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SM-50609-A

CKD

INSTRUCTION MANUAL
FOR
High vacuum air-operated valve

AVB ※ 1V

- Before using this product, thoroughly read this instruction manual.
- In particular, read the safety precautions carefully.
- After reading this instruction manual, keep it in a safe place where all concerned personnel can refer to it immediately.

CKD Corporation

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Introduction

Thank you for purchasing of CKD's high vacuum air-operated valve AVB-series. Before using this product, thoroughly read this Instruction manual to fully understand its contents and always operate the product in correct manner.

1. Purpose

This product is a valve intended for the vacuum open/close switch control in the semi-conductor manufacture equipment, as well as its auxiliary equipment.

2. General cautions

(1) This instruction manual describes the general cautions and procedures for handling of the product, such as unpacking, installation, operation, maintenance, and disposal.

(2) This instruction manual is intended for personnel who have the basic knowledge about materials, fluids, piping, and electricity necessary to use the valve.

Before designing and constructing the system, read this instruction manual carefully to keep the operational safety of the machine and equipment, and to handle this product properly.

3. Safety precautions

(1) To avoid expansion of property damage, such as personal injury and fire, warning labels are provided appropriately in this instruction manual.

(2) According to the risk assessment, the warning labels are classified into three groups, DANGER, WARNING, and CAUTION.

Since this product is a component that is to be installed in the customer's machine and/or equipment, only CAUTION labels are used in this manual.

(Example)

⚠ CAUTION	Contents and instructions

Discontinue

We would like to thank you for purchase of the CKD “AVB Series” high vacuum air-operated valve.

This product is a high vacuum air-operated valve developed for use in the wafer process on semiconductor manufacturing lines.

Please read this instruction manual thoroughly before use.

Please be assured that all CKD equipment undergoes the strictest of quality control procedures during manufacture.

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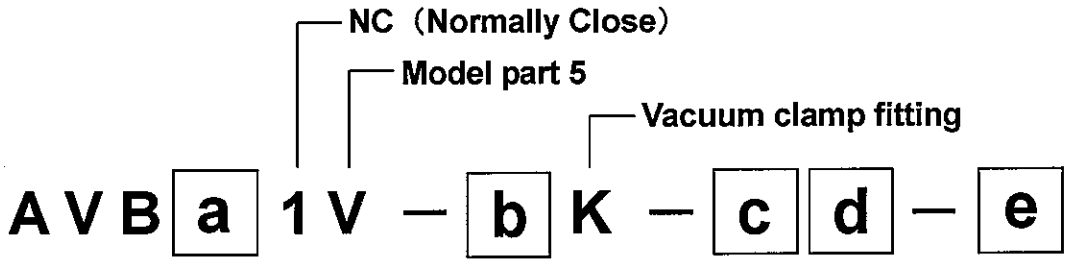
1. Reading the model code

1-1 Model code of valve (option)



a : Series	
5	Oriffice ϕ16
6	Oriffice ϕ24
7	Oriffice ϕ40
8	Oriffice ϕ50

b : Connection diameter	
16	16A
25	25A
40	40A
50	50A

c : Switch type			
T0H	Lead wire straight outlet type	Contact point	2-core
T5H			
T2H		Poximity	
T3H			3-core
T0V	Lead wire elbow outlet type	Contact point	2-core
T5V			
T2V		Poximity	
T3V			3-core

d : Lead wire length	
None	1m
3	3m
5	5m

e : Switch number	
H	Oren valve sensor
R	Close valve sensor
D	Open / Close valve sensor

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1-2 Model code of switch rail kit

AVB f 1V − R − g h − i

f : Series	
4	for AVB41V
5	for AVB51V
6	for AVB61V
7	for AVB71V

g : Switch type			
T0H	Lead wire straight outlet type	Contact point	2−core
T5H			
T2H		Poximity	
T3H			3−core
T0V	Lead wire elbow outlet type	Contact point	2−core
T5V			
T2V		Poximity	
T3V			3−core

h : Lead wire length	
None	1m
3	3m
5	5m

i : Switch number	
H	Oren valve sensor
R	Close valve sensor
D	Open / Close valve sensor

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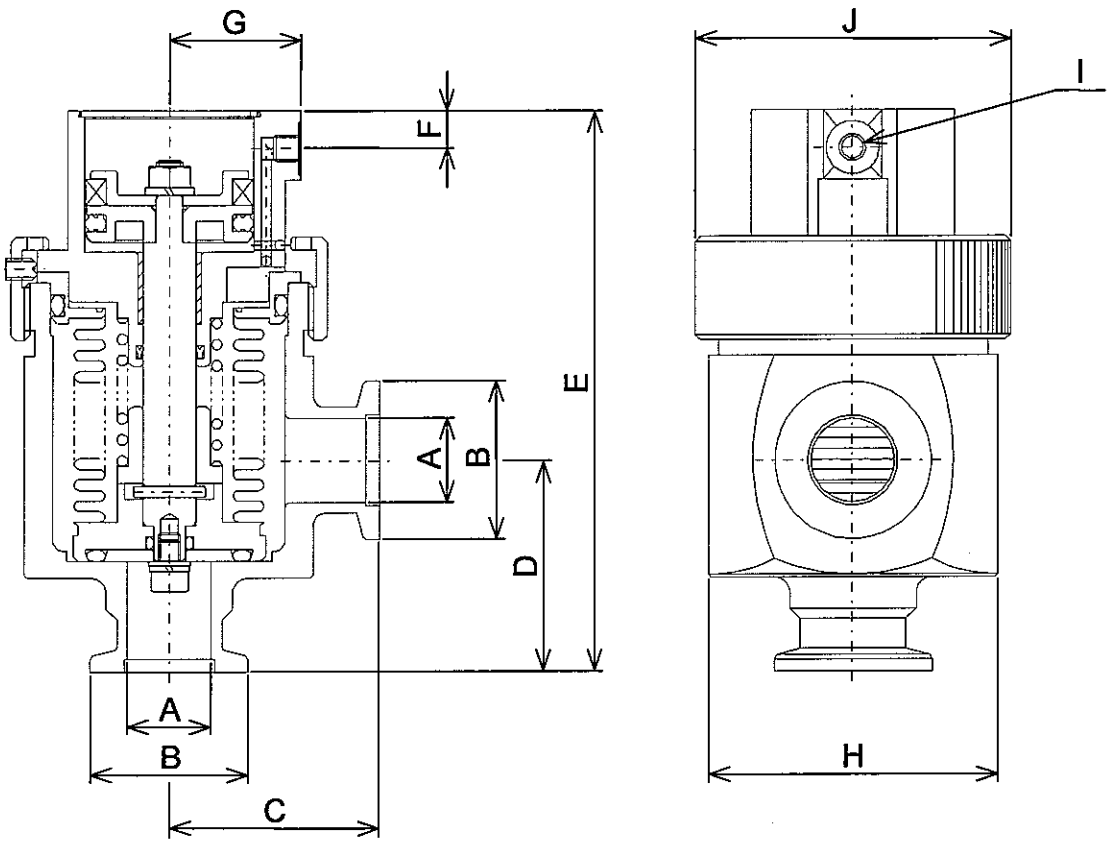
2. Outer dimensions



MODEL	A	B	C	D	E	F	G	H	I	J
AVB41V	ϕ16	ϕ30	40	40	106	7	25	ϕ55	M5	ϕ60
AVB51V	ϕ24	ϕ40	50	50	106	7	25	ϕ55	M5	ϕ60
AVB61V	ϕ40	ϕ55	65	65	157.5	17	35.5	ϕ80	Rc1/8	ϕ80
AVB71V	ϕ50	ϕ75	70	70	163	17	35.5	ϕ80	Rc1/8	ϕ80

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3. Specifications

3-1 Main body Specifications

	AVB41V	AVB51V	AVB61V	AVB71V
Media	Vacuum and inert gas			
Working pressure range	1.3×10^{-6}～1.0×10^{5} Pa(abs)			
Max. differential pressure	0.1 MPa			
Seat leakage	1.3×10^{-10} Pa·m³/s or less			
External leakage	1.3×10^{-11} Pa·m³/s or less			
Withstanding pressure	Air pressure : 0.3 MPa			
Media temperature	5～60 ℃			
Ambient temperature	0～60 ℃			
Orifice	φ16 mm	φ24 mm	φ40 mm	φ50 mm
Conductance ※1	5 L/s	13 L/s	47 L/s	80 L/s
Connecting port diameter	NW16	NW25	NW40	NW50
Operating pressure	0.4～0.6 MPa			
Weight	0.45 kg	0.50 kg	1.15 kg	1.20 kg

※1 : Conductance is not measured value, but theorical value at molecular flow.

3-2 Switch Specifications

Type / Model	Proximity switch		Contact point switch	
	T2H ・ T2V	T3H ・ T3V	T0H ・ T0V	T5H ・T5V
Power voltage	—	DC10～28V	—	—
Load voltage Load current	DC10～30V 5～20mA ※3	DC30V or less 100mA	DC12/24V 5～50mA or less AC100V 7～20mA or less	DC12/24V 5～50mA or less AC100V 7～20mA or less
Consumption current	—	10mA or less at DC24V	—	—
Internal voltage drop	4V or less	0.5V or less	2.4V or less	0V
Lamp	LED (Lit at ON)			—
Leakage current	1mA or less	10μA or less	0	0
Lead wire length ※2	1m (Oil-resistant PVC insulated and cabtire cable,2-core, 0.2mm²)	1m (Oil-resistant PVC insulated and cabtire cable,3-core, 0.2mm²)	1m (Oil-resistant PVC insulated and cabtire cable, 2-core, 0.2mm²)	
Max.shock resistance	100G		30G	
Insulation resistance	20MΩ or more when measured with DC500V megger			
Withstand voltage	No abnormality occurs when AC1000V is applied for 1min.			
Ambient temperature	-10～+60℃			
Degree of protection	IEC standard IP67, JIS C 0920 (water tight type), oil resistance			

※2 : We have lead wire length is 3 meter and 5 meter as option.

※3 : Maximum value 20mA of load current is value at 25℃.
In case of ambient temperature of switch is higher than 25℃, maximum value of load current is lower than 20mA. (5～10mA at 60℃)

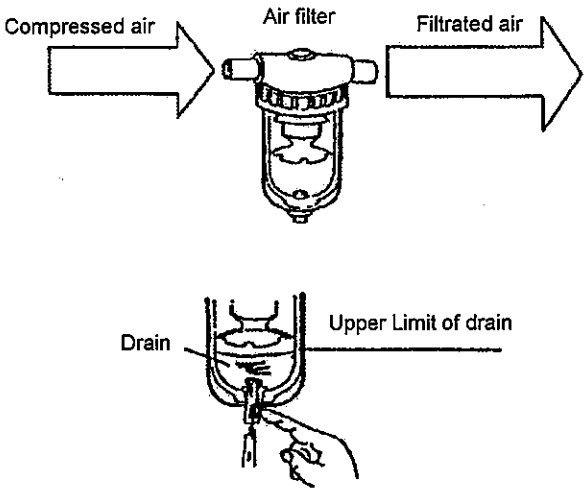
Discontinue

4. Cautions for installation

4-1 Fluid

(1) Use the compressed air, filtrated and dehumidified. Carefully select a filter of an adequate filtration rate (5 μm or lower preferred), flow rate and its mouting location. (as closest to directional control valve as possible)

(2) Be sure to drain out the accumulation in filter periodically.



⚠ CAUTION	Note that the intrusion of carbide of compressor oil (such as carbon or tarry substance) into the circuit causes malfunction of solenoid valve and cylinder.

Discontinue

4-2 Piping

(1) For pipng beyond the fillter, use pipes that hardly get corroded such as galvanized pipes, nylon tubes, rubber tubes, etc.

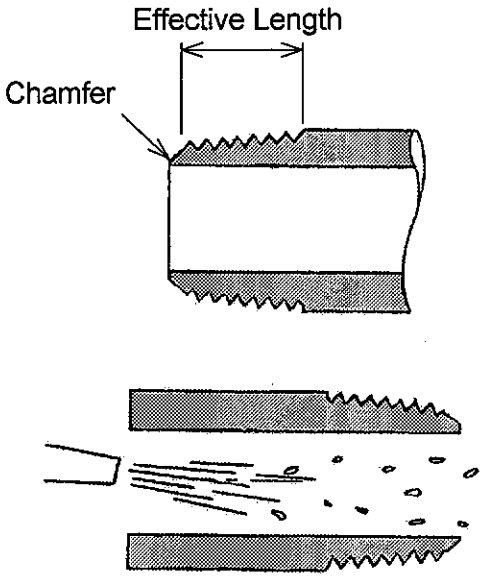
(2) See to it that the pipe connecting cylinder and solenoid valve has effective sectional area needed for the cylinder to drive at specified speed.

(3) Install filter preferably adjacent upper-stream to solenoid valve for eliminating rust, foreign substance and drain in the pipe.

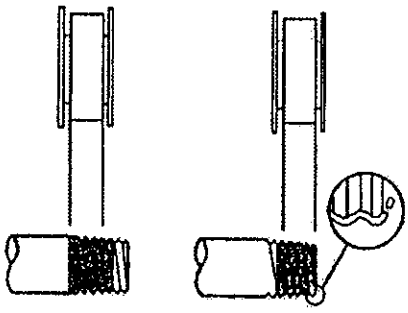
(4) Strictly observe the effective thread length of gas pipe and give a chamfer of approx. 1/2 pitch from the threaded end.

(5) Flush air into the pipe to blow out foreign substances and chips before piping.

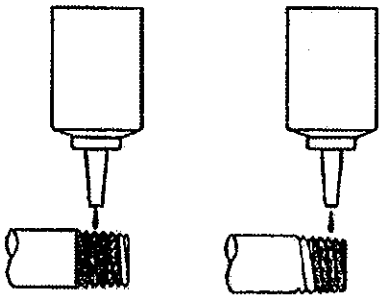
(6) Refrain applying sealant or sealing type approx. Two pitches of thread off the tip of pipe to avoid residual substances from falling into piping system.



●seal Type



●Sealant (Paste or liquid)



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4-3 Main fluid

(1) If gas other than the vacuum and inert gas may flow, check the materials of the product components and compatibility with the gas to be used. Depending on the type of gas, internal or external leakage may occur during the initial operation.

(2) The fluid temperature and ambient temperature should be within the specified levels. If the fluid with a temperature higher than the specified level is to be used, separately consult with CKD since it is necessary to change the packing material.

(3) Do not use fluid which its crystal may deposit and accumulate in the piping. Use of such fluid may cause the internal leakage or damage to the bellows.

※ Material of gas contacting part of valve

Part names	Material	Remarks
Body	A6063	About 10 μm H_2SO_4 standard alumite
Bellows assembly	SUS316L	Using formed bellows
Gasket	FKM	

4-4 Main piping

(1) Dust in the piping may greatly affect the performance of this product. If duct and/or foreign matter enter the piping, the optimal performed in the clean room as much as possible.

(2) Carefully perform the piping work so that the vacuum flange is not damaged. If the vacuum flange is damaged, this may cause the external leakage.

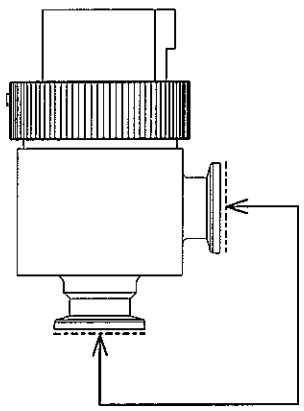
(3) Always confirm that no dust is sticking to the O-ring of the center ring and surface of the flange seal during the piping work.

(4) Avoid the piping work that all of the pipe weight directly apply to the flange. If an excessive load is applied to the flange, this may cause the external leakage.

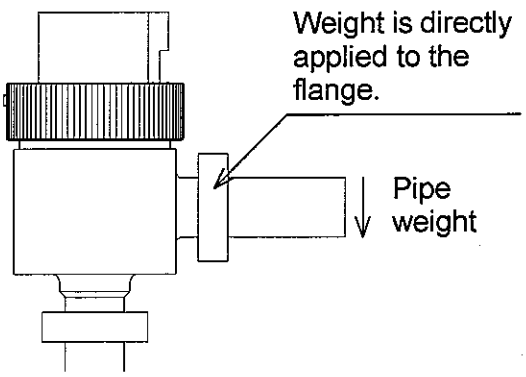
(5) Securely tighten the wing nuts on the clamp joint. If nuts are loose, this may cause the external leakage.

(6) Perform the flushing of the entire piping after the piping work has been completed.

(7) Check the entire piping system for leakage after the piping work has been completed.



No damage are allowed.



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5. Operational cautions of switches

5-1 General caution

(1) Magnetic environment

Avoid usage of these switches within the area where strong magnetic field or large current exists.

(2) Protection of lead wire

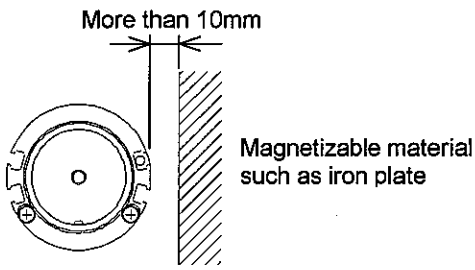
Pay consideration to eliminate repeating bending stress of stretching of lead wire while laying the wire.

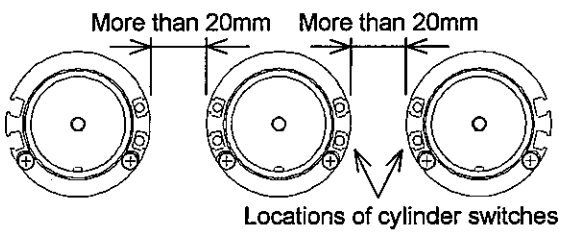
(3) Shock

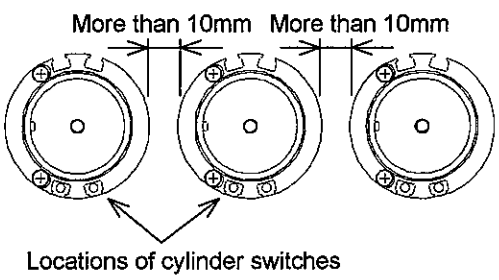
Carefully avoid big shock or vibration during transportation of cylinder or mouting and adjusting switch.

(4) Set near by magnetizable material

Magnetizable material such as iron plate near by cylinder switch is apt to cause malfunction of cylinder switches. Keep it from cylinder surface at least 10mm away.

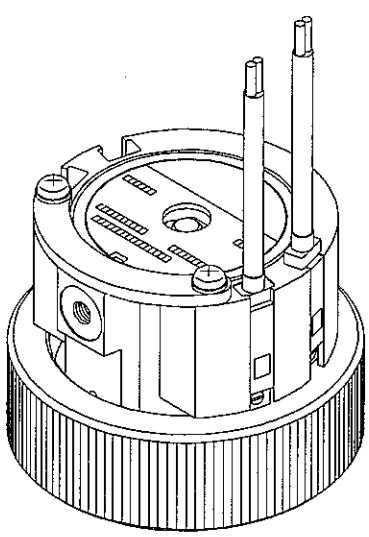






(5) In case of set near by cylinderswitch on the other valve

It usually causes malfunction of cylinder switches when plural cylinders are laid adjoining.
Keep a space between each other as illustrated to right.



⚠ CAUTION	In case of adjusting locations of cylinder switch, secure it firmly at a position where cylinder switch is activated and keep the valve in the close state or open state completely. Reconfirm what cylinder switch is activated surely.

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5-2 Operational caution, Proximity switch (model : T2, T3)

(1) Connection of lead wire

Comply with the color wiring specified on the illustrations. Be sure to turn the power off before starting connecting work. An erroneous wiring or short circuiting of load causes damage to not only switches but load side circuit.

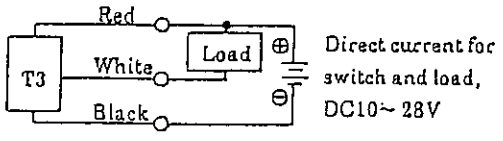

Fig.1 An example of the power for switch and load is the same.

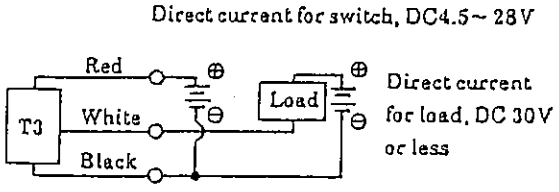

Fig.2 An example when the power for switch and load is independent.

Protection of output circuit

Install some protective circuit as per illustrated in Fig.3 when inducing type load (Relay or solenoid valve) are to be used because those types apt to generate surge current at turning switch off.
Install some protective circuit as per illustrated in Fig.4 when capacitor type load (Capacitor type) are to be used because those types apt to generate dash current at turning switch on.
Install some protective circuit as per illustrated in Fig.5 or 6 (in case of model T2) and Fig.7 (in case of model T3).

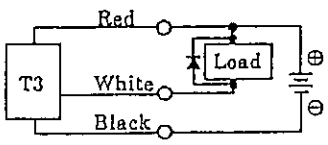

Fig.3 An example of using inducing load together with surge absorptive element (diode). (Hitachi Mfg. made diode V06C or equivalent is recommended.)

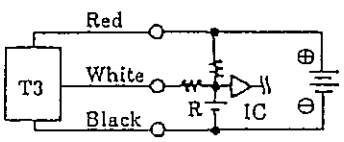

Fig.4 An example of using capacitor type load together with current regulating resister R. Comply with the following formula to figure out required R.

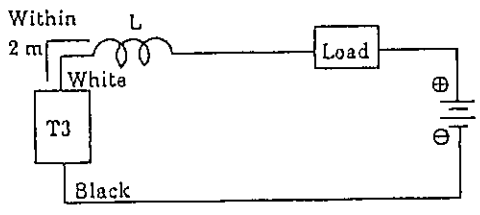

Fig.5 ·Choke coil L
L = a couple hundred μH ~ a couple mH surpassing high frequency characteristic.
·Install it near by a switch (within 2m).

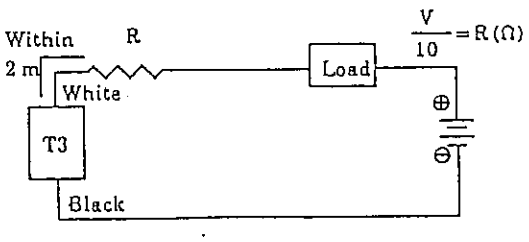

Fig.6 ·Dash current restriction resister R
R = As much large resister as the load circuit can afford.
·Install it near by a switch (Within 2m).

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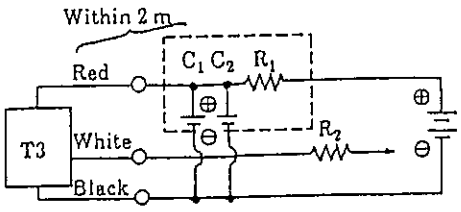

Fig.7

- Electric power noise absorptive circuit C1
  C1 = 20～50 μF electrolytic capacitor (withstanding 50V or more)
  C2 = 0.01～0.1 μF ceramic capacitor
  R1 = 20～30Ω
- Dash current restriction resister R2
  R2 = As much large resister as the load circuit can afford.
- Install it near by a switch (within 2m).

(2) Connection to a programmable controller (Sequencer)

Type of the connection varies depending upon the model of the programmable controller. Refer to the following Fig.8～12 respectively.

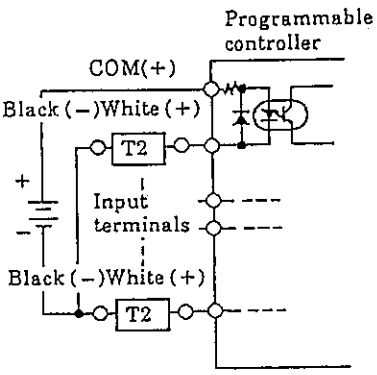

Fig.8 An example of T2 connection to source input type (an external power of source)

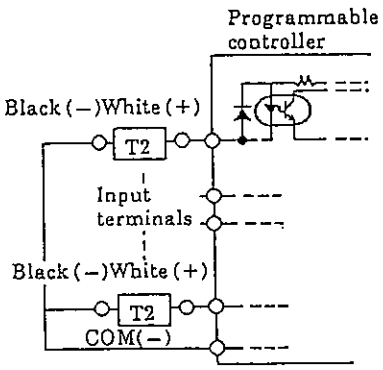

Fig.9 An example of T2 connection to source input type (an internal power of source)

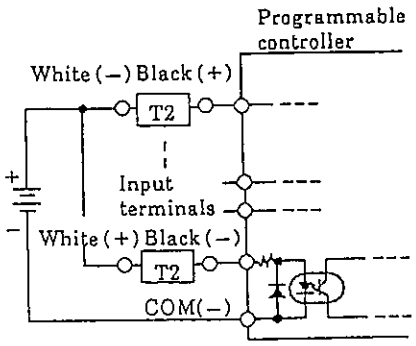

Fig.10 An example of T2 connection to sink input type (an internal power of source)

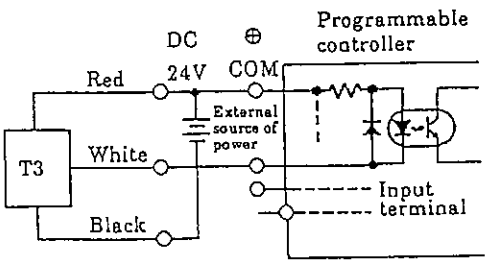

Fig.11 An example of T3 connection to source input type (an external power of source)

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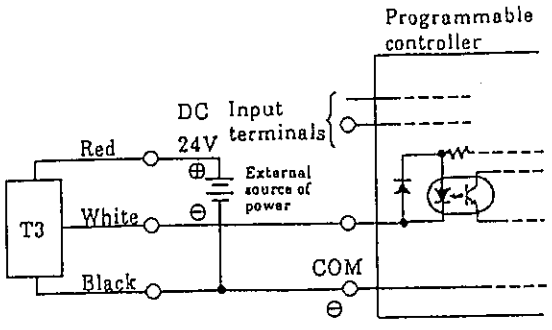


Fig.12 An example of T3 connection to source input type (an internal power of source)

(3) Series connection

The total voltage loss when series connected T2 switches according to the number of switches connected. Therefore confirm the input specifications of programmable controllers which are connecting load. However, it may dim lamp or sometimes no lamp may be lit.
T3 switches, on the contrary, leak current is usually very minor (less than 10 μA) to the extent of negligble, although leakage increases according total number of switches connected. Therefore, there is no incident of dim lamp or no lit lamp.

(4) Magnetic environment

Avoid usage of these switches within the area where strong magnetic field or large current exists. (such as a large magnet or spot welding equipment) Position sensoring errors will be resulted when installing many cylinders with switch in parallel or magnetized piece come across the cylinder due to intervention among each other.

(5) Protection of lead wire

Pay consideration to eliminate repeating bending stress or stretching of Lead wire while laying the wire. To the moving portion, use such wire of Flexibility as for building a robot.

Discontinue

5-3 Operational caution, Contact point switch (model : T0, T5)

(1) Connection of lead wire

Instead of connecting a cord to the power source directly, always connect to the load in series. In case of model T0 connection, pay the following precautions.

(A) For DC connection, use such polarities of wires as white ⊕ and black ⊖. The switch still functions right with reversed polarities but lamp is not lit.

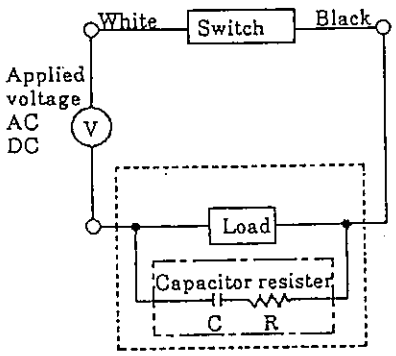
(B) For AC connection, to either relay or input terminal to programmable controller, switch lamp sometimes is not lit in case when half-wave rectification is being carried out. Lamp is lit, in this occasion, when polarities of cords for switch is reversed.

(2) Capacity of contact points

Avoid using a load exceeding the max. capacity of contact points. On the other hand, in case of T0 model, switch lamp may not be lit sometimes when current is lower than rated current.

(3) Protection of contact point

Install such protective circuit as illustrated in either Fig.1 or Fig.2 as follows, when inducing type load such as relay is to be used. Furthermore, install such protective circuit as illustrated in either Fig.3 or Fig.4, on the following page, in case the wire length exceeds the length per following table.

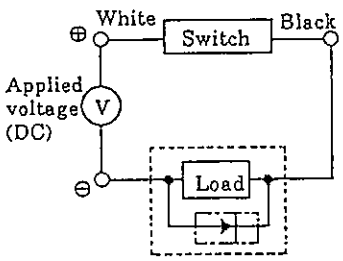


User circuit

Protective circuit
(Spark absorbing circuit)

Recommended valve
C(Capacitor) = 0.033 ~ 0.1 μF
R(Resister) = 1 ~ 3kΩ

Fig.1 When capacitor resister is used.



Load User circuit

Protective circuit

Rectifying diode, general use
Hitachi Mfg. product V06C or equivalent

Fig.2 When diode is used.

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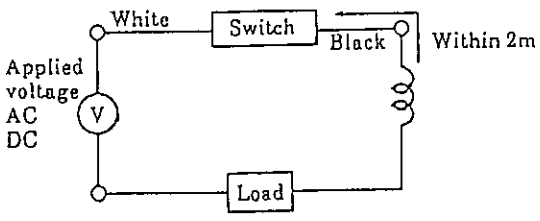
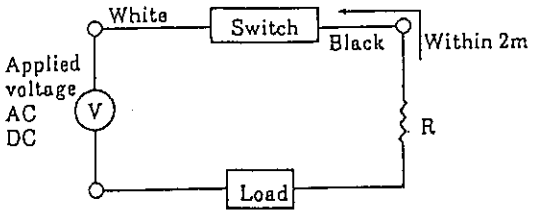


・Choke coil L
L = a couple hundred μH ~ a couple mH
surpassing high frequency characteristic.
・Install it near by a switch (within 2m).

Fig.3



・Dash current restriction resister R
R = As much large resister as the load circuit
can afford.
・Install it near by a switch (within 2m).

Fig.4

(4) Relay

Use such products as specified below or equivalent.

Tateishi Denki Mfg. ・・・・・・・・・・ model MY
Fuji Denki Mfg. ・・・・・・・・・・・・ model HH5
Tokyo Denki Mfg. ・・・・・・・・・・・ model MPM
Matsushita Denki Mfg. ・・・・・・・・・ model HC

(5) Series connection

Total voltage loss, when connected T0 switches in series, equials to the sum of respective voltage loss of each switch. The total voltage loss becomes equivalent to one T0 (approx. 2.4V) when connecting the combination of one T0 for actuation confirming and rest of switches T5s. Lamp is lit only when all switches turn on.

(6) Parallel connection

There is no restriction in parallel connection number of switches of these types. Multi number connection of model T0s, sometimes, cause dimmed lamp or no lamp lit.

(7) Magnetic environment

Avoid usage of these switches within the area where strong magnetic field or large current exists. (such as a large magnet or spot welding equipment) Position censoring errors will be resulted when installing many cylinders with switch in parallel or magnetized piece come across the cylinder due to intervention among each other.

(8) Protection of lead wire

Pay consideration to eliminate repeating bending stress or stretching of lead wire while laying the wire. To the moving portion, use such wire of flexibility as for building a robot.

Discontinue

6. Maintenance and inspection

6-1 Periodic inspection

(1) To operate the valve at its optimal level, perform the periodic inspection once or twice a year.

(2) Inspection items

Check the valve for external leakage.
Check the valve seat for leakage (internal leakage).
Check that the valve is operated smoothly.
Check the piping and valve for loose screws.
Check the packing for wear and corrosion.

(3) Replace the following parts when their service lives last.

Main maintenance parts

- O-ring
- bellows assembly

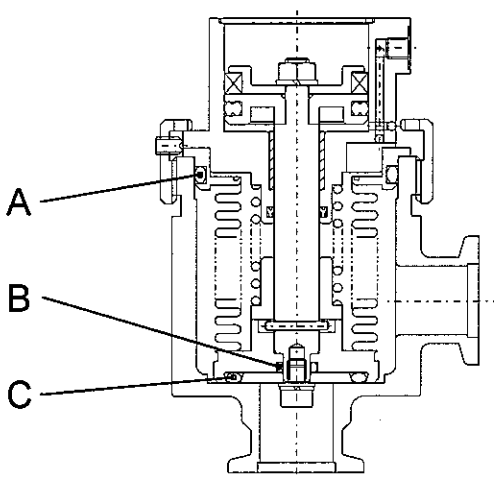
(For details, see the replacement procedures on page 18.)

6-2 Replacement time

(1) Guarantee period of this valve is for 21 months after shipment from CKD.
(2) Life cycle is a million times.
(3) Maintenance time is when valve is out of order (leakage of valve seat) and when valve is achieved life cycle.

MODEL	Parts No.		
	A	B	C
AVB41V	G40	P6	G25
AVB51V			
AVB61V	G65	P8	G50
AVB71V			

Size conforms to JIS B2401.
Material : FKM



Discontinue

6-3 Caution for disassembly and reassembly

(1) Thoroughly read the disassembly and reassembly procedures on page 18 and follow the instructions. The specified performance may not be obtained if the product is disassembled using procedures other than those specified.

(2) Disassembly and reassembly work should be performed in the clearn room.

(3) Do not twist, pull, and compress the bellows.
Doing so many lower the durability of the bellows.

(4) Do not touch the surface of the bellows by bare hand.
Doing so may cause the bellows to be corroded and the durability to lower.

(5) Carefully disassemble and reassemble the valve so that no scatches and dents are produced on the surface of the vacuum seal.

(6) Tighten screws with specified torque during reassembly of the product. (Torque is specified in the disassembly procedure.)
Excessive or insufficient tightening may lower the performance of the product.

(7) Always confirm that no dust is sticking to the seal during the reassembly work.

(8) Check the following performance after reassembly of the product.
- Check the valve for external leakage.
- Check the valve seat for leakage.
- Check that the valve is operated smoothly.
- Check the piping and valve for loose screws.

⚠ **CAUTION**	Never disassemble the valve using produres other than those specified. (Do not remove springs and disassemble the cylinder.) It is dangerous to disassemble units other than those specified. If the disassembly of other units other than those specified is required, separately consult with CKD.

Discontinue

6-4 Disassembly procedure

(1) Apply pressure to the valve open port of the cylinder.

(2) Remove two hexagon socket set screw ① (Retighten the bolts with tightening torque specified in Table.2.)

(3) Remove the ring ② by hand, hold the cylinder ③ and put it out from the body ⑩. Stop applying pressure to the valve open port of the cylinder.

(4) Remove the hexagon socket head bolt on the top of the bellows. (Retighten the bolt with tightening torque specefied in Table.2.)

(5) Hold the cylinder ③ and pull the bellows ④ out from the rod. (At this time, the spring is supported by the parallel pin not to jump out.)

(6) Remove the bellows adapter and replace three types of O-rings (⑤,⑥,⑦) with new ones and reassemble the valve.

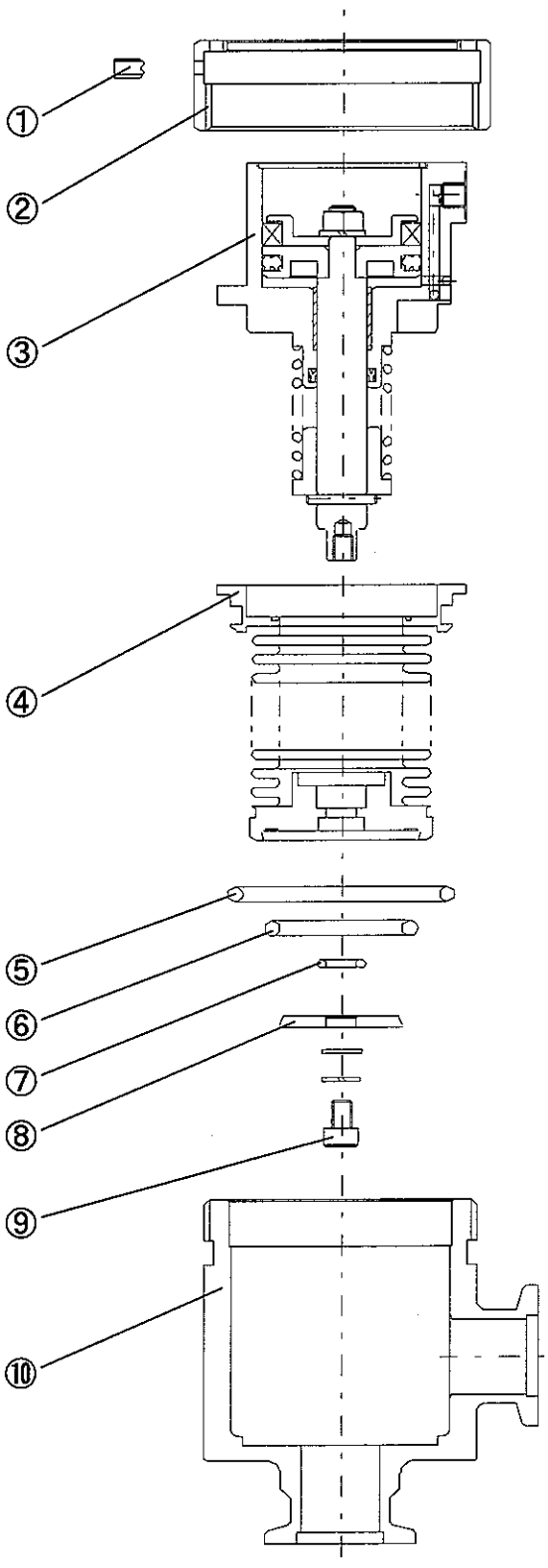


Table.2 List of tightening torque

MODEL	Parts No.	
	①	⑨
AVB41V AVB51V	1.0～1.2 N·m	1.2～1.4 N·m
AVB61V AVB71V	1.0～1.2 N·m	1.5～1.8 N·m

Discontinue

6-5 Remove switch rail, reassembly

(1) Remove

1. Loose a hexagon socket set screw (M3×6) ①.
2. Remove a switch rail ②.

(2) Reassembly

1. Put switch rail ② on cylinder.
2. Bring A into contact with B, and tighten a hexagon socket set screw (M3×6) ①. (Tightening torque : 0.1～15N·m)
3. Reconfirm what cylinder switch is activated by opening and closing action of valve. (If cylinder switch is not activated, adjusting locations of cylinder switch at a position where cylinder switch is activated.)