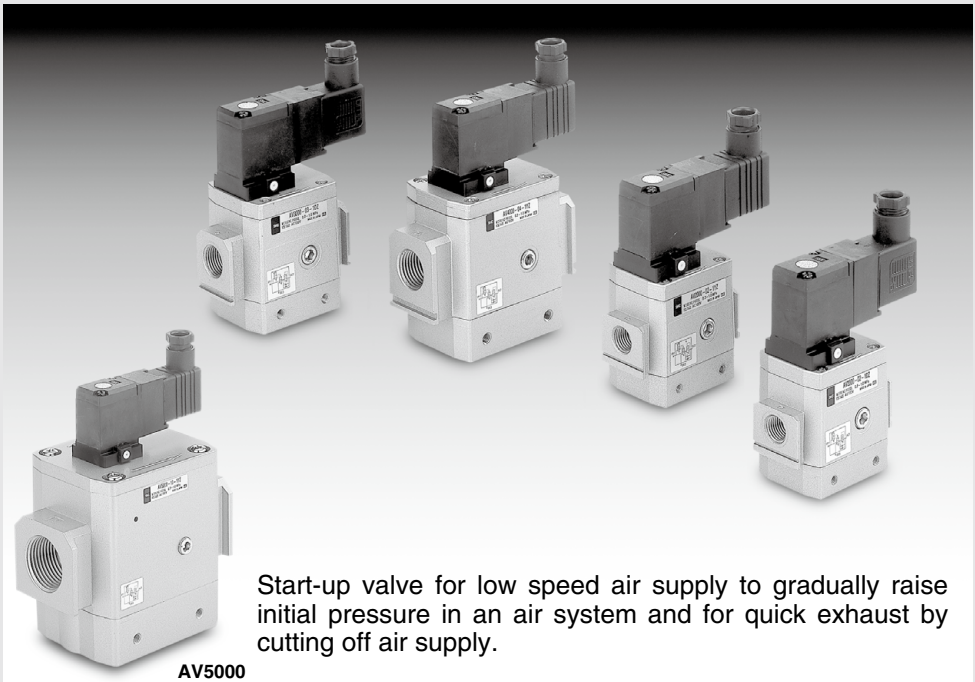
Soft Start-up Valve

AV2000/3000/4000/5000 Series

CE [Option]



AV5000

Start-up valve for low speed air supply to gradually raise initial pressure in an air system and for quick exhaust by cutting off air supply.

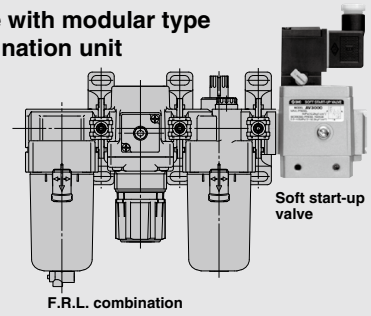
Large effective area (mm²)

AV2000/ 20 (Body size: 1/4)
AV3000/ 37 (Body size: 3/8)
AV4000/ 61 (Body size: 1/2)
AV5000/ 113 (Body size: 3/4)
AV5000/ 122 (Body size: 1)

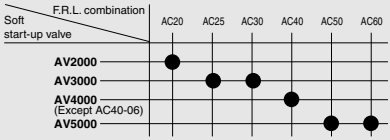
With supply/exhaust function by manual operation

Low power consumption

Connectable with modular type F.R.L. combination unit



Combination with F.R.L. unit



CE

[Option]

Note) CE compliant: "G", grommet is not available.

Soft Start-up Valve

AV2000/3000/4000/5000

How to Order

AV **20** 00 – □ **02** □ – **1** **G** □ □ – □ – □

Soft start-up valve

Body size

20	1/4
30	3/8
40	1/2
50	3/4,1

Thread type

Nil	Rc
F	G
N	NPT

Port size

02	1/4 (AV2000 only)
03	3/8 (AV3000 only)
04	1/2 (AV4000 only)
06	3/4 (AV5000 only)
10	1 (AV5000 only)

Option

Nil	None
G	With pressure gauge

Coil rated voltat

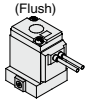
1	100 VAC (50/60 Hz)
2	200 VAC (50/60 Hz)
3	110 to 120 VAC (50/60 Hz)
4	220 VAC (50/60 Hz)
5	24 VDC
6	12 VDC
7	240VAC (50/60 Hz)

For other rated voltages, please consult with SMC.

Light/Surge voltage suppressor

Nil	None
S	With surge voltage suppressor (Grommet type only)
Z	With light/surge voltage suppressor (Not possible with grommet type)

Manual override

Nil: Non-locking push type (Flush)	**B:** Locking type (Tool required)	**C**: Locking type (Lever)
		

Flow direction

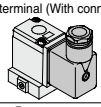
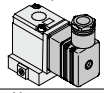
Nil	Left to right
R	Right to left

CE-compliant

Nil	—
Q	CE-Compliant Note 2)

Note 2) "G", grommet is not available.

Electrical entry

	CE-compliant
G: Grommet Note 1) 	—
D: Type D DIN terminal (With connector) 	●
DO: Type D DIN terminal (Without connector)	●
Y: Type Y DIN terminal (With connector) 	●
YO: Type Y DIN terminal (Without connector)	●

Note 1) The grommet type can have a surge voltage suppressor (direct coupling type lead wire), but without indicator light.

How to Order Pilot Valve Assembly

SF4 – **1** **G** □ □ – **80** – □ – □

Rated coil voltage

1	100 VAC (50/60 Hz)
2	200 VAC (50/60 Hz)
3	110 to 120 VAC (50/60 Hz)
4	220 VAC (50/60 Hz)
5	24 VDC
6	12 VDC
7	240 VAC (50/60 Hz)

For other rated voltages, please consult with SMC.

Soft start-up valve

CE-compliant

Nil	—
Q	CE-Compliant Note 2)

Note 2) "G", grommet is not available.

Flow direction

Nil	Left to right
R	Right to left

Electrical entry

		CE-compliant
G	Grommet Note 1)	—
D	Type D DIN terminal (With connector)	●
Y	Type Y DIN terminal (With connector)	●
DO	Type D DIN terminal (Without connector)	●
YO	Type Y DIN terminal (Without connector)	●

Note 1) The grommet type can have a surge voltage suppressor (direct coupling type lead wire), but without indicator light.

Manual override

Nil	Non-locking push type (Flush type)
B	Locking type (Tool required)
C	Locking type (Lever type)

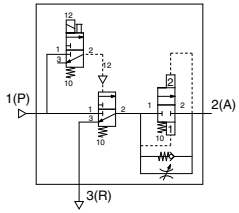
Light/Surge voltage suppressor

Nil	None
S	With surge voltage suppressor (Grommet type only)
Z	With light/surge voltage suppressor(Not possible with grommet type)

Type D DIN terminal

Type Y DIN terminal

Symbol



Accessory/Pressure Gauge

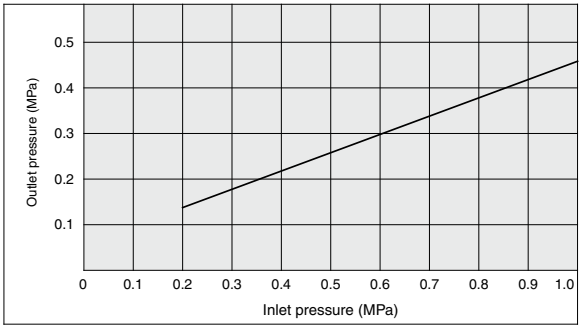
Description	Pressure gauge
Part no.	G36-10-01
Pressure range	1 MPa

Specifications

Model		AV2000	AV3000	AV4000	AV5000	
Port size		1/4	3/8	1/2	3/4	1
Proof pressure		1.5 MPa				
Operating pressure range		0.2 to 1 MPa				
Pressure gauge port size		1/8				
Ambient and fluid temperature		0 to 60°C (1)				
Effective area (mm²)	1(P) → 2(A)	20	37	61	113	122
	2(A) → 3(R)	24	49	76	132	141
Weight (kg)		0.27	0.48	0.74	1.60	1.54
Electrical specifications	Rated coil voltage	100, 200, 110 to 120, 220 VAC (50/60 Hz), 240 VAC (50/60 Hz) 12, 24 VDC				
	Allowable voltage fluctuation	–15 to +10% of rated voltage				
	Coil insulation type	Equivalent to B type (130°C)				
	Apparent power (Current consumption) AC Inrush	5.6 VA (50 Hz), 5.0 VA (60 Hz)				
	Apparent power (Current consumption) AC Energized	3.4 VA (2.1 W)/50 Hz, 2.3 VA (1.5 W)/60 Hz				
	Current consumption DC	1.8 W				
	Electrical entry	Grommet, Type D DIN terminal, Type Y DIN terminal				
	Option specifications	Indicator light/Surge voltage suppressor (2)				
Pilot valve manual override		Non-locking push type (Flush), Locking type (Tool required), Locking type (Lever)				

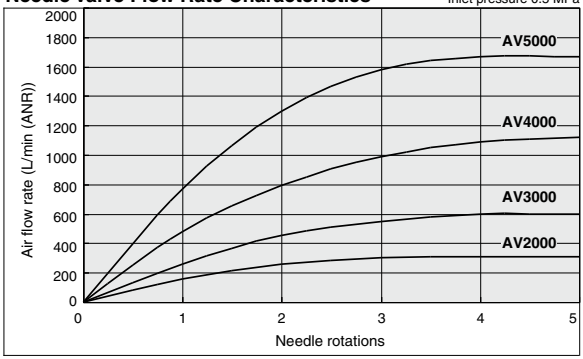
Note 1) Use dry air when operating at a low temperature.
Note 2) The grommet type is equipped with a surge voltage suppressor (direct coupling type lead wire), but not an indicator light.

Piston B Switching Pressure (Close → Open)

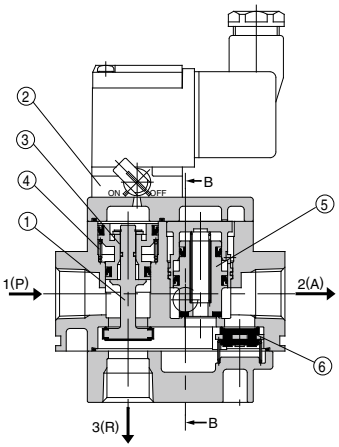


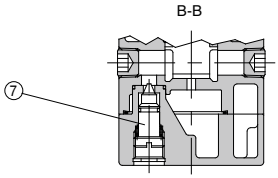
Needle Valve Flow Rate Characteristics

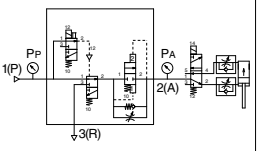
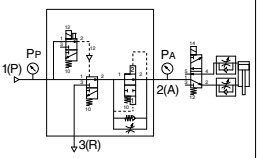
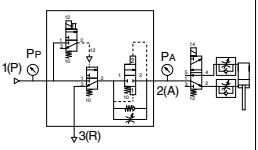
Inlet pressure 0.5 MPa



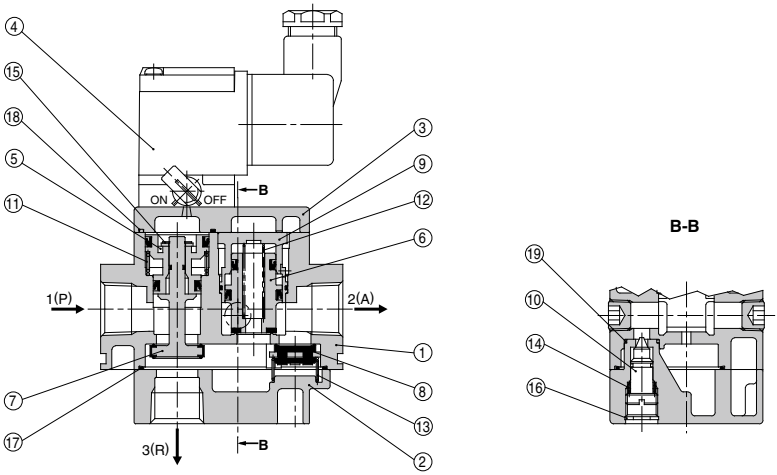
Working Principle





Working condition	Pilot valve	Pressure conditions	Working description	Pressure time chart (Meter-out control) example	Cylinder drive circuit (Meter-out control) example
Low speed supply	ON	1/2 P_P > P_A	When pilot valve ② is turned ON by energization or manual override, the pilot air pushes piston A ③ and main valve ① downward and opens main valve ① while R port closes simultaneously. The air from P portmoves to needle valve ⑦ , where its flow is adjusted, and flows to A port. The meter-in control of needle valve ⑦ slowly moves the cylinder from Ⓐ to Ⓑ.	Initial Operation Return Stroke Pressure stroke P_P Cylinder movement with fixed orifice Ⓑ Ⓓ P_A Ⓒ P_R (Atmospheric pressure) Ⓐ Time	
High speed supply		1/2 P_P ≤ P_A	When 1/2 P_P ≤ P_A after the cylinder reaches Ⓑ, piston B ⑤ fully opens and P_A increases rapidly as shown from Ⓒ to Ⓓ and becomes the same pressure as P_P.		
Normal operation		P_P ≈ P_A	Since piston B ⑤ holds the fully open condition, during normal operation the cylinder's speed will be controlled by the usual meter-out control.		
Quick exhaust	OFF	—	When pilot valve ② is turned OFF, spring ④ pushes piston A ③ and main valve ① upward and opens R port while shutting off the air supply from P port. The pressure difference generated at this time lets the check valve ⑥ open and the residual pressure on the A port side is quickly exhausted from R port.		

Construction



Component Parts

No.	Description	Material
1	**Body**	Aluminum die-casted
2	**Cap**	Aluminum die-casted
3	**Cover**	Aluminum die-casted

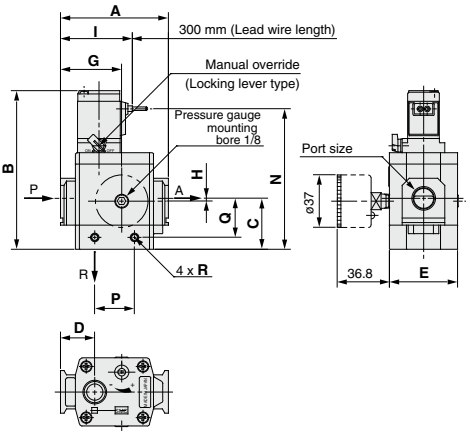
Replacement Parts

No.	Description	Material	Part no.			
			AV2000	**AV3000**	**AV4000**	**AV5000**
4	**Pilot valve assembly**	——	SF4-□-80*1(-Q)			
5	**Piston A assembly**	POM, NBR	P424204A	P424304A	P424404A	P424504A
6	**Piston B assembly**	Brass, NBR (HNBR)	P424205A	P424305A	P424405A	P424505A
7	**Main valve assembly**	Brass, NBR (HNBR)	P424206A	P424306A	P424406A	P424506A
8	**Check valve**	Brass, NBR (HNBR)	P424207	P424307	P424407	P424507
9	**Piston guide assembly**	POM, NBR	P424208A	P424308A	P424408A	P424508A
10	**Needle assembly**	Brass, NBR	P424209A	P424309A	P424409A	P424509A
11	**Valve spring**	Steel wire	P424211	P424311	P424411	P424511
12	**Piston spring**	Stainless steel	P424212	P424312	P424412	P424512
13	**Check spring**	Stainless steel	P424213	P424313	P424413	P424513
14	**Needle spring**	Steel wire	P424214	P424314	P424414	—
15	**Type C retaining ring for shaft**	Tool steel	G-5	STW-5	STW-8	STW-10
16	**Type C retaining ring for hole**	Tool steel	0-9	0-10	RTW-12	RTW-15
17	**Seal**	NBR	P424210	P424310	P424410	P424510
18	**Seal**	NBR	P424218	P424315	P424415	P424514
19	**O-ring**	NBR	10 x 8 x 1	11 x 9 x 1	12.5 x 9.5 x 1.5	16.5 x 12.5 x 2

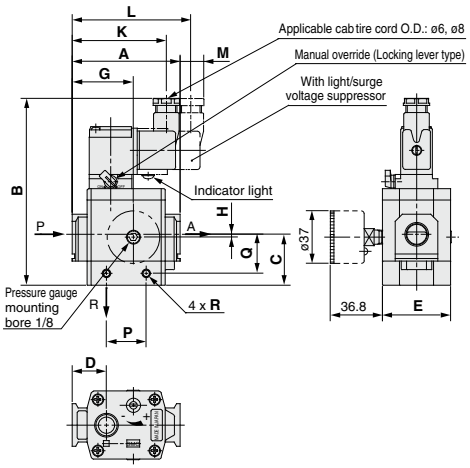
*1 For "How to Order" pilot valve assembly, refer to page 652.

Dimensions

Grommet: AV□00-□-□G, GS



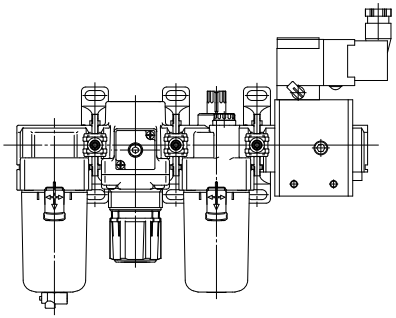
DIN terminal: AV□00-□-□D, DZ
DIN terminal for European use: AV□00-□-□Y, YZ



Model	Port size	A	B	C	D	E	G	H	I	K	L	M	N	P	Q	R
AV2000-□02-□G□	1/4	66	105	31	22	40	38	0	47.5	—	—	—	93	29	23.5	M4 x 0.7 Depth 4.5
AV2000-□02-□GS□																
AV2000-□02-□D□	1/4	66	125	31	22	40	38	0	—	65.5	—	6	—	29	23.5	M4 x 0.7 Depth 4.5
AV2000-□02-□DZ□										—	80.5	23				
AV2000-□02-□Y□	1/4	66	125	31	22	40	38	0	—	67.5	—	10.5	—	29	23.5	M4 x 0.7 Depth 4.5
AV2000-□02-□YZ□										—	84.5	27.5				
AV3000-□03-□G□	3/8	76	112	36	24	48	43	2	50.5	—	—	—	100	28	27.5	M5 x 0.8 Depth 5
AV3000-□03-□GS□																
AV3000-□03-□D□	3/8	76	132	36	24	48	43	2	—	66.5	—	—	—	28	27.5	M5 x 0.8 Depth 5
AV3000-□03-□DZ□										—	83.5	16				
AV3000-□03-□Y□	3/8	76	132	36	24	48	43	2	—	70.5	—	3.5	—	28	27.5	M5 x 0.8 Depth 5
AV3000-□03-□YZ□										—	87.5	20.5				
AV4000-□04-□G□	1/2	98	127	47	32	52	57	3	62.5	—	—	—	115	42	37	M6 x 1 Depth 6
AV4000-□04-□GS□																
AV4000-□04-□D□	1/2	98	147	47	32	52	57	3	—	78.5	—	—	—	42	37	M6 x 1 Depth 6
AV4000-□04-□DZ□										—	95.5	6				
AV4000-□04-□Y□	1/2	98	147	47	32	52	57	3	—	82.5	—	—	—	42	37	M6 x 1 Depth 6
AV4000-□04-□YZ□										—	99.5	10.5				
AV5000-□ 06/10 -□G□	3/4, 1	128	155	59	39	74	77	0	74	—	—	—	143	50	46	M6 x 1 Depth 7.5
AV5000-□ 06/10 -□GS□																
AV5000-□ 06/10 -□D□	3/4, 1	128	175	59	39	74	77	0	—	90	—	—	—	50	46	M6 x 1 Depth 7.5
AV5000-□ 06/10 -□DZ□										—	107	—				
AV5000-□ 06/10 -□Y□	3/4, 1	128	175	59	39	74	77	0	—	94	—	—	—	50	46	M6 x 1 Depth 7.5
AV5000-□ 06/10 -□YZ□										—	111	—				

Connecting Spacer for Modular Type F.R.L. Unit

Select one of the spacers below when connecting to an F.R.L. combination unit (AC20 to AC60).
(Spacers must be ordered separately.)



Spacer

Y200-A

Y400-A

Model	Applicable model
Y200-A	AV2000
Y300-A	AV3000
Y400-A	AV4000
Y600-A	AV5000

Spacer with bracket

Y200T-A

Y400T-A

Model	Applicable model
Y200T-A	AV2000
Y300T-A	AV3000
Y400T-A	AV4000
Y600T-A	AV5000

AV2000/3000/4000/5000 Series
Specific Product Precautions 1

Be sure to read this before handling the products.
Refer to back page 50 for Safety Instructions and pages 387 to 391 for F.R.L. Precautions.

Caution on Design

⚠Warning

1. Actuator drive
When using solenoid valve or actuator in the outlet side of this product, implement appropriate measures to prevent potential danger caused by actuator operation.

2. Holding pressure
Since the valve might have slight interal leakage, it is not suitable for holding pressure in a tank or another vessel for a long period of time.

3. Maintenance space
Allow the sufficient space for maintenance and inspection.

Selection

⚠Warning

1. Confirm the specifications.
The products presented in this catalog are designed only for use in compressed air systems. Do not operate at pressures or temperatures, etc., beyond the range of specifications, as this can causedamage or malfunction. (Refer to specifications.) Please contact SMC if using for other fluids than compressed air.

2. Extended periods of continuous energization
Please contact SMC if valves will be continuously energized for extended periods of time.

3. Operation of closed center solenoid valves
Even if this product is used for closed center solenoid valves or actuator with a load factor of more then 50%, jumping (stick-slip phenomenon) cannot be prevented.

4. Using a regulator in the outlet side
When mounting a regulator in the outlet side (A port side), use a residual pressure relief regulator (AR25K to 40K) or a check type regulator. With a standard regulator (AR10 to 60), the outlet side pressure may not be released when this valve is exhausted.

5. Operation of solenoid valves in the outlet side
To operate solenoid valves mounted on this product's outlet side (A port side), first confirm that the outlet side's pressure (P_A) has increased to become equal to the inlet side's pressure (P_P).

6. Operation
The residual pressure release function of this product is for emergency use only; therefore, avoid the operation in the same manner as ordinary 3 port valves.

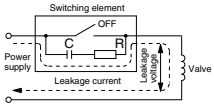
7. Using a lubricator
If mounting a lubricator, mount it on the inlet side (P port side), of this product. If mounted on the outlet side (A port side), back flow of oil will occur and may spurt out of the valve's R port.

8. Operation for air blowing
This product cannot be operated for air blowing due to the mechanism that switches the main valve to be fully open after the outlet side's pressure increases to approximately 1/2 of the inlet side.

Selection

⚠Caution

1. Voltage leakage
Particularly when using a C-R element (surge voltage suppressor) for protection of the switching element, use cation that leakage voltage will increase due to leakage current flowing through the C-R element, etc.



AC coil is 20% or less of rated voltage.
DC coil is 3% or less of rated voltage.

2. Low temperature operation
Although the valve can be operated at temperature as low as 0°C, measures should be taken to avoid solidifying or freezing drainage and moisture, etc.

Mounting

⚠Warning

1. If air leakage increases or equipment does not operate properly, stop operation.
After mounting or maintenance, etc., connect the compressed air and power supplies, and perform appropriate function and leakage tests to confirm that the unit is mounted properly.

2. Operation manual
Mount and operate the product after reading the manual carefully and understanding its contents. Also keep the manual in a place where it can be referred to as necessary.

3. Painting and coating
Warnings or specifications printed or labeled on a product should not be erased, removed or covered up.
Furthermore, please contact SMC before painting the resin parts, as this may cause adverse effects depending on the solvent.

Adjustment

⚠Caution

1. To perform the initial speed adjustment of a outlet side actuator, supply air from this valve's inlet side and turn ON the pilot valve. Then, rotate the needle counterclockwise from the fully closed position.

AV2000/3000/4000/5000 Series
Specific Product Precautions 2

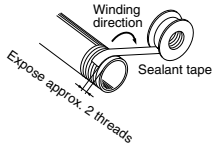
Be sure to read this before handling the products.
Refer to back page 50 for Safety Instructions and pages 387 to 391 for F.R.L. Precautions.

Piping

⚠Caution

1. Preparation before piping
Before piping is connected, it should be thoroughly blown out by air (flushed) or washed to eliminate cutting chips, cutting oil, and other debris from the pipe inside.

2. Winding of sealant tape
When screwing piping or fittings into ports, ensure that chips from the pipe threads or sealing material do not enter the piping. Also, if sealant tape is used, leave 1.5 to 2 thread ridges exposed at the end of the threads.



3. Tighten threads with the proper tightening torque.
When screwing fittings into valves, tighten with the torques given below.

Tightening Torque when Piping

Connection threads	Proper tightening torque (N·m)
Rc 1/4	12 to 14
Rc 3/8	22 to 24
Rc 1/2	28 to 30
Rc 3/4	28 to 30
Rc 1	36 to 38

4. Piping to products
When piping to products, avoid making an error of supply port, etc., by referring to the operation manuals.

5. F.R.L. module combination
When connecting to a modular F.R.L. combinations (AC20 to 60), select one of the spacers, which are included. (Refer to page 657 for details.) However, modular combinations with AC40-06 are not possible.
Furthermore, connect soft start-up valves to the outlet side of the F.R.L. combination.

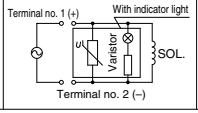
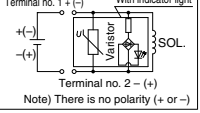
6. Inlet side piping conditions
The nominal size of the piping material's or equipment's bore should be equal to or larger than the soft start-up valve's port size. The composite effective area of the inlet side's (P port side's) piping or equipment should be equal to or larger than the values below.

Model	Composite effective area (mm^2)
AV2000	5
AV3000	22
AV4000	35
AV5000	50

When the piping is restricted or the supply pressure is insufficient, the main valve will not switch and air leakage may occur from the R port.

Light/Surge Voltage Suppressor

⚠Caution

Voltage	AC and 100 VDC	24 VDC or less
Electrical circuit		

Note) There is no polarity (+ or –)

●Type G: Lead wire comes directly from the solenoid part. Connect it with the power source. Grommet with DC voltage surge voltage suppressor has polarity. Connect red lead wire to + (positive) side and black to – (negative) side.

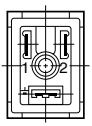
Surge voltage suppressor	
DC	AC
	

Electrical Connection

⚠Caution

The DIN terminal is no polarity (+, –).

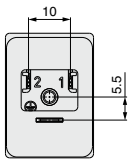
DIN terminal



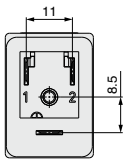
DIN (EN175301-803) Terminal

Y type DIN terminal corresponds to the DIN connector with terminal pitch 10 mm, which complies with EN175301-803B. Since the terminal pitch is different from the D type DIN connector, these two types are not interchangeable.

Y type



D type



AV2000/3000/4000/5000 Series
Specific Product Precautions 3

Be sure to read this before handling the products.
Refer to back page 50 for Safety Instructions and pages 387 to 391 for F.R.L. Precautions.

Air Supply

⚠Warning

1. Use clean air.
Do not use compressed air which contains chemicals, synthetic oils containing organic solvents, salts or corrosive gases, etc., as this can cause damage or malfunction.

⚠Caution

1. Install air filters.
Install air filters close to valves at their upstream side. A filtration degree of 5 μm or less should be selected.

2. Implement countermeasures by installing after-cooler or air dryer, or water separator, etc.
The air including excess drain may result in a malfunction of valves and other pneumatic equipment. Implement countermeasures by installing after-cooler or air dryer, or water separator, etc.

Operating Environment

⚠Warning

1. Do not use valves in such environments where corrosive gases, chemicals, or brine or water or steam is airborne, or where valves can be directly exposed to any of those.
2. Do not use in an explosive environment.
3. Do not use in locations influenced by vibrations or impacts.
4. A protective cover, etc., should be used to shield valves from direct sunlight.
5. Shield valves from radiated heat generated by nearby heat sources.
6. Take suitable protective measures in locations where there are contacts with water droplets, oil, or welding spatter, etc.
7. In a dusty environment or when valve switching noise is intrusive, install a silencer in the R port to prevent dust from entering, and to reduce noise.

Lubrication

⚠Caution

1. The valve has been lubricated for life at the factory, and does not require any further lubrication.

2. Use turbine oil Class 1, ISO VG32 (with no additives), if lubricated. Besides, if the lubrication is suspended halfway, the original lubricant will be lost and may result in a malfunction. Be sure to keep lubricating continuously.

Note) Refer to SMC's website for details about each manufacturer's brand name of class 1 turbine oil (no additive) ISO VG32. Additionally, please contact SMC for details about class 2 turbine oil (with additives) ISO VG32.

Maintenance

⚠Warning

1. Perform maintenance and inspection as shown in the operation manual.
If handled improperly, damage may occur in machine or equipment or an operational error may result in.

2. Equipment removal and supply/exhaust of compressed air
When equipment is removed, first confirm that measures are implemented to prevent dropping of workpiece and runaway of equipment, etc. Then cut the supply pressure and power, and exhaust all compressed air from the system using its residual pressure release function.

3. Low frequency operation
Valves should be switched at least once every 30 days to prevent malfunction. (Use caution regarding the air supply.)

4. Manual override operation
When the manual override is operated, connected equipment will be actuated.
Confirm the safety before operating.

⚠Caution

1. Drain removal
Remove drain from air filters periodically.

How to Find the Flow Rate

(At air temperature of 20°C)

Choke flow: $(P_2 + 0.1)/(P_1 + 0.1) \leq 0.5$

$$Q = 120 \times S \times (P_1 + 0.1) \times \sqrt{\frac{293}{273 + t}}$$

Subsonic flow: when $(P_2 + 0.1)/(P_1 + 0.1) > 0.5$

$$Q = 240 \times S \times \sqrt{(P_1 - P_2)(P_2 + 0.1)} \times \sqrt{\frac{293}{273 + t}}$$

Q: Air flow rate [L/min (ANR)]
S: Effective area [mm²]
P_1: Inlet pressure [MPa]
P_2: Outlet pressure [MPa]
t: Air temperature [°C]

Note 1) Formulas above are applied to pneumatics only.