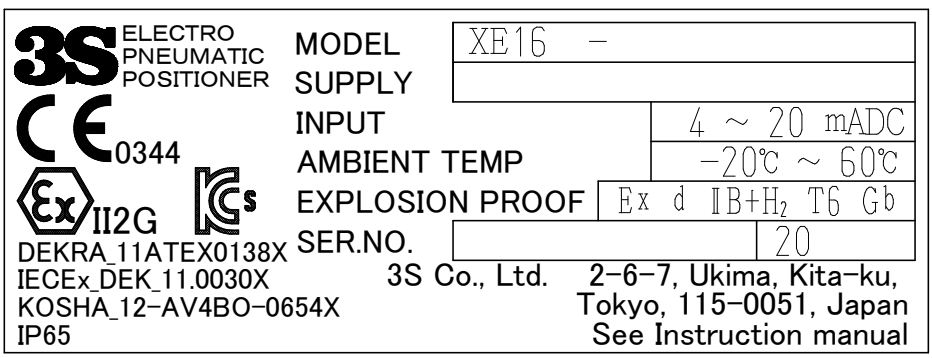


【ATEX & IEC & KOSHA Flame-proof】

- Specification of Flameproof ⅡB -



- Specification of Flameproof ⅡB+H_2 -



5. Wiring of Flame-proof Equipment

【TIIS Flame-proof】

1. Please use designed cable gland and blind plug for electric conduit connection, when using this positioner as flame proof equipment. (One blind plug attached.)
2. If XE100 series Positioner has flame-proof construction, both conduit fitting type and packing type are available for the wiring.

① Flame-proof conduit fitting type

Use rigid steel conduit (16) G1/2 or equivalent, and conduit and connect using a lock nut for rigid steel conduit and tighten firmly.
Alternatively use sealing fitting around the vicinity.
Apply a sealant to the threads of the connection port for waterproofing.

② Flame-proof packing type

For cable wiring of Flame-proof packing type, cable glands specified or supplied with the equipment shall be directly attached to the wiring connections to complete sealing of the equipment.
Apply a sealant to the threads of the connection port for waterproofing.
Cable gland used for exterior lead instrument of flame-proof equipment has been approved in combination with flame-proof equipment.
Accordingly, please use the following Cable gland specified by us. Also, please select the correct size to fit the cable used.

Cable gland specified by 3S

Cable gland code	Fit cable size	Manufacturer
KHB-0-16/PK1610	φ8 ～φ10	Ex-Kokusan
KHB-0-16/PK1611	φ9 ～φ11	
KHB-0-16/PK1612	φ10～φ12	

※ **After installing the Terminal Box Cover, lock the cover using a set screw required of flame-proof construction.**

※ **Details of flame-proof structures can be found in the report “Recommended Practices for Explosion-Protected Electrical Installations in General Industries”, issued by the National Institute of Occupational Safety and Health, Japan.**

【ATEX & IEC & KOSHA Flame-proof】

For wiring connection port of positioner, use cable gland and bling plug corresponding positioner certificate class (Ex d IIB / Ex d IIC) or specified by us.
Please use the cable gland is selected with the correct size to fit the cable used.
Apply a sealant to the threads of the connection port for waterproofing.
For the wiring, please conduct in accordance with national legislation of the country to be used.
When the earth connection a cable lug, it shall be between spring washer and plain washer.

6. Maintenance of Flame-proof Equipment

For maintenance of Flame-proof Equipment, please according to the following.

Details of maintenance, please conducted in accordance with national legislation of the country to be used.

(1) Maintenance

Flame-proof equipment shall not be maintenance with its power turned on.

However, in cases where maintenance is to be conducted with the power turned on, with ※the cover (Terminal Box Cover) of flame-proof enclosure removed, always check that there is no explosive gas or vapor in that location.

※XE100 series positioner base-cover is not flame-proof enclosure.

If it cannot be checked whether an explosive gas or vapor is present or not, note the following, no matter the power is on or not.

a) Adjustment such as Zero and Span adjustment shall be limited to adjustable it without opening the cover (Terminal Box Cover) of flame-proof enclosure.
In this case, great care must be taken not to cause mechanical sparks with tools.

(2) Repair

If the flame-proof equipment requires repair, turn off the power and transport it to a safety (non-hazardous) location.

For the flame-proof equipment, the gaps and path lengths of joints and mating surfaces, and mechanical strength of enclosures are critical factors in explosion protection.

And the flameproof joints are not intended to be repaired.

Therefore, the parts (e.g. torque motor unit and terminal box) related to the frame-proof performance is prohibited disassemble and removal. Because there is the fear that cannot keep flame-proof characteristics and specifications after reassembling it.

If any damage occurs (e.g. in threads, joints or mating surfaces, connections between the base and terminal box, locking, external wiring connection), immediately stop using and contact 3S.

Before starting to service the equipment, be sure to check all parts necessary for retaining the requirements for flame-proof equipment.

(3) Prohibition of specification changes and modifications

Do not attempt to change specifications or make modifications involving addition of or changes in external wiring connections.

Cable gland not specified in Clause 5, please do not use.

(4) Cleaning

Always clean with a wet cloth, in order to minimize the risk from electrostatic discharge, on maintenance, repair and etc.

(5) Others

The hexagon socket head cap screw must use the stainless steel material of property class “A2-70”.