## Direct Operated 2-Port Solenoid Valve

Coil force increased by **10%**

Power consumption reduced by **14%**

### Series Variations

<table>
<thead>
<tr>
<th>Model</th>
<th>Orifice diameter [mm]</th>
<th>Flow rate*1 [L/min]</th>
<th>Seal material</th>
<th>Electrical entry</th>
</tr>
</thead>
<tbody>
<tr>
<td>JSX10 Series</td>
<td>1/8</td>
<td>1.6, 2.4</td>
<td>NBR</td>
<td>Grommet</td>
</tr>
<tr>
<td>JSX20 Series</td>
<td>1/8, 3/8</td>
<td>3.2, 4, 5.6, 7.1</td>
<td>FKM, EPDM</td>
<td>DIN terminal, Conduit</td>
</tr>
<tr>
<td>JSX30 Series</td>
<td>1/4, 3/8</td>
<td>4, 5.6, 7.1</td>
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<td></td>
</tr>
</tbody>
</table>

**Note:**
- *1 At the maximum operating pressure differential (Fluid: Water)
- *2 Compared with the existing model
- IP65 for models with a DIN connector

### Space saving

<table>
<thead>
<tr>
<th>Compact</th>
<th>Lightweight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valve volume</td>
<td>25% reduction*1</td>
</tr>
</tbody>
</table>

### Environmental resistance

- **Stainless steel body**
- **IP67**

---

**New**

RoHS

**IP67**

Air | Water | Oil

---

**CAT.ES70-56A**
Direct Operated 2-Port Solenoid Valve  **JSX Series**

**Energy saving**
- **Coil force:** 10% increase (Compared with the existing model)
- **Power consumption:** 14% reduction (Compared with the existing model)
- Coil attraction force improved by 10% and power consumption reduced by 14% for the optimal magnetic efficiency.

**Lead wire**
360° entry possible
- 360° rotation of coil facilitates lead wire handling.

**IP67 enclosure**
- *IP65 for models with a DIN connector*

**Power consumption**
- *For DC voltages*
  - **4 W** (10 series)
  - **6 W** (20 series)
  - **8 W** (30 series)

**Full-wave rectifier type**
(AC specification: Insulation type Class B)
- **Improved durability**
  - Extended service life due to the special construction (Compared with the existing shading coil)
- **Reduced buzz noise**
  - Rectified to DC by the full-wave rectifier, resulting in a buzz noise reduction
- **Reduced apparent power**
  - *Class B, N.C. valve (Compared with the existing model)*
  - 9.5 VA → 8 VA (20 series)
  - 12 VA → 9.5 VA (30 series)
- **Improved OFF response**
  - Specially constructed to improve the OFF response when operated with a higher viscosity fluid such as oil
- **Low-noise construction**
  - Specially constructed to reduce metal noise during operation

**Stopper construction**
- Metal noise reduced by the resin stopper
- Longer service life

**Improved armature durability**

**Highly corrosion resistant**
Standardized stainless steel body

**IP65 for models with a DIN connector**

**Electrical entry variations**
- **Grommet**
- **DIN terminal**
- **Conduit**
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Flow Rate Characteristics

<table>
<thead>
<tr>
<th>Series</th>
<th>Port size</th>
<th>Orifice diameter (mm)</th>
<th>Flow rate characteristics**</th>
<th>Air (dm³/(s·bar))</th>
<th>Water, Oil (dm³/(s·bar))</th>
<th>Max. operating pressure differential (MPa)</th>
<th>Model</th>
<th>Weight [g]</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>1/8</td>
<td>1.6</td>
<td>0.35, 0.58, 0.08, 0.07, 0.05</td>
<td>0.9</td>
<td>JSX11-S1101</td>
<td>160</td>
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<td></td>
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<td>2.4</td>
<td>0.62, 0.45, 0.15, 0.15, 0.15</td>
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<td>JSX11-S1201</td>
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<td>20</td>
<td>1/4</td>
<td>3.2</td>
<td>1.35, 0.48, 0.35, 0.30, 0.35</td>
<td>0.7</td>
<td>JSX21-S301</td>
<td>320</td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td>3.2</td>
<td>1.35, 0.48, 0.35, 0.30, 0.35</td>
<td>0.7</td>
<td>JSX21-S302</td>
<td>320</td>
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<td>4.0</td>
<td>2.02, 0.48, 0.52, 0.45, 0.52</td>
<td>0.3</td>
<td>JSX21-S303</td>
<td>320</td>
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<td>5.6</td>
<td>2.62, 0.43, 0.73, 0.63, 0.73</td>
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<td>JSX21-S304</td>
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<td>7.1</td>
<td>3.15, 0.44, 0.88, 0.76, 0.88</td>
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<td>7.1</td>
<td>3.15, 0.44, 0.88, 0.76, 0.88</td>
<td>0.2</td>
<td>JSX21-S306</td>
<td>320</td>
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</tbody>
</table>

Applicable Fluid Check List

- The list shows the compatibility between general fluids and seal materials. Consider the operating environment and application sufficiently before selecting the seal material. Fluid and component compatibility should be checked in the application before use. If something is not clear, please contact SMC.

<table>
<thead>
<tr>
<th>Applicable fluid</th>
<th>Seal material</th>
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</thead>
<tbody>
<tr>
<td>Air</td>
<td>NBR — FKM — EPDM</td>
</tr>
<tr>
<td>Water</td>
<td>— — —</td>
</tr>
<tr>
<td>Oil</td>
<td>— —</td>
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</tbody>
</table>

*1 The flow rate characteristics of this product have variations.
*2 The values were calculated based on the combination of Rc, NPT thread, and grommet. Add 30 g for G thread (port size 3/8).
Add 20 g for grommet with PCB, 70 g for conduit, and 50 g for DIN terminal.
**Common Specifications**

<table>
<thead>
<tr>
<th>Component Parts</th>
<th>Material</th>
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<tbody>
<tr>
<td>No.</td>
<td>Description</td>
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<tr>
<td>1</td>
<td>Clip</td>
</tr>
<tr>
<td>2</td>
<td>Solenoid coil</td>
</tr>
<tr>
<td>3</td>
<td>Stopper</td>
</tr>
<tr>
<td>4</td>
<td>Tube assembly</td>
</tr>
<tr>
<td>5</td>
<td>Armature assembly</td>
</tr>
<tr>
<td>6</td>
<td>Spring</td>
</tr>
<tr>
<td>7</td>
<td>Set nut</td>
</tr>
<tr>
<td>8</td>
<td>Gasket</td>
</tr>
<tr>
<td>9</td>
<td>Body</td>
</tr>
</tbody>
</table>

**Valve specifications**

<table>
<thead>
<tr>
<th>Valve type</th>
<th>Normally closed (N.C.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluid and fluid temperature</td>
<td>Air: −10 to 60°C (Dew point temperature: −10°C or less)</td>
</tr>
<tr>
<td>Withstand pressure</td>
<td>2.0 MPa</td>
</tr>
<tr>
<td>Max. system pressure</td>
<td>1.0 MPa</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>−20 to 60°C</td>
</tr>
<tr>
<td>Valve leakage*1</td>
<td>Air: 1 cm³/min or less</td>
</tr>
<tr>
<td>Enclosure*2</td>
<td>IP67 (IP65 for the DIN connector)</td>
</tr>
<tr>
<td>Standards*3</td>
<td>CE, UL Recognized, UL Listed</td>
</tr>
<tr>
<td>Operating environment</td>
<td>Location without the presence of corrosive gases, explosive gases, or constant fluid adhesion</td>
</tr>
<tr>
<td>Body material</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>Seal material</td>
<td>NBR, FKM, EPDM</td>
</tr>
<tr>
<td>Rated voltage AC/DC</td>
<td>24 V, 48 V, 100 V, 110 V, 120 V, 200 V, 220 V, 230 V, 240 V</td>
</tr>
<tr>
<td>Allowable voltage fluctuation AC/DC</td>
<td>±10% of rated voltage</td>
</tr>
<tr>
<td>Allowable leakage AC/DC</td>
<td>5% or less of rated voltage</td>
</tr>
<tr>
<td>Voltage AC/DC</td>
<td>2% or less of rated voltage</td>
</tr>
<tr>
<td>Apparent power*4, 5, 6</td>
<td>AC: 4.5 VA, 8 VA, 9.5 VA</td>
</tr>
<tr>
<td>Power consumption*4, 5, 6</td>
<td>AC/DC: 70/65°C</td>
</tr>
</tbody>
</table>

*1 Valve leakage: The value at a temperature of 20°C
*2 This product ensures IP67, but if water enters the product, it may result in operation failure or breakage. Therefore, take appropriate measures to prevent water from entering the product when used in an environment where it is constantly exposed to water.
*3 Conformance to standards varies depending on the model. For details, refer to pages 3 and 9.
*4 Power consumption/Apparent power: The value at an ambient temperature of 20°C and when the rated voltage is applied (Variation: ±10%)
*5 There is no difference in the frequency and the inrush and energized apparent power, since a rectifying circuit is used in the AC.
*6 Temperature rise: The value at an ambient temperature of 20°C and when the rated voltage is applied. The value depends on the ambient environment. This is for reference. Be sure to read "Specific Product Precautions" before handling.
### JSX Series

#### Dimensions: 10 Series

**G: Grommet**

2 x Rc, NPT1/8
1(IN), 2(OUT) port

**GS: Grommet with PCB**

2 x Rc, NPT1/8
1(IN), 2(OUT) port

**DS: DIN terminal**

2 x M3 x 5

**DZ: DIN terminal with light**

2 x M3 x 5

**DN: Without DIN connector**

2 x M3 x 5

**Applicable cable**

ø3.5 to ø7

**G thread type**

* Dimensions other than those below are the same as those of the Rc type.
Dimensions: 20 Series, Port Size 1/8 Type

G: Grommet

\[
\begin{align*}
\varnothing36 & \approx 500 \\
28 & \approx 300 \\
18 & 2 \times \text{M5 x 6.5}
\end{align*}
\]

2 x Rc, NPT1/8
1(IN), 2(OUT) port

GS: Grommet with PCB

\[
\begin{align*}
\varnothing36 & \approx 300 \\
28 & \approx 38 \\
18 & 2 \times \text{M5 x 6.5}
\end{align*}
\]

2 x Rc, NPT1/8
1(IN), 2(OUT) port

CS: Conduit

\[
\begin{align*}
\varnothing36 & \approx 500 \\
48.9 & \approx 45.3 \\
28 & \approx 300 \\
18 & 2 \times \text{M5 x 6.5}
\end{align*}
\]

2 x Rc, NPT1/8
1(IN), 2(OUT) port

DS: DIN terminal

\[
\begin{align*}
\varnothing36 & \approx 55.3 \\
67.3 & \approx 63.4 \\
18 & 2 \times \text{M5 x 6.5}
\end{align*}
\]

2 x Rc, NPT1/8
1(IN), 2(OUT) port

DZ: DIN terminal with light

\[
\begin{align*}
\varnothing36 & \approx 55.3 \\
67.3 & \approx 63.4 \\
18 & 2 \times \text{M5 x 6.5}
\end{align*}
\]

2 x Rc, NPT1/8
1(IN), 2(OUT) port

G thread type

- Dimensions other than those below are the same as those of the Rc type.

DN: Without DIN connector

\[
\begin{align*}
\varnothing36 & \approx 31.5 \\
28 & \approx 300 \\
18 & 2 \times \text{M5 x 6.5}
\end{align*}
\]

2 x G1/8
1(IN), 2(OUT) port
**JSX Series**

**Dimensions:** 20/30 Series, Port Size 1/4, 3/8 Type

**G: Grommet**

2 x Port size 1(IN), 2(OUT) port

2 x Port size 1(IN), 2(OUT) port

**GS: Grommet with PCB**

2 x Port size 1(IN), 2(OUT) port

2 x Port size 1(IN), 2(OUT) port

**CS: Conduit**

2 x Port size 1(IN), 2(OUT) port

2 x Port size 1(IN), 2(OUT) port

**DS: DIN terminal**

Applicable cable ø6 to ø12

**DZ: DIN terminal with light**

**DN: Without DIN connector**

**Dimensions**

<table>
<thead>
<tr>
<th>Series</th>
<th>Port size</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>Grommet</th>
<th>Grommet with PCB</th>
<th>Conduit</th>
<th>DIN terminal</th>
<th>Without DIN connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>1/4</td>
<td>28.1</td>
<td>40</td>
<td>48</td>
<td>69</td>
<td>36</td>
<td>12.5</td>
<td>39</td>
<td>28.5</td>
<td>44.8</td>
<td>48.9</td>
<td>47.9</td>
</tr>
<tr>
<td></td>
<td>3/8</td>
<td>28.1</td>
<td>48</td>
<td>72</td>
<td>36</td>
<td>14</td>
<td>18</td>
<td>42</td>
<td>47.8</td>
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<td>50.9</td>
<td>55.3</td>
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<td>G3/8</td>
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<td>48</td>
<td>81</td>
<td>42</td>
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<td>12.5</td>
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<td>48.9</td>
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<td>28.1</td>
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<td>81</td>
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<td>G3/8</td>
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<td>48</td>
<td>81</td>
<td>42</td>
<td>12.5</td>
<td>21</td>
<td>43</td>
<td>48.8</td>
<td>50.4</td>
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<td>48.9</td>
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</table>
# Dimensions: Bracket Options

## Port size 1/8 type

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>mm</th>
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<tbody>
<tr>
<td>10 Series</td>
<td>14 33 4 20 39 1 — 15 3.4</td>
</tr>
<tr>
<td>20 Series</td>
<td>13 46 7 40 56 1.5 15 17.5 5.3</td>
</tr>
<tr>
<td>20/30 Series</td>
<td>13 46 4 33 56 1.5 22.2 22.2 5.3</td>
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</tbody>
</table>

## Port size 1/4, 3/8 type

<table>
<thead>
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<th>Dimensions</th>
<th>mm</th>
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<tbody>
<tr>
<td>10 Series</td>
<td>14 33 4 20 39 1 — 15 3.4</td>
</tr>
<tr>
<td>20 Series</td>
<td>13 46 7 40 56 1.5 15 17.5 5.3</td>
</tr>
<tr>
<td>20/30 Series</td>
<td>13 46 4 33 56 1.5 22.2 22.2 5.3</td>
</tr>
</tbody>
</table>

---

### Direct Operated 2-Port Solenoid Valve

**JSX Series**

---
# JSX11/21/31 Series

## Table of UL-compliant Products

*Refer to the table below for UL-compliant products.

### Recognized

<table>
<thead>
<tr>
<th>Size/Valve type</th>
<th>Body material</th>
<th>Seal material</th>
<th>Orifice diameter/Port size</th>
<th>Thread type</th>
<th>Rated voltage</th>
<th>Electrical entry</th>
<th>Option</th>
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<tbody>
<tr>
<td>JSX11</td>
<td>S</td>
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</table>

### Listed

<table>
<thead>
<tr>
<th>Size/Valve type</th>
<th>Body material</th>
<th>Seal material</th>
<th>Orifice diameter/Port size</th>
<th>Thread type</th>
<th>Rated voltage</th>
<th>Electrical entry</th>
<th>Option</th>
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<tbody>
<tr>
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<td>302</td>
<td>N</td>
<td>F</td>
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<td>J</td>
<td>CS</td>
</tr>
</tbody>
</table>

*1 Only applicable to rated voltage symbols “5” and “6”
1. Material
NBR: Nitrile rubber
FKM: Fluororubber
EPDM: Ethylene propylene rubber

2. Symbol
In the symbol (                   ), when the valve is closed, flow is blocked from port 1 to port 2. However, if the pressure in port 2 is higher than port 1, the valve will not be able to block the fluid and it will flow from port 2 to port 1.

Pressure Terminology

1. Maximum operating pressure differential
The maximum pressure differential (the difference between the inlet and outlet pressure) which is allowed for operation. When the outlet pressure is 0 MPa, this becomes the maximum operating pressure.

2. Maximum system pressure
The maximum pressure that can be applied inside the pipelines (line pressure).
[The pressure differential of the solenoid valve portion must not exceed the maximum operating pressure differential.]

3. Withstand pressure
The pressure in which the valve must be withstood without a drop in performance after holding for one minute under prescribed pressure and returning to the operating pressure range. (value under the prescribed conditions)

Electrical Terminology

1. Apparent power (VA)
Volt-ampere is the product of voltage (V) and current (A).
Power consumption (W): For AC, \( W = V \cdot A \cdot \cos \theta \).
For DC, \( W = V \cdot A \).
\* \( \cos \theta \) shows power factor. \( \cos \theta \approx 0.9 \)

2. Surge voltage
A high voltage which is momentarily generated by shutting off the power in the shut-off area.

3. Degrees of protection
A degree defined in the “JIS C 0920: Waterproof test of electric machinery/appliance and the degree of protection against the intrusion of solid foreign objects.”

<table>
<thead>
<tr>
<th>IP -</th>
<th>First digit</th>
<th>Second digit</th>
</tr>
</thead>
</table>

● First Digit:
Degree of protection against solid foreign objects

<table>
<thead>
<tr>
<th>0</th>
<th>Not protected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Protected against solid foreign objects of 50 mmø and larger</td>
</tr>
<tr>
<td>2</td>
<td>Protected against solid foreign objects of 12 mmø and larger</td>
</tr>
<tr>
<td>3</td>
<td>Protected against solid foreign objects of 2.5 mmø and larger</td>
</tr>
<tr>
<td>4</td>
<td>Protected against solid foreign objects of 1.0 mmø and larger</td>
</tr>
<tr>
<td>5</td>
<td>Dust protected</td>
</tr>
<tr>
<td>6</td>
<td>Dust-tight</td>
</tr>
</tbody>
</table>

● Second Digit:
Degree of protection against water

<table>
<thead>
<tr>
<th>0</th>
<th>Not protected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Protected against vertically falling water droplets</td>
</tr>
<tr>
<td>2</td>
<td>Protected against vertically falling water droplets when enclosure is tilted up to 15°</td>
</tr>
<tr>
<td>3</td>
<td>Protected against rain when enclosure is tilted up to 60°</td>
</tr>
<tr>
<td>4</td>
<td>Protected against splashing water</td>
</tr>
<tr>
<td>5</td>
<td>Protected against water jets</td>
</tr>
<tr>
<td>6</td>
<td>Protected against powerful water jets</td>
</tr>
<tr>
<td>7</td>
<td>Protected against the effects of temporary immersion in water</td>
</tr>
<tr>
<td>8</td>
<td>Protected against the effects of continuous immersion in water</td>
</tr>
</tbody>
</table>
1. Indication of flow rate characteristics

The flow rate characteristics of equipment, such as a solenoid valve, etc., are indicated in their specifications as shown in Table (1).

<table>
<thead>
<tr>
<th>Table (1) Indication of Flow Rate Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Corresponding equipment</strong></td>
</tr>
<tr>
<td>--------------------------------</td>
</tr>
</tbody>
</table>
| Pneumatic equipment | $C$, $b$ | — | ISO 6358:1989  
JIS B 8390:2000 |
| | — | $S$ | JIS B 8390:2000  
Equipment: JIS B 8379, 8381-1, 8381-2 |
| | — | $C_v$ | ANSI/NFPA T3.21.3 R1-2008 |
| Process fluid control equipment | $K_v$ | — | IEC 60534-1:2005  
IEC 60534-2-3:1997  
JIS B 2005-1:2012  
Equipment: JIS B 8471, 8472, 8473 |

2. Pneumatic equipment

2.1 Indication according to the international standards

(1) Compliant standards

- **ISO 6358:1989**: Pneumatic fluid power—Components using compressible fluids—Determination of flow rate characteristics
- **JIS B 8390:2000**: Pneumatic fluid power—Components using compressible fluids—How to test flow rate characteristics

(2) Definition of flow rate characteristics

The flow rate characteristics are indicated as a result of a comparison between the sonic conductance $C$ and the critical pressure ratio $b$.

- **Sonic conductance $C$**: Value which divides the passing mass flow rate of a piece of equipment in a choked flow condition by the product of the upstream absolute pressure and the density in a standard condition.

- **Critical pressure ratio $b$**: Pressure ratio (downstream pressure/upstream pressure) which will turn to a choked flow when the value is smaller than this ratio.

- **Choked flow**: Flow in which the upstream pressure is higher than the downstream pressure and where sonic speed in a certain part of a piece of equipment is reached. Gaseous mass flow rate is in proportion to the upstream pressure and not dependent on the downstream pressure.

- **Subsonic flow**: Flow greater than the critical pressure ratio.

- **Standard condition**: Air in a temperature state of 20°C, absolute pressure 0.1 MPa (= 100 kPa = 1 bar), relative humidity 65%.


(3) Formula for flow rate

It is described by the practical units as follows.

When $\frac{P_2+0.1}{P_1+0.1} \leq b$, choked flow

$$Q = 600 \times C \left( \frac{P_1+0.1}{293} \right)^{\frac{293}{273+T}}$$  \hspace{1cm} \text{(1)}$$

When $\frac{P_2+0.1}{P_1+0.1} > b$, subsonic flow

$$Q = 600 \times C \left( \frac{P_1+0.1}{P_2+0.1} \right)^{\frac{1}{1-b}} \left(1 - \frac{P_2+0.1}{P_1+0.1} \right)^{\frac{293}{273+T}}$$  \hspace{1cm} \text{(2)}$$
**Q**: Air flow rate [L/min (ANR)]

**C**: Sonic conductance [dm³/(s·bar)], dm³ (Cubic decimeter) of SI units = L (liter)

**b**: Critical pressure ratio [—]

**P₁**: Upstream pressure [MPa]

**P₂**: Downstream pressure [MPa]

**T**: Temperature [°C]

* Formula of subsonic flow is the elliptic analogous curve.

Flow rate characteristics are shown in Graph (1). For details, please use the calculation software available from the SMC website.

**Example**

Obtain the air flow rate for **P₁** = 0.4 [MPa], **P₂** = 0.3 [MPa], **T** = 20 [°C] when a solenoid valve is performed in **C** = 2 [dm³/(s·bar)] and **b** = 0.3.

According to formula 1, the maximum flow rate = \(600 \times 2 \times (0.4 + 0.1) \times \sqrt{\frac{293}{273 + 20}} = 600 [\text{L/min (ANR)}]\)

Pressure ratio = \(\frac{0.3 + 0.1}{0.4 + 0.1} = 0.8\)

Based on Graph (1), it will be 0.7 if the pressure ratio is 0.8 and the flow rate ratio is **b** = 0.3.

Hence, the flow rate = Max. flow x flow ratio = 600 \times 0.7 = 420 [L/min (ANR)]

**Graph (1) Flow rate characteristics**

(4) **Test method**

Connect the piece of test equipment to the test circuit as shown in Fig. (1). While maintaining the upstream pressure at a fixed value above 0.3 MPa, measure the maximum flow to be saturated initially. Next, measure this flow rate at 80%, 60%, 40%, and 20%, as well as the upstream and downstream pressure. The sonic conductance **C** can be calculated based on this maximum flow rate. Use the data of the others and the subsonic flow formula to find **b**, and calculate the critical pressure ratio **b** from that average.
2.2 Effective area $S$

(1) Compliant standards

JIS B 8390:2000: Pneumatic fluid power—Components using compressible fluids—
How to test flow rate characteristics

Equipment standards: JIS B 8373: Solenoid valve for pneumatics
JIS B 8379: Silencer for pneumatics
JIS B 8381-2: Fittings for pneumatics—Part 2: Compression fittings for thermoplastic resin tubing

(2) Definition of flow rate characteristics

Effective area $S$: Cross-sectional area that has an ideal throttle without friction or reduced flow. The value is derived by calculating pressure changes inside of an air tank when the compressed air is discharged from a piece of equipment mounted on the tank in a choked flow. The value of the effective area $S$, like that of sonic conductance $C$, expresses the “ease of flow.”

(3) Formula for flow rate

When

$$\frac{P_2 + 0.1}{P_1 + 0.1} \leq 0.5, \text{ choked flow}$$

$$Q = 120 \times S \left( P_1 + 0.1 \right) \frac{293}{273 + T}$$

When

$$\frac{P_2 + 0.1}{P_1 + 0.1} > 0.5, \text{ subsonic flow}$$

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

Conversion with sonic conductance $C$:

$$S = 5.0 \times C$$

(4) Test method

Connect the piece of test equipment to the test circuit as shown in Fig. (2). Discharge the air from the air tank filled with compressed air at a fixed value above 0.6 MPa (0.5 MPa) into the atmosphere until the pressure inside the tank falls to 0.25 MPa (0.2 MPa). Measure the discharge time and the residual pressure inside the tank after discharging until it has returned to the normal value. Then, calculate the effective area $S$ using the following formula. Select an air tank with a volume within the specified range of the test equipment’s effective area. For JIS B 8379, the pressure values are in parentheses and the coefficient of the formula is 12.9.

$$S = 12.1 \log_{10} \left( \frac{P_s + 0.1}{P + 0.1} \right) \frac{293}{T}$$

Fig. (2) Test circuit based on JIS B 8390:2000
2.3 Flow coefficient \( \text{Cv} \) factor

The United States Standard ANSI/(NFPA)T3.21.3:R1-2008R: Pneumatic fluid power—Flow rating test procedure and reporting method for fixed orifice components

This standard defines the \( \text{Cv} \) factor of the flow coefficient by the following formula that is based on the test conducted by the test circuit analogous to ISO 6358.

\[
\text{QCv} = \frac{Q}{114.5 \sqrt{\frac{\Delta P (P_2 + P_a)}{T_1}}} \tag{7}
\]

\( \Delta P \): Pressure drop between the static pressure tapping ports [bar]
\( P_1 \): Pressure of the upstream tapping port [bar gauge]
\( P_2 \): Pressure of the downstream tapping port [bar gauge]: \( P_2 = P_1 - \Delta P \)
\( Q \): Flow rate [L/s standard condition]
\( P_a \): Atmospheric pressure [bar absolute]
\( T_1 \): Upstream absolute temperature [K]

The test conditions are \( P_1 + P_a = 6.5 \pm 0.2 \text{ bar absolute}, T_1 = 297 \pm 5 \text{K}, 0.07 \text{ bar} \leq \Delta P \leq 0.14 \text{ bar}. \)

This is the same concept as the effective area \( A \) which ISO 6358 stipulates as being applicable only when the pressure drop is smaller than the upstream pressure and the compression of air does not become a problem.

3. Process fluid control equipment

(1) Compliant standards

Equipment standards: JIS B 8471: Solenoid valve for water
JIS B 8472: Solenoid valve for steam
JIS B 8473: Solenoid valve for fuel oil

(2) Definition of flow rate characteristics

\( \text{Kv} \) factor: Value of the clean water flow rate (represented by \( \text{m}^3/\text{h} \)) which runs through a valve (test equipment) at 5 to 40°C when the pressure difference is 1 x 10^5 Pa (1 bar). It is calculated using the following formula.

\[
\text{Kv} = Q \sqrt{\frac{1 \times 10^5}{\Delta P} \cdot \frac{\rho}{1000}} \tag{8}
\]

\( \text{Kv} \): Flow coefficient [\( \text{m}^3/\text{h} \)]
\( Q \): Flow rate [\( \text{m}^3/\text{h} \)]
\( \Delta P \): Pressure difference [Pa]
\( \rho \): Density of fluid [kg/m^3]

(3) Formula of flow rate

It is described by practical units. Also, the flow rate characteristics are shown in Graph (2).

For liquids:

\[
Q = 53 \text{Kv} \sqrt{\frac{\Delta P}{G}} \tag{9}
\]

\( Q \): Flow rate [L/min]
\( \text{Kv} \): Flow coefficient [\( \text{m}^3/\text{h} \)]
\( \Delta P \): Pressure difference [MPa]
\( G \): Relative density [water = 1]

For saturated aqueous vapor:

\[
Q = 232 \text{Kv} \sqrt{\frac{\Delta P (P_2 + 0.1)}{P_1}} \tag{10}
\]

\( Q \): Flow rate [kg/h]
\( \text{Kv} \): Flow coefficient [\( \text{m}^3/\text{h} \)]
\( \Delta P \): Pressure difference [MPa]
\( P_1 \): Upstream pressure [MPa]: \( \Delta P = P_1 - P_2 \)
\( P_2 \): Downstream pressure [MPa]
Conversion of flow coefficient:

\[ Kv = 0.865 \cdot Cv \] \hspace{1cm} (11)

Here, 

\[ Cv \] factor: Value of the clean water flow rate (represented by US gal/min) which runs through a valve at 40 to 100°F when the pressure difference is 1 lbf/in² (psi)

The values of \( Kv \) and \( Cv \) factors for pneumatic purposes are different due to different test methods.

(4) Test method

Connect the piece of test equipment to the test circuit as shown in Fig. (3), and run water at 5 to 40°C. Then, measure the flow rate with a pressure difference where vaporization does not occur in a turbulent flow (pressure difference of 0.035 MPa to 0.075 MPa when the inlet pressure is within 0.15 MPa to 0.6 MPa). However, as the turbulent flow is definitely caused, the pressure difference needs to be set with a large enough difference so that the Reynolds number does not fall below \( 1 \times 10^5 \), and the inlet pressure needs to be set slightly higher to prevent vaporization of the liquid. Substitue the measurement results in formula (8) to calculate \( Kv \).

**Graph (2) Flow rate characteristics**

Example 1)

Obtain the pressure difference when 15 [L/min] of water runs through a solenoid valve with a \( Kv = 1.5 \) [m³/h].

As the flow rate when \( kv = 1 \) is calculated as the formula: \( Q_0 = 15 \times 1/1.5 = 10 \) [L/min], read off \( \Delta P \) when \( Q_0 \) is 10 [L/min] in Graph (2). The reading is 0.036 [MPa].

Example 2)

Obtain the saturated steam flow rate when \( P_1 = 0.8 \) [MPa] and \( \Delta P = 0.008 \) [MPa] with a solenoid valve with a \( Kv = 0.05 \) [m³/h]. Read off \( Q_0 \) when \( P_1 = 0.8 \) and \( \Delta P = 0.008 \) in Graph (2), the reading is 20 [kg/h].

Therefore, the flow rate is calculated as the formula: \( Q = 0.05/1 \times 20 = 1 \) [kg/h].
**Warning**

1. Confirm the specifications.
   *Give careful consideration to the operating conditions, such as the application, fluid, and environment, and use within the specified operating ranges. If the product is used beyond the specification range, this may cause the product to break or malfunction. We do not guarantee against any damage if the product is used outside of the specification range.*

2. **Cannot be used as an emergency shutoff valve, etc.**
   *This product is not designed for safety applications such as an emergency shutoff valve. If the valves are used in this type of system, other reliable safety assurance measures should also be adopted.*

3. **Cannot be used for pressure (including vacuum) holding**
   *It is not usable for an application such as holding the pressure (including vacuum) inside of a pressure vessel because air leakage is entailed in valves.*

4. **Closed liquid circuit**
   *In a closed circuit, when liquid is static, pressure could rise due to changes in temperature. This pressure rise could cause malfunction and damage to components such as valves. To prevent this, install a relief valve in the system.*

5. **Actuator drive**
   *When an actuator, such as a cylinder, is to be driven using a valve, take appropriate measures to prevent potential danger caused by actuator operation.*

6. **Extended periods of continuous energization**
   *The solenoid coil will generate heat when continuously energized. Avoid using in a tightly shut container. Install the valve in a well-ventilated area. Furthermore, do not touch it while it is being energized or right after it has been energized.*

7. **Water hammer**
   *When an impact, such as water hammer, etc., caused by rapid pressure fluctuation is applied, the valve may be damaged. Install water hammer relief equipment (accumulator, etc.) or use an SMC water hammer relief valve (VXR series). Please contact SMC for details.*

8. **Reverse pressure**
   *If there is a possibility that reverse pressure will be applied, take countermeasures by installing a check valve, etc., on the downstream side.*

9. **Do not disassemble the product and replacement parts or make any modifications, including additional machining.**
   *Doing so may cause human injury and/or an accident.*

---

**Operating Environment**

**Warning**

5. **Locations that are outdoors (Excludes outdoor specification valves)**
   *Although using an indoor specification product outdoors voids its product warranty, if outdoor use proves unavoidable, be sure to implement the protective measures mentioned below.*
   1. Install a protective cover, etc., to protect the product from direct sunlight.
   2. Encase the product in an enclosure to protect it from rain and wind.
      *If only a roof-type cover is provided for the product, it will not be sufficiently protected from side winds or rain splashing up from the ground, which will result in water adhering to and entering the product. In addition, when the product is encased in an enclosure, be sure to implement proper ventilation measures to prevent overheating due to long-term energizing of the product.*
   3. **Be sure to confirm that the location is not one in which condensation is easily generated.**
      *If the product is used in an environment with large temperature changes, condensation may be generated and water may adhere to the external surface of the product. Be sure to implement protective measures against condensation, such as ambient temperature control, in such locations where condensation is easily generated.*

6. **Locations where freezing may occur within piping lines**
   **[When the fluid is liquid]**
   *If the product is to be used in cold regions or in winter, be sure to implement measures to prevent the freezing of fluids.*
   **[When the fluid is air]**
   *If the fluid is likely to freeze, implement measures such as draining the water in the piping when the equipment is OFF, or installing a heater or insulation in the piping.*
   *If warming the solenoid valve, be sure to avoid the coil portion as it will result in poor heat dissipation.*

---

**Fluid**

**Warning**

1. **Fluid selection**
   1) Compatibility between the components and fluids should be checked in the application before use.
   2) Since the compatibility of the fluid used may vary depending on its type, additives, concentration, temperature, etc., give sufficient consideration when selecting the material. Please contact SMC if anything is unclear.
   3) Use a fluid with a dynamic viscosity of 50 mm²/s or less.

2. **Do not use the product with the fluids shown below.**
   1) Fluids that are harmful to humans
   2) Combustion-supporting or flammable fluids
   3) Corrosive gas
   4) Sea water, Saline solution

3. **Take measures to prevent static electricity, since some fluids can cause static electricity.**

4. **Fluid temperature**
   *Operate within the specified operating fluid temperature range.*

5. **Install a filter (strainer) to ensure clean fluids.**
   1) The use of a fluid that contains foreign matter can cause problems, such as malfunction and seal failure by promoting the wear of the valve seat and armature, by sticking to the sliding parts of the armature, etc. Install a filter (strainer) on the upstream side of the valve to remove foreign matter.
      *Air: 5 μm or less Water: 100 mesh or more*
   2) Replace or clean the filter (strainer) when the pressure drop reaches 0.1 MPa to prevent them from getting clogged.
**Warning**

1. **Air**
   1) Do not use compressed air that contains chemicals, synthetic oils that include organic solvents, salt, corrosive gases, etc., as it can cause malfunction or damage.
   2) Compressed air that contains excessive drainage may cause the malfunction of valves and other pneumatic equipment. Install an aftercooler or an air dryer on the inlet side of the valve as a countermeasure against drainage.
   3) If excessive carbon powder is generated by the compressor, it may adhere to the inside of the valves and cause malfunction. Install a mist separator on the inlet side of the valve as a countermeasure to remove any carbon powder.
   4) For compressed air quality, refer to the Best Pneumatics No. 6 catalog.
   5) When operating fluid air with a dew point of −70°C or lower, the inside of the valve may wear and the product life will be shortened.

2. **Water**
   1) Operation failure due to the rust generated or chloride in the piping may result in the breakage of the product. If the product is broken, fluids or components may be ejected, so install a protective measure.
   2) In the case that water contains substances such as calcium and magnesium, which generate hard scale and sludge, install water softening equipment and a filter (strainer) directly upstream from the valve to remove these substances, as this scale and sludge can cause the valve to malfunction.
   3) The water pressure of tap water is usually 0.4 MPa or less, but the pressure can sometimes increase to 1.0 MPa in tall buildings. Therefore, pay attention to the maximum operating pressure differential.

3. **Oil**
   Generally, FKM is used as seal material, as it is resistant to oil. The resistance of the seal material may deteriorate depending on the type of oil, manufacturer, or additives. Check the resistance before use.

**Caution**

1. **1. Mounting orientation**
   When mounting a valve with its coil positioned downward, foreign objects in the fluid will adhere to the iron core, leading to a malfunction. Mount a valve with its coil position upward.

2. **2. Painting and coating**
   Warnings or specifications printed or labeled on the product should not be erased, removed, or covered up.

**How to Assemble Brackets**

1. **1. Port size 1/8 type**
   **How to assemble**
   1) Mount the bracket ① to the bottom of the valve using mounting screws ②.
   2) Tightening torque: 10 series: 0.6 N·m ±5%
   20 series: 1.5 N·m ±5%

   **Bracket Assembly Part Nos.**
<table>
<thead>
<tr>
<th>Series</th>
<th>Port size</th>
<th>Thread type</th>
<th>Bracket assembly part no. (With mounting screws)</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>1/8</td>
<td>Rc, NPT, G</td>
<td>JSX021-12A-3</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>20</td>
<td>1/8</td>
<td>Rc, NPT, G</td>
<td>JSX022-12A-3</td>
<td>Stainless steel</td>
</tr>
</tbody>
</table>

2. **2. Port size 1/4, 3/8 type**
   **How to assemble**
   1) Insert bracket ① to the IN port side of the valve.
   2) Secure it with the hexagon socket set screw ②.
   3) Tightening torque: 0.4 N·m ±5%

   **Bracket Assembly Part Nos.**
<table>
<thead>
<tr>
<th>Series</th>
<th>Port size</th>
<th>Thread type</th>
<th>Bracket assembly part no. (With set screw)</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>20/30</td>
<td>1/4</td>
<td>Rc, NPT, G</td>
<td>JSX022-12A-2-1</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>3/8</td>
<td>3/8</td>
<td>Rc, NPT, G</td>
<td>JSX022-12A-2-2</td>
<td>Stainless steel</td>
</tr>
</tbody>
</table>

**Warning**

1. **Piping**
   1. There may be cases in which the tubing detaches from the fitting and thrashes around uncontrollably due to tubing degradation or fitting breakage. To prevent this, fit the tubing with a protective cover or secure it in place.
   2. If using tube piping, secure the product to a permanent fixture. Do not suspend it by the tubing.
**Piping**

1. **For handling One-touch fittings**, refer to the “Fittings and Tubing Precautions” in the Handling Precautions for SMC Products.

2. **Preparation before piping**
   Before piping is connected, it should be thoroughly blown out with air (flushing) or washed to remove chips, cutting oil, and other debris from inside the pipe. Install piping so that it does not apply pulling, pressing, bending, or other forces on the valve body.

3. **Winding of sealant tape**
   When connecting pipes, fittings, etc., be sure that chips from the pipe threads and sealing material do not enter the valve. Furthermore, when sealant tape is used, leave 1.5 to 2 thread ridges exposed at the end of the threads.

4. **Connection of piping and fittings**
   When screwing SMC fittings into the valve, tighten them as follows. Tighten the fitting by hand, then use a suitable wrench to tighten the hexagonal portion of the body an additional two or three turns. For the tightening torque, refer to the table below.

<table>
<thead>
<tr>
<th>Connection thread size</th>
<th>Proper tightening torque [N·m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/8</td>
<td>3 to 5</td>
</tr>
<tr>
<td>1/4</td>
<td>8 to 12</td>
</tr>
<tr>
<td>3/8</td>
<td>15 to 20</td>
</tr>
</tbody>
</table>

5. **When using a fitting other than an SMC fitting**
   Follow the instructions given by the fitting manufacturer.

6. **Avoid connecting ground lines to piping**, as this may cause the electric corrosion of the system.

7. **When connecting piping to a product**, avoid mistakes regarding the supply port, etc.

8. **Recommended piping conditions**
   When connecting piping to the One-touch fitting, use a pipe length with sufficient margin, in accordance with the piping conditions shown in Fig. 1. Also, when using a tying band, etc., to bind the piping together, make sure that external force does not come to bear on the fitting. (See Fig. 2.)

9. **When connecting a fitting to the valve**, clamp the side of the body with a vise.

10. **When using a bracket with 1/4" or 3/8" bore size**, connect the fitting in accordance with the following procedure.
   - Step 1) Connect the fittings to both the IN and OUT sides of the valve.
   - Step 2) Insert the IN side port of the valve into the bracket hole.
   - Step 3) Secure the valve to the bracket with the hexagon socket set screw.

   **Caution:** If the tightening torque is applied to the fitting while the valve is secured to the bracket, the bracket might be broken.
**Warning**

The solenoid valve is an electrical product. For safety, install an appropriate fuse and circuit breaker before use. When using multiple solenoid valves, it is not sufficient to merely install one fuse. For protecting the equipment more safely, select an appropriate fuse to each circuit of the solenoid valve.

**Caution**

1. As a rule, use electrical wire with a cross sectional area of 0.5 to 1.25 mm² for wiring.
2. External force applied to the lead wire
   - If an excessive force is applied to the lead wire, this may cause faulty wiring. Take appropriate measures so that a force of 10 N or more is not applied to the lead wire. Do not bend the lead wires beyond 90° with a radius of less than 20 mm or damage may occur.
3. Use electrical circuits which do not generate chattering in their contacts.
4. Use voltage which is within ±10% of the rated voltage. In cases with a DC power supply where importance is placed on responsiveness, stay within ±5% of the rated value. The voltage drop is the value in the lead wire section connecting the coil.
5. When a surge from the solenoid affects the electrical circuitry, install a surge voltage suppressor, etc., in parallel with the solenoid. Or, use the product with a surge voltage suppressor.
6. Leakage voltage
   - When the solenoid valve is operated using the controller, etc., the leakage voltage should be the product allowable leakage voltage or less. Particularly when using a resistor in parallel with a switching element and using a C-R element to protect the switching element, take note that leakage current will flow through the resistor, C-R element, etc., creating a possible danger that the valve may not turn off.

**Electrical Connections**

1. **Grommet**
   - Lead wire: AWG20 Insulator O.D.: 2.6 mm
   - | Rated voltage | Lead wire color |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DC</td>
<td>Black Red</td>
</tr>
<tr>
<td>100 VAC</td>
<td>Blue Blue</td>
</tr>
<tr>
<td>200 VAC</td>
<td>Red Red</td>
</tr>
<tr>
<td>Other AC</td>
<td>Gray Green/Yellow</td>
</tr>
</tbody>
</table>
   - *There is no polarity.

2. **Conduit**
   - Lead wire: AWG18 Insulator O.D.: 2.8 mm
   - | Rated voltage | Lead wire color |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DC</td>
<td>Black Red Green/Yellow</td>
</tr>
<tr>
<td>100 VAC</td>
<td>Blue Blue Green/Yellow</td>
</tr>
<tr>
<td>200 VAC</td>
<td>Red Red Green/Yellow</td>
</tr>
<tr>
<td>Other AC</td>
<td>Gray Green/Yellow</td>
</tr>
</tbody>
</table>
   - *1 There is no polarity.

3. **DIN terminal**
   - **Disassembly**
     1. After loosening the binding head screw with flange, then if the housing is pulled in the direction of the arrow, the connector will be removed from the solenoid valve.
     2. Pull out the binding head screw with flange from the housing.
     3. There is a cutout on the bottom of the terminal block. Insert a small flat head screwdriver, etc., into this cutout, and remove the terminal block from the housing. (Refer to the figure below.)
     4. Remove the gland nut, and pull out the washer and the rubber seal.
   - **Wiring**
     1. Pass the cable through the gland nut, washer, and rubber seal in this order, and insert these parts into the housing.
     2. Loosen the binding head screw of the terminal block, then insert the core wire or the crimped terminal of the lead wire into the terminal, and securely fix it with the binding head screw. The binding head screw of the terminal block is M3.
       - +1 Tighten the screw to a torque of between 0.5 and 0.6 N·m.
       - +2 Cable O.D.: ø6 to ø12 mm
       - +3 For an outside cable diameter of ø9 to ø12 mm, remove the internal parts of the rubber seal before use.
   - **Assembly**
     1. Pass the cable through the gland nut, washer, rubber seal, and the housing in this order, and connect to the terminal block. Then, set the terminal block inside the housing. (Push in the terminal block until it snaps into position.)
     2. Insert the rubber seal and the washer in this order into the cable entry of the housing, and then tighten the gland nut securely.
     3. Insert the gasket between the bottom part of the terminal block and the plug attached to the equipment, and then insert the binding head screw with flange from the top of the housing, and tighten it.
       - +1 Tighten the screw to a torque of between 0.5 and 0.6 N·m.
       - +2 The orientation of the connector can be changed in steps of 90° by changing the method of assembling the housing and the terminal block.

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For 2-port solenoid valve for fluid control precautions, refer to the “Handling Precautions for SMC Products” and the “Operation Manual” on the SMC website: https://www.smcworld.com
**Electrical Connections**

**Caution**

Internal connections are as shown below. Make connections to the power supply accordingly.

* There is no polarity.

<table>
<thead>
<tr>
<th>Terminal no.</th>
<th>1 (+, −)</th>
<th>2 (+, −)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIN terminal</td>
<td>+ (−)</td>
<td>− (+)</td>
</tr>
</tbody>
</table>

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**DIN (EN175301-803) Terminal**

This DIN terminal corresponds to the Form C DIN connector with an 8 mm terminal pitch.

This DIN terminal corresponds to the Form A DIN connector with an 18 mm terminal pitch.

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**Electrical Circuits**

**Caution**

**1. DC circuit**

- **Grommet**

- **Grommet, Conduit, DIN terminal**

**2. AC circuit**

The standard product is equipped with surge voltage suppressor.

**Grommet, Conduit, DIN terminal**

**DIN terminal**

---

**Warning**

**1. Removal of product**

1) Shut off the fluid supply and release the fluid pressure in the system.
2) Shut off the power supply.
3) Confirm that the valve temperature has dropped sufficiently before removing the product.

**2. Replace or clean filters (strainers) periodically.**

1) Replace filters after one year of use, or earlier if the pressure drop reaches 0.1 MPa.
2) Clean strainers when the pressure drop reaches 0.1 MPa.

**3. Exhaust the drainage from air filters periodically.**

If condensation in the drain bowl is not emptied on a regular basis, the bowl will overflow and allow the condensation to enter the compressed air lines. This causes the malfunction of pneumatic equipment. If the drain bowl is difficult to check and remove, the installation of a drain bowl with an auto drain option is recommended.

**4. Low frequency operation**

Switch valves at least once every 30 days to prevent malfunction. Also, in order to use them under the optimum state, conduct a regular inspection biannually.

**5. Storage**

In the case of long-term storage after use, thoroughly remove all moisture and store it in a location where the product is not exposed to sunlight and higher humidity to prevent rust and deterioration of rubber materials, etc.

**6. Perform a maintenance and inspection periodically.**

Confirm that the product is mounted correctly by conducting suitable function and leakage tests periodically. If air leakage increases or equipment does not operate properly, stop operation.

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**Return of Product**

**Warning**

If the product to be returned is contaminated or is possibly contaminated with substances that are harmful to humans, for safety reasons, please contact SMC beforehand and then employ a specialist cleaning company to decontaminate the product. After the decontamination prescribed above has been carried out, submit a Product Return Request Sheet or the Detoxification/Decontamination Certificate to SMC and await SMC’s approval and further instructions before attempting to return the item. Please refer to the International Chemical Safety Cards (ICSC) for a list of harmful substances.

If you have any further questions, please don't hesitate to contact your SMC sales representative.
These safety instructions are intended to prevent hazardous situations and/or equipment damage. These instructions indicate the level of potential hazard with the labels of “Caution,” “Warning” or “Danger.” They are all important notes for safety and must be followed in addition to International Standards (ISO/IEC)*1, and other safety regulations.

**Remark:**

1. ISO 4414: Pneumatic fluid power – General rules relating to systems.
2. ISO 4413: Hydraulic fluid power – General rules relating to systems.
3. IEC 60204-1: Safety of machinery – Electrical equipment of machines. (Part 1: General requirements)
4. ISO 10218-1: Manipulating industrial robots – Safety. etc.

**Safety Instructions**

Be sure to read the “Handling Precautions for SMC Products” (M-E03-3) and “Operation Manual” before use.