CKD

SM－1183-A/5

INSTRUCTION MANUAL

EXPLOSION PROOF 5 PORT PILOT OPERATED VALVE

4F3E to 4F7E
M4F3E to M4F7E

- Please read this instruction manual carefully before using this product, particularly the section describing safety.
- Retain this instruction manual with the product for further consultation whenever necessary.

Revision6
CKD Corporation

Safety precautions

When designing and manufacturing a device using CKD products, the manufacturer is obligated to manufacture a safe product by confirming safety of the system comprising the following items:

- Device mechanism
- Pneumatic or water control circuit
- Electric control that controls the above

It is important to select, use, handle, and maintain the product appropriately to ensure that the CKD product is used safely.
Observe warnings and precautions to ensure device safety.
Check that device safety is ensured, and manufacture a safe device.

⚠ WARNING

1. This product is designed and manufactured as a general industrial machine part. It must be handled by someone having sufficient knowledge and experience.

2. Use this product within its specifications.

This product cannot be used beyond its specifications. Additionally, the product must not be modified or machined.
This product is intended for use in general industrial devices and parts. Use beyond such conditions is not considered. Consult with CKD for details when using the product beyond the unique specification range, in the following conditions or environments. In any case, measures for safety shall be provided when the vavle malfunctions.

① Use for special applications requiring safety including nuclear energy, railroad, aviation, ship, vehicle, medical equipment, equipment or applications coming into contact with beverage or food, amusement equipment, emergency shutoff circuits, press machine, brake circuits, or for safeguard.
② Use for applications where life or assets could be adversely affected, and special safety measures are required.

3. Observe corporate standards and regulations, etc., related to the safety of device design and control, etc.

SO4414, JIS B 8370 (pneumatic system rules)
JFPS2008 (principles for pneumatic cylinder selection and use)
Including High Pressure Gas Maintenance Law, Occupational Safety and Sanitation Laws, other safety rules, standards and regulations, etc.

4. Do not handle, pipe, or remove devices before confirming safety.

① Inspect and service the machine and devices after confirming safety of the entire system related to this product.
② Note that there may be hot or charged sections even after operation is stopped.
③ When inspecting or servicing the device, turn off the energy source (air supply or water supply), and turn off power to the facility. Release any compressed air from the system, and pay enough attention to possible water leakage and leakage of electricity.
④ When starting or restarting a machine or device that incorporates pneumatic components, make sure that system safety, such as pop-out prevention measures, is secured.

5. Observe warnings and cautions on the pages below to prevent accidents.

■The safety cautions are ranked as "DANGER", "WARNING" and "CAUTION" in this section.

 DANGER :When a dangerous situation may occur if handling is mistaken leading to fatal or serious injuries, or when there is a high degree of emergency to a warning.

 WARNING :When a dangerous situation may occur if handling is mistaken leading to fatal or serious injuries.

 CAUTION :When a dangerous situation may occur if handling is mistaken leading to minor injuries or physical damage.

Note that some items described as "CAUTION" may lead to serious results depending on the situation. In any case, important information that must be observed is explained.

Precautions with regard to guarantee

- **Guarantee period**

The guarantee period of our product shall be one (1) year after it is delivered to the place specified by the customer.

- **Guarantee coverage**

If any failure for which CKD CORPORATION is recognized to be responsible occurs within the above warranty period, a substitute or necessary replacement parts shall be provided free of charge, or the product shall be repaired free of charge at the plant of CKD CORPORATION.

However, the guarantee excludes following cases:

① Defects resulting from operation under conditions beyond those stated in the catalogue or specifications.
② Failure resulting from malfunction of the equipment and/or machine manufactured by other companies.
③ Failure resulting from wrong use of the product.
④ Failure resulting from modification or repairing that CKD CORPORATION is not involved in.
⑤ Failure resulting from causes that could not be foreseen by the technology available at the time of delivery.
⑥ Failure resulting from disaster that CKD is not responsible of.

Guarantee stated here covers only the delivered products. Any other damage resulting from failure of the delivered products is not covered by this guarantee.

- **Confirmation of product compatibility**

Our customer shall be responsible of confirming compatibility of our product used in our customer's system, machinery or device.

DESIGN & SELECTION (Page 8)

⚠ WARNING :

a)This valve is used in a Class1 or 2 Danger Zone containing combustible gas or vapor. It cannot be used in a Class 0 Zone.

b)Select and install the mode following JIS C 60079. Please perform the factory explosion-proof equipment guide for a user (JNIOSH-TR-NO.44 (2012)).

c)4F Flame-proof series is not applicable neither within dust environment nor marine.

UNPACKING (Page 13)

⚠ CAUTION :

Bags containing solenoid valves should be opened only when you are ready to connect the valves to the pipes immediately afterward.

- If bags are opened before the valves are ready to be connected to the pipes, the entry of foreign matter from the piping ports could cause the solenoid valves to fail or malfunction.

INSTALLATION (Page 14)

⚠ CAUTION :

If you have to use the product under conditions that are different from the specified conditions or if you intend to use the product for a special application, be sure to consult us about the product specifications before using the product.

ENVIRONMENT (Page 14)

⚠ CAUTION :

a)In a dusty environment, foreign matter may enter even through the exhaust port.

- The movement of the exhaust valve causes a respiratory action at the exhaust valve, which may cause inhalation of foreign matter near the exhaust port. This potential situation would be worse if the exhaust port is facing upward. Attach a silencer to the exhaust port or have the exhaust port face downward.

b)Keep the solenoid valve system dry. Take care to avoid direct contact with dripping water or splashes of cutting oil.

- If the solenoid valve system is wet by a direct contact with water or cutting oil, an electrical leak or burnt solenoid coils may result. Protect the solenoid valve system by using a cover or by installing it inside a paneled casing. If the cylinder rod is splashed with cutting oil, the oil may penetrate through the cylinder into the secondary side piping of the solenoid valve. This must be prevented to avoid malfunctions. Consult us for preventive measures.

c)The coils will produce heat.

- Particularly if the solenoid valve system is installed in a control board or if the solenoid coils need to be energized for a long time, consider providing sufficient ventilation to release the heat. The coils can get very hot.

ENVIRONMENT (Page 14)

⚠ CAUTION :

d)Do not use the solenoid valve system in an atmosphere that includes a corrosive gas or solvent vapors.

- Do not use the solenoid valve system in an atmosphere that includes a corrosive gas such as the sulfur dioxide gas or in an atmosphere that includes solvent vapors.

e) Vibration resistance and Shock resistance

- Do not subject the solenoid valve system to vibrations 50m/s^2 or stronger or shocks 300m/s^2 or stronger.

f) Avoid using the solenoid valve system in a humid environment because the humidity is likely to cause condensation with a change in the temperature.

g)The packing and gaskets may deteriorate sooner than usual if used in an atmosphere with a higher than normal density of ozone (for example, the atmosphere near a beach or in an area with frequent thunderstorms).

- Please replace parts periodically.

INSTALLATION (Page 15)

⚠ WARNING :

When installing a solenoid valve unit, never attempt to hold it in position by means of the pipes connected to it.

- Mount the solenoid valve by applying the mounting screws and/or mounting plate to the solenoid valve.

PIPING (Page 15)

⚠ CAUTION :

a)Observe the recommended tightening torque when connecting pipes.

- Observing the recommended tightening torque prevents air leakage and damage to the screw threads. To prevent damage to the screw threads, first use your hand to lightly tighten the screw and then use a tool to tighten the screw to the recommended torque.

b)Make sure that the pipes will not be disconnected at the joints by mechanical movements, vibrations or tension.

- If the exhaust piping of the pneumatic circuit is disconnected, the actuator speed control is disabled.
- If the above happens to a chuck holding mechanism, the chuck will open. The inadvertent opening of the chuck may cause a serious accident.

c)When supplying the compressed air for the first time after completing the piping, be sure to check every joint in the piping for air leakage.

d)When supplying the compressed air for the first time after completing the piping, increase the air pressure gradually but never introduce a highly pressurized air suddenly.

- A sudden introduction of a highly pressurized air may disconnect pipes at joints and/or cause the tubes to jump around, any of which may cause an injury.

PIPING (Page 15,16)

⚠ CAUTION :

e)Do not decrease the inside diameter of the piping from any of the solenoid valve exhaust ports to a diameter less than the exhaust pipe connecting port size.

- Normal operation of the actuator depends on the smoothness of the exhaust flow. With a manifold system, a restriction to the exhaust flow may prevent normal operation of other solenoid valves.

f) Removal of foreign matter

- Rust and other foreign matter in the pneumatic circuit may cause a malfunction or leakage from the valve seat. Insert a filter (maximum allowable particle size 5 μm or less) immediately upstream of the solenoid valve.

g)Air supply

- Do not restrict the flow of air through the air supply piping. With a manifold system with multiple stations, a drop in the air supply pressure may cause trouble through a delay in the operation timing.

h)A pilot air bleed hole is provided on the pilot actuator. Consult with CKD when using this product where problems could occur form exhaust, such as in a clean room.

WIRING (Page 18)

⚠ WARNING :

When carrying out electrical connections, please perform disassembling and assembling work after reading the Instruction Manual carefully and with full understanding of its contents.

- Your understanding of the structure of solenoid valve and its operation principle is required in order to secure the safety.

⚠ CAUTION :

a)Before supplying the power, check the power supply voltage and the current type (AC or DC).

b)Check leakage current to prevent malfunctions caused by current leaking from other control components.

c) For outdoors, use the T-type and ensure that rain water does not enter from lead wire outlet G1/2.
The G type is for indoor use and must not be used outdoors.

d)Select the cable for the G type from CKD specification cables to ensure explosion proof performance.

MANUAL OVERRIDE (Page 26)

⚠ WARNING :

a)After using the manual override, be sure to reset the manual override to the original (OFF) position before resuming the operation of the device.
After a lock type operation (push and lock), be sure to release the lock to turn the manual override OFF.

b)Before using the manual override, make sure that nobody is present near the cylinder to be activated.

AIR QUALITY (Page 27)

⚠ WARNING :

a)Do not supply anything other than compressed air.

b)Supply clean compressed air without any mixture of corrosive gas.

AIR QUALITY (Page 27)

⚠ CAUTION :

a)Compressed air usually contains a large amount of drain, oxidized oil, tar, foreign matter, and rust from the piping. Filter out those elements in the supplied air because they may cause a malfunction and decrease service life. In addition, clean the exhaust before it is released to the air to minimize pollution.

b)Once you have lubricated a pre-lubricated valve, the valve is no longer capable of running without being lubricated from the outside. Do not leave the valve without lubrication but keep it lubricated.

c)Do not use spindle oil or machine oil. They may induce expansion of the rubber parts, which may cause a malfunction.

ELECTRIC CIRCUITS (Page 28)

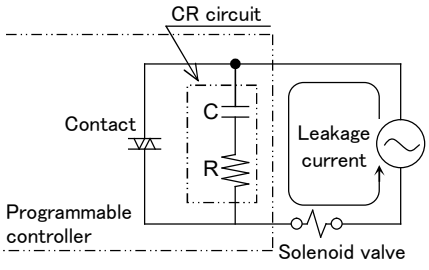
⚠ CAUTION :

a)Check for the presence of any current leak from the external control device because it may cause an erroneous valve operation.

- When a programmable controller or a similar control device is used, a current leak may prevent the normal returning of the valve when the solenoid is de-energized.

b)Restriction on current leak

- When controlling solenoid valves using a programmable controller or a similar control device, make sure that the current leak in the programmable controller output is equal to or less than the level shown in the table below. A current leak larger than the allowable level may cause an erroneous valve operation.



12 to 127VAC	4.0 mA or less
200 to 380VAC	2.0 mA or less
12 to 48VDC	1.5 mA or less
80 to 125VDC	0.6 mA or less

PERIODIC INSPECTION (Page 29)

⚠ WARNING : Before providing a maintenance service, cut the power and the supply of compressed air and confirm the absence of residual pressure.

- The above is required to ensure safety.

⚠ CAUTION : Regularly perform the daily and periodic inspections to correctly maintain product performance.

- If the product is not correctly maintained, product performance may deteriorate dramatically, resulting in a shorter service life, fractures of components, and malfunctions.

DISASSEMBLING AND REASSEMBLING (Page 30)

⚠ WARNING : a)Before disassembling and reassembling solenoid valves, read the instruction manual carefully and understand the instructions.

- A person who disassembles and reassembles a solenoid valve system needs to have a knowledge for safely performing such operation based on the understanding about the mechanisms and operating principles of solenoid valves.
- Personnel involved in this step must have passed the Pneumatic Pressure Skill Test Class 2 or higher.

b)Do not disassemble components of the pilot actuator other than the terminal box cap. The explosion proof structure cannot not be guaranteed if disassembled.

c)The explosion proof certification is acquired for the pilot actuator assembly. When replacing the coil, replace the pilot actuator assembly.

Complies with "Recommended Practices for Explosion-Protected Electrical Installations in General Industries"

Explosion proof functionality d2G4

(Pressure and explosion proof structure / flame-proof grade 2 / ignitability G4)

Certification No. Class A : No.T64364
Class H : No.T64363

Overview

4F series this explosion proof 5 port valve provides reliable and high performance, compact design and easy operation even in the flammable working environment Optimum for driving cylinders of 63 to 250 mm bore.

Features

- Light weight/compact
  Weight is reduced by 1/2 or less. (CKD comparison)
- Easy wiring
- Outdoors use is available.(Except for model numbers that contain GP)
  Conforms to JIS protection grade IP65.
  Outdoors use is possible.
- Energy saving type
  Low wattage (4.5W) and pre-lubricated.

Design & Selection

⚠ WARNING :

a) This valve is used in a Class1 or 2 Danger Zone containing combustible gas or vapor. It cannot be used in a Class 0 Zone.

b) Select and install the mode following JIS C 60079. Please perform the factory explosion-proof equipment guide for a user (JNIOSH-TR-NO.44 (2012)).

c) 4F Flame-proof series is not applicable neither within dust environment nor marine.

INDEX

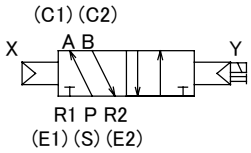
EXPLOSION PROOF 5 PORT
PILOT OPERATED VALVE

Manual No.SM-1183-A/5

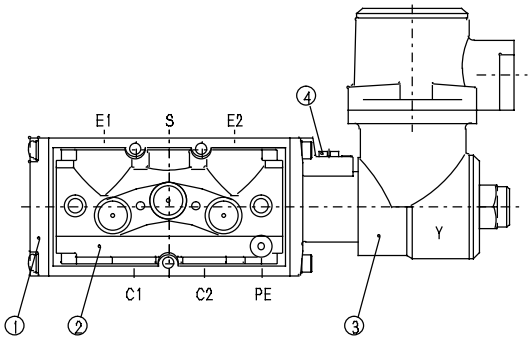
1. PART NAME AND DESCRIPTION

● 2-position single

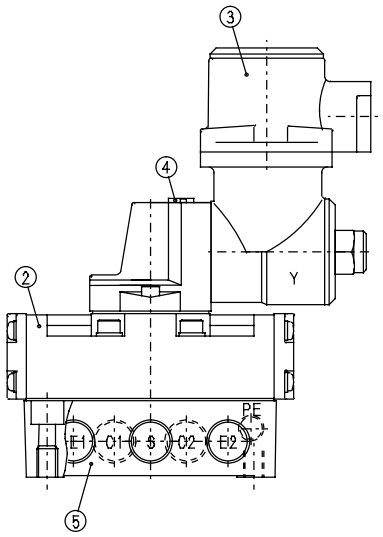
JIS SYMBOL



• 4F3



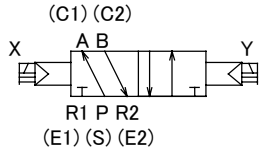
• 4F4 to 7



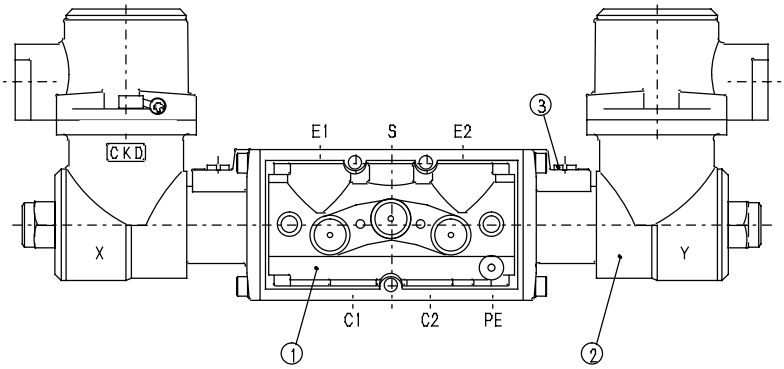
No.	Parts Name	Description
①	Cap	Seal the pressure, which is returned to the return side as the pressure of the air source is received.
②	Body ass'y	Changing the main flow passage
③	Pilot actuator ass'y	The pilot flow passage is changed by the electric signal to supply or exhaust the pilot pressure.
④	Manual override	Change the pilot flow passage using manual operation.
⑤	Sub plate	Main flow passage

● 2-position double

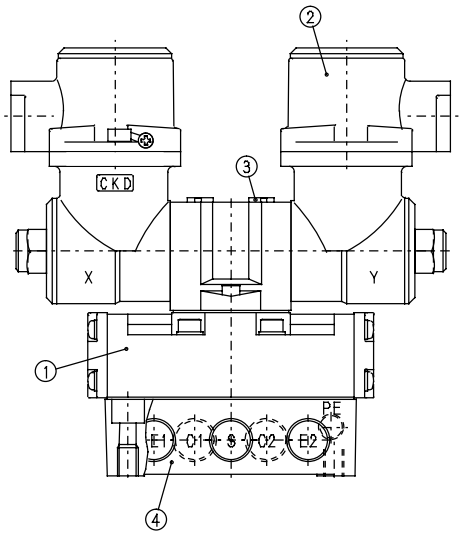
JIS SYMBOL



• 4F3



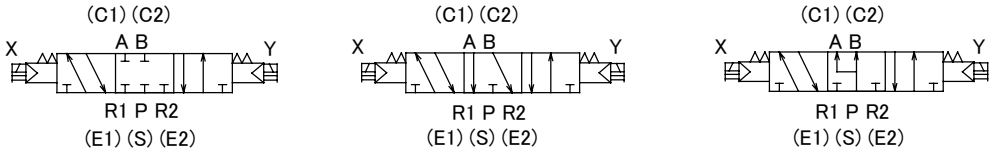
• 4F4 to 7



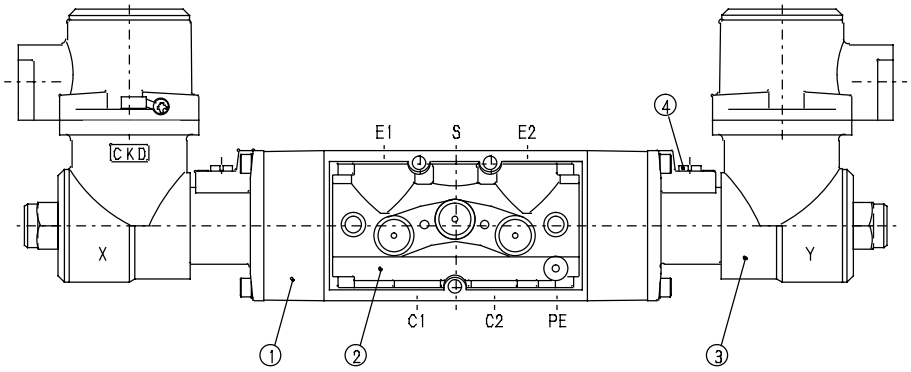
No.	Parts Name	Description
①	Body ass'y	Changing the main flow passage
②	Pilot actuator ass'y	The pilot flow passage is changed by the electric signal to supply or exhaust the pilot pressure.
③	Manual override	Change the pilot flow passage using manual operation.
④	Sub plate	Main flow passage

● 3-pos. all ports closed　　3-pos. ABR connection　　3-pos. PAB connection

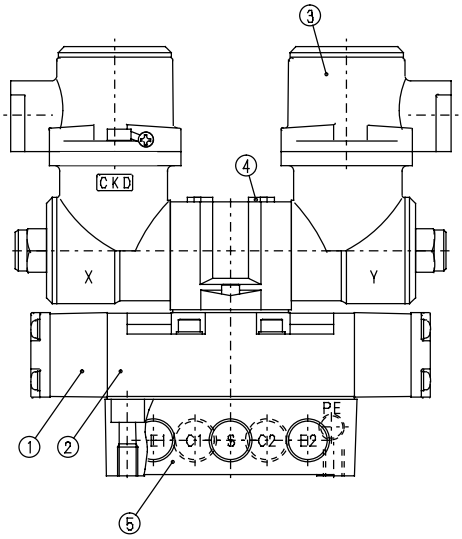
JIS SYMBOL



• 4F3



• 4F4 to 7



No.	Parts Name	Description
①	Body block	A spring is mounted to return to the neutral position when the 3-position type is energized or turned OFF.
②	Body ass'y	Changing the main flow passage
③	Pilot actuator ass'y	The pilot flow passage is changed by the electric signal to supply or exhaust the pilot pressure.
④	Manual override	Change the pilot flow passage using manual operation.
⑤	Sub plate	Main flow passage

2. INTERNATIONAL SYSTEM OF UNITS (SI) AND PORT INDICATION

2.1 Conversion between International System of Units (SI) and Conventional Units

In this manual, values are expressed using the International System of Units (SI). Use the table below to convert them into values expressed in conventional units.

Table of conversion between SI units and conventional units

(The values printed in Bolds fonts are values given in the International System of Units (SI)):

Example (converting a pressure value):

1kgf/cm^2 → **0.980665MPa** **1MPa** → 1.01972×10kgf/cm^2

- Force

N	dyn	kgf
1	1×10^{5}	1.01972×10^{-1}
1×10^{-5}	1	1.01972×10^{-6}
9.80665	9.80665×10^{5}	1

- Stress

Pa or N/m^2	Mpa or N/mm^2	kgf/mm^2	kgf/cm^2
1	1×10^{-6}	1.01972×10^{-7}	1.01972×10^{-5}
1×10^{6}	1	1.01972×10^{-1}	1.01972×10
9.80665×10^{6}	9.80665	1	1×10^{2}
9.80665×10^{4}	9.80665×10^{-2}	1×10^{-2}	1

Note: 1Pa=1N/m^2, 1MPa=1N/mm^2

- Pressure

Pa	kPa	MPa	bar	kgf/cm^2	atm	mmH2O	mmHg or Torr
1	1×10^{-3}	1×10^{-6}	1×10^{-5}	1.01972×10^{-5}	9.86923×10^{-6}	1.01972×10^{-1}	7.50062×10^{-3}
1×10^{3}	1	1×10^{-3}	1×10^{-2}	1.01972×10^{-2}	9.86923×10^{-3}	1.01972×10^{2}	7.50062
1×10^{6}	1×10^{3}	1	1×10	1.01972×10	9.86923	1.01972×10^{5}	7.50062×10^{3}
1×10^{5}	1×10^{2}	1×10^{-1}	1	1.01972	9.86923×10^{-1}	1.01972×10^{4}	7.50062×10^{2}
9.80665×10^{4}	9.80665×10	9.80665×10^{-2}	9.80665×10^{-1}	1	9.67841×10^{-1}	1×10^{4}	7.35559×10^{2}
1.01325×10^{5}	1.01325×10^{2}	1.01325×10^{-1}	1.01325	1.01323	1	1.03323×10^{4}	7.60000×10^{2}
9.80665	9.80665×10^{-3}	9.80665×10^{-6}	9.80665×10^{-5}	1×10^{-4}	9.67841×10^{-5}	1	7.35559×10^{-2}
1.33322×10^{2}	1.33322×10^{-1}	1.33322×10^{-4}	1.33322×10^{-3}	1.35951×10^{-3}	1.31579×10^{-3}	1.35951×10	1

Note: 1Pa=1N/m^2

3. UNPACKING

⚠ CAUTION: Bags containing solenoid valves should be opened only when you are ready to connect the valves to the pipes immediately afterward.

- If bags are opened before the valves are ready to be connected to the pipes, the entry of foreign matter from the piping ports could cause the solenoid valves to fail or malfunction.

1) Check the model number imprinted on the product to make sure that the product you received is exactly the product you ordered.
2) Check the exterior of the product for any damage.
3) Before using the product, read the supplied documentation.

4. INSTALLATION

⚠ CAUTION : If you have to use the product under conditions that are different from the specified conditions or if you intend to use the product for a special application, be sure to consult us about the product specifications before using the product

4.1 Environment

⚠ CAUTION :

a) In a dusty environment, foreign matter may enter even through the exhaust port.
- The movement of the exhaust valve causes a respiratory action at the exhaust valve, which may cause inhalation of foreign matter near the exhaust port. This potential situation would be worse if the exhaust port is facing upward. Attach a silencer to the exhaust port or have the exhaust port face downward.

b) Keep the solenoid valve system dry. Take care to avoid direct contact with dripping water or splashes of cutting oil.
- If the solenoid valve system is wet by a direct contact with water or cutting oil, an electrical leak or burnt solenoid coils may result. Protect the solenoid valve system by using a cover or by installing it inside a paneled casing. If the cylinder rod is splashed with cutting oil, the oil may penetrate through the cylinder into the secondary side piping of the solenoid valve. This must be prevented to avoid malfunctions. Consult us for preventive measures.

c) The coils will produce heat.
- Particularly if the solenoid valve system is installed in a control board or if the solenoid coils need to be energized for a long time, consider providing sufficient ventilation to release the heat. The coils can get very hot.

d) Do not use the solenoid valve system in an atmosphere that includes a corrosive gas or solvent vapors.
- Do not use the solenoid valve system in an atmosphere that includes a corrosive gas such as the sulfur dioxide gas or in an atmosphere that includes solvent vapors.

e) Vibration resistance and Shock resistance
- Do not subject the solenoid valve system to vibrations 50m/s^2 or stronger or shocks 300m/s^2 or stronger.

f) Avoid using the solenoid valve system in a humid environment because the humidity is likely to cause condensation with a change in the temperature.

g) The packing and gaskets may deteriorate sooner than usual if used in an atmosphere with a higher than normal density of ozone (for example, the atmosphere near a beach or in an area with frequent thunderstorms).
- Please replace parts periodically.

4.2 Installation

⚠ WARNING : When installing a solenoid valve unit, never attempt to hold it in position by means of the pipes connected to it.

- Mount the solenoid valve by applying the mounting screws and/or mounting plate to the solenoid valve.

4.2.1 A workspace for installation, removal, wiring, and piping operations should be provided around the installed solenoid valve system.

4.3 Piping

⚠ CAUTION :

a) Observe the recommended tightening torque when connecting pipes.

- Observing the recommended tightening torque prevents air leakage and damage to the screw threads. To prevent damage to the screw threads, first use your hand to lightly tighten the screw and then use a tool to tighten the screw to the recommended torque.

b) Make sure that the pipes will not be disconnected at the joints by mechanical movements, vibrations or tension.

- If the exhaust piping of the pneumatic circuit is disconnected, the actuator speed control is disabled.
- If the above happens to a chuck holding mechanism, the chuck will open. The inadvertent opening of the chuck may cause a serious accident.

c) When supplying the compressed air for the first time after completing the piping, be sure to check every joint in the piping for air leakage.

d) When supplying the compressed air for the first time after completing the piping, increase the air pressure gradually but never introduce a highly pressurized air suddenly.

- A sudden introduction of a highly pressurized air may disconnect pipes at joints and/or cause the tubes to jump around, any of which may cause an injury.

e) Do not decrease the inside diameter of the piping from any of the solenoid valve exhaust ports to a diameter less than the exhaust pipe connecting port size.

- Normal operation of the actuator depends on the smoothness of the exhaust flow. With a manifold system, a restriction to the exhaust flow may prevent normal operation of other solenoid valves.

f) Removal of foreign matter

- Rust and other foreign matter in the pneumatic circuit may cause a malfunction or leakage from the valve seat. Insert a filter (maximum allowable particle size 5 μm or less) immediately upstream of the solenoid valve.

4.3 Piping

⚠ CAUTION :

g) Air supply
- Do not restrict the flow of air through the air supply piping. With a manifold system with multiple stations, a drop in the air supply pressure may cause trouble through a delay in the operation timing.

h) A pilot air bleed hole is provided on the pilot actuator. Consult with CKD when using this product where problems could occur form exhaust, such as in a clean room.

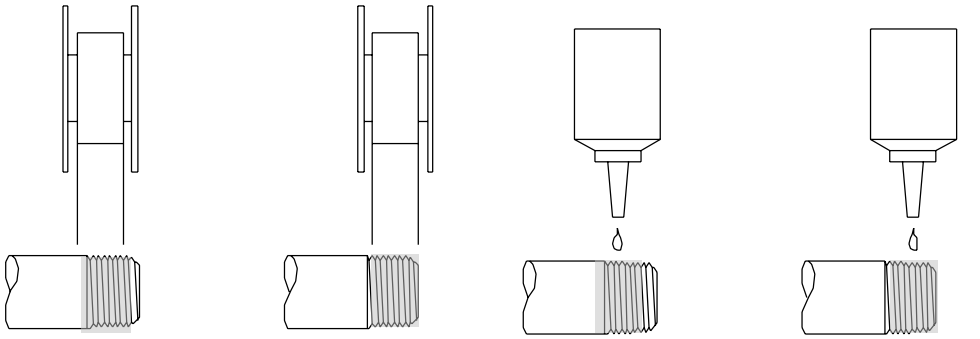
Appropriate torque

Joint screw	Appropriate torque N·m	Joint screw	Appropriate torque N·m
Rp1/8,Rc1/8	3 to 5	Rc1/2	16 to 18
Rp1/4,Rc1/4	6 to 8	Rc1/4	19 to 40
Rp3/8,Rc3/8	13 to 15	Rc1	41 to 70

4.3.1 Sealant

Refrain from applying sealant or sealing tape approx. two pitches of thread off the tip of pipe to avoid residual substances from falling into piping system.

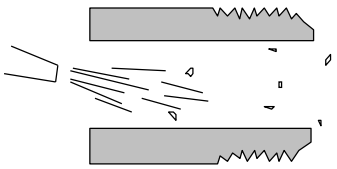
●Seal Tape ●Sealant (Paste or liquid)



(Correct) (Incorrect) (Correct) (Incorrect)

4.3.2 Flushing

Before connecting pipes, flush the interiors of the tubes, solenoid valves, and connected devices to remove foreign matter.



4.3.3 Blow circuit

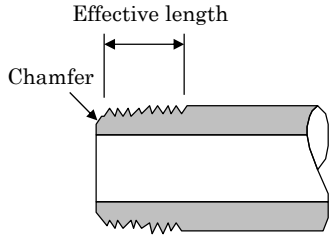
Do not open the cylinder port circuit to the air because a drop in the air supply pressure may cause a malfunction. Additionally, when opened to the atmosphere, the grease of the sliding part flows out and the minimum working pressure is increased, causing the service life of the seal part to be shortened.
The lowest allowable pressure with the internal pilot type design is 0.15MPa.

4.3.4 Exhaust port

Minimize the restriction to the flow of the exhaust air because such restriction may cause a delay in the cylinder response. If such a delay happens, the speed needs to be adjusted between the cylinder and solenoid valve.
Avoid applying a plug screw at the end of PE, otherwise its exhaust is hindered.

4.3.5 Pipe connections

(1) Strictly observe the effective thread length of gas pipe and give a chamfer of approx. 1/2 pitch from the threaded end.



(2) Tubes to be used
For use with solenoid valves with one-touch joints, select tubes of the type specified by us:

Soft nylon tubes (F-1500 Series)
Urethane tubes (U-9500 Series)

(3) For installation at a site that has spatters in the air, select incombustible tubes or metal pipes.

(4) For piping used for both hydraulic and pneumatic controls, select a hydraulic hose.
When combining a spiral tube with a standard one-touch joint, fix the tube origin using a hose band. Otherwise the rotation of the tube will decrease the efficiency of the clamping.
For use in a high-temperature atmosphere, select fastener joints instead of one-touch joints.

(5) When selecting from tubes commercially available, carefully study the accuracy of the outside diameter as well as the wall thickness and the hardness. The hardness of an urethane tube should be 93℃ or more (as measured by a rubber hardness meter).
With a tube that does not have a sufficient accuracy of the outside diameter or the specified hardness, a decrease in the chucking force may cause disconnection or difficulty in inserting.

Tube dimensions

Outside diameter mm	Inside diameter mm	
	Nylon	Urethane
φ4	φ2.5	φ2
φ6	φ4	φ4
φ8	φ5.7	φ5
φ10	φ7.2	φ6.5

Outside diameter allowance

Soft or hard nylon		±0.1mm
Urethane	φ4, φ6	+0.1mm −0.15mm
Urethane	φ8, φ10	+0.1mm −0.2mm

(6) Minimum bending radius of tubes
Observe the minimum bending radius of tubes. Neglecting the minimum bending radius may cause disconnection or leaks.

Tube bore	Minimum bending radius mm	
	Nylon	Urethane
ϕ 4	10	10
ϕ 6	20	20
ϕ 8	30	30
ϕ 10	40	40

(7) Cutting a tube

To cut a tube, use a tube cutter to cut the tube perpendicularly to the length of the tube. Inserting an obliquely cut end of a tube may cause air leakage.

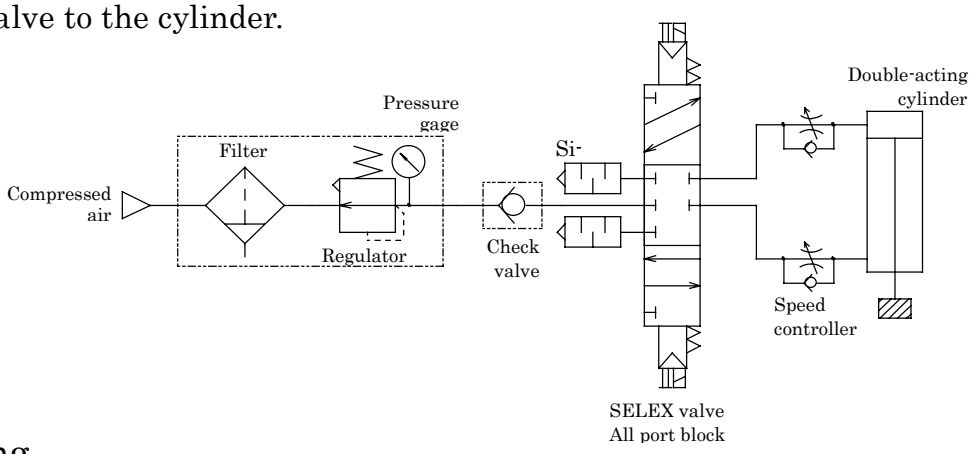
(8) Tube connections

Do not bend a tube immediately at where it is connected to the joint but lead it out straight from the end of the joint for a length equal to or greater than the outside diameter of the tube. The tension applied sideways through the tube should not exceed 40N.

4.3.6 Prevention of back flow from C1/C2 port to S

Make sure a check valve is installed to Supply port of selex valve, 3-position, all closed type, because much more accuracy of intermediate stopping position is achieved once a check valve is added to the supply port of this type valve.

Verify that there is no leakage from the sealed portions of the piping from the check valve to the cylinder.



4.4 Wiring

⚠ WARNING :

When carrying out electrical connections, please perform disassembling and assembling work after reading the Instruction Manual carefully and with full understanding of its contents.

- Your understanding of the structure of solenoid valve and its operation principle is required in order to secure the safety.

⚠ CAUTION :

a) Before supplying the power, check the power supply voltage and the current type (AC or DC).

b) Check leakage current to prevent malfunctions caused by current leaking from other control components.

c) For outdoors, use the T-type and ensure that rain water does not enter from lead wire outlet G1/2.
The G type is for indoor use and must not be used outdoors.

d) Select the cable for the G type from CKD specification cables to ensure explosion proof performance.

4.4.1 Wiring connections

1)Wring work

(1) Please the wiring in accordance perform factory explosion-proof equipment guide for a user.

(2) Remove the terminal box cap with the enclosed disassembling tool. Use the tool below to crimp the crimp terminal during wiring. After wiring, tighten the terminal box cap correctly.
Personnel should store the disassembling tool for maintenance.

(3) Select the cable for the G type from the following cables to ensure explosion proof performance.

Cable type	No. of conductors	Nominal section area	Strand description	Finish diameter
Polyethylene cable (EV) 600V vinyl insulated vinyl sheath cable (VV) Control vinyl insulated vinyl sheath cable (CVV)	2 conductor	2mm²	7／0.6	10.5 dia.

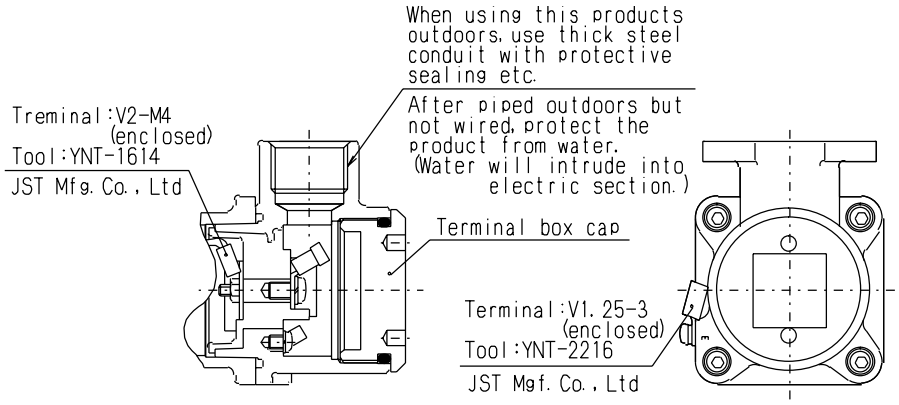
(4) Use fuse of 0.5 to 1A within a circuit.

(5) It is recommended the use of snap action switch(es) such as relay or magnetic switch to build a circuit.

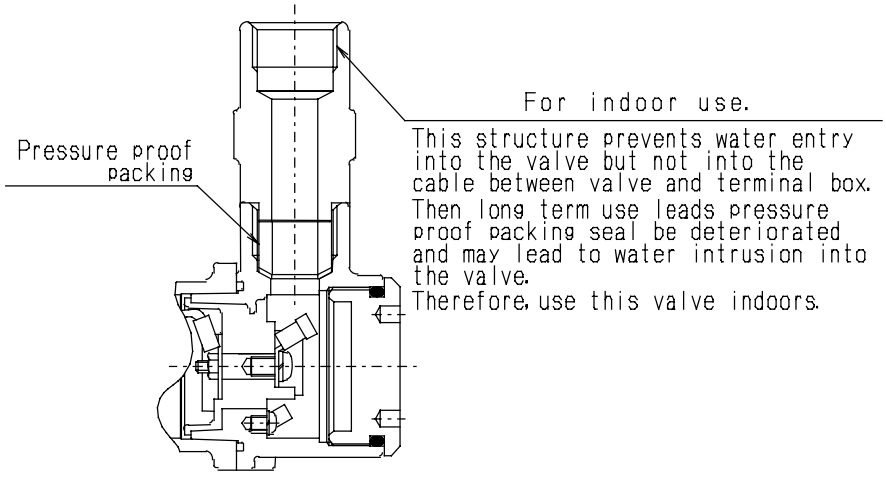
(6) AC100/200V coil can be used for AC110/220V(60Hz).

2)Junction box

(1) T-type : Conduit screw connection method

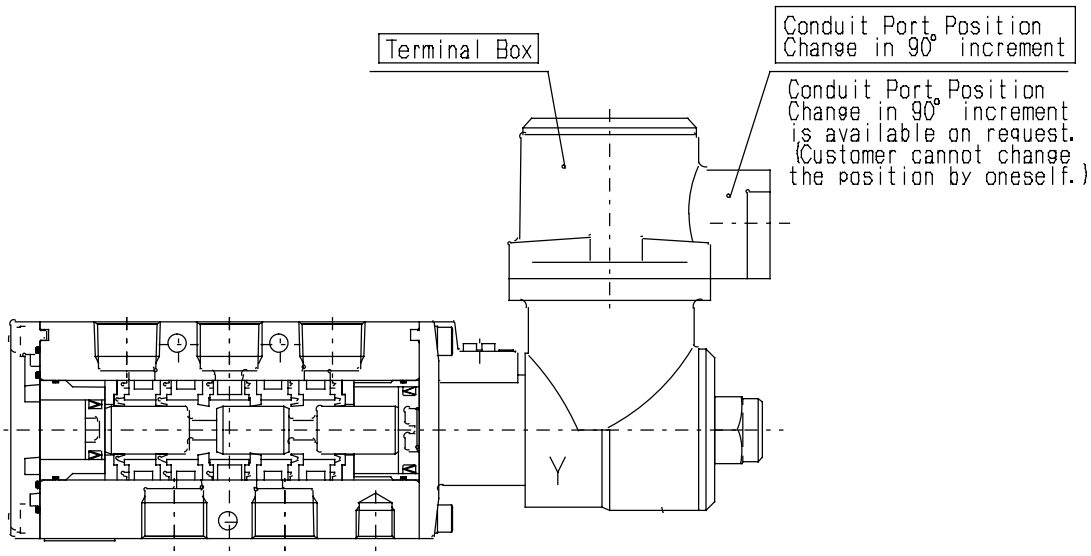


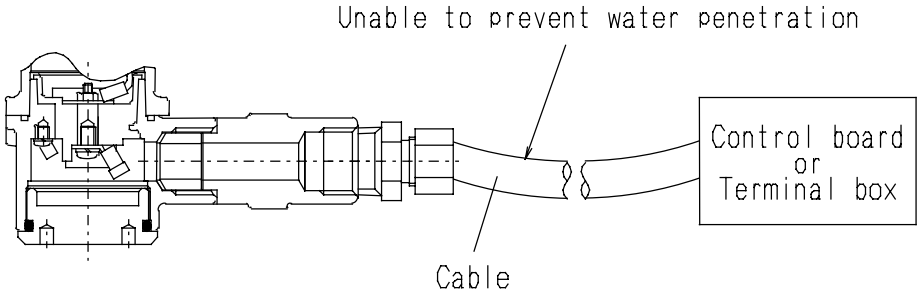
(2) G-type : Pressure proof packing seal protection tube screw method



(3) Direction of conductor entry point

Direction of terminal box and conductor entry point can be changed.





Make it corrugated plumbing using pressure-proof packing over TP type when anticipate to use it outdoor.

[NOTE]

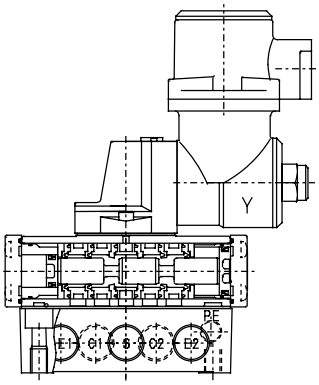
Apply protective cover over terminal box and leading in port of cord as well during outdoor installation, because it may cause short circuit due to penetrated water resulting coil burning, if leave it without any protective measure.

5. OPERATING RECOMMENDATION

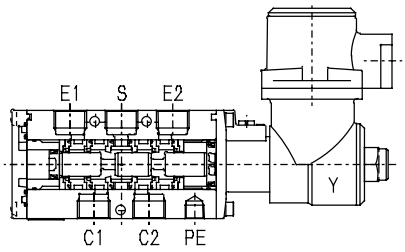
5.1 Operation

- 2-position single

4F4 to 4F7



4F3

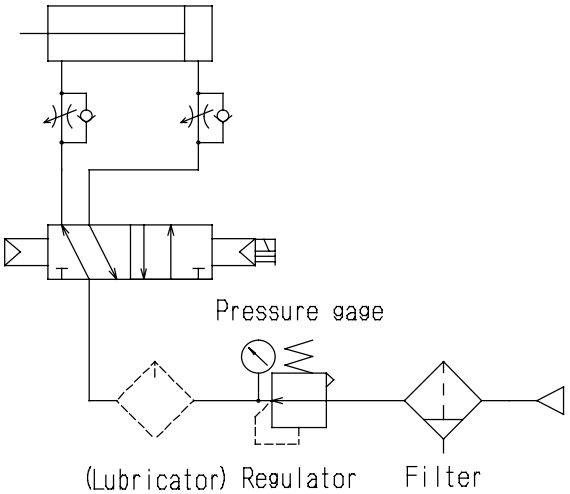


1) Valve operation

Operation when not energized	S→C1 C2→E2 E1→Closed
Operation when energized	S→C2 C1→E1 E2→Closed

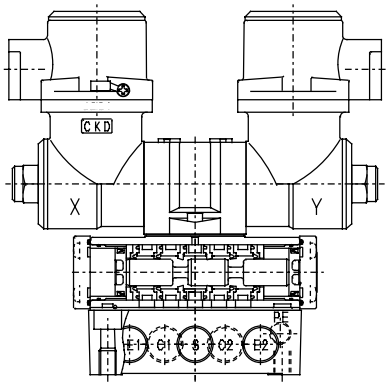
- Solenoid on = Cylinder advances(retracts)
  Solenoid off = Cylinder retracts(advances)

2) Fundamental circuit diagram

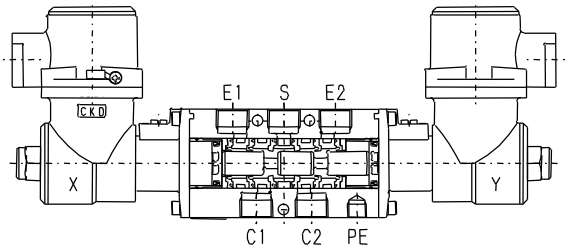


• 2-position double

4F4 to 4F7



4F3

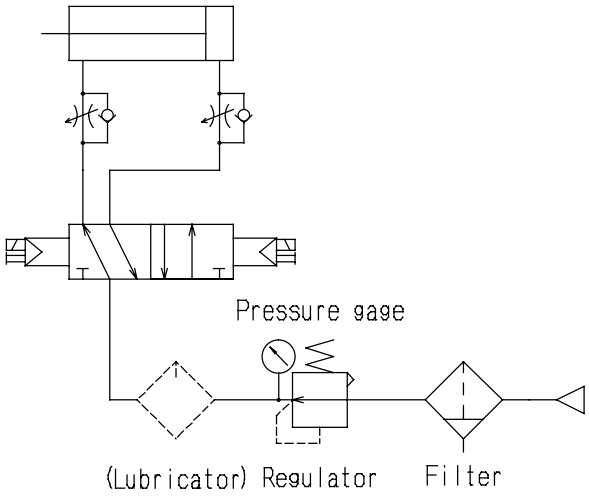


1) Valve operation

X solenoid on	S→C1 C2→E2 E1→Closed
Y solenoid on	S→C2 C1→E1 E2→Closed

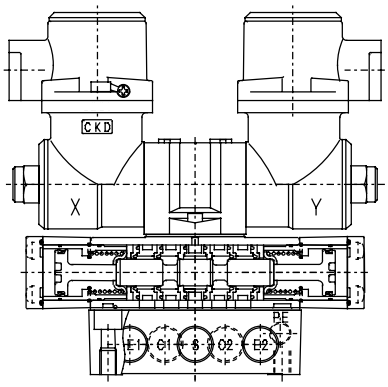
- One side solenoid on = Cylinder advances(retracts)
  The same solenoid off = Holds present position
  The other solenoid on = Cylinder retracts(advances)
- This concept is also used for self holding (Cylinder does not move even at the occasion of power failure.)

2) Fundamental circuit diagram

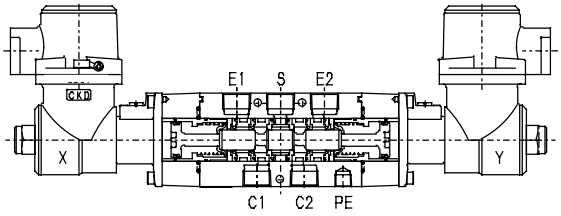


- 3-position

4F4 to 4F7



4F3



1) Valve operation

(1) All ports closed

When both solenoids receive no signal current — Every port such as S, C1, C2, E1 and E2 is blocked.

X solenoid on
S→C1
C2→E2
E1→Closed

Y solenoid on
S→C2
C1→E1
E2→Closed

- Cylinder stops at intermediate positions (when off). Once it stops, cylinder is locked and external force is unable to move the cylinder.

(2) ABR connection

When both solenoids receive no signal current
S→Closed
C1→E1
C2→E2

X solenoid on
S→C1
C2→E2
E1→Closed

Y solenoid on
S→C2
C1→E1
E2→Closed

- Cylinder stops at intermediate positions same as (1) above. But an external force is able to move the once stopped cylinder.

(3) PAB connection

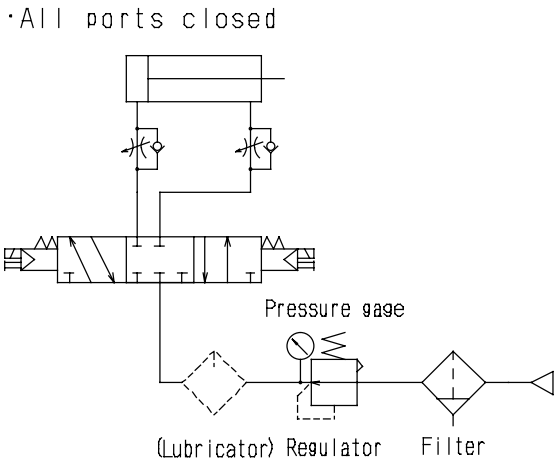
When both solenoids receive no signal current S→C1・C2
E1→Closed
E2→Closed

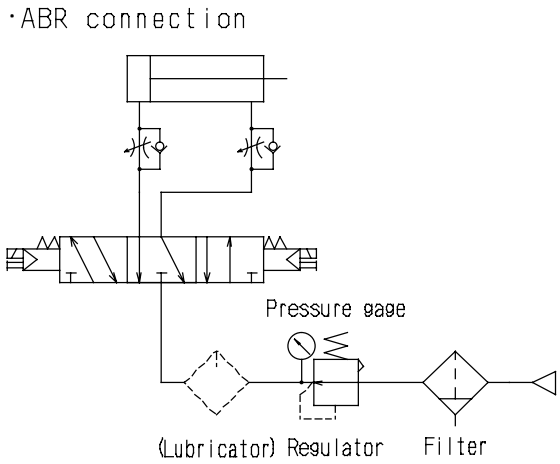
X solenoid on S→C1
C2→E2
E1→Closed

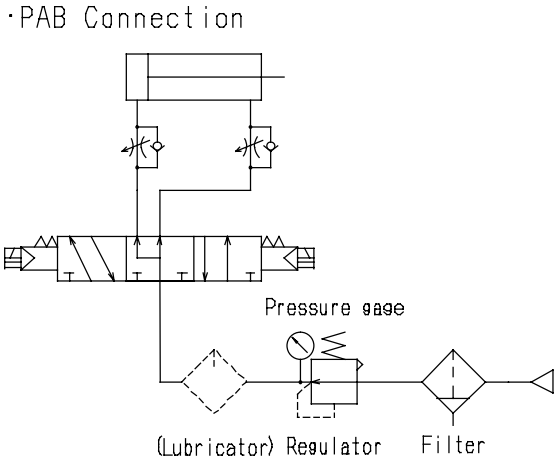
Y solenoid on S→C2
C1→E1
E2→Closed

- Cylinder stops at intermediate positions (when current is off) as same as (1) above. But the cylinder is not to stay still unless the unit pressure from both side of cylinder balances up due to individual pressurization to C1 port as well as to C2 port.

2) Fundamental circuit diagram







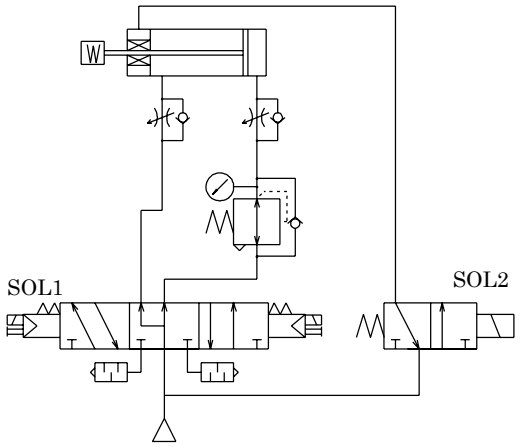
PAB connection is used for the purpose of letting either Rod-less cylinder or Sel-top cylinder make intermediate stops.

3) Circuit diagrams for Seltop cylinder application are as shown below.

(1) In case of horizontal load

When piping is laid as shown in Fig1, equal pressure is applied to both sides of the piston when the system is in the OFF mode, thereby preventing the piston from jumping out. Install a regulator with a check valve on the head cover side to balance the thrust.

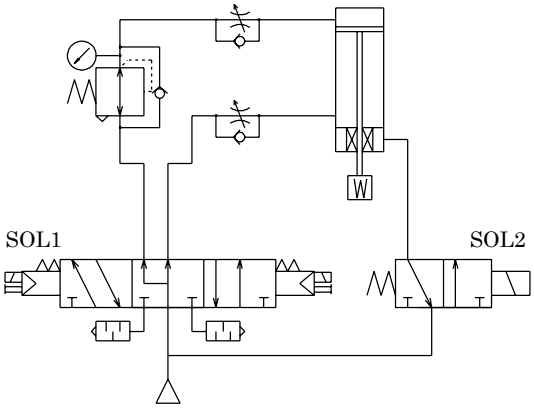
Fig 1



(2) In case of downward load

When the lay-out of circuit is as shown in Fig. 2, install a reducing valve with a check valve to the circuit of cylinder head side for the purpose of reducing the downward thrust of the rod and keeping a balance because the cylinder rod is apt to be suddenly pulled down due to the load at the moment the brake system is released.

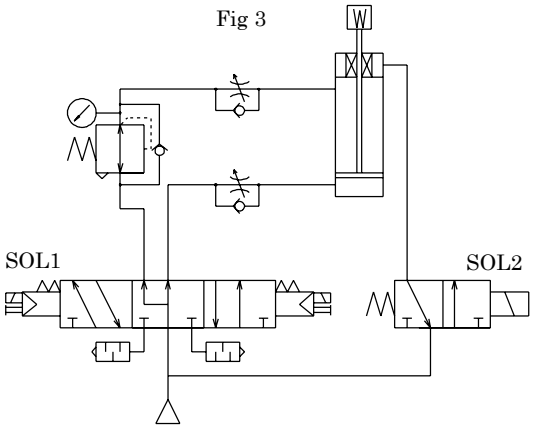
Fig 2



(2) In case of upward load

When the load is upward as shown in Fig.3, install a reducing valve with a check a check valve to the circuit of piston rod side for the purpose of reducing reversed thrust of the rod and keeping a balance because the cylinder rod is apt to be pushed backward due to the load at the moment the brake system is released.

Fig 3



5.2 Manual Override

⚠ WARNING :

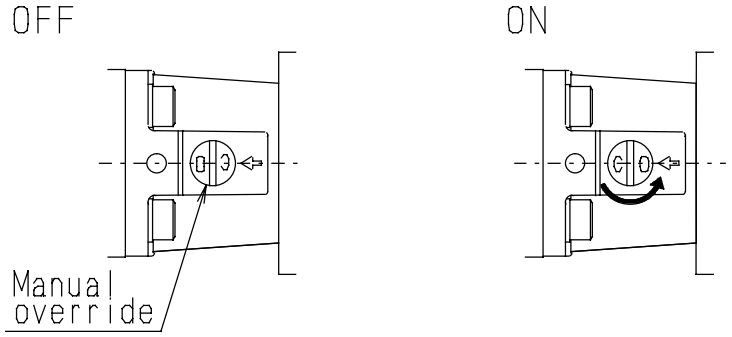
a) After using the manual override, be sure to reset the manual override to the original (OFF) position before resuming the operation of the device.
After a lock-type operation (push and lock), be sure to release the lock to turn the manual override OFF.

b) Before using the manual override, make sure that nobody is present near the cylinder to be activated.

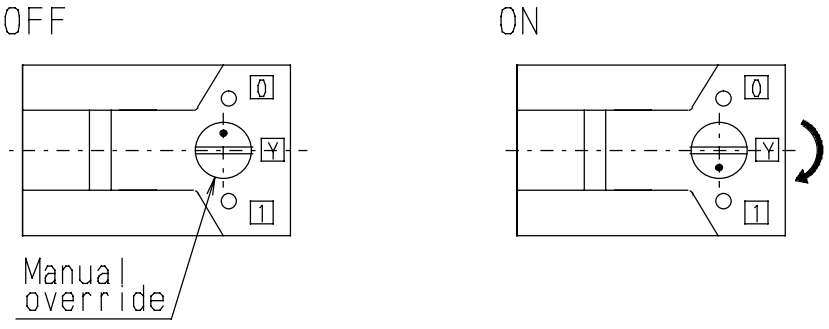
5.2.1 Manual Operation Device

Since manual override is with a lock, Lock off the manual override when it not used. When using, turn manual override with minus screw driver.

- 4F3 C: OFF Match "C" to the arrow.
  O: ON Turn to the arrow direction until it is locked.
  (The arrow and "O" may not match.)



- 4F4 to7 0: OFF Match "•" to "0".
  1: ON Turn to "1" direction until it is locked.
  ("1" and "•" may not match.)



Note: Do not stop turning the manual override halfway.
Doing so may cause unstable operation.

5.3 Air Quality

⚠ WARNING :
a) Do not supply anything other than compressed air.
b) Supply clean compressed air without any mixture of corrosive gas.

⚠ CAUTION :
a) Compressed air usually contains a large amount of drain, oxidized oil, tar, foreign matter, and rust from the piping. Filter out those elements in the supplied air because they may cause a malfunction and decrease service life. In addition, clean the exhaust before it is released to the air to minimize pollution.
b) Once you have lubricated a pre-lubricated valve, the valve is no longer capable of running without being lubricated from the outside. Do not leave the valve without lubrication but keep it lubricated.
c) Do not use spindle oil or machine oil. They may induce expansion of the rubber parts, which may cause a malfunction.

5.3.1 Lubrication

The 4F Series this explosion proof valve systems use pre-lubricated valves that usually do not require lubrication from the outside. If you have to lubricate a valve, use Type 1 turbine oil (ISO-VG32) without additives.
Excessive lubrication and extremely low pressure may cause a longer response time. The response time in the catalogue assumes no lubrication from the outside and the air supply pressure of 0.5 MPa.

5.3.2 Ultra-dry compressed air

The use of ultra-dry compressed air will cause splashing of the lubrication oil and result in a shorter service life.

5.3.3 Drain

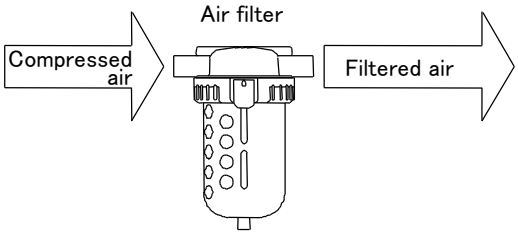
1) The drain is produced by a drop of temperature in pneumatic piping and devices.
2) The drain may enter and instantaneously block a passage inside a pneumatic device and cause a malfunction.
3) The drain accelerates the production of rust, which may cause the failure of pneumatic devices.
4) The drain may wash away the lubrication pill, causing a malfunction from the lack of lubrication.

5.3.4 Foreign matter in the compressed air

1) Supply clean compressed air that does not include oxidized oil, tar, carbon, or other foreign matter from the air compressor.
   (1) If oxidized oil, tar, carbon, or the like enters a pneumatic device and sticks to its components, an increase in the resistance at sliding portions may cause a malfunction.
   (2) If oxidized oil, tar, carbon, or the like is mixed with the supplied lubrication oil, wear of the sliding components of the pneumatic device may be accelerated.
2) Supply clean compressed air that does not include solid foreign matter.
   (1) Solid foreign matter in the compressed air may cause wear of the sliding components of the pneumatic device or stick to such components and cause hydraulic lock.

5.3.5 Cleaning the supplied air

Compressed air usually contains a large amount of drain (water, oxidized oil, tar, and foreign matter). Remove these elements and clean the supplied air because they may cause a failure of the air compressor. For example, remove the humidity using an after-cooler dryer and remove the tar using a tar filter.



5.4 Electric Circuits

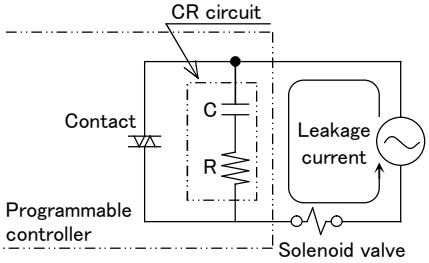
⚠ CAUTION :

a) Check for the presence of any current leak from the external control device because it may cause an erroneous valve operation.

- When a programmable controller or a similar control device is used, a current leak may prevent the normal returning of the valve when the solenoid is de-energized.

b) Restriction on current leak

- When controlling solenoid valves using a programmable controller or a similar control device, make sure that the current leak in the programmable controller output is equal to or less than the level shown in the table below. A current leak larger than the allowable level may cause an erroneous valve operation.



12 to 127VAC	4.0 mA or less
200 to 380VAC	2.0 mA or less
12 to 48VDC	1.5 mA or less
80 to 125VDC	0.6 mA or less

(1) With a double solenoid type valve system, energize the solenoid for at least 0.1 second even for an instantaneous valve operation. However, since the cylinder may malfunction depending on the load conditions on the secondary side, energize or perform the manual operation until the cylinder reaches its stroke end position. If the target valve can be affected by a back pressure induced by another solenoid valve, it is recommendable to energize the solenoid as long as the cylinder is making an action.

(2) If solenoids are energized for a prolonged period of time, the surface temperature of the manifold will rise. Through this increase in the temperature should not be regarded as abnormal, provide a suitable means of ventilation or heat release.

6. MAINTENANCE

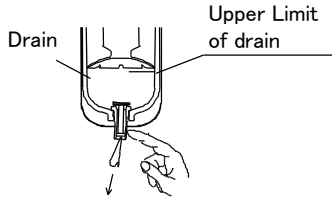
6.1 Periodic Inspection

⚠ WARNING : Before providing a maintenance service, cut the power and the supply of compressed air and confirm the absence of residual pressure.
- The above is required to ensure safety.

⚠ CAUTION : Regularly perform the daily and periodic inspections to correctly maintain product performance.
- If the product is not correctly maintained, product performance may deteriorate dramatically, resulting in a shorter service life, fractures of components, and malfunctions.

1) To use the solenoid valve system under optimum conditions, perform a periodic inspection once or twice a year.

2) Check the screws for loosening and the joints in the piping for integrity of the sealing.
Regularly remove the drain from the air filters.



(1) Checking the compressed air supply pressure:
Is the supply pressure at the specified level?
Does the pressure gauge indicate the specified pressure when the system is operating?

(2) Checking the air filters:
Is the drain normally discharged?
Is the amount of dirt attached to the bowl and element at a normal level?

(3) Checking joints in the piping for the leakage of compressed air:
Are the pipes normally connected at joints, especially at the movable parts?

(4) Checking the operation of solenoid valves:
Is not there any delay in the operation? Is the exhaust flow normal?

(5) Checking the operation of pneumatic actuators:
Is the operation smooth?
Does the actuator stop normally at the end of the stroke?
Is the coupling with the load normal?

(6) Checking the lubricator:
Is the amount of oil adjusted properly?

(7) Checking the lubrication oil:
Is the supplied lubrication oil of the type specified by the manufacturer?

6.2 Disassembling and Reassembling

⚠ WARNING :

a) Before disassembling and reassembling solenoid valves, read the instruction manual carefully and understand the instructions.
- A person who disassembles and reassembles a solenoid valve system needs to have a knowledge for safely performing such operation based on the understanding about the mechanisms and operating principles of solenoid valves.
- Personnel involved in this step must have passed the Pneumatic Pressure Skill Test Class 2 or higher.

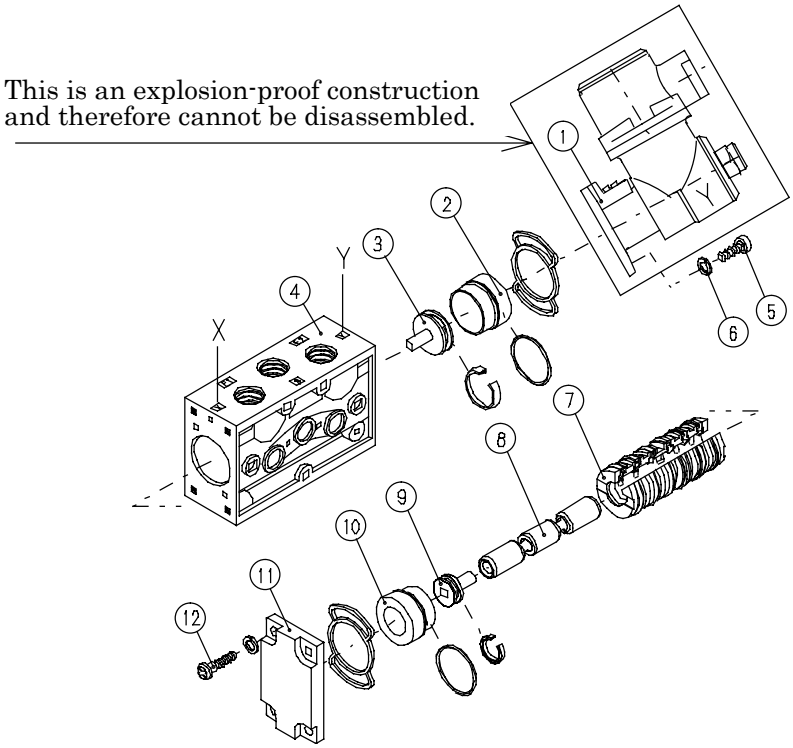
b) Do not disassemble components of the pilot actuator other than the terminal box cap. The explosion proof structure cannot not be guaranteed if disassembled.

c) The explosion proof certification is acquired for the pilot actuator assembly. When replacing the coil, replace the pilot actuator assembly.

6.2.1 Solenoid valve mounting and detaching

Be sure top discharge the residual pressure before starting disassembling and reassembling.
When replacing the solenoid valve, play special attention so that no gaskets and O-ring are fallen down.
The proper tightening torque of the solenoid valve mounting screw is 1.7 to 1.9 N･m.

- 4F3 2-position single



1) Disassembling Pilot actuator ass'y
   (1) When removing the hexagon socket head cap screw⑤, the pilot actuator ass'y① can be disassembled from the body④.
   The pilot actuator ass'y① cannot be disassembled as it is an explosion-proof component.

2) Disassembling and assembling Body part

(1) Loosen the mounting screws⑫ of the caps⑪ on the X to detach the cap. Push the internal spacer from the E2 port of the body④ toward the Y side using a standard driver to project the cylinder② forward. After that, take out the cylinder② and piston③.

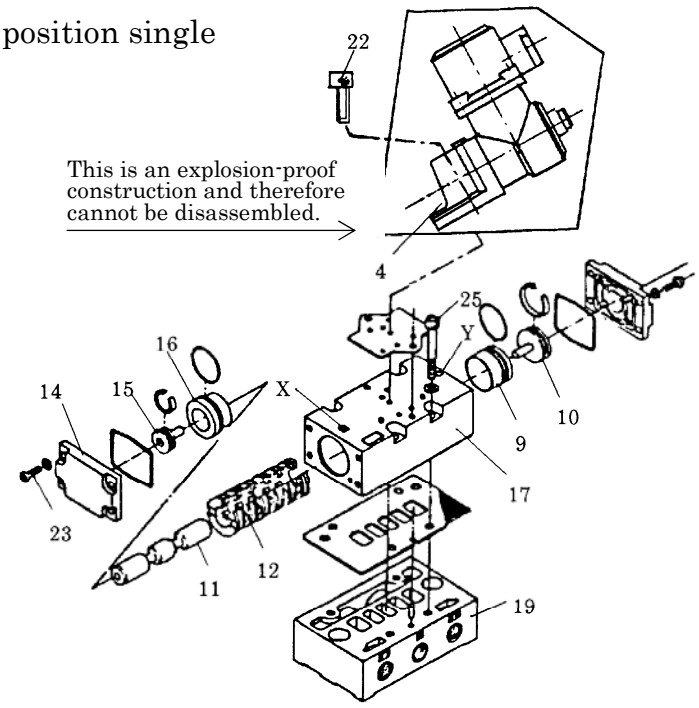
(2) After the internal spacer has been pushed from the E1 port of the body④ toward the X side using a standard driver, take out the cylinder⑩ and piston⑨.

(3) For built-in components, after the spool⑧ has been taken out from the body④, put your finger and take out the seal ass'y⑦.

(4) The assembly position and orientation of the built-in piston③⑨, cylinder② ⑩ and seal ass'y⑦ are specified. Always carefully check the position and orientation when reassembling the parts after disassembly.
Carry out the above work if the valve operation is faulty or if leak occurs.

- Wash parts or blow each part or replace it with a new one.
- Carefully avoid giving striking indentation because each part is vitally important component for sealing effect.
- Eliminate of using organic solvent. There is potentiality of deterioration of rubber parts of malfunction due to swollen rubber parts.
- Take the reversed sequence of disassembling to assemble it back.
  Avoid minor assembling forgotten, o-ring getting out of place or leaving loosen screws.
- Carefully avoid slipping gasket out and contamination with foreign particles.
- Apply our company specification greases over seal ass'y, spool, cylinder, piston ass'y of sliding parts, body guide part and packing of stem ass'y.

• 4F4 to 7 2-position single



1) Disassembling Pilot actuator ass'y

(1) When removing the hexagon socket head cap screw㉒, the pilot actuator ass'y④ can be disassembled from the body⑰.
The pilot actuator ass'y④ cannot be disassembled as it is an explosion-proof component.

2) Disassembling and assembling Body part

(1) Loosen the mounting screws㉓ of the caps⑭ on the X and Y sides to detach the caps. Push the internal spacer from the exhaust passage of the body⑰ toward the Y side using a standard driver to project the cylinder⑨ forward. After that, take out the cylinder⑨ and piston⑩.

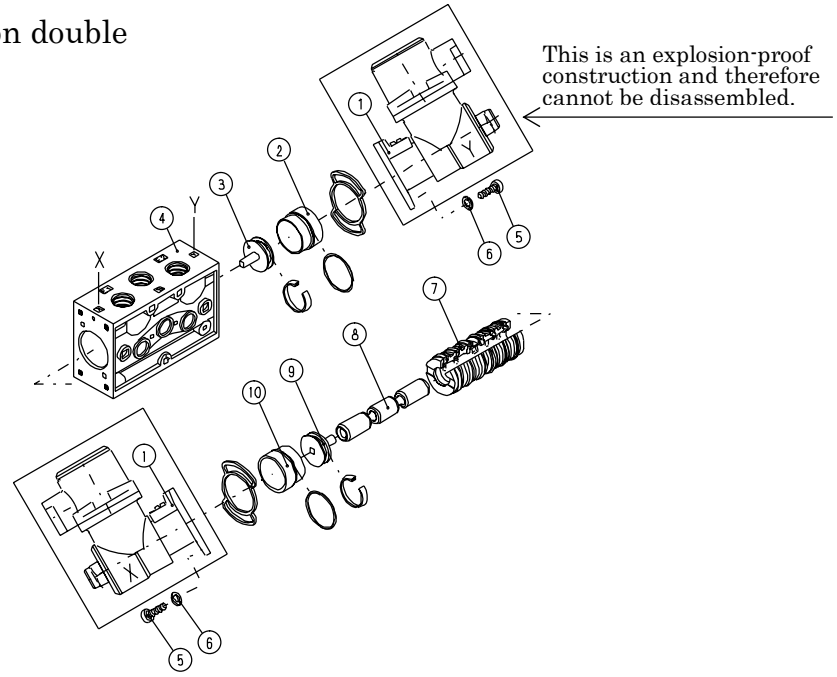
(2) After the internal spacer has been pushed from the exhaust passage of the body⑰ toward the X side using a standard driver, take out the cylinder⑯ and piston⑮.

(3) For built-in components, after the spool⑪ has been taken out from the body⑰, put your finger and take out the seal ass'y⑫.

(4) The assembly position and orientation of the built-in piston⑩⑮, cylinder⑨⑯ and seal ass'y⑫ are specified. Always carefully check the position and orientation when reassembling the parts after disassembly.
Carry out the above work if the valve operation is faulty or if leak occurs.

- Wash parts or blow each part or replace it with a new one.
- Carefully avoid giving striking indentation because each part is vitally important component for sealing effect.
- Eliminate of using organic solvent. There is potentiality of deterioration of rubber parts of malfunction due to swollen rubber parts.
- Take the reversed sequence of disassembling to assemble it back.
Avoid minor assembling forgotten, o-ring getting out of place or leaving loosen screws.
- Carefully avoid slipping gasket out and contamination with foreign particles.
- Apply our company specification greases over seal ass'y, spool, cylinder, piston ass'y of sliding parts, body guide part and packing of stem ass'y.

• 4F3 2-position double

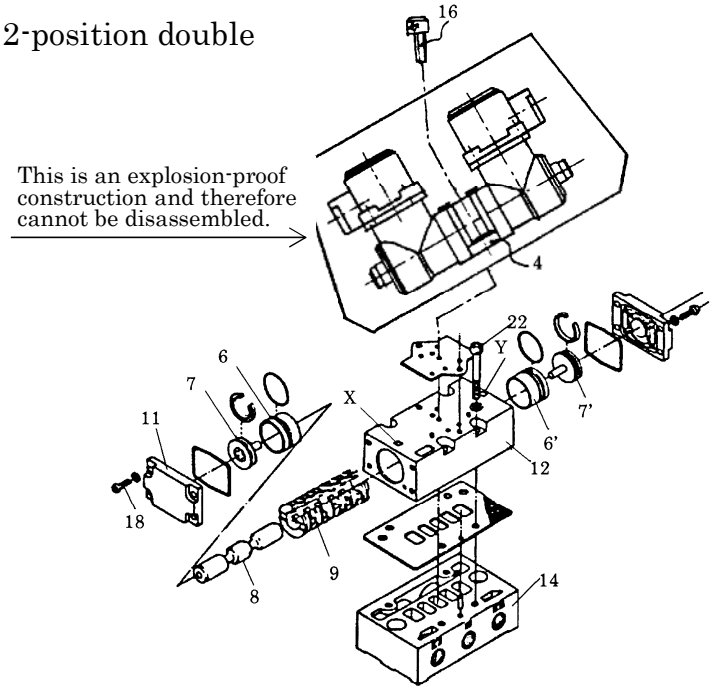


1) Disassembling Pilot actuator ass'y
   (1) When removing the hexagon socket head cap screw⑤, the pilot actuator ass'y① can be disassembled from the body④.
   The pilot actuator ass'y① cannot be disassembled as it is an explosion-proof component.

2) Disassembling and assembling Body part
   (1) After the pilot actuator ass'y① has been removed, push the internal spacer from the E2 port of the body④ toward the Y side using a standard driver to project the cylinder② forward. After that, take out the cylinder② and piston③.
   (2) After the internal spacer has been pushed from the E1 port of the body④ toward the X side using a standard driver, take out the cylinder⑩ and piston⑨.
   (3) For built-in components, after the spool⑧ has been taken out from the body④, put your finger and take out the seal ass'y⑦.
   (4) The assembly position and orientation of the built-in piston③⑨, cylinder② ⑩ and seal ass'y⑦ are specified. Always carefully check the position and orientation when reassembling the parts after disassembly.
   Carry out the above work if the valve operation is faulty or if leak occurs.

- Wash parts or blow each part or replace it with a new one.
- Carefully avoid giving striking indentation because each part is vitally important component for sealing effect.
- Eliminate of using organic solvent. There is potentiality of deterioration of rubber parts of malfunction due to swollen rubber parts.
- Take the reversed sequence of disassembling to assemble it back.
  Avoid minor assembling forgotten, o-ring getting out of place or leaving loosen screws.
- Carefully avoid slipping gasket out and contamination with foreign particles.
- Apply our company specification greases over seal ass'y, spool, cylinder, piston ass'y of sliding parts, body guide part and packing of stem ass'y.

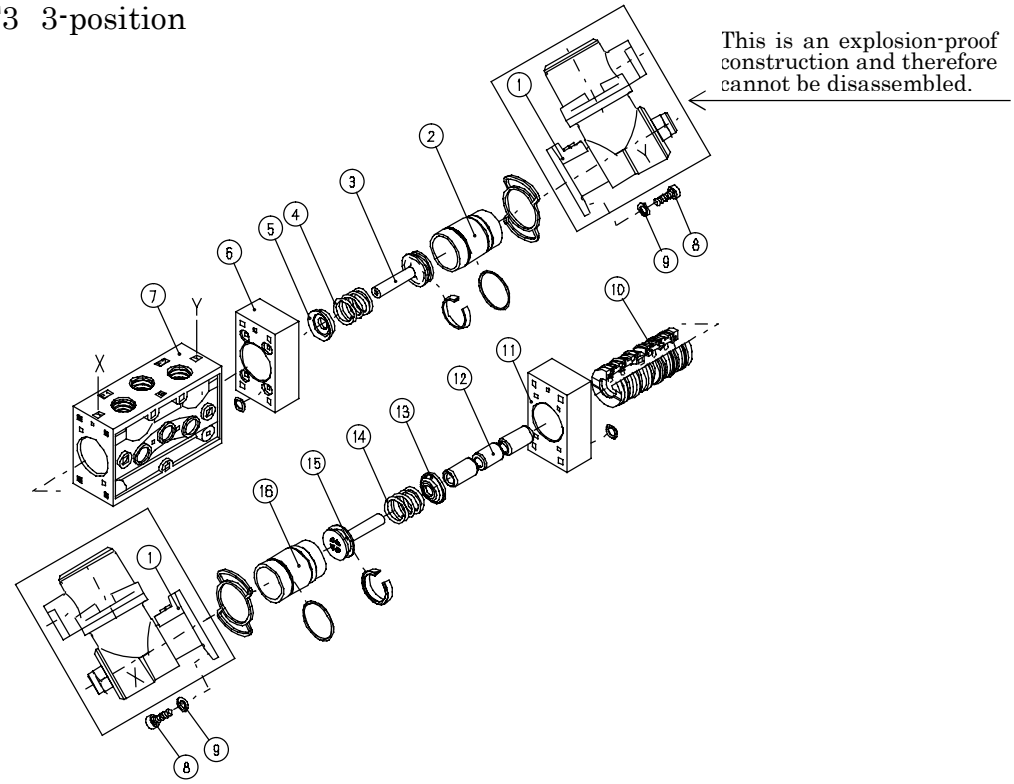
• 4F4 to 7 2-position double



1) Disassembling Pilot actuator ass'y
   (1) When removing the hexagon socket head cap screw⑯, the pilot actuator ass'y④ can be disassembled from the body⑫.
   The pilot actuator ass'y④ cannot be disassembled as it is an explosion-proof component.
2) Disassembling and assembling Body part
   (1) Loosen the mounting screws⑱ of the caps⑪ on the X and Y sides to detach the caps. Push the internal spacer from the exhaust passage of the body⑫ toward the Y side using a standard driver to project the cylinder⑥' forward. After that, take out the cylinder⑥' and piston⑦'.
   (2) After the internal spacer has been pushed from the exhaust passage of the body⑫ toward the X side using a standard driver, take out the cylinder⑥ and piston⑦.
   (3) For built-in components, after the spool⑧ has been taken out from the body⑫, put your finger and take out the seal ass'y⑨.
   (4) The assembly position and orientation of the built-in piston⑦⑦', cylinder⑥⑥' and seal ass'y⑨ are specified. Always carefully check the position and orientation when reassembling the parts after disassembly.
   Carry out the above work if the valve operation is faulty or if leak occurs.

- Wash parts or blow each part or replace it with a new one.
- Carefully avoid giving striking indentation because each part is vitally important component for sealing effect.
- Eliminate of using organic solvent. There is potentiality of deterioration of rubber parts of malfunction due to swollen rubber parts.
- Take the reversed sequence of disassembling to assemble it back.
  Avoid minor assembling forgotten, o-ring getting out of place or leaving loosen screws.
- Carefully avoid slipping gasket out and contamination with foreign particles.
- Apply our company specification greases over seal ass'y, spool, cylinder, piston ass'y of sliding parts, body guide part and packing of stem ass'y.

• 4F3 3-position

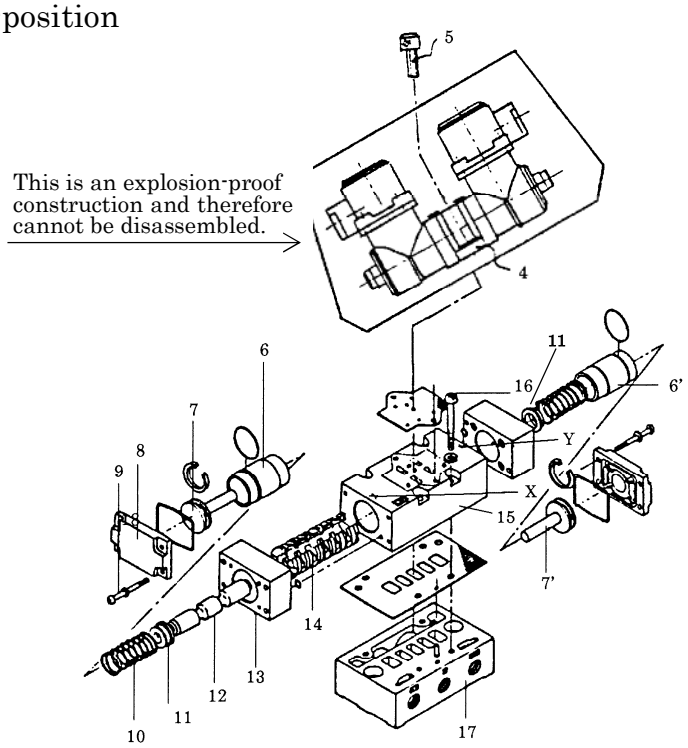


1) Disassembling Pilot actuator ass'y
   (1) When removing the hexagon socket head cap screw⑧, the pilot actuator ass'y① can be disassembled from the body⑦. Since the spring④⑭ is put inside, pay special attention to jump-up of the spring④⑭.
   (2) After the cylinder②⑯ has been taken out from the pilot actuator ass'y①, take out the piston③⑮ spring④⑭ and spring holder⑤⑬.
   The pilot actuator ass'y① cannot be disassembled as it is an explosion-proof component.

2) Disassembling and assembling Body part
   (1) For built-in components, after the spool⑫ has been taken out from the body⑦, put your finger and take out the seal ass'y⑩.
   (2) The assembly position and orientation of the built-in piston③⑮, cylinder②⑯ spring holder⑤⑬, and seal ass'y⑩ are specified. Always carefully check the position and orientation when reassembling the parts after disassembly. Carry out the above work if the valve operation is faulty or if leak occurs.

- Wash parts or blow each part or replace it with a new one.
- Carefully avoid giving striking indentation because each part is vitally important component for sealing effect.
- Eliminate of using organic solvent. There is potentiality of deterioration of rubber parts of malfunction due to swollen rubber parts.
- Take the reversed sequence of disassembling to assemble it back.
  Avoid minor assembling forgotten, o-ring getting out of place or leaving loosen screws.
- Carefully avoid slipping gasket out and contamination with foreign particles.
- Apply our company specification greases over seal ass'y, spool, cylinder, piston ass'y of sliding parts, body guide part and packing of stem ass'y.

• 4F4 to 7 3-position



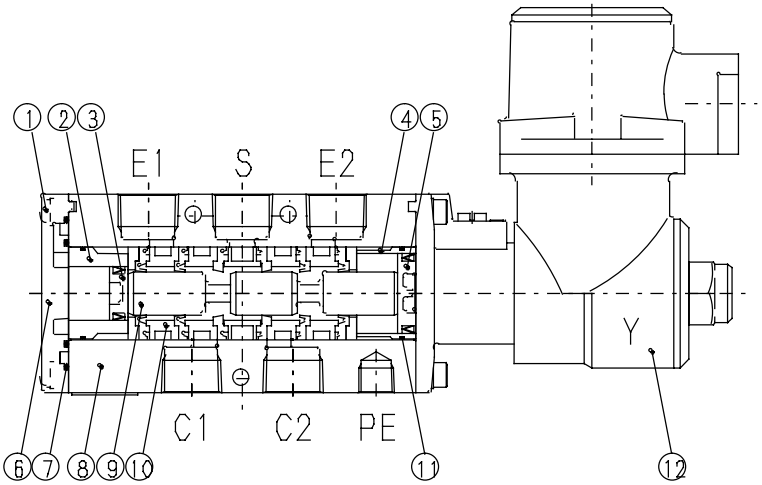
1) Disassembling Pilot actuator ass'y
   (1) When removing the hexagon socket head cap screw⑤, the pilot actuator ass'y④ can be disassembled from the body⑮.
   The pilot actuator ass'y④ cannot be disassembled as it is an explosion-proof component.
2) Disassembling and assembling Body part
   (1) Loosen the mounting screws⑨ of the caps⑧ on the X and Y sides to detach the caps. When taking out the caps⑧, pay special attention to jump-up of the spring⑩ since the spring⑩ is put inside.
   After the cylinder⑥ has been taken out from the body⑮, take out the piston⑦, spring⑩, spring holder⑪ and body block⑬.
   (2) For built-in components, after the spool⑫ has been taken out from the body⑮, put your finger and take out the seal ass'y⑭.
   (3) The assembly position and orientation of the built-in piston⑦⑦', cylinder⑥⑥' spring holder⑪⑪' and seal ass'y⑭ are specified. Always carefully check the position and orientation when reassembling the parts after disassembly. Carry out the above work if the valve operation is faulty or if leak occurs.

- Wash parts or blow each part or replace it with a new one.
- Carefully avoid giving striking indentation because each part is vitally important component for sealing effect.
- Eliminate of using organic solvent. There is potentiality of deterioration of rubber parts of malfunction due to swollen rubber parts.
- Take the reversed sequence of disassembling to assemble it back.
  Avoid minor assembling forgotten, o-ring getting out of place or leaving loosen screws.
- Carefully avoid slipping gasket out and contamination with foreign particles.
- Apply our company specification greases over seal ass'y, spool, cylinder, piston ass'y of sliding parts, body guide part and packing of stem ass'y.

6.3 Internal Structure and Consumable Parts List

●4F3 2-position single

1)Internal Structure



No	Parts	Material		No	Parts	Material	
①	Cross headed pan small screw with spring washer	SWRM	Steel	⑦	Gasket	NBR	Acryloni-trile-butadiene rubber
②	Cylinder (B)	—		⑧	Body	ADC12	Aluminum alloy die casting
③	Piston ass'y (B)	—		⑨	Spool	A5056	Aluminum alloy
④	Cylinder (A)	—		⑩	Seal ass'y	—	
⑤	Piston ass'y (A)	—		⑪	O-Ring	NBR	Acryloni-trile-butadiene rubber
⑥	Cap	ADC12	Aluminum alloy die casting	⑫	Actuator ass'y	—	

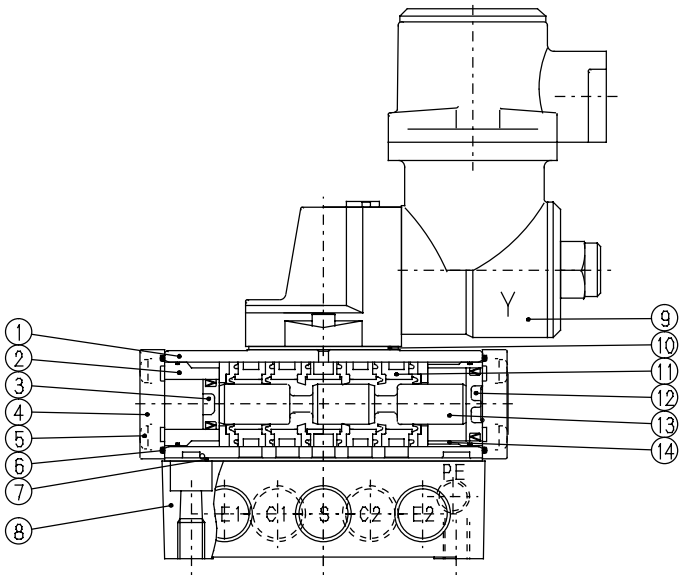
2)Consumable Parts List

Part no. and name / Model no.	⑩ Seal ass'y	⑤ Piston ass'y (A)	③ Piston ass'y (B)	⑫ Actuator ass'y
4F310E	4F9－106	4F9－104	4F9－103	Actuator ass'y model No.

Note: For consumable parts, kit is available. Please replace a whole kit but not a part. (The kit includes packing seal ass'y, piston ass'y (A) and (B).)
: When replacing the coil, replace the pilot actuator assembly.

●4F4 to 7　2-position single

1)Internal Structure



No	Parts	Material		No	Parts	Material	
①	Body	ADC12	Aluminum alloy die casting	⑧	Sub plate	ADC12	Aluminum alloy die casting
②	Cylinder (B)	—		⑨	Actuator ass'y	—	
③	Piston ass'y (B)	—		⑩	Gasket	NBR	Acryloni-trile-butadiene rubber
④	Cap	ADC12	Aluminum alloy die casting	⑪	Seal ass'y	—	
⑤	Cross headed pan small screw with spring washer	SWRM	Steel	⑫	Piston ass'y (A)	—	
⑥	Gasket	NBR	Acryloni-trile-butadiene rubber	⑬	Spool	A5056	Aluminum alloy
⑦	Gasket	NBR	Acryloni-trile-butadiene rubber	⑭	Cylinder	—	

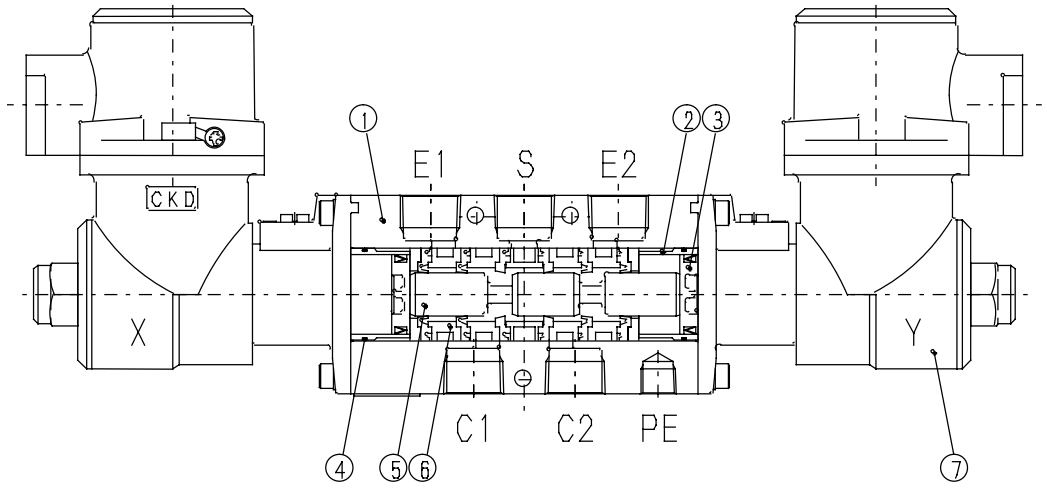
2)Consumable Parts List

Part no. and name / Model no.	⑪ Seal ass'y	⑫ Piston ass'y (A)	③ Piston ass'y (B)	⑨ Actuator ass'y
4F410E	4F9－106	4F9－104	4F9－103	Actuator ass'y model No.
4F510E	4F9－107	4F9－108	4F9－109	
4F610E	4F9－118	4F9－117	4F9－116	
4F710E	4F9－119	4F9－121	4F9－120	

Note: For consumable parts, kit is available. Please replace a whole kit but not a part. (The kit includes packing seal ass'y, piston ass'y (A) and (B).)
: When replacing the coil, replace the pilot actuator assembly.

●4F3　2-position Double

1)Internal Structure



No	Parts	Material		No	Parts	Material	
①	Body	ADC12	Aluminum alloy die casting	⑤	Spool	A5056	Aluminum alloy
②	Cylinder (A)	—		⑥	Seal ass'y	—	
③	Piston ass'y (A)	—		⑦	Actuator ass'y	—	
④	O-Ring	NBR	Acryloni-trile-butadiene rubber				

2)Consumable Parts List

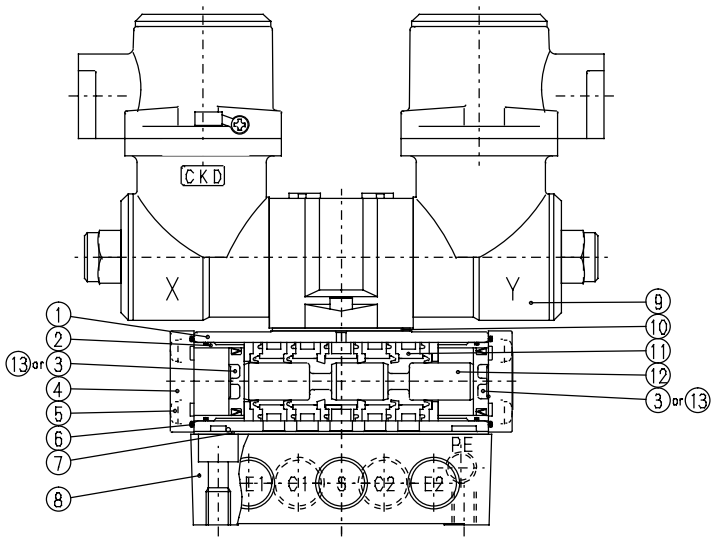
Part no. and name / Model no.	⑥ Seal ass'y	③ Piston ass'y (A)	⑦ Actuator ass'y
4F320E	4F9－106	4F9－104	Actuator ass'y model No.

Note: For consumable parts, kit is available. Please replace a whole kit but not a part. (The kit includes packing seal ass'y, piston ass'y (A).)

: When replacing the coil, replace the pilot actuator assembly.

4F3 2-position Double

1)Internal Structure



No	Parts	Material		No	Parts	Material	
①	Body	ADC12	Aluminum alloy die casting	⑧	Sub plate	ADC12	Aluminum alloy die casting
②	Cylinder (A)	—		⑨	Actuator ass'y	—	
③	Piston ass'y (A)	—		⑩	Gasket	NBR	Acryloni-trile-butadiene rubber
④	Cap	ADC12	Aluminum alloy die casting	⑪	Seal ass'y	—	
⑤	Cross headed pan small screw with spring washer	SWRM	Steel	⑫	Spool	A5056	Aluminum alloy
⑥	Gasket	NBR	Acryloni-trile-butadiene rubber	⑬	Piston ass'y (B)	—	
⑦	Gasket	NBR	Acryloni-trile-butadiene rubber				

2)Consumable Parts List

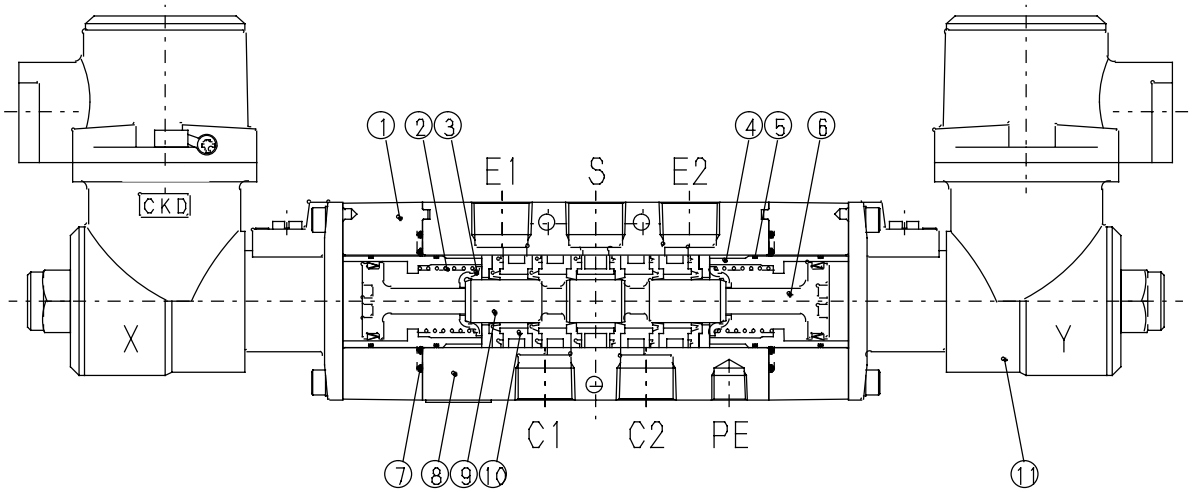
Part no. and name / Model no.	⑪ Seal ass'y	③ Piston ass'y (A)	③ Piston ass'y (B)	⑨ Actuator ass'y
4F420E	4F9－106	4F9－104	—	Actuator ass'y model No.
4F520E	4F9－107	4F9－108	—	
4F620E	4F9－118	—	4F9－116	
4F720E	4F9－119	—	4F9－120	

Note: For consumable parts, kit is available. Please replace a whole kit but not a part. (The kit includes packing seal ass'y, piston ass'y (A) and (B).)

: When replacing the coil, replace the pilot actuator assembly.

●4F3　3-position

1)Internal Structure



No	Parts	Material		No	Parts	Material	
①	Body block	ADC12	Aluminum alloy die casting	⑦	O-Ring	NBR	Acryloni-trile-butadiene rubber
②	Spring	SWP	Steel	⑧	Body	ADC12	Aluminum alloy die casting
③	Spring holder	SUS304	Stainless steel	⑨	Spool	A5056	Aluminum alloy
④	Cylinder	—		⑩	Seal ass'y	—	
⑤	O-Ring	NBR	Acryloni-trile-butadiene rubber	⑪	Actuator ass'y	—	
⑥	Piston ass'y	—					

2)Consumable Parts List

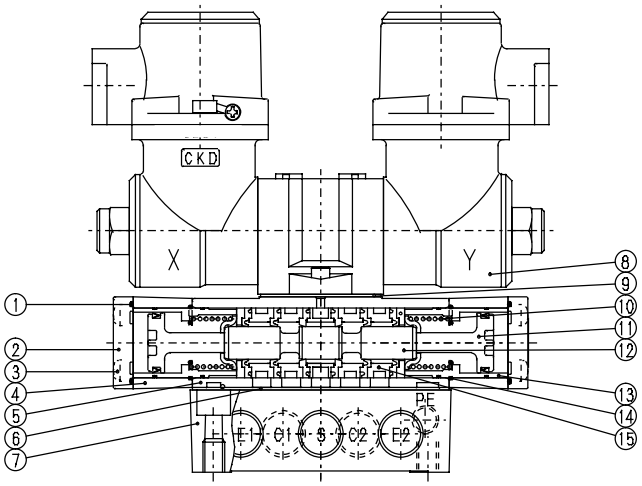
Part no. and name / Model no.	⑩ Seal ass'y	⑥ Piston ass'y	⑪ Actuator ass'y
4F330E	4F9－106	4F9－114	Actuator ass'y model No.
4F340E			
4F350E			

Note: For consumable parts, kit is available. Please replace a whole kit but not a part. (The kit includes packing seal ass'y, piston ass'y.)

: When replacing the coil, replace the pilot actuator assembly.

●4F4 to 7　3-position

1)Internal Structure



No	Parts	Material		No	Parts	Material	
①	Gasket	NBR	Acryloni-trile-butadiene rubber	⑨	Gasket	NBR	Acryloni-trile-butadiene rubbe
②	Cap	ADC12	Aluminum alloy die casting	⑩	Spring	SWP	Steel
③	Cross headed pan small screw with spring washer	SWRM	Steel	⑪	Piston ass'y	—	
④	Body block	ADC12	Aluminum alloy die casting	⑫	Spool	A5056	Aluminum alloy
⑤	Body	ADC12	Aluminum alloy die casting	⑬	O-Ring	NBR	Acryloni-trile-butadiene rubber
⑥	Gasket	NBR	Acryloni-trile-butadiene rubber	⑭	Cylinder	—	
⑦	Sub plate	ADC12	Aluminum alloy die casting	⑮	Seal ass'y	—	
⑧	Actuator ass'y	—					

2)Consumable Parts List

Part no. and name / Model no.	⑮ Seal ass'y	⑪ Piston ass'y	⑧ Actuator ass'y
4F430E	4F9－106	4F9－114	Actuator ass'y model No.
4F440E			
4F450E			
4F530E	4F9－107	4F9－115	
4F540E			
4F550E			
4F630E	4F9－118	4F9－122	
4F640E			
4F650E			
4F730E	4F9－119	4F9－123	
4F740E			
4F750E			

Note: For consumable parts, kit is available. Please replace a whole kit but not a part. (The kit includes packing seal ass'y, piston ass'y.)
: When replacing the coil, replace the pilot actuator assembly.

7. TROUBLE SHOOTING

Motion troubles	Suspected cause	Remedies
Does not actuate	No electric signals	Turn on the power
	Damage to signal wiring system	Repair the control circuit
	Excessive fluctuating range of current or voltage	Reaffirm the power capacity. (within ±10% of voltage fluctuation)
Malfunctions	Excessive leaking current	Correct control circuit and / or set a bleed circuit
	Chattering	Inspect switching system and / or tighten each loosen terminal screw
	Voltage deviates than specified on the name plate	Rectify the voltage to meet the specification
	Damaged or short circuited coil	Replace the coil
	Erroneous shut off pressure source	Turn on the power source
	Insufficient pressure	Reset the pressure reducer valve or install a pressure raising valve
	Insufficient flow of fluid	Rectify the size of pipe or install a surge tank
	Erroneous piping, erroneous omitting some piping	Rectify the piping system
	Speed control valve completely closed by error	Reset the needle valve
	Sticking tarry or liquid jelly substitute	Carry out pipe dressing Operate it periodically
	Valve is frozen	Add remedies of avoiding freezing (Heating system or dehumidifying system etc.)
	Delayed return of a plunger (Excessive oil, existence of far)	Check the quality of the lubricant. (Turbine oil class 1, ISO VG 32 or equivalent)
	〃	Rectify the quantity of lubricant drip
	〃	Install a tar removing filter
	Clogged-up exhausting port with dust	Install a cover or silencer and clean it regularly.
Internal leakage	Bulged or decomposed packing Initial lubricant is washed off or excessive lubricants	Check the quality of the lubricant. (Turbine oil class 1, ISO VG 32 or equivalent)
	〃	Relocate the valves away from splashing area of cutting coolant
	〃	Keep organic chemicals away from valves.
	Initial lubricant is washed off or drain contamination	Change the piping to an external pilot system. Install dryer, Filter or grease up. Grease it up
	Foreign particles cut into packing lips.	Remove the foreign particle away from the packing Install a filter.
Malfunctions when manifold is used	Delayed response when multiple blocks are used. Insufficient air supply flow.	Install Sup. (P) piping to P ports on both sides of manifold block
	Delayed response when multiple blocks are used. Insufficient exhaust air flow.	Connect Exh. (R) piping to R ports on both sides of manifold block so as to exhaust to an open air through
	Adjacent cylinder pops out. Intrusion of exhaust air.	Rewire to have the solenoid valve in question is actuated prior to others sequentially. Increase exhaust air Change type to individual exhaust

8. PRODUCT SPECIFICATIONS AND HOW TO ORDER

8.1.1 Product Specifications

1)4F3 Specifications

Descriptions		2-postion Single	2-postion Double	3pos. All port closed	3-pos. ABR connection	3-pos.PAB connection
Working fluid		Compressed air				
Valve type and operation		Pilot type soft spool valve				
Min. working pressure	MPa	0.10		0.15		
Max. working pressure	MPa	1.0				
Proof pressure	MPa	1.5				
Ambient temperature ※1	℃	−10 to 60				
Fluid temperature	℃	5 to 60				
Lubrication ※2		Not required				
Explosion-proof performance		d2G4				
Vibration resistance	m/s^2	50 or less				
Shock resistance	m/s^2	300 or less				
Atmosphere		No corrosive gas should exist				
Port size Air supplying port S※3		Rp1/4 ・ Rp3/8				
Cylinder port C						
Exhaust port E						
Pilot exhaust port PE		Rp1/8				
Sonic conductance(C) $dm^3/(s\cdot bar)$	Rp1/4	3.9		4.0	4.5	4.0
	Rp3/8	5.8		4.4	5.1	4.4
Response time ※4		100				
Weight	kg	0.80	1.24	1.45		

※1 Ambient temperature applies when stored or sitting, and does not apply to the fluid temperature in operation.
※2 Use turbine oil type 1,ISO VG32 when required. If the oil is lubricated excessively or intermittently, this may cause unstable operation.
※3 As for models 4F3, Rp thread is adopted so as to be built with manifold. Rp, parallel female thread, has been adopted broadly to put in tapered male thread. (It is, also, clearly specified in JIS.)
※4 The response time above is the figure on the non-lubricated type at the supply pressure of 0.5MPa,and is subject to change by pressure and or quality of lubrication.

2)Electric Specifications

Descriptions / Rated voltage (V)	Starting current (A) (50／60Hz)	Holding current (A) (50／60Hz)	Power consumption (W)
AC100	0.186／0.135	0.060／0.050	4.5／4.0
AC200	0.093／0.068	0.030／0.025	4.5／4.0
AC110	0.169／0.123	0.055／0.045	4.5／4.0
AC220	0.085／0.061	0.027／0.023	4.5／4.0
DC12	0.332	0.332	4.0
DC24	0.166	0.166	4.0
Voltage fluctuation	±10%		
Thermal class	A ・ (H)		

1)4F4 Specifications

Descriptions	2-postion Single	2-postion Double	3pos. All port closed	3-pos. ABR connection	3-pos.PAB connection
Working fluid	Compressed air				
Valve type and operation	Pilot type soft spool valve				
Min. working pressure MPa	0.10		0.15		
Max. working pressure MPa	1.0				
Proof pressure MPa	1.5				
Ambient temperature ※1 ℃	−10 to 60				
Fluid temperature ℃	5 to 60				
Lubrication ※2	Not required				
Explosion-proof performance	d2G4				
Vibration resistance m/s^2	50 or less				
Shock resistance m/s^2	300 or less				
Atmosphere	No corrosive gas should exist				
Port size Air supplying port S	Rc1/4 ・ Rc3/8				
Cylinder port C					
Exhaust port E					
Pilot exhaust port PE	Rc1/8				
Sonic conductance(C) $dm^3/(s\cdot bar)$	5.0		4.7	5.3	5.3
Response time ※3	120				
Weight kg	1.17	1.61	1.77		

※1 Ambient temperature applies when stored or sitting, and does not apply to the fluid temperature in operation.
※2 Use turbine oil type 1,ISO VG32 when required. If the oil is lubricated excessively or intermittently, this may cause unstable operation.
※3 The response time above is the figure on the non-lubricated type at the supply pressure of 0.5MPa,and is subject to change by pressure and or quality of lubrication.

2)Electric Specifications

Descriptions / Rated voltage (V)	Starting current (A) (50／60Hz)	Holding current (A) (50／60Hz)	Power consumption (W)
AC100	0.186／0.135	0.060／0.050	4.5／4.0
AC200	0.093／0.068	0.030／0.025	4.5／4.0
AC110	0.169／0.123	0.055／0.045	4.5／4.0
AC220	0.085／0.061	0.027／0.023	4.5／4.0
DC12	0.332	0.332	4.0
DC24	0.166	0.166	4.0
Voltage fluctuation	±10%		
Thermal class	A ・ (H)		

1)4F5 Specifications

Descriptions	2-postion Single	2-postion Double	3pos. All port closed	3-pos. ABR connection	3-pos.PAB connection
Working fluid	Compressed air				
Valve type and operation	Pilot type soft spool valve				
Min. working pressure MPa	0.10		0.15		
Max. working pressure MPa	1.0				
Proof pressure MPa	1.5				
Ambient temperature ※1 ℃	−10 to 60				
Fluid temperature ℃	5 to 60				
Lubrication ※2	Not required				
Explosion-proof performance	d2G4				
Vibration resistance m/s^2	50 or less				
Shock resistance m/s^2	300 or less				
Atmosphere	No corrosive gas should exist				
Port size Air supplying port S	Rc3/8 ・ Rc1/2				
Cylinder port C					
Exhaust port E					
Pilot exhaust port PE	Rc1/8				
Sonic conductance(C) $dm^3/(s\cdot bar)$	10.0		9.7	9.8	
Response time ※3	140				
Weight kg	1.41	1.90	2.16		

※1 Ambient temperature applies when stored or sitting, and does not apply to the fluid temperature in operation.
※2 Use turbine oil type 1,ISO VG32 when required. If the oil is lubricated excessively or intermittently, this may cause unstable operation.
※3 The response time above is the figure on the non-lubricated type at the supply pressure of 0.5MPa,and is subject to change by pressure and or quality of lubrication.

2)Electric Specifications

Descriptions / Rated voltage (V)	Starting current (A) (50／60Hz)	Holding current (A) (50／60Hz)	Power consumption (W)
AC100	0.186／0.135	0.060／0.050	4.5／4.0
AC200	0.093／0.068	0.030／0.025	4.5／4.0
AC110	0.169／0.123	0.055／0.045	4.5／4.0
AC220	0.085／0.061	0.027／0.023	4.5／4.0
DC12	0.332	0.332	4.0
DC24	0.166	0.166	4.0
Voltage fluctuation	±10%		
Thermal class	A ・ (H)		

1)4F6 Specifications

Descriptions	2-postion Single	2-postion Double	3pos. All port closed	3-pos. ABR connection	3-pos.PAB connection
Working fluid	Compressed air				
Valve type and operation	Pilot type soft spool valve				
Min. working pressure MPa	0.15				
Max. working pressure MPa	1.0				
Proof pressure MPa	1.5				
Ambient temperature ※1 ℃	−10 to 60				
Fluid temperature ℃	5 to 60				
Lubrication ※2	Not required				
Explosion-proof performance	d2G4				
Vibration resistance m/s^2	50 or less				
Shock resistance m/s^2	300 or less				
Atmosphere	No corrosive gas should exist				
Port size Air supplying port S	Rc1/2 ・ Rc3/4				
Cylinder port C					
Exhaust port E					
Pilot exhaust port PE	Rc1/4				
Sonic conductance(C) $dm^3/(s\cdot bar)$	18		15		
Response time ※3	400				
Weight kg	2.08	2.58	2.88		

※1 Ambient temperature applies when stored or sitting, and does not apply to the fluid temperature in operation.
※2 Use turbine oil type 1,ISO VG32 when required. If the oil is lubricated excessively or intermittently, this may cause unstable operation.
※3 The response time above is the figure on the non-lubricated type at the supply pressure of 0.5MPa,and is subject to change by pressure and or quality of lubrication.

2)Electric Specifications

Descriptions / Rated voltage (V)	Starting current (A) (50／60Hz)	Holding current (A) (50／60Hz)	Power consumption (W)
AC100	0.186／0.135	0.060／0.050	4.5／4.0
AC200	0.093／0.068	0.030／0.025	4.5／4.0
AC110	0.169／0.123	0.055／0.045	4.5／4.0
AC220	0.085／0.061	0.027／0.023	4.5／4.0
DC12	0.332	0.332	4.0
DC24	0.166	0.166	4.0
Voltage fluctuation	±10%		
Thermal class	A ・ (H)		

1)4F7 Specifications

Descriptions	2-postion Single	2-postion Double	3pos. All port closed	3-pos. ABR connection	3-pos.PAB connection
Working fluid	Compressed air				
Valve type and operation	Pilot type soft spool valve				
Min. working pressure MPa	0.15				
Max. working pressure MPa	1.0				
Proof pressure MPa	1.5				
Ambient temperature ※1 ℃	−10 to 60				
Fluid temperature ℃	5 to 60				
Lubrication ※2	Not required				
Explosion-proof performance	d2G4				
Vibration resistance m/s^2	50 or less				
Shock resistance m/s^2	300 or less				
Atmosphere	No corrosive gas should exist				
Port size Air supplying port S	Rc3/4 ・ Rc1				
Cylinder port C					
Exhaust port E					
Pilot exhaust port PE	Rc1/4				
Effective cross-sectional area mm^2	160				
Response time ※3	600				
Weight kg	3.62	4.10	5.12		

※1 Ambient temperature applies when stored or sitting, and does not apply to the fluid temperature in operation.
※2 Use turbine oil type 1,ISO VG32 when required. If the oil is lubricated excessively or intermittently, this may cause unstable operation.
※3 The response time above is the figure on the non-lubricated type at the supply pressure of 0.5MPa,and is subject to change by pressure and or quality of lubrication.

2)Electric Specifications

Descriptions / Rated voltage (V)	Starting current (A) (50／60Hz)	Holding current (A) (50／60Hz)	Power consumption (W)
AC100	0.186／0.135	0.060／0.050	4.5／4.0
AC200	0.093／0.068	0.030／0.025	4.5／4.0
AC110	0.169／0.123	0.055／0.045	4.5／4.0
AC220	0.085／0.061	0.027／0.023	4.5／4.0
DC12	0.332	0.332	4.0
DC24	0.166	0.166	4.0
Voltage fluctuation	±10%		
Thermal class	A ・ (H)		

8.1.2 Manifold Product Specifications

1)Specifications

Descriptions		
Manifold structure		Manifold integrated
Manifold type		Common exhaust ・ Individual exhaust (M4F3)
Station #		2 to 10 station
Working fluid		Refer to following 8.1.1 Product Specifications.
Valve type and operation		
Min. working pressure	MPa	
Max. working pressure	MPa	
Proof pressure	MPa	
Ambient temperature ※1	℃	
Fluid temperature	℃	
Lubrication ※2		
Vibration resistance	m/s^2	
Shock resistance	m/s^2	
Atmosphere		
Port size		Refer to following individual specifications.
Sonic conductance(C) (M4F3-6)	$dm^3/(s\cdot bar)$	Refer to following 8.1.1 Product Specifications.
Effective cross-sectional area (M4F7)	mm^2	

※1 Ambient temperature applies when stored or sitting, and does not apply to the fluid temperature in operation.
※2 Use turbine oil type 1,ISO VG32 when required. If the oil is lubricated excessively or intermittently, this may cause unstable operation.

2) Individual specifications

Descriptions			M4F3	M4F4	M4F5	M4F6	M4F7
Port size ※3	Common exhaust method	Cylinder port C	Rp1/4 (08) Rp3/8 (10)	Rc1/4	Rc3/8	Rc1/2	Rc3/4
		Exhaust port E	Rc1/2	Rc3/8	Rc1/2	Rc3/4	Rc3/4
		Air supplying port S					Rc1
	Individual exhaust method	Cylinder port C	Rp1/4 (08) Rp3/8 (10)	Rc1/4	Rc3/8	Rc1/2	Rc3/4
		Exhaust port E	Rc1/4 (08) Rc3/8 (10)				Rc1/2
		Air supplying port S	Rc1/2	Rc3/8	Rc1/2	Rc3/4	Rc1
	Pilot exhaust port PE		Rp1/8	Rc1/8	Rc1/8	—	—

※3 As for models M4F3, Rp thread is adopted so as to be built with manifold. Rp, parallel female thread, has been adopted broadly to put in tapered male thread. (It is, also, clearly specified in JIS.)
※4 The response time above is the figure on the non-lubricated type at the supply pressure of 0.5MPa,and is subject to change by pressure and or quality of lubrication.

Electric Specifications

Descriptions / Rated voltage (V)	Starting current (A) (50／60Hz)	Holding current (A) (50／60Hz)	Power consumption (W)
AC100	0.186／0.135	0.060／0.050	4.5／4.0
AC200	0.093／0.068	0.030／0.025	4.5／4.0
AC110	0.169／0.123	0.055／0.045	4.5／4.0
AC220	0.085／0.061	0.027／0.023	4.5／4.0
DC12	0.332	0.332	4.0
DC24	0.166	0.166	4.0
Voltage fluctuation	±10%		
Thermal class	A・(H)		

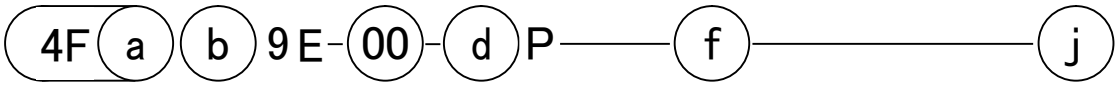
8.2 How to Order

- Explosion proof 5 port valve

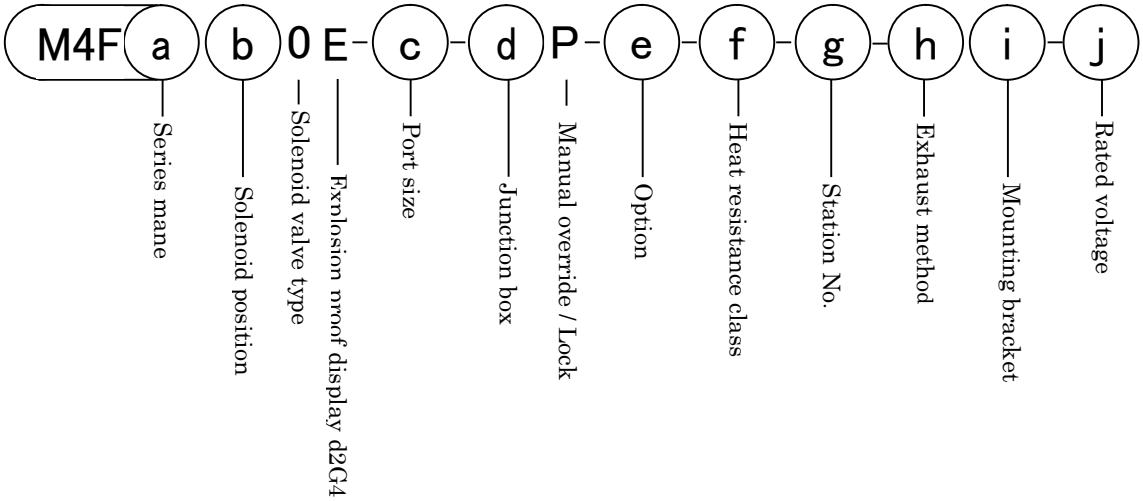
- Pilot actuator assembly

- Discrete solenoid valve of manifold (4F3)

- Discrete solenoid valve of manifold (4F4 to 7)



- Manifold



Note: Screws and gasket are also supplied together with models 4F4※9, 4F5※9, 4F6※9 & 4F7※9.
For the seal assembly, piston assembly(A) and piston assembly(B), refer to the kit number (ex.4F9-104) stated in 6.3 Internal Structure and Consumable Parts List.

a :Series		b :Solenoid position		c :Port size						
3	3	1	2-position single			4F3	4F4	4F5	4F6	4F7
4	4	2	2-position double	08	Rp1/4	○				
5	5	3	3-position all ports closed		Rc1/4		○			
6	6	4	3-position ABR connection	10	Rp3/8	○				
7	7	5	3-position PAB connection		Rc3/8		○	○		
		8	Mix. manifold	15	Rc1/2			○	○	
				20	Rc3/4				○	○
				25	Rc1					○

- As for models 4F3, Rp thread is adopted so as to be built with manifold.
  Rp, parallel female thread, has beenadopted broadly to put in tapered
  male thread. (It is, also, clearly specified in JIS.)

d :Junction box		e :Option	
T	Conduit screw connection method	Blank	None option
G	Pressure proof packing protection tube screw in type	P	Mounting bracket attached (4F31＊E－L type), (4F4 to 7－U type)
		P1	Mounting bracket attached (4F32＊E to 4F35＊E－U type)
		H	Check valve attached (Only 3-position all ports closed)
		N	Plug attached (3 port valve)
		NC	Plug assembly (C1 : A, E1 : R1)
		NO	Plug assembly (C2 : B, E2 : R2)
		R	Position change of manual override

f :Thermal class		g :Station number	
Blank	A	2	2
X	H	to	to
		10	10

h :Exhaust method		i :Mounting bracket	
C	Common exhaust type	L	L model bracket (Single only) attached (Note)
I	Individual exhaust type	U	U shaped bracket attached (Note)

(Note) Tightening torque for mounting bracket assembly screws : 5.0～5.5 N･m

j :Rated voltage	
AC100V	100 VAC (50/60Hz)
AC200V	200 ACV (50/60Hz)
DC24V	24 VDC
DC12V	12 VDC
AC110V	110 VAC (50/60Hz)
AC220V	220 VAC (50/60Hz)

AC100V coil is available for AC110V, while AC200V is available for AC220V.

※1 : As custom order, following voltages are available.

AC (V) 50/60Hz	12, 24, 48, 115, 120, 125, 127, 210, 230, 240, 250, 380
DC (V)	45, 48, 80, 100, 110, 125

※2 : As custom order, following voltages are available.

• When building a system using one kind of manifold

M4F310E－08－TP－N－7－CL－AC100V

・Explosion proof 5 port pilot operated valve manifold
・Solenoid position : 2-position single
・Port size : Rp1/4
・Junction box : Conduit screw connection method
・Option : Plug attached
・Heat resistance class : A
・Station No. : 7 station
・Exhaust method : Common exhaust type
・Mounting bracket : L model bracket
・Rated voltage : 100 VAC

• Mix manifold

・How to indicate mix manifold description
When selecting mix manifold [indicate (b) as 8.], indicate model No., function symbol (A table reference) and allocation number (1 to station No. from left) according to the example.

A table

Symbol	Type
S1	2-position single
S2	2-position double
S3	3-position all port closed
S4	3-position ABR connection
S5	3-position PAB connection
MP	Masking plate

・Model No. mix manifold, as the B table, Port size Rp1/4, Conduit screw connection method, Heat resistance class A, Common exhaust type, U shaped bracket, Voltage AC100V.

Model No.

M4F380E－08－TP－7－CU－AC100V－ 2 2 1 1 1 0

S1 S2 S3 S4 S5 MP

Quantity of mix manifold

Remarks: S1=1,6、S2=2,5、S3=3、S4=7、S5=4、MP = None

B table

Symbol	Type
1	2-position single (S1)
2	2-position double (S2)
3	3-position all port closed (S3)
4	3-position PAB connection (S5)
5	2-position double (S2)
6	2-position single (S1)
7	3-position ABR connection (S4)

9. APPENDIX

9.1 REFERENCE DATE - 1

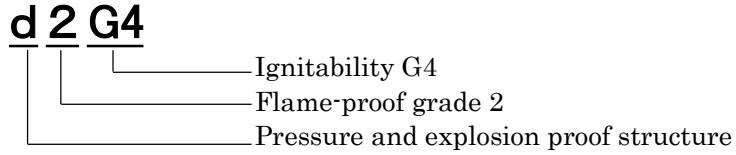
1.Explosion proof certification model

Explosion proof certification is certificate to a whole pilot actuator assembly.
Certification type and model of pilot actuator assembly is as the following table.

Model	Certification type Thermal class A	Model	Certification type Thermal class H
4F310E to 4F350E−TP	E3−TP	4F310E to 4F350E−TP−X	H3−TP
4F410E to 4F710E−TP	E4−TP	4F410E to 4F710E−TP−X	H4−TP
4F420E to 4F720E−TP	E5−TP	4F420E to 4F720E−TP−X	H5−TP
4F430E to 4F730E−TP		4F430E to 4F730E−TP−X	
4F440E to 4F750E−TP		4F440E to 4F750E−TP−X	
4F450E to 4F750E−TP		4F450E to 4F750E−TP−X	

2.Flammable and explosion proof structure

The degree of flammable gas danger is classified according to the ignitability and flame-proof grade. Then gases whose hazardous grade are categorized in the same category, and explosion proof standards are applied according to the category.
The type, flame-proof grade and ignitability are indicated on explosion proof electric components with symbols. These symbols must be indicated in this set order. This shows product categories that electric components are sorted by flame-proof grade, ignitability and applied gas. This also shows availability of the product. For example, when d2G4 is indicated for explosion proof solenoid valve.



shows that this valve can be used up to the hazardous gas categorized in Flame-proof grade 2, Ignitability G4 on Table 2.

The ignition degree is the indexed ignitability and it is classified into 5 degrees as shown in Table 2, below. The larger numeric value, the lower ignition temperature indicating the more hazardous gas explosion. Explosion class indicates the degree of danger that fire goes outside through narrow clearances. It indicates
and is classified into 3 classes by size of clearance as shown in Table 1. The larger
number, the higher explosion energy is which means the more hazardous gas.

9 APPENDIX

Table 1

Item			Marking
Ignition degree	Ignition degree	G1	G1
	Ignition degree	G2	G2
	Ignition degree	G3	G3
	Ignition degree	G4	G4
	Ignition degree	G5	G5
Explosion class	Explosion class	1	1
	Explosion class	2	2
	Explosion class	3	3

Table 2

Ignitability / Flame-proof grade	G1	G2	G3	G4	G5
1	Acetone	Ethanol	Gasoline	Acetaldehyde	
	Ammonia	Isoamyl acetate	Hexane	Ethyl ether	
	Carbon monoxide	1-butanol			
	Ethane	Butane			
	Acetic acid	Acetic anhydride			
	Ethyl acetate				
	Toluene				
	Propane				
	Benzene				
	Methanol				
	Methane				
2	Coal gas	Ethylene	Isoprene		
		Ethylene oxide			
3	Water gas, Hydrogen	Acetylene			Carbon disulfide

3.Danger zone

Zone where flammable gases and air mix at a level high enough to cause an explosion or combustion are called danger zones These zones are classified into Class O zones, Class I zones and Class 2 zones according to the time and frequency that the dangerou8 atmosphere exists. The explosion proof structure that can be used is determined according to these c asses.

- Class 0 zone (4F Explosion-proof series is not applicable to be installed with in this place.)
  Zone where a dangerous atmosphere is or could be continuously generated, and where the concentration of flammable gas is maintained continuously or for a long term above the lower limit for explosions.
  Example a. Room above liquid level in vessel or tank of flammable liquid.
  b. Inside of a flammable gas vessel and a tank etc.
  c. Close to liquid level of flammable liquid in a opened vessel.

- Class 1 zone
  (1) Zone where flammable gas could accumulate to a dangerous concentration during normal operation such as during opening-closing of product take-out lid, or operation of a safety valve.
  (2) Zone where flammable gas could accumulate to a dangerous concentration during repairs, maintenance or due to a leakage etc.

- Class 2 zone
  (1) Zone where combustible gases or flammable fluids are always handled, but where the gases and fluid are sealed in a vessel or equipment and where the gas could leak to a dangerous concentration only if the vessel or equipment breaks by accidents or if the operation is mistaken.
  (2) Zone where measures to prevent accumulation or flammable gas are taken with a certain mechanical ventilation device but where flammable gas could accumulate to a dangerous concentration if the ventilation device fails.
  (3) The place around Class I zone or the room which adjacent to Class 1 zone and flammable gas that reaches hazardous concentration may enter into.

9.2 REFERENCE DATA - 2

Explosive Class, Ignition Grade and Major Hazard

	Name of material	Explosion Class	Igniting Grade	Ignition Temperature ℃	Flash Point ℃	Explosion Limit		Steam Density (Air=1)
						Min. vol %	Max. vol %	
	Acrylic Acid Ethyl	1	G2	350	9	1.7	–	3.45
	Acrylic Acid Methyl	1	G2	415	–3	2.4	25	2.97
	Acrylonitrile	1	G1	480	–5	2.8	28	1.83
×	Nitrous Acid Ethyl	1	G6	90	–35	3.0	50	2.59
	Acetyl Acetone	1	G2	340	34	1.7	–	3.45
×	Acetylene	3	G2	305	Gas	1.5	100	0.90
	Acetaldehyde	1	G4	140	–37.8	4.0	57	1.52
	Acetonitrile	1	G1	525	2	3.0	–	1.41
	Acetone	1	G1	540	< –20	2.5	13	2.00
	Ammonia	1	G1	630	Gas	15.0	28	0.59
	Isooctane	1	G2	410	–12	1.0	6	3.94
	Isobutanol	1	G2	430	27	1.7	–	2.55
	Isobutyl methylketone	1	G1	475	14	1.2	8.0	3.46
	Isoprene	2	G3	220	–53.9	1.0	9.7	2.35
	Isopentane	1	G2	420	<–51.1	1.3	7.6	2.49
	Carbon Monexide	1	G1	605	Gas	12.5	74	0.97
	Ethanol	1	G2	425	12	3.5	19	1.59
	Ethane	1	G1	515	Gas	3.0	15.5	1.04
	Diethyl Ether	1	G4	170	–45	1.7	36	2.55
	Ethyl-Methyl Ketone	1	G1	505	–1	1.8	11.5	2.48
	Ethylene	2	G2	425	Gas	2.7	34	0.97
	Ethylene Oxide	2	G2	440	Gas	3.0	100	1.52
	Epichlorohydrin	1	G2	385	28	2.3	34.4	3.29
	Isopropyl Chloride	1	G1	590	–32.2	2.8	10.7	2.71
	Vinyl Chloride	1	G2	415	Gas	3.8	29.3	2.16
	Butyl Chloride	1	G3	245	–12	1.8	10.1	3.20
	Octane	1	G3	210	12	0.8	6.5	3.94
	o-Xylene	1	G1	465	30	1.0	7.6	3.66
	m-Xylene	1	G1	525	25	1.1	7.0	3.66
	p-Xylene	1	G1	525	25	1.1	7.0	3.66
	Chlorobenzene	1	G1	590	28	1.3	11.0	3.88
	Acetic Acid	1	G1	485	40	4.0	17	2.07
	Acetic Isopentyl	1	G2	380	25	1	10	4.49
	Acetic Ethyl	1	G1	460	–4	2.1	11.5	3.04
	Acetic Vinyl	1	G2	385	–8	2.6	13.4	2.98
	Acetic Butyl	1	G2	370	22	1.2	7.5	4.01
	Acetic Propyl	1	G2	430	10	1.7	8.0	3.52
	Acetic Pentyl	1	G2	375	37	1.0	–	4.49
	Acetic Methyl	1	G1	475	–10	3.1	16	2.56
	Hydrogen Cyanide	1	G1	535	< –20	5.4	46.6	0.93
	Cyclohexanone	1	G2	430	43	1.3	9.4	3.38
	Cyclohexane	1	G3	260	–18	1.2	8.3	2.90
	Ethyl Bromide	1	G1	510	< –20	6.7	11.3	3.76
	Diisopropyl ether	1	G2	405	–27.8	1.4	21	3.53
	1,4 Dioxane	1	G2	375	11	1.9	22.5	3.03
	1,2 Dichloroethane	1	G2	440	13	6.2	16	3.42

Note) 4F Explosion-proof type valves are inapplicable for × marked material.

	Name of material	Explosion Class	Igniting Grade	Ignition Temperature ℃	Flash Point ℃	Explosion Limit		Steam Density (Air=1)
						Min. vol %	Max. vol %	
	1,1 Dichloroethylene	1	G1	530	–10	5.6	16	3.35
	(trans-)1,2-Dichloroethylene	1	G1	460	6	9.7	12.8	3.35
	Dibuty ether	1	G4	175	25	0.9	8.5	4.48
	Dimethyl ether	1	G3	240	Gas	3.0	27	1.59
×	Ethyl Nitrate	3	G6	85	10	3.8	–	3.14
×	Hydrogen	3	G1	560	Gas	4.0	75.6	0.07
	Styrene	1	G1	490	32	1.1	8.0	3.59
	Thiophene	1	G2	395	–9	1.5	12.5	2.90
	Tetrahydrofuran	1	G3	230	–20	2.0	12.4	2.49
	Decane	1	G3	205	46	0.7	5.4	4.90
	1,2,4-Trimethyl benzene	1	G1	485	50	1.1	7.0	4.15
	Toluene	1	G1	535	6	1.2	7.0	3.18
×	Carbon Disulfide	3	G5	102	–30	1.0	60	2.64
	1,3-Butagene	2	G2	415	Gas	1.1	12.5	1.87
	Furan	1	G2	390	< –20	2.3	14.3	2.35
	1-Butanol	1	G2	340	29	1.4	11.3	2.55
	Butane	1	G2	365	Gas	1.5	8.5	2.05
	Butyraldehyde	1	G3	230	–6.7	1.4	12.5	2.48
	2-Propanol	1	G2	425	12	2.0	12	2.07
	Propane	1	G1	470	Gas	2.1	9.5	1.56
	Propylene	1	G2	410	Gas	2.0	11.7	1.49
	Propylene Oxide	2	G2	430	–37.2	1.9	24	2.00
	1-Hexanol	1	G3	290	63	1.3	–	3.53
	Hexane	1	G3	240	–21.7	1.2	7.4	2.79
	Heptane	1	G3	215	–4	1.1	6.7	3.46
	Benzene	1	G1	555	–11	1.2	8.0	2.70
	Benzotrifflolid	1	G1	620	12	–	–	5.04
	1-Pentanol	1	G3	300	32.8	1.2	11	3.04
	Pentane	1	G3	285	< –40	1.4	7.8	2.49
	Acetic Anhydride	1	G2	330	49	2.0	10.2	3.52
	Methyl methacrylate	1	G2	430	10	2.1	12.5	3.45
	Methanol	1	G1	455	11	5.5	44	1.10
	Methane	1	G1	595	Gas	5.0	15.0	0.55
	2-Methyl Hexane	1	G3	280	<0	2.1	13	3.46
	3-Methyl Hexane	1	G3	280	<0	–	–	3.46
	Hydrogen Sulfide	2	G3	270	Gas	4.3	45.5	1.19
	Gasoline	1	G3	～260～	< –20	1	7	3 to 4
×	Water Gas	3	G1	～600～	Gas	6	72	0.6 to 0.7
	Coal Gas	2	G1	～560～	Gas	4	40	0.5 to 0.6

Note) 4F Explosion-proof type valves are inapplicable for × marked material.