CKD

Residual pressure exhaust valve with spool position detection

SNS Series

INSTRUCTION MANUAL

SM-A11929-A

- Make sure to read this Instruction Manual before using the product.
- Read the safety notes carefully.
- Keep this Instruction Manual in a safe and convenient place for future reference.

CKD Corporation

PREFACE

Thank you for purchasing CKD's **residual pressure exhaust valve with spool position detection**.
This Instruction Manual contains basic matters such as installation and usage instructions in order to ensure optimal performance of the product. Please read this Instruction Manual thoroughly and use the product properly.
Keep this Instruction Manual in a safe place and be careful not to lose it.

Product specifications and appearances presented in this Instruction Manual are subject to change without notice.

SAFETY INFORMATION

When designing and manufacturing any device incorporating the product, the manufacturer has an obligation to ensure that the device is safe. To that end, make sure that the safety of the machine mechanism of the device, the pneumatic or water control circuit, and the electric system that controls such mechanism is ensured.

To ensure the safety of device design and control, observe organization standards, relevant laws and regulations, which include the following:

ISO 4414, JIS B 8370, JFPS 2008 (the latest edition of each standard), the High Pressure Gas Safety Act, the Industrial Safety and Health Act, other safety rules, organization standards, relevant laws and regulations

In order to use our products safely, it is important to select, use, handle, and maintain the products properly.
Observe the warnings and precautions described in this Instruction Manual to ensure device safety.

Although various safety measures have been adopted in the product, customer's improper handling may lead to an accident. To avoid this:

Thoroughly read and understand this Instruction Manual before using the product.

To explicitly indicate the severity and likelihood of a potential harm or damage, precautions are classified into three categories: "DANGER", "WARNING", and "CAUTION".

⚠ **DANGER**	Indicates an imminent hazard. Improper handling may cause death or serious injury to people.
⚠ **WARNING**	Indicates a potential hazard. Improper handling may cause death or serious injury to people.
⚠ **CAUTION**	Indicates a potential hazard. Improper handling may cause injury to people or damage to property.

Some statements classified as "CAUTION" may still lead to serious results depending on the situation. All statements that follow these labels are important and must be observed.

Other general precautions and tips on using the product are indicated by the following icon.

Indicates general precautions and tips on using the product.

Precautions on Product Use

⚠ WARNING

The product must be handled by a qualified person who has extensive knowledge and experience.

The product is designed and manufactured as general industrial machinery and parts.

Use the product within its specifications.

The product must not be used beyond its specifications. Also, the product must not be modified and additional work on the product must not be performed.

The product is intended for use in general industrial machinery and parts. It is not intended for use outdoors or in the conditions or environments listed below.

- In applications for nuclear power, railroad system, aviation, ship, vehicle, medical equipment, and equipment that directly touches beverage or food.
- For special applications that require safety including amusement equipment, emergency shut-off circuit, press machine, brake circuit, and safety measures.
- For applications where life or properties could be adversely affected and special safety measures are required.

(Exception is made if the customer consults with CKD prior to use and understands the specifications of the product. However, even in that case, safety measures must be taken to avoid danger in case of a possible failure.)

Do not handle the product or remove pipes and devices until confirming safety.

- Inspect and service the machine and devices after confirming the safety of the entire system. Also, turn off the energy source (air supply or water supply) and power to the relevant facility. Release compressed air from the system and use extreme care to avoid water or electric leakage.
- Since there may be hot or live parts even after operation has stopped, use extreme care when handling the product or removing pipes and devices.
- When starting or restarting a machine or device that incorporates pneumatic components, make sure that a safety measure (such as a pop-out prevention mechanism) is in place and system safety is secured.

⚠ WARNING	Work on safety related systems should be performed only by qualified personnel familiar with safety engineering.

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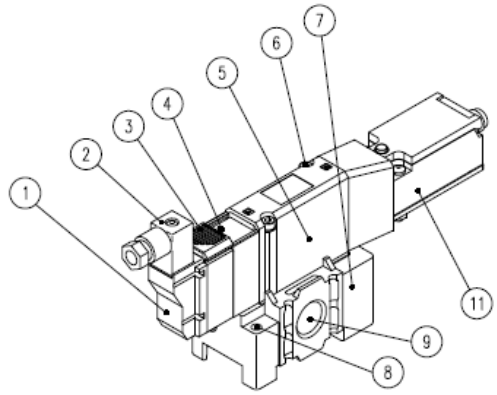
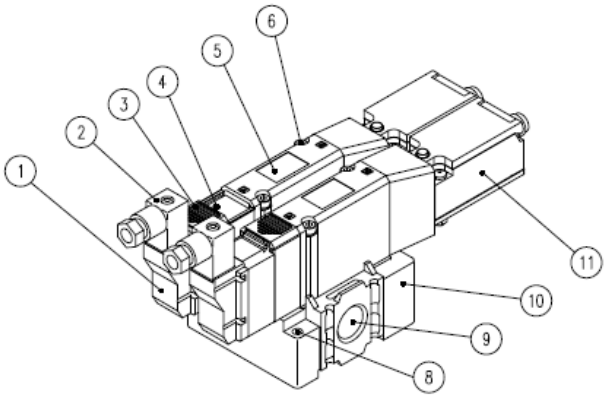
1. PRODUCT OVERVIEW

1.1 Part Name



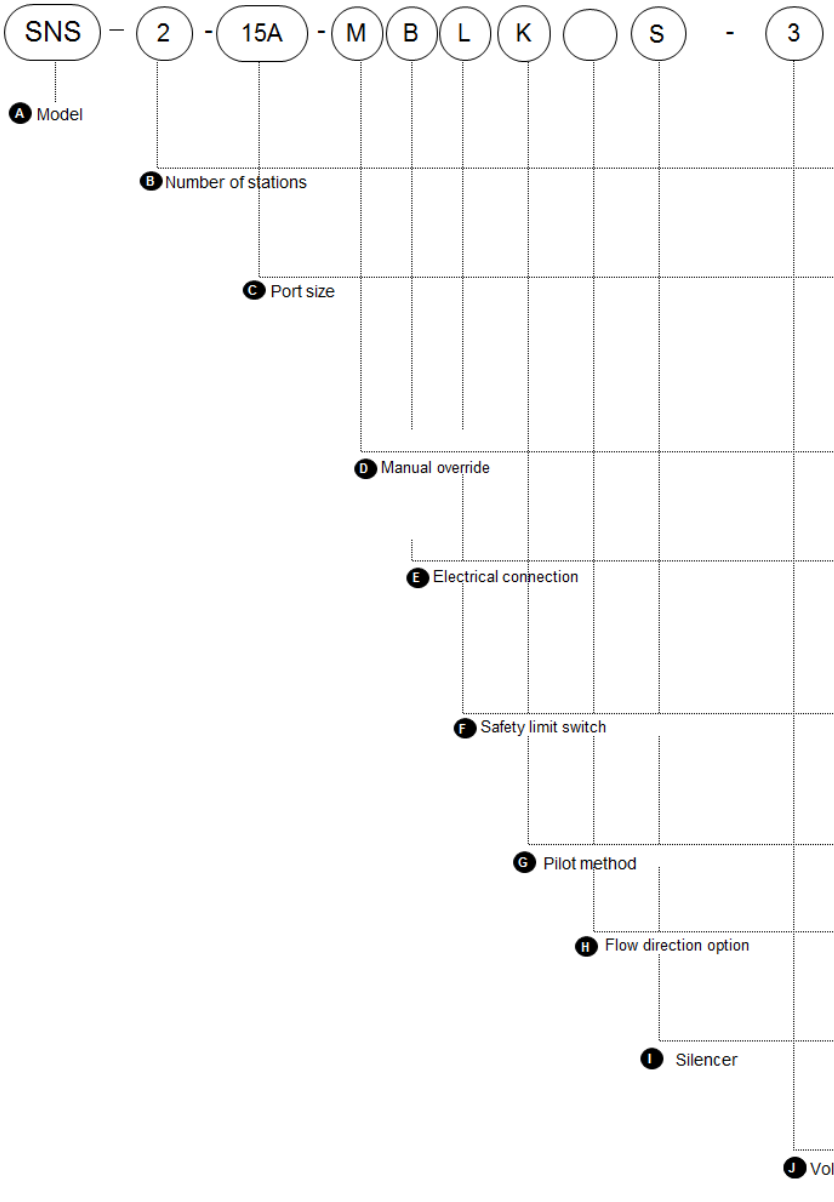
1 station
(shown with limit switch)



2 stations
(shown with limit switch)

No.	Part name	Description
1	Coil assembly	Coil assembly provided for DIN terminal box type valve.
2	DIN terminal box	Terminal box provided with a power indicator which lights green while the coil is energized.
3	Manual protection cover	Cover which prevents accidental operation of the manual override and is opened to operate the manual override.
4	Manual override	Non-locking/locking combination type(standard) or select a non-locking
5	Single valve	Valve which constitutes the valve mechanism part of the product.
6	Single valve mounting screw	Screw used for securing a single valve to various bases (2 screws provided for each valve).
7	1-station subplate	Subplate provided with piping port and used for securing the product.
8	Mounting hole	Hole used for direct mounting.
9	Piping port	Port provided for supply, indicated by 1(P); for exhaust, indicated by 3(R); for output, indicated by 2(A).
10	2-station subplate	Subplate provided with piping port and used for securing the product.
11	Limit switch	Safety limit switch used for detecting the position of the spool valve.

1.2 Model Number Indication



Symbol	Description
B Number of stations	
1	1 station
2	2 stations

C Port size	
10A	Rc3/8
15A	Rc1/2
15G	G1/2
10N	NPT3/8
15N	NPT1/2

D Manual override	
Blank	Non-locking/locking combination type (standard)
M	Non-locking type

E Electrical connection	
B	DIN terminal box (Pg7) with surge suppressor/lamp
BN	DIN terminal box (Pg7) (no terminal box) with surge suppressor

F Safety limit switch	
Blank	No switch (*1)
L	Pg13.5(D4N-1B31：Omron)
M	M12-4P connector (D4N-9B31：Omron)

G Pilot method	
Blank	Internal pilot
K	External pilot

H Flow direction option	
Blank	Standard flow(Left to Right)
X1	Reverse flow(Right to Left) (*2)

I Silencer	
Blank	None
S	Silencer (SLW-10L) provided (*3)

J Voltage	
3	24 VDC

*1 Available only if B (Number of stations) is" 1" .
Not certified to a safety standard.
*2 Available only if B (Number of station) is "1" .
*3 Available only if C (Port size) is 10A or 15A.

Refer to the catalog for precautions on selecting the model number.

1.3 Specifications and characteristics

1.3.1 Common specifications

Valve and operation		Pilot-operated soft spool valve
Working fluid		Compressed air
Max. working pressure	**MPa**	0.7
Min. working pressure	**MPa**	0.2 Note 3
Proof pressure	**MPa**	1.05
Ambient temperature	**°C**	-5 to 55 (no freezing)
Fluid temperature	**°C**	5 to 55
Manual override		Non-locking/locking combination type (standard)
		Non-locking type
Lubrication	**Note 1**	Not required
Degree of protection	**Note 2**	IP65 (water-jet proof)
Vibration resistance	**m/s^2**	50 or less
Shock resistance	**m/s^2**	300 or less
Atmosphere		Not for use in corrosive gas atmosphere
Maximum operating frequency	**times/min**	30
Minimum operating frequency	**times/week**	1
Safety function		Protection from unexpected startup due to residual pressure release
Category conforming to ISO 13849-1		Category 2 (1 station) Note4 Category 3, 4 (2 stations)
Reliability data B10		5 million times

Note 1: If lubrication is necessary, use Class 1 ISO VG 32 turbine oil.
Excessive or intermittent lubrication results in unstable operation.
Note 2: Use a cord (cable) with an appropriate outside diameter and secure with the specified tightening torque.
Do not use in an environment where water and oil are always splashing onto the product.
Note 3: Working pressure is 0 MPa to 0.7 MPa when the external pilot (option symbol: K) is selected. Set the external pilot pressure to a value between 0.2 MPa and 0.7 MPa.
Note4: Applicable when safety limit switch is attached.
* Pressure of at least 0.2 MPa is necessary in order to operate the SNS Series. If the cross-sectional area of the piping on the fluid supply side is reduced, the pressure inside the valve may decrease due to the pressure drop that occurs when the valve is operated and the operation may become unstable.

1.3.2 Electrical specifications

Rated voltage		24 VDC
Voltage fluctuation range		± 10%
Holding current	**A**	0.042
Power consumption	**W**	1.0
Thermal class		B
Surge suppressor		Varistor
Indicator		Lamp

1.3.3 Limit switch specifications

Limit switch specifications			
Manufacturer model		D4N-1B31 (Omron)	D4N-9B31 (Omron)
Terminal		Pg13.5	M12-4P connector
Contact resistance		25 mΩ or less	
Minimum applicable load		5 VDC 1 mA resistance load	
Rated insulation voltage	**V**	300	
Insulation resistance	**MΩ**	100	
Electric shock protection class		Class II	
Pollution degree (working environment)		3 (EN 60947-5-1)	
Conditional short-circuit current	**A**	100	

Refer to the catalog provided by the manufacturer for details.

1.3.4 Flow characteristics

Model	Number of stations	1(P)→2(A)	2(A)→3(R)
		C[dm³/(s·bar)]	C[dm³/(s·bar)]
SNS	1 station	13	14
	2 stations	10	14

* Formula for converting sonic conductance C to effective cross-sectional area S is S ≈ 5.0 x C.

1.3.5 Weight

Number of stations	Safety limit switch		Weight (kg)
1 station	With safety limit switch	Pg 13.5	0.7
		M12-4P connector	0.7
	No switch		0.6
2 stations	With safety limit switch	Pg 13.5	1.2
		M12-4P connector	1.2

1.3.6 Exhaust time characteristic

The exhaust time until the pressure 0.7 MPa of the output port reaches 0.05 MPa after turning OFF the residual pressure discharge valve is shown in the table below.

Tank capacity [L]	Exhaust time [s]
5	1.2
12	2.4
25	5.2

1.3.7 Response time

Solenoid	Response time [ms]
ON	100 or less
OFF	100 or less

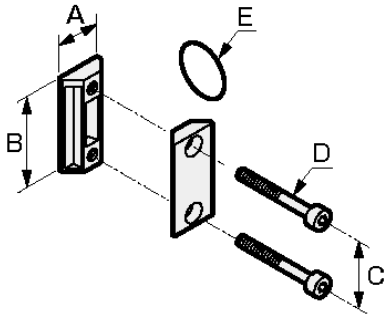
Response time is from "supply voltage is off" to "spool moves to exhaust position".

1.3.8 Related products

■ Joiner set

<C4000-J400-W>

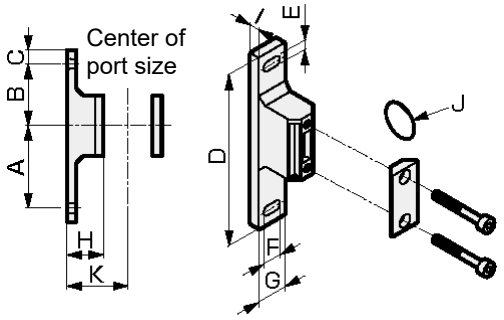
Model number	A	B	C	D	E
C4000-J400-W	21	44	32	M5	JIS B 2401-P21



■ T-type bracket set

<B310-W, B410-W>

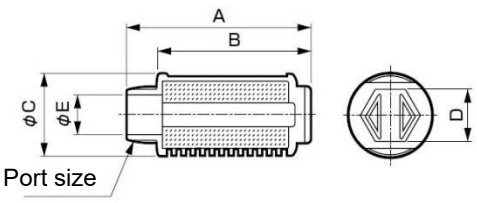
Model number	A	B	C	D	E	F	G	H	I	J	K
B310-W	60	45	10	125	7	14	22	27	7	JIS B 2401-P21	45
B410-W	60	45	10	125	7	14	22	37	7	JIS B 2401-P21	55



■ Silencer

<SLW-10L>

Model number	Noise reduction effect dB(A)	Effective cross-sectional area mm²	A	B	C	D	E	Port size
SLW-10L	30 or more	60	68.2	58.4	28	19	12	R3/8

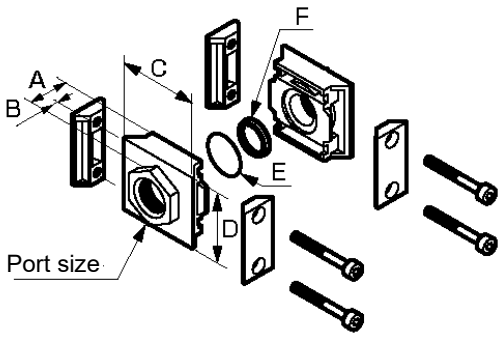


■ Pipe adaptor set

<A400-□-W>

Model number	Port size	A	B	C	D	E (O-ring)	F (Gasket)
A400-8*-W	1/4	20	6	50	45	JIS B 2401-P21 1 piece	1 piece
A400-10*-W	3/8						
A400-15*-W	1/2						
A400-20*-W	3/4	25	11				
A400-25*-W	1	34	20				

*Blank: Rc thread, N: NPT thread, G: G thread

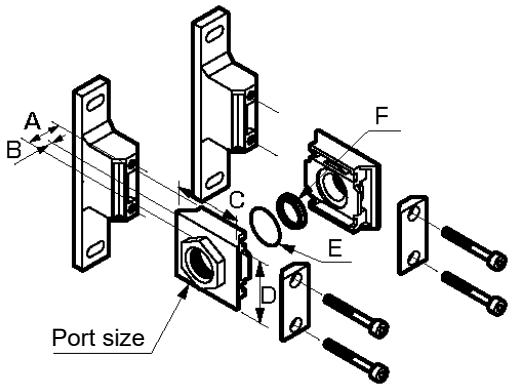


■ Pipe adaptor set with T-type bracket

<A400-□-W-B□W>

Model number	Port size	A	B	C	D	E (O-ring)	F (Gasket)
A400-8*-W-B31W	1/4	20	6	50	45	JIS B 2401-P21 1 piece	1 piece
A400-10*-W-B31W	3/8						
A400-15*-W-B31W	1/2						
A400-8*-W-B41W	1/4						
A400-10*-W-B41W	3/8						
A400-15*-W-B41W	1/2						
A400-20*-W-B41W	3/4	25	11				
A400-25*-W-B41W	1	34	20				

*Blank: Rc thread, N: NPT thread, G: G thread



1.4 Internal Structure

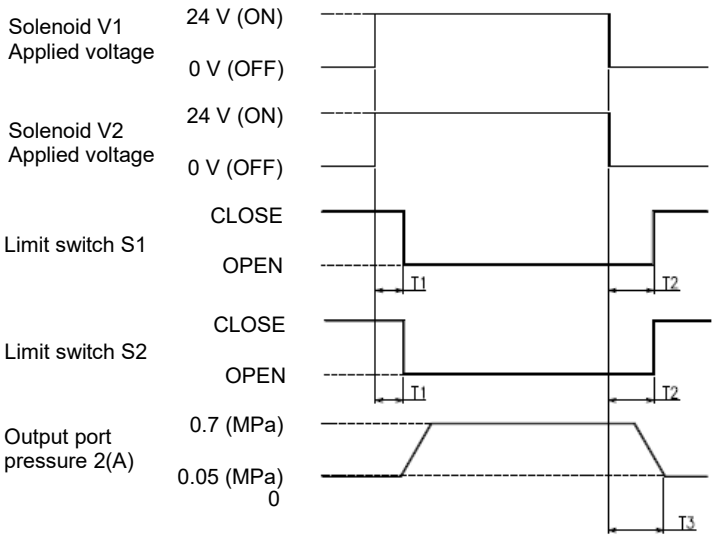
1.4.1 Description of operation

■ Limit switch operation

Product in compliance with category 2 (SNS-1…)
In order to perform the check of the safety function, a limit switch for detecting the position of the spool valve is mounted on the main body of the residual pressure exhaust valve.

Product in compliance with categories 3 and 4 (SNS-2…)
In addition to the above, 2 units of residual pressure exhaust valve are connected in series to provide redundancy. Even if one unit fails, the switching operation of the other unit will release the compressed air remaining in the output port to the exhaust port.

This limit switch is a direct opening action safety limit switch. When compressed air is output from output port (2A), the electric contact of the limit switch becomes OPEN; when compressed air remaining in output port (2A) is released to the outside from exhaust port (3R), the electric contact of the limit switch becomes CLOSE.



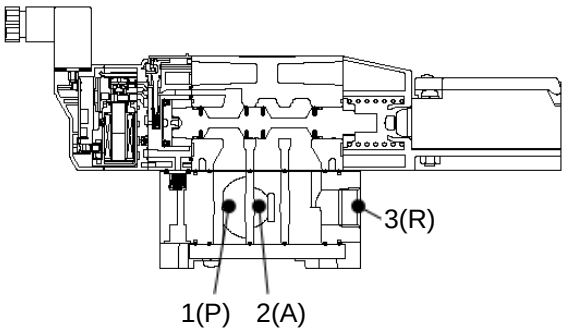
T1: Time from when residual pressure exhaust valve is ON until when limit switch is OPEN :30ms
T2: Time from when residual pressure exhaust valve is OFF until when limit switch is CLOSE :120ms
T3: Response time (OFF)
Time from when residual pressure exhaust valve is OFF until when pressure is exhausted from output port : Please refer to 1.3.6

※Each of the time is the value in CKD defined conditions.

■ Valve operation

De-energized (see figure below)

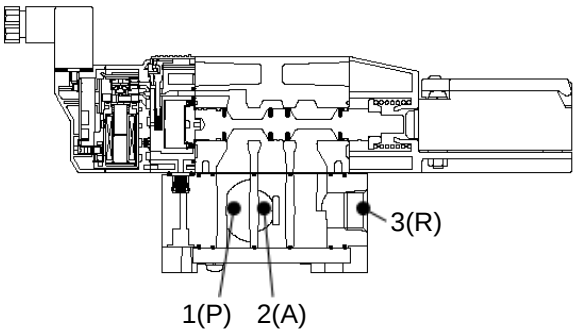
Flow path: 2(A) and 3(R) are connected (residual pressure is exhausted).
Limit switch: CLOSE



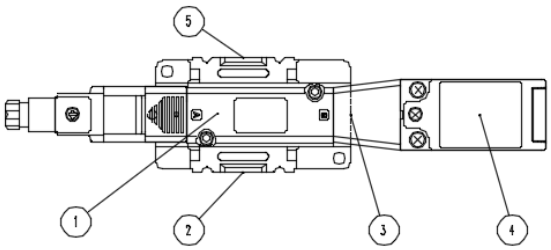
OFF state

Energized (see figure below)

Flow path: 1(P) and 2(A) are connected
Limit switch: OPEN

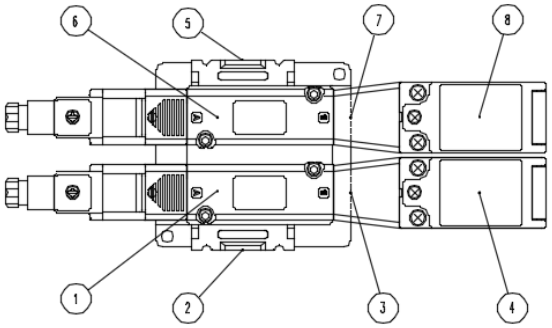


ON state



1 station

① Solenoid valve V1
② Air supply port 1 (P)
③ Exhaust port 3 (R1)
④ Limit switch S1
⑤ Output port 2 (A)



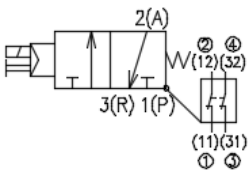
2 stations

① Solenoid valve V1
② Air supply port 1 (P)
③ Exhaust port 3 (R1)
④ Limit switch S1
⑤ Output port 2 (A)
⑥ Solenoid valve V2
⑦ Exhaust port 3 (R2)
⑧ Limit switch S2

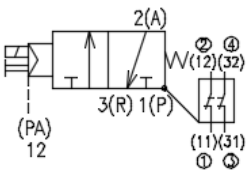
Number of stations	Solenoid valve [V]	Limit switch	Condition
	V1	S1	
1 station	0	CLOSE	Solenoid valve V1: When OFF, flow path: 2 (A) and 3 (R) are connected. (Residual pressure discharge state) Limit switch S1 is CLOSE state.
	24	OPEN	Solenoid valve V1: When ON, flow path: 1 (P) and 2 (A) are connected. Limit switch S1 is OPEN state.

Number of stations	Solenoid valve [V]		Limit switch		Condition
	V1	V2	S1	S2	
2stations	0	0	CLOSE	CLOSE	Solenoid valve V1, V2: When OFF: Flow path: 2 (A) and 3 (R2) are connected. (Residual pressure discharge state) Limit switches S1, S2 is CLOSE state.
	24	0	OPEN	CLOSE	Solenoid valve V1: ON, V2: OFF flow path: 2 (A) and 3 (R2) are connected. (Residual pressure discharge state) Limit switch S1 is OPEN state, S2 is CLOSE state.
	0	24	CLOSE	OPEN	Solenoid valve V1: OFF, V2: ON Flow path: 2 (A) and 3 (R2) are connected. (Residual pressure discharge state) Limit switches S1 is CLOSE state, S2 is OPEN state.
	24	24	OPEN	OPEN	Solenoid valve V1, V2: When ON, flow path: 1 (P) and 2 (A) are connected. Limit switches S1, S2 is OPEN state.

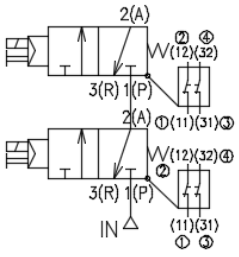
1.4.2 JIS symbol



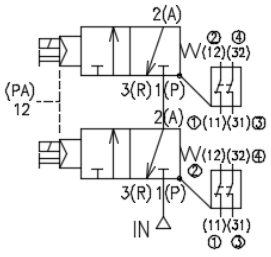
Internal pilot specification



External pilot specification (Option K)



Internal pilot specification



External pilot specification (Option K)

2. INSTALLATION

2.1 Environment

⚠ CAUTION

Take measures to prevent foreign matters from entering the exhaust port in a dusty environment.

Foreign matters may enter the exhaust port of a solenoid valve due to the intake/exhaust actions generated by the valve operation or if the exhaust port is facing up. Install a silencer to prevent foreign matters from entering the exhaust port or mount the valve so that the exhaust port faces down.

Do not use the product in an application where water or cutting oil always splashes on the valve directly.

In an environment where water and cutting oil are always splashing onto the valve, protect it by using a cover or by installing the system inside a paneled casing. If cutting oil splashes onto the cylinder rod, the oil may enter into the secondary side piping of the solenoid valve through the cylinder, causing a malfunction. Consult CKD before using the product in such an environment.

Observe the following precautions since coils produce heat.

- Since installing the product in a control board or energizing the solenoid coil for a long period generates heat, consider appropriate ventilation or heat dissipation measures and use the product within its working temperature range.
- The coil temperature may rise depending on the surrounding temperature and energization time. Be careful when touching the valve.

Do not use the product in the presence of corrosive gas or solvents.

Do not use the product in an environment where corrosive gas such as sulfur dioxide gas and solvents are present.

Do not use the product where it is subject to vibrations or shocks.

Do not subject the product to vibrations exceeding 50 m/s^2 or shocks exceeding 300 m/s^2.

Avoid using the product in a humid environment.

Condensation may occur due to temperature change.

Do not use the product in an explosive environment.

For use in an explosive environment, select explosion-proof solenoid valves.

Use extreme care to avoid deterioration of packings and gaskets when using the product in a place with high ozone concentration (for example, near a beach or in an area with frequent thunderstorms).

Packing and gaskets may deteriorate sooner than usual.

Take measures against lightning surges on the device side.

The product has no resistance to lightning surges.
Use AC voltage models in an installation category II environment.

2.2 Unpacking

⚠ CAUTION

Do not remove the solenoid valves from their packaging bag until just before piping.
If bags are opened before the valves are ready to be connected to the pipes, foreign matters may enter inside the solenoid valves from the piping ports and may cause a failure or malfunction.

- Check that the model number ordered and the model number indicated on the product are the same.
- Check the exterior of the product for any damage.
- When any cautionary documents are provided with the product, read them, as well as this Instruction Manual, before use.
- Secure working space around the solenoid valve for installation, removal, wiring, and piping.

2.3 Mounting

⚠ WARNING

Before using the product under conditions not specified for the product or for special applications, make sure to consult CKD about its specifications.

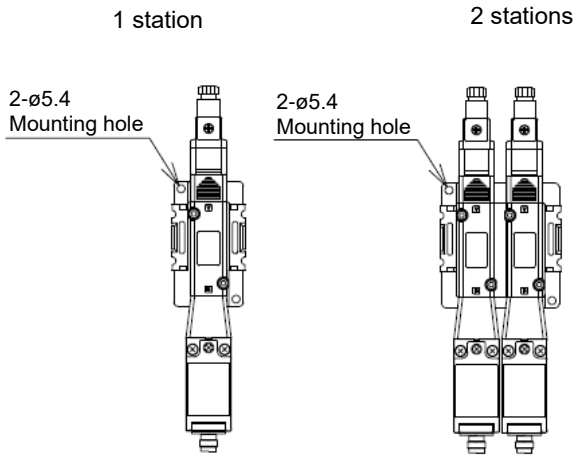
⚠ CAUTION

Do not use a method of mounting that relies on support from the piping when mounting the solenoid valve.
Mount and secure the solenoid valve body.

Tighten the screws with the appropriate tightening torque.
If assembly or tightening is not properly done, it may result in air leakage, product falling off, screw breakage, or deformation of DIN rails.

■ Mounting directly

Secure the mounting screws through the mounting holes (2 places).

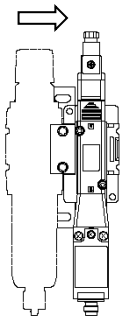
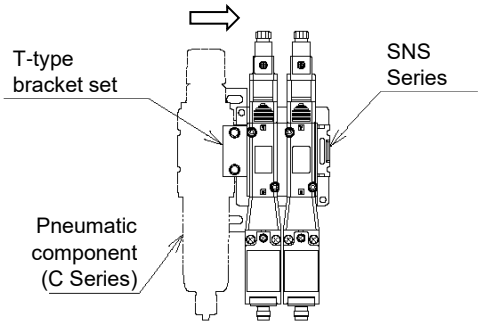


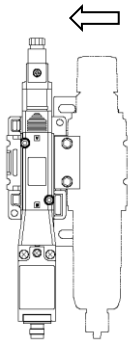
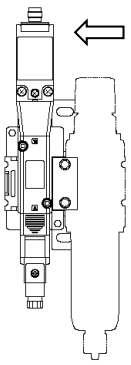
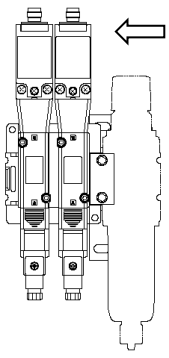
Flow direction option X1 is available only with the module connection specified on the next page.

■ Module connection with pneumatic components

Module connection combines the product into one unit with pneumatic components (C2000, C3000, C4000 Series).
Following parts are required for combining into one unit.

Part name	Model number
Joiner set	C4000-J400-W
T-type bracket set	B310-W (for C2000, C3000 Series)
	B410-W (for C4000 Series)

<table>
<tr><th></th><th>1 station</th><th>2 stations</th></tr>
<tr><td>Standard flow
Left to Right</td><td> 
Flow direction option: Blank</td><td> 

Flow direction option: Blank</td></tr>
<tr><td rowspan="2">Reverse flow
Right to Left</td><td> 
Flow direction option: X1</td><td>Flow direction option X1 is not available.
Invert the product.</td></tr>
<tr><td> 
Flow direction option:
Invert the blank option model</td><td> 
Flow direction option:
Invert the blank option model</td></tr>
</table>

2.4 Piping

⚠ CAUTION

Tighten the pipes with appropriate tightening torque.
Observe the appropriate tightening torque to prevent air leakage and damage to the threads. To prevent damage to the screw threads, first use your hands to lightly tighten the screw and then use a tool to tighten the pipe further.

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 pressure circuit is disconnected, the actuator speed cannot be controlled.
- For the chuck holding mechanism, the chuck holding force is lost when the piping is disconnected.

Check every joint in the piping for air leakage when supplying compressed air for the first time after connecting the pipes.

Do not apply high pressure suddenly when supplying compressed air for the first time after connecting the pipes.
Sudden introduction of highly-pressurized air may disconnect pipes at joints and/or cause the tubes to jump around, any of which may cause an accident.

Do not decrease the inside diameter of the piping from any of the solenoid valve exhaust ports to a diameter less than the piping port size.
Smooth exhaust flow is important for normal operation of the actuator.

Install a silencer to the exhaust port of the valve.
Noise can be a disturbance to people nearby.

Remove foreign matters.
Rust and other foreign matters in the piping may cause a malfunction or valve seat leakage.
Insert a filter (which removes particles exceeding 5 μm) immediately upstream of the solenoid valve.

Do not restrict the flow of air through the supply piping.
A delay in operation may occur due to a drop in the supply pressure when multiple valves are operated.

Secure space around the silencer.
Exhaust air may be trapped and the residual pressure discharge function may be impaired.

2.4.1 Recommended tightening torque

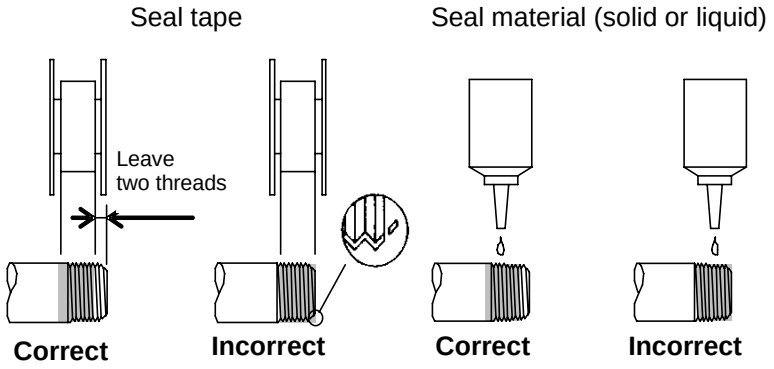
The following table shows the tightening torque for each pipe size.

Pipe size	Tightening torque (N·m)
Rc1/8	3 to 5
Rc3/8	13 to 15
Rc1/2	16 to 18

2.4.2 Seal material

Apply a seal tape or seal material to the screw threads leaving two or more threads at the pipe end uncovered or uncoated. If the pipe end is fully covered or coated, a shred of seal tape or residue of seal material may enter the inside of the solenoid valve and cause a failure.

When using a seal tape, wind it around the screw threads in the direction opposite from the screw threads and press the tape down with your fingers to attach it firmly.
When using a liquid seal material, take care not to apply it to resin parts. It damages resin parts, causing a failure or malfunction. Also, do not apply liquid seal material to internal threads.



2.4.3 Flushing

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

2.4.4 Blow circuit

Do not open the output port to the atmosphere because a drop in the supply pressure may cause a malfunction. Select the external pilot type. The lowest allowable pressure with the internal pilot type is 0.2 MPa.

2.4.5 Exhaust port

Avoid restricting the flow of exhaust air as much as possible.
The pilot exhaust is open to the atmosphere.

2.4.6 Piping

■ Spatter

In an environment exposed to spatter, use flame-retardant tubes or steel pipes.

■ Hydraulic hose

When piping is for use in both hydraulic and pneumatic systems, use a hydraulic hose.
When the standard push-in fitting is used with a spiral tube, secure the base or end of the tube with a hose clamp. Otherwise, the tube will rotate and lose its clamping ability.
In an atmosphere where the temperature is high, use fastening fittings, not push-in fittings.

■ Tubes commercially available

When using commercially available tubes, check the outside diameter accuracy, wall thickness, and hardness of such tubes. The hardness of a urethane tube should be 93° or more (as measured by a rubber hardness meter).
Using a tube with insufficient diameter accuracy and hardness will cause the chucking force to drop, which makes the tube come off easily or difficult to insert.

Tube dimensions

Outside diameter (mm)	Inside diameter (mm)	
	Nylon	Urethane
ø 1.8	—	ø 1.2
ø 4	ø 2.5	ø 2
ø 6	ø 4	ø 4
ø 8	ø 5.7	ø 5
ø 10	ø 7.2	ø 6.5
ø 12	ø 8.9	ø 8

Outside diameter tolerance	
Soft or hard nylon	± 0.1 mm
Urethane ø1.8	± 0.1 mm
Urethane ø4, ø6	+0.1 mm -0.15 mm
Urethane ø8, ø10, ø12	+0.1 mm -0.2 mm

■ Minimum bending radius of tubes

Observe the minimum allowable bending radius of tubes. Neglecting the minimum allowable bending radius may cause disconnection or leakage.

Outside diameter (mm)	Minimum bending radius (mm)	
	Nylon	Urethane
ø 1.8	—	4
ø 4	10	10
ø 6	20	20
ø 8	30	30
ø 10	40	40
ø 12	55	50

■ 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.

■ Tube connections

From the end of the fitting, secure a straight section as long as the outside diameter of the tube and do not bend the tube abruptly at the fitting connection point. Do not apply torsion, tension, and moment load to the fitting and tube.

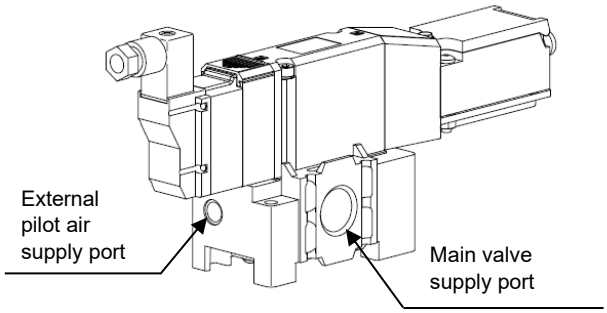
2.4.7 Piping ports for external pilot (option symbol: K)

Make sure to supply the pilot air to the correct port. Otherwise, a malfunction may result.

Port identification

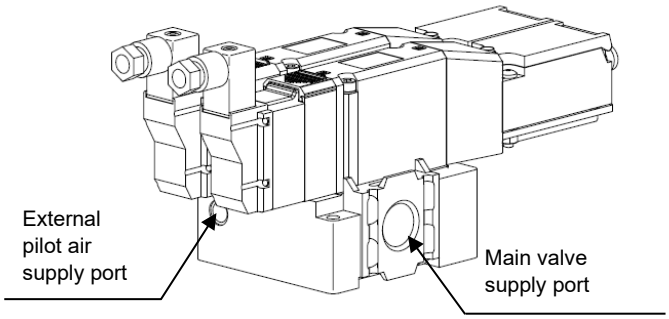
Usage	Identification (ISO standard)	
Pilot air	Supply port	12/14

1 station



External pilot air supply port is located on the left side when the main valve supply port is facing the user.

2 stations



External pilot air supply port is located on the left side when the main valve supply port is facing the user.

2.5 Wiring

⚠ WARNING

Carry out wiring work while the power is turned off.
Otherwise, an electric shock may occur.

Do not touch the terminals or put wet hands near them while the power is being supplied.
Otherwise, an electric shock may occur.

Thoroughly read and understand this Instruction Manual before working on electrical wiring.
The product must be handled by a person who understands the structure and operation principle of solenoid valve and has knowledge to secure the safety.

⚠ CAUTION

Check the power supply voltage and the type of current (AC or DC) before supplying power.
Protection class: Class III (Ⅲ)

Do not apply stress to the lead wires.
Undue stress may cause such problems as disconnection of the lead wires or the contact terminals.

Make sure that the voltage drop on the solenoid does not exceed 10% of the rated voltage.
Voltage drop occurs due to energizing solenoids at the same time or depending on the cable length.

Connect the product to the output unit.
Connecting the product to the input unit may cause failures, not only in the product but also in peripheral devices. Do not connect the product to the input unit.

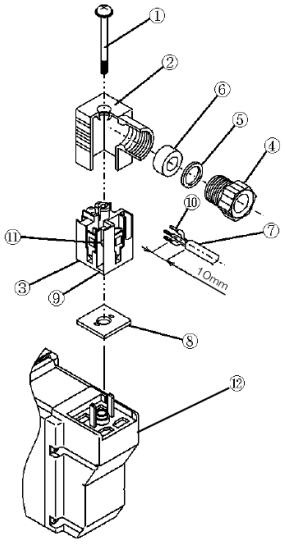
Only use a power supply with guaranteed reliable electrical insulation.
Voltage conforming to IEC 60204-1.
Please also comply with the general requirements of PELV circuit that conforms to IEC 60204-1.

2.5.1 DIN terminal box

■ Disassembling the DIN terminal box

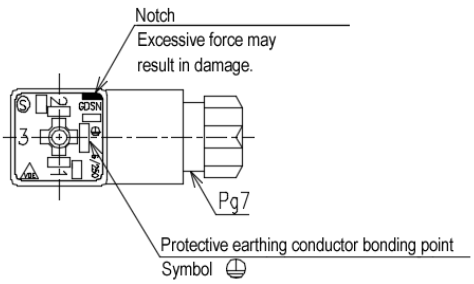
1 Loosen screw (1) and pull cover (2) in the direction of screw (1) to remove the connector from coil assembly (12).

2 Pull out screw (1) from cover (2).

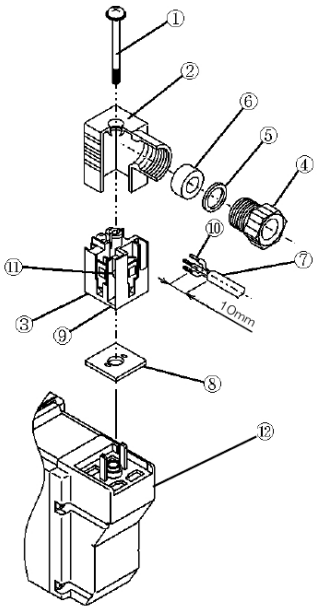


3 Locate notch (9) (next to the GDSN mark) at the bottom of terminal block (3). Insert a compact flat blade screwdriver into the gap between cover (2) and terminal block (3) and pry to remove terminal block (3) from cover (2) (refer to the figure to the right). Do not apply excessive force when removing terminal block (3) as this may damage it.

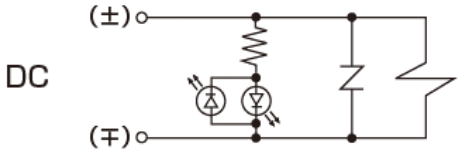
4 Remove cable gland (4) and take out washer (5) and rubber packing (6).Wiring the DIN terminal box.



1 How to prepare for wiring:
Applicable dimension for cable (7) is VCTF 2-conductor (3-conductor) (ø3.5 to ø7) defined in JIS C 3306.
Length of sheath peeled from lead wires of cable is 10 mm.
Either twisted wire or solid wire can be used for wiring. When using twisted wire, avoid connecting a pre-soldered wire.
When using crimp sleeve (10) at the end of twisted wire, select H0.5/6 (0.3 mm^2 to 0.5 mm^2) or H0.75/6 (0.75 mm^2) ferrule manufactured by Weidmüeller or an equivalent product.
The crimp sleeve is not supplied with the product.

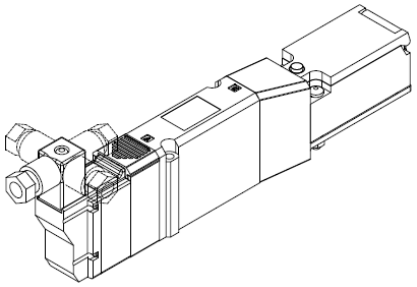


2 How to install the wiring:
Insert cable gland (4), washer (5), and rubber packing (6) through cable (7) in order and insert them into cover (2).
Wire cable (7) to terminals 1 and 2. There is no polarity.
Recommended tightening torque is 0.2 N·m to 0.25 N·m.



■ Assembling the DIN terminal box

1 Push the wired terminal block (3) into cover (2) until it clicks.
Terminal block (3) can be set in four different directions (refer to the figure to the right).



2 Insert rubber packing (6) and washer (5) in this order into the cable through-hole on cover (2) and securely tighten cable gland (4).
Recommended tightening torque for cable gland (4) is 1.0 N·m to 1.5 N·m.

3 Check that cable (7) does not disconnect.

4 Place gasket (8) between the bottom part of terminal block (3) and the plug of coil assembly (12), insert the connector, insert screw (1) from top of cover (2), and tighten it.
Recommended tightening torque for screw (1) is 0.4 N·m to 0.45 N·m.

2.5.2 Limit switch

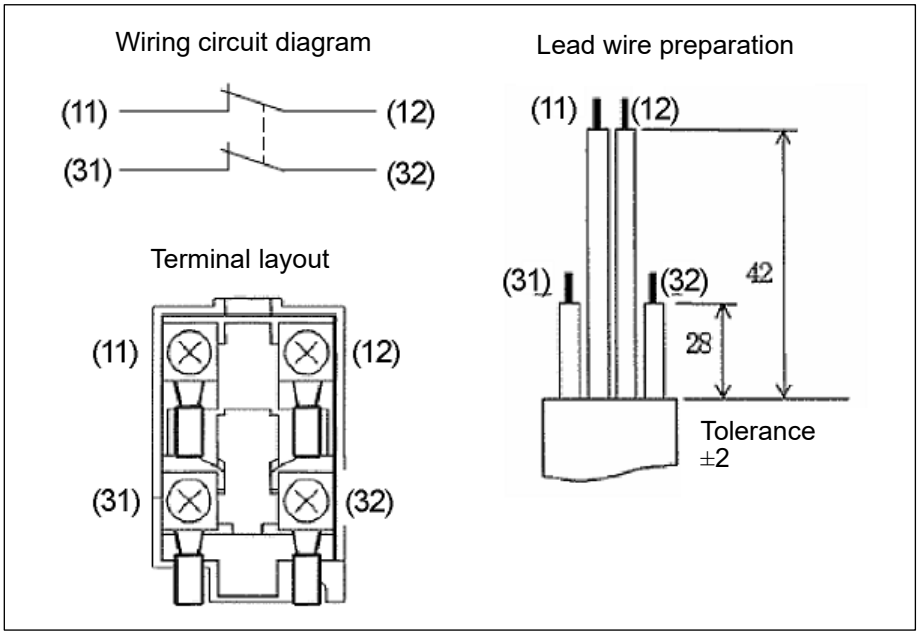
■ Limit switch (option symbol: L)

⚠ CAUTION

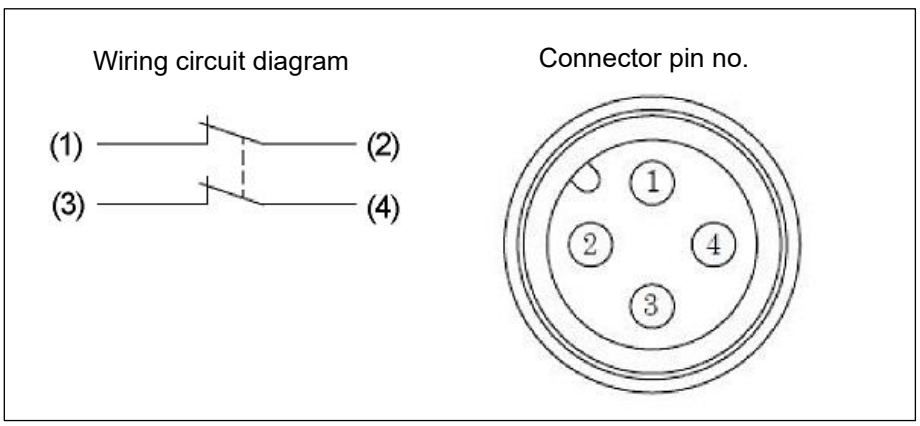
Do not force the crimp terminal into the gaps inside the case.
Forcing the crimp terminal into the gaps may cause the case to be damaged or deformed.

Use a crimp terminal with thickness of 0.5 mm or less.
Make sure to use a crimp terminal with thickness of 0.5 mm or less to avoid contact with the inside of the switch case.

- When connecting the limit switch to terminals using insulation tubes and crimp terminals for M3.5, arrange the terminals as shown in the figure below and wire so that wires do not come on top of the case and the cover.
- Adequate lead wire size is AWG 20 to 18 (0.5 mm^2 to 0.75 mm^2). Prepare the lead wires to the lengths as shown in the figure below. Otherwise, the excess length will interfere with cover and prevent the cover from staying closed.
  If a connecter is to be attached to the conduit opening, use a connector with thread length not exceeding 9 mm to prevent interference with the internal switch.
  Recommended connector: ST-13.5 5301-5030 (LAPP)
  Recommended sealing packing: JPK-16, GP-13.5 or GPM20



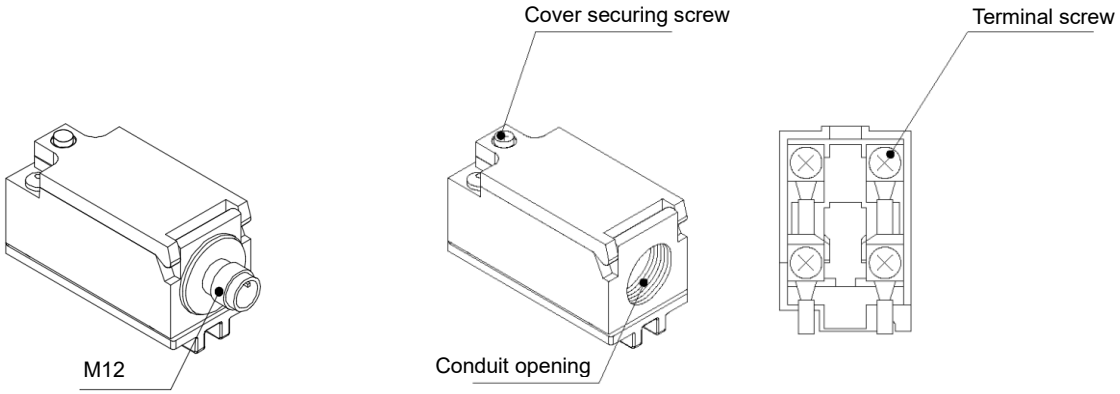
■ Limit switch (option symbol: M)



■ Precautions on limit switches (option symbols: L and M)

- Refer to the table below for the tightening torque for threaded parts.

Threaded parts	Recommended tightening torque (N·m)
Terminal screw	0.6 to 0.8
Cover securing screw	0.5 to 0.7
Connector (conduit opening, for M12)	1.8 to 2.2



- When opening or closing the general loads (250 VAC, 3 A), do not operate two circuits or more at the same time. Insulation performance may deteriorate.
- The limit switches are D4N-1B31 (option symbol: L) and D4N-9B31 (option symbol: M) manufactured by OMRON Corporation. Refer to the catalog provided by the manufacturer for details.

3. USAGE

3.1 Safety Instructions

3.1.1 Air quality

⚠ WARNING

Do not supply anything other than compressed air.
Use clean compressed air that does not contain corrosive gases.

⚠ CAUTION

Improve the quality of air.

Compressed air usually contains a large amount of drainage, oxidized oil, tar, foreign matters, and rust from the piping, which may cause malfunction such as an operation fault and short service life. In addition, the exhaust causes pollution.

If lubrication is necessary, use Class 1 ISO VG 32 turbine oil (additive free).

Although the product is designed for oil-free operations, if lubricated even once, it will require periodic lubrication from then on. Make sure to keep it lubricated.

Do not use spindle oil and machine oil.

They induce expansion of the rubber parts and cause operation faults.

■ Super-dry air

The super-dry air (humidity class of 0 to 3 as specified in JIS B 8392-1) may cause the lubricant to scatter, resulting in short service life.

■ Lubrication

Generally, the SNS Series does not require any lubrication. If lubrication is necessary, use Class 1 ISO VG 32 turbine oil.
If the product is lubricated excessively or if the pressure is significantly low, the response time may be delayed.

■ Drainage

- If the temperature inside the pneumatic piping or pneumatic component drops, drainage may occur.
- If drainage enters and momentarily blocks the air passage inside the pneumatic component, it may cause an operation fault.
- If drainage generates rust, it may cause a failure in the pneumatic component.
- If drainage flushes the lubricant, it may cause a lubrication failure.
-

■ Contaminants

- Use compressed air that does not contain oxidized oil, tar, carbon, or other contaminants from the air compressor.
  If oxidized oil, tar, or carbon enters into and adheres to pneumatic components, the resistance of the sliding section may increase and result in operation faults.
  If the supplied lubricant mixes in with oxidized oil, tar, or carbon, the sliding section of the pneumatic components will wear out.
- Use compressed air that does not contain solid foreign matters.
  If solid foreign matters in compressed air enter the pneumatic components, the sliding section will wear out and contaminants will adhere to the inside.

■ Improvement of air quality

Measures such as dehumidifying with an after cooler and dryer, removing foreign matters with an air filter, and removing tar with a tar removing filter must be taken to improve the quality of air.

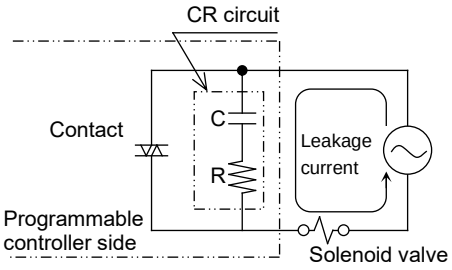
3.1.2 Electric circuit

⚠ CAUTION

Check for leakage current from external control devices to avoid any malfunction of the product.

When a programmable controller or a similar control device is used, a leakage current may prevent the valve from operating correctly even if the solenoid valve is de-energized.

When controlling solenoid valves using a programmable controller or a similar control device, make sure that the leakage current from the programmable controller output is as specified in the table below.



For 24 VDC	1.8 mA or less

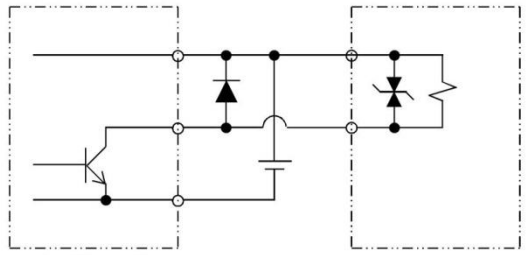
The surge suppressor limits the surge voltage generating from the solenoid valve, which can reach several hundred volts, to a low voltage level bearable for output contacts. However, this function may be insufficient for some output circuits and the voltage may cause breakage or malfunction of the product. Check the surge voltage limitation level of the solenoid valve to be used, the withstand voltage and circuit configuration of the output devices, and the reset delay time to determine serviceability.

If necessary, take a different measure against surge. The SNS Series solenoid valves equipped with a surge suppressor suppress the terminal-to-terminal reverse voltage surge generated upon shut off, to the level shown in the table below.

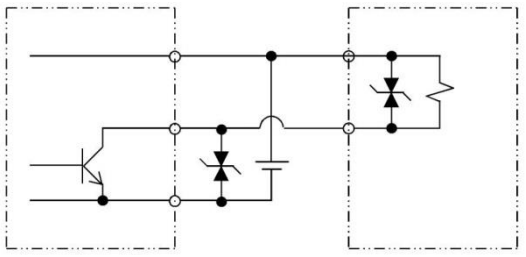
For 24 VDC	Approx. 47 V

For an NPN type output unit, install an additional contact protection circuit since the output transistor is susceptible to the surge voltage of the sum of the voltage specified in the table above and the source voltage.

- Example 1 of additional output transistor protection circuit



- Example 2 of additional output transistor protection circuit



3.2 Manual operation

⚠ WARNING

After operating the manual override, return the cylinder to the original position (initial position) before re-starting operation.

Make sure that nobody is near the cylinder to be activated before performing manual operation.

Release the lock before performing normal operation for non-locking/locking combination type manual override.

- Performing normal operation while the manual override is locked causes malfunction.
- If the manual cover is closed, the lock is released.

- The SNS Series is a pilot operated solenoid valve. If air is not supplied to port P (or port PA for external pilot type), the main valve does not switch even if the manual override is operated.
- Manual protection cover is provided to this solenoid valve as standard. Since the manual protection cover is closed when shipped out of the factory, open it to operate the manual override. Note that the manual protection cover will not close unless the locking manual override is released.
- Manual override is used for both non-locking and locking. It is locked by pressing down and turning the lever. When locking, turn the lever while pressing it down. Turning the lever without pressing it down could damage the manual override and cause air leakage.

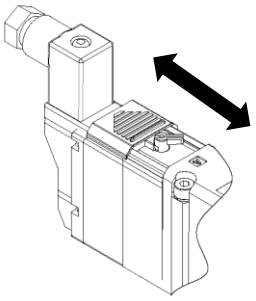
.

■ How to open and close the manual protection cover

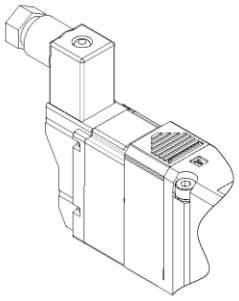
Do not apply excessive force to the manual protection cover when opening and closing the cover. Excessive external force may cause damage (below 5 N).

Slide type

Opened



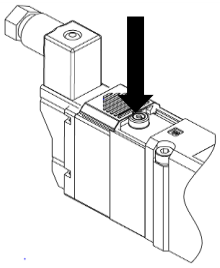
Closed



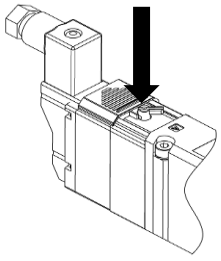
■ How to operate the manual override

Non-locking operation: Press the lever down in the direction of the arrow until it stops.
Manual operation can be performed while the lever is pressed down.
The lever returns to the original position when released and the manual operation is disabled.

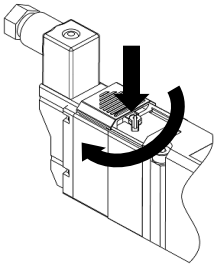
Non-locking type
Option symbol : M

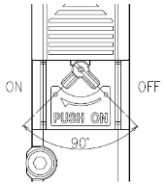


Non-locking/locking combination type
Option symbol : Blank



Locking operation: Press the lever down and turn it In the direction of the arrow until it stops.
The lever is locked in place, keeping the manual operation state.
To disable manual operation, return the lever to the original position.





4. MAINTENANCE AND INSPECTION

4.1 Periodic Inspection

⚠ WARNING

Turn off the power, stop the supply of compressed air, and make sure that there is no residual pressure before conducting maintenance.
Observe the condition to ensure safety.

⚠ CAUTION

Plan and conduct daily and periodic inspections so that maintenance can be managed correctly.
If maintenance is not properly managed, the product's functions could deteriorate significantly and this may lead to faults (such as short service life, damage and malfunction) or accidents.

To use the solenoid valves under optimum conditions, conduct a periodic inspection once or twice a year.

■ Pressure of supplied compressed air

- Is the set pressure supplied? Yes or No
- Does the pressure gauge indicate the set pressure during operation of the device? Yes or No

■ Pneumatic filter

- Is drainage correctly discharged? Yes or No
- Is the bowl or element clean enough to use? Yes or No

■ Leakage of compressed air from piping connections

- Are all connections, especially at movable sections, correctly connected? Yes or No

■ Operation of solenoid valves

- Is there any delay in operation? Yes or No
- Are the valves exhausting properly? Yes or No

■ Operation of pneumatic actuator

- Are operations smooth? Yes or No
- Is the actuator reaching the end stop properly? Yes or No
- Are loads connected properly? Yes or No

■ Lubricator

- Is the oil rate correctly adjusted? Yes or No

■ Lubricant

- Is the specified lubricant supplied? Yes or No

■ Screws

- Are there any loose screws? Yes or No

4.2 Disassembling and Assembling

⚠ WARNING

Do not disassemble or reassemble the inside of the solenoid valve.

- Disassembling and reassembling the inside of the solenoid valve will impair the sealing performance.
- Disassembling and reassembling the solenoid valve will void the warranty.

5. TROUBLESHOOTING

5.1 Problems, Causes, and Solutions

If the product does not operate as intended, check the table below for a possible solution.

Problem	Cause	Solution
Does not operate at all	There is no electric signal.	Turn on the power.
	Electric signals are faulty.	Repair the control circuit.
	Voltage or current fluctuation is excessive.	Check the power capacity (voltage fluctuation range: ± 10%).
	Wiring is incorrect.	Correct the wiring.
Does not operate properly	Leakage current is excessive.	Correct the control circuit and/or add a bleed circuit.
	Chattering occurs.	Check the switching system and check for loose wiring.
	Voltage is not as specified on the nameplate.	Correct the voltage to meet the specification.
	Coil is damaged or short-circuited.	Replace the coil.
	Pressure source is disconnected.	Turn on the pressure source.
	Pressure is insufficient.	Readjust the pressure reducing valve or install a valve for increasing pressure.
	Flow rate is insufficient.	Inspect and correct the piping or install a surge tank.
	Pressure is supplied through exhaust port.	Inspect and correct the piping.
	Piping is incorrect or omitted.	Inspect and correct the piping.
	Valve is frozen.	Take measures against freezing (such as keeping the product warm and draining water).
	Port A is left open to atmosphere.	Use a pipe fitting with diameter equal to or smaller than that of port P fitting.
	There is a delay in the return of plunger (excessive oil or existence of tar).	Check the quality of the lubricant (Class 1 ISO VG 32 turbine oil). Readjust the lubricator drip rate. Install a tar removing filter.
	Exhaust ports are clogged with dust.	Install a cover or silencer. Clean the exhaust ports periodically.
Requires high pressure to operate	Packing is swelling.	Check the quality of the lubricant (Class 1 ISO VG 32 turbine oil). Use the solenoid valves away from where cutting oil is used. Keep organic chemicals away.
	Port A is left open to atmosphere.	Inspect and correct the piping.
	Foreign matters are stuck in the packing.	Remove foreign matters.

If you have any other questions or concerns, contact your nearest CKD sales office or distributor.

6. WARRANTY PROVISION

6.1 Warranty Conditions

■ Warranty coverage

If the product specified herein fails for reasons attributable to CKD within the warranty period specified below, CKD will promptly provide a replacement for the faulty product or a part thereof or repair the faulty product at one of CKD's facilities free of charge.
However, following failures are excluded from this warranty:

- Failure caused by handling or use of the product under conditions and in environments not conforming to those stated in the catalog, Specifications, or this Instruction Manual.
- Failure not caused by the product.
- Failure caused by use not intended for the product.
- Failure caused by modifications/alterations and repairs not carried out by CKD.
- Failure caused by reasons unforeseen at the level of technology available at the time of delivery.
- Failure caused by acts of nature and disasters beyond control of CKD.

The warranty stated herein covers only the delivered product itself. Any loss or damage induced by failure of the delivered product is excluded from this warranty.

■ Confirmation of product compatibility

It is the responsibility of the customer to confirm compatibility of the product with any system, machinery, or device used by the customer.

6.2 Warranty Period

The product is warranted for one (1) year from the date of delivery to the location specified by the customer.

7. REFERENCE INFORMATION

7.1 Port Identification

Piping ports are identified and labeled, such as 1P and 2A.

Port	ISO	JIS
Supply port	1	P
Output port	2	A
Exhaust port	3	R
Pilot air supply port	12/14	PA

There is no restriction on the mounting orientation of the solenoid valves.

8. Safety

8.1 General safety information

⚠ CAUTION

Take measures against common cause failure (CCF).

- Common cause failure (CCF) is the failure of the safety function after the failure of two residual pressure discharge valves at the same time in the case of this product.
  If you do not manage the CCF, you may not be able to expedite and the safety function may be impaired.
  In order to achieve the desired performance level, implement applicable measures for CCF according to ISO 13849-2.
- If you do not observe the specifications and characteristics of the product, safety functions may be impaired.

8.2 Usage purpose

The SNS series has a safety limit switch on the valve body and checks the safety function. Direct opening operation conforms to ISO 13849-1 Category 2.
2 stations is compliant with ISO 13849-1 Categories 3 and 4 by providing redundancy.

8.3 Corresponding standard

- ISO13849-1：2015-12
- ISO13849-2：2012-10
- EN61000-6-2,4

8.4 Safety functions according to ISO13849

8.4.1 Specifications

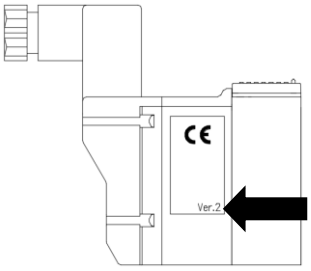
d_{OP}	365	Note 1
h_{OP}	24	Note 1
t_{cycle}	3,600	Note 1
B10d	10,984,840 times	
MTTFd	12,540	Note 2
DCavg	0～99%	Note 3
Diagnostic test interval T1	1	Note 1
Proof test interval T2	8,760	Note 1

Note 1: These parameters are assumption to calculate "calculated results", therefore you can be use other conditions.

Note 2: Recalculate according to the value of assumption.

Note 3: The achievable diagnostic rate depends on the overall system configuration.
The contacts of the limit switch can be used as part of the diagnostic technique of Direct monitoring acc. Table E.1 of ISO 13849-1.

・SNS series can achieve safety function complying with ISO13849 by residual pressure discharge function.
・If customer use it in Cat.2 applications, the system should monitor the output of limit switch and if a fault is detected by it, OTE shall let the system transit to safe state within process safety time.
・If customer use it in Cat.3,4 applications, also the system should monitor the output and if a fault in one channel is detected by it, the system shall keep safe state by using other channel until fault is cleared.
・Calculate the diagnostic interval of safety function according to the category, PL.
・Lifespan will be 5 years, but to overhaul every year.It is recommended.
・When there is a change in the HW version, it will be shown in the following figure. (From Ver.2)



8.5 Safety functions according to IEC61508

8.5.1 Specifications

HFT（Hardware fault tolerance）	0 (1 station) 1 (2 stations)
Product classification	Type A
Maximum safety integrity level	SIL 3
d_{OP}	365 Note 1
h_{OP}	24 Note 1
t_{cycle}	3,600 Note 1
B10d	10,984,840 times
λ d	9 FIT Note 2
DCavg	0～99% Note 3

Calculation results when DCavg 99% can be achieved are shown below.

β	10% Note 1
Diagnostic test interval T1	1 Note 1
Proof test interval T2	8,760 Note 1
$\lambda_{DU\text{-}all}$ 1oo2d (HFT=1)	9.10E-10 Note 4
$PFH_{D\text{-}all}$ 1oo2d (HFT=1)	9.10E-10 Note 4
$\lambda_{DU\text{-}single}$ 1oo1d (HFT=0)	9.10E-11 Note 5
$PFH_{D\text{-}all}$ 1oo1d (HFT=0)	9.10E-11 Note 5
PTC（Proof Test Coverage）	100% Note 6
MTC（Maintenance Test Coverage）	100% Note 6
SFF（Safe Failure Fraction）	96% Note 6

Note 1: These parameters are assumption to calculate "calculated results", therefore you can be use other conditions.

Note 2: Recalculate according to the value of assumption.

Note 3: The achievable diagnostic rate depends on the overall system configuration.
The contacts of the limit switch can be used as part of the diagnostic technique of Monitoring acc. A.13.1 of IEC 61508-7.

Note 4: Recalculate according to the value of assumption.Calculated from IEC 62061(D.2).

Note 5: Recalculate according to the value of assumption.Calculated from IEC 62061(C).

Note 6: B10d, FMEDA results are used.

9. Proof testing

If the activation command signal and the signal from the limit switch are not valid, take the following measures.

■1 station
1. Turn off solenoid valve V1.
2. Check limit switch S1.
3. Cancel the new switching operation.

Diagnosis at power on

		State
1	Apply voltage to solenoid valve V1.	V1:ON
2	Check the limit switch S1.	S1:CLOSE⇒OPEN

Diagnosis at power off

		State
1	Turn off solenoid valve V1.	V1:OFF
2	Check the limit switch S1.	S1:OPEN⇒CLOSE

■2 stations
1. Turn off solenoid valve V1 and solenoid valve V2.
2. Check limit switch S1 and S2.
3. Cancel the new switching operation.

Diagnosis at power on

		State
1	Apply voltage to solenoid valves V1 and V2.	V1:ON V2:ON
2	Check the limit switches S1 and S2.	S1:CLOSE⇒OPEN S2:CLOSE⇒OPEN

Diagnosis at power off

		State
1	Turn off solenoid valves V1 and V2.	V1:OFF V2:OFF
2	Check the limit switches S1 and S2.	S1:OPEN⇒CLOSE S2:OPEN⇒CLOSE

Diagnosis at power on / off

		State
1	Turn on solenoid valve V1.	V1:ON
2	Check the limit switch S1.	S1:CLOSE⇒OPEN
3	Turn off solenoid valve V1.	V1:OFF
4	Check the limit switch S1.	S1:OPEN⇒CLOSE
5	It does not move even if solenoid valve V2 is turned on by itself.	V2:ON
6	Check the limit switch S2.	S2:CLOSE
7	Turn off solenoid valve V2.	V2:OFF
8	Check the limit switch S2.	S2:CLOSE