SMC Pneumatic Clean Series

- Air Cylinder
- Rotary Actuator
- Air Gripper
- Directional Control Valve
- Flow Control Equipment
- Filter / Pressure Control Equipment
- Fittings & Tubing
- Air Preparation Equipment
- Pressure Switch
- Clean Gas Filter
Particle generation level of SMC pneumatic clean series equipment can be classified into 1-4 grades by the particle generation measurement test, and each equipment can be used according to the clean room cleanliness class.

<table>
<thead>
<tr>
<th>Class M2.5 (ISO class 4)</th>
<th>Class M3.5 (ISO class 5)</th>
<th>Class M4.5 (ISO class 6)</th>
<th>Class M5.5 (ISO class 7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 1</td>
<td>Grade 2</td>
<td>Grade 3</td>
<td>Grade 4</td>
</tr>
</tbody>
</table>

The view above shows an image. Refer to front matter 13 to 22 and the specifications for particle generation grade of each equipment.

**Clean Series**  
*Series 10-/11-/12-/13-*

Available for clean environment.  
Particle generation in a clean room can be prevented.

<table>
<thead>
<tr>
<th>Applicable model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actuator, (Air cylinder, Rotary actuator, Air gripper), Directional control valve, Flow control equipment, Filter &amp; Pressure control equipment, Fittings &amp; Tubing, Air preparation equipment, Pressure switch, Clean gas filter</td>
</tr>
</tbody>
</table>

Note) 11-/12-/13- are available only for actuators.

**Special Clean Series**

Special clean series pursues improvement of cleanliness than the clean series.  
This series was developed considering construction, material and assembly environment for use in a clean environment.

<table>
<thead>
<tr>
<th>Applicable model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean rodless cylinder, Clean regulator, Clean one-touch fitting, Clean tubing, Clean gas filter</td>
</tr>
</tbody>
</table>

**Copper, Fluorine, and Silicon free + Low particle generation**  
*Series 21-/22-*

For the environment in which the use of copper, fluorine and silicon are restricted.  
The same structure as clean series. (Grease and package style are different.)

<table>
<thead>
<tr>
<th>Applicable model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actuator (Air cylinder, Rotary actuator, Air gripper), Directional control valve, Flow control equipment, Pressure control equipment, Fittings &amp; Tubing</td>
</tr>
</tbody>
</table>

Note) 22-: Available only for actuators.
No dust is carried into the clean room.

After inspection, products are blown with high purity air (clean bench/class M3.5) in a clean environment. Products are sealed and shipped in anti-static double bags.

The grade classification is the SMC original method. The smaller the grade no., the less the particle generation. The upper concentration limit of the cleanliness class based on Fed. Std. 209E-1992 is shown in parentheses. (Refer to Front matter 23 "Particle generation measuring method" and Front matter 24 "Comparison of cleanliness standards" for details.)

Note) Do not use one-touch fittings 10-KQ (including solenoid valves with built-in one-touch fittings and speed controllers with one-touch fittings) in Grade 1 or Grade 2 areas because internal pressure change may move the collet chuck slightly, which may cause particle generation. This does not apply to insert fittings (KF), miniature fittings (M, MS), clean one-touch fittings (KP, KPO, KPG) and speed controllers with clean one-touch fittings (AS-FPQ/FPG).

Refer to Front matter 23 "Particle generation measuring method" and Front matter 24 "Comparison of cleanliness standards" for details.

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Refer to Front matter 23 "Particle generation measuring method" and Front matter 24 "Comparison of cleanliness standards" for details.
### Basic specifications of actuator

<table>
<thead>
<tr>
<th></th>
<th>Series 10-</th>
<th>Series 11-</th>
<th>Series 12-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>- Double seal type / release to atmosphere</td>
<td>- Single seal type / vacuum suction</td>
<td>- Guide cylinder / Dual rod cylinder</td>
</tr>
<tr>
<td></td>
<td>Relief port</td>
<td>Vacuum port (vacuum suction)</td>
<td>Double seal type / release to atmosphere (Series 10- equivalent) and specially treated guide</td>
</tr>
<tr>
<td></td>
<td>Bushing</td>
<td>Bushing</td>
<td>Ball bushing guide</td>
</tr>
<tr>
<td></td>
<td>Rod seal</td>
<td>Rod seal</td>
<td>Linear guide</td>
</tr>
</tbody>
</table>

- Restricted material: No
- Grease: Fluorine grease
- Assembly environment: General environment (Assembly and inspection in a workshop)
- Packaging style: Clean packaging: Products are sealed in anti-static double bags after giving

### Basic specifications of other equipment

<table>
<thead>
<tr>
<th></th>
<th>Series 10-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>- Directional control valve</td>
</tr>
<tr>
<td></td>
<td>Main valve and pilot valve common exhaust</td>
</tr>
<tr>
<td></td>
<td>- Pressure control equipment</td>
</tr>
<tr>
<td></td>
<td>- Air filter</td>
</tr>
<tr>
<td></td>
<td>- Clean regulator</td>
</tr>
<tr>
<td></td>
<td>Clean one-touch fittings(for blow)</td>
</tr>
</tbody>
</table>

- Restricted material: No
- Grease: Fluorine grease
- Assembly environment: General environment (Assembly and inspection in a workshop)
- Packaging style: Clean packaging: Products are sealed in anti-static double bags after giving
### Special clean series

<table>
<thead>
<tr>
<th>Series 13-</th>
<th>Special clean series</th>
<th>Series 21-</th>
<th>Series 22-</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Guide cylinder • Air slide table</td>
<td>• Clean rodless cylinder</td>
<td>• Double seal type / release to atmosphere</td>
<td>• Single seal type/ vacuum suction</td>
</tr>
<tr>
<td>Single seal type/ vacuum suction (Series 11- equivalent) and specially treated guide</td>
<td>No contact between the cylinder tube exterior and the slider interior</td>
<td>Relief port</td>
<td>Bushing</td>
</tr>
<tr>
<td>Ball bushing guide Linear guide</td>
<td>No seal to the thread parts</td>
<td>Vacuum port (vacuum suction)</td>
<td>Bushing</td>
</tr>
</tbody>
</table>

#### Parts
- Copper, fluorine and silicon-free
- Lithium soap base grease
- General environment (Assembly and inspection in a workshop)
- Standard packaging

#### Note)
- Contact SMC for clean packaging.

### Special clean

<table>
<thead>
<tr>
<th>Special clean</th>
<th>Series 21-</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Clean one-touch fittings(for drive system air piping) • Clean speed controller</td>
<td>• Directional control valve • Pressure control equipment • The same construction as Series 10- • Clean one-touch fittings (for drive system air piping) • Clean speed controller</td>
</tr>
<tr>
<td>Polypropylene resin</td>
<td>No seal to the thread parts</td>
</tr>
<tr>
<td>Metal part Brass (Electroless nickel plated) or Stainless steel 304</td>
<td>• Available for uni thread. (Made to Order)</td>
</tr>
</tbody>
</table>

#### Parts
- Copper, fluorine and silicon-free
- Lithium soap base grease
- General environment (Assembly and inspection in a workshop)
- Standard packaging

#### Note)
- Contact SMC for clean packaging.
<table>
<thead>
<tr>
<th>Model</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-MGF</td>
<td>40, 63, 100</td>
</tr>
<tr>
<td>12-MXS</td>
<td>6, 8, 12, 16, 20, 25</td>
</tr>
<tr>
<td>MXP</td>
<td>6, 10, 12, 16</td>
</tr>
<tr>
<td>MXPJ6</td>
<td>6</td>
</tr>
<tr>
<td>MXQ</td>
<td>6, 8, 12, 16, 20, 25</td>
</tr>
<tr>
<td>CYP</td>
<td>15, 32</td>
</tr>
<tr>
<td>12-CY1B</td>
<td>6, 10, 50, 63</td>
</tr>
<tr>
<td>12-CY3B</td>
<td>15, 20, 25, 40</td>
</tr>
<tr>
<td>12-CY1R</td>
<td>6, 10, 50, 63</td>
</tr>
<tr>
<td>12-CY3R</td>
<td>15, 20, 25, 32, 40</td>
</tr>
<tr>
<td>12-REA</td>
<td>25, 32, 40, 50, 63</td>
</tr>
<tr>
<td>CQ2X</td>
<td>32, 40, 50, 63</td>
</tr>
<tr>
<td>CM2X</td>
<td>20, 25, 32, 40</td>
</tr>
</tbody>
</table>
Following are the actuator driving system and circuit configuration of blow system employed to reduce particle generation when using pneumatic equipment in a clean room.

**Actuator driving system**

Inside of clean room

- Cylinder relief port piping
- Solenoid valve exhaust piping
- Breathing piping of regulator
- Drain piping
- Exhaust Cleaner for Clean room/AMP series

**Cylinder relief port piping**

**Series 10-/12-/21- (atmospheric release type)**

Connect the relief port piping with the dedicated duct piping installed outside the clean room or with the exhaust cleaner for clean room/AMP series.

**Series 11-/13-/22- (Vacuum suction type)**

**With a vacuum pump**

When several air cylinders are used together or a model with high vacuum suction flow is used.

**With an ejector**

When a few air cylinders are locally used.
• **Clean blow system**

Example of equipment to suit each clean blow grade
- Line A: For oil-free air blow
- Line B: For clean blow
- Line C: For clean blow
  (With clean gas filter)
- Line D: For \( \text{N}_2 \) blow

![Diagram of clean blow system](image)

- **Example of air line equipment**

![Diagram of air line equipment](image)

- **Example of \( \text{N}_2 \) equipment**

![Diagram of \( \text{N}_2 \) equipment](image)
How to Use Clean Series

The position of the pneumatic equipment to the workpiece is determined by the particle generation degree.

<table>
<thead>
<tr>
<th>Classification of particle generation grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particle concentration (Particles/m³)</td>
</tr>
<tr>
<td>10⁰</td>
</tr>
<tr>
<td>10ⁱ</td>
</tr>
<tr>
<td>10²</td>
</tr>
<tr>
<td>10³</td>
</tr>
<tr>
<td>10⁴</td>
</tr>
<tr>
<td>10⁵</td>
</tr>
<tr>
<td>10⁶</td>
</tr>
<tr>
<td>10⁷</td>
</tr>
<tr>
<td>10⁸</td>
</tr>
<tr>
<td>10⁹</td>
</tr>
<tr>
<td>10¹⁰</td>
</tr>
</tbody>
</table>

Particle diameter (mm)

The grade classification is the SMC original method. The smaller the grade number, the less the particle generation. The upper concentration limit of the cleanliness class based on Fed. Std. 209E-1992 is shown in parentheses. (Refer to Front matter 23 "Particle generation measuring method" and Front matter 24 "Comparison of cleanliness standards" for details.)

Note) Do not use one-touch fittings 10-KQ (including solenoid valves with built-in one-touch fittings and speed controllers with one-touch fittings ) in Grade 1 or Grade 2 areas because internal pressure change may cause slight move of the collet chuck, which may cause particle generation. This does not apply to insert fittings (KF), miniature fittings (M, MS), clean one-touch fittings (KP, KPQ, KPG) and speed controllers with clean one-touch fittings (AS-FPQ/FPG).

Selection procedure

1. **Required clean room cleanliness?**
   - Class M2.5 or Class M3.5 or Class M4.5?
2. **Air flow to the workpiece (Refer to Diagram 1.)**
3. **Where is the pneumatic equipment located?**
   - (Refer to Diagram 2.)
4. **Determine the particle concentration grade no. around the workpiece based on above (1) to (3). (Refer to Table 1.)**
5. **Select the equipment to be used. (Refer to Front matter 13 to 22.)**

<table>
<thead>
<tr>
<th>Cleanliness class</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMC</td>
</tr>
<tr>
<td>Grade 1</td>
</tr>
<tr>
<td>Grade 2</td>
</tr>
<tr>
<td>Grade 3</td>
</tr>
<tr>
<td>Grade 4</td>
</tr>
<tr>
<td>–</td>
</tr>
<tr>
<td>–</td>
</tr>
</tbody>
</table>

Table 1  Particle concentration grade around the workpiece

<table>
<thead>
<tr>
<th>(2) Workpiece</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>(3) Position of the equipment to be used</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper area of the workpiece</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower area of the workpiece</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unstable area</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stable area</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1) Cleanliness</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class M2.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class M3.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class M4.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Determine the particle concentration grade no. around the workpiece based on above (1) to (3). (Refer to Table 1.)

Note) Do not use one-touch fittings 10-KQ (including solenoid valves with built-in one-touch fittings and speed controllers with one-touch fittings ) in Grade 1 or Grade 2 areas because internal pressure change may cause slight move of the collet chuck, which may cause particle generation. This does not apply to insert fittings (KF), miniature fittings (M, MS), clean one-touch fittings (KP, KPQ, KPG) and speed controllers with clean one-touch fittings (AS-FPQ/FPG).

Front matter 12
## Cylinder

<table>
<thead>
<tr>
<th>Description</th>
<th>Model</th>
<th>Particle generation grade by series</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Standard</strong></td>
</tr>
<tr>
<td>Compact Guide Cylinder</td>
<td>17/18</td>
<td>4</td>
</tr>
<tr>
<td>Guide Table</td>
<td>10-MGF</td>
<td>4</td>
</tr>
<tr>
<td>Air Slide Table</td>
<td>11/12</td>
<td>-</td>
</tr>
<tr>
<td>Air Slide Table</td>
<td>11/12</td>
<td>-</td>
</tr>
<tr>
<td>Air Slide Table</td>
<td>11/12</td>
<td>-</td>
</tr>
<tr>
<td>Clean Rodless Cylinder</td>
<td>CYP</td>
<td>2</td>
</tr>
<tr>
<td>Magnetically Coupled Rodless Cylinder</td>
<td>12-CY1B</td>
<td>4</td>
</tr>
<tr>
<td>Magnetically Coupled Rodless Cylinder (Direct Mount Type)</td>
<td>12-CY3B</td>
<td>4</td>
</tr>
<tr>
<td>Magnetically Coupled Rodless Cylinder (Direct Mount Type)</td>
<td>12-CY1R</td>
<td>4</td>
</tr>
<tr>
<td>Magnetically Coupled Rodless Cylinder (Direct Mount Type)</td>
<td>12-CY3R</td>
<td>4</td>
</tr>
<tr>
<td>Sine Rodless Cylinder</td>
<td>12-REA</td>
<td>4</td>
</tr>
<tr>
<td>Low Speed Cylinder</td>
<td>10/CQSX</td>
<td>3</td>
</tr>
<tr>
<td>Low Speed Cylinder</td>
<td>10/CQ2X</td>
<td>3</td>
</tr>
<tr>
<td>Low Speed Cylinder</td>
<td>10/CM2X</td>
<td>3</td>
</tr>
</tbody>
</table>

Note) The grade is different depending on the type of the adjuster option.

### MXP

<table>
<thead>
<tr>
<th>Option</th>
<th>11-</th>
<th>22-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without adjuster</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Rubber stopper</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Metal stopper</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

### MXQ, MXS

<table>
<thead>
<tr>
<th>Option</th>
<th>13-</th>
<th>22-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without adjuster</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Rubber stopper</td>
<td></td>
<td>4</td>
</tr>
</tbody>
</table>

Front matter 14
Particle Generation Measuring Method

The particle generation data for SMC CLEAN SERIES are measured in the following test method.

**Test method (Example)**

Place the specimen in the acrylic resin chamber and operate it while supplying the same flow rate of clean air as the suction flow rate of the measuring instrument (15 l/min). Measure the changes of the particle concentration over time until the number of cycles reaches the specified point. The chamber is placed in a Class M3.5 clean bench.

**Measuring conditions**

<table>
<thead>
<tr>
<th>Chamber</th>
<th>Internal volume</th>
<th>15 l</th>
<th>Supply air quality</th>
<th>Same quality as the supply air for driving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Laser dust monitor (Automatic particle counter by light-scattering method)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model no.</td>
<td>TS-1500</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum measurable particle diameter</td>
<td>0.17 μm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suction flow rate</td>
<td>15 l/min</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturer</td>
<td>Hitachi Electronics Engineering Co. Ltd.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Setting conditions</td>
<td>Sampling time</td>
<td>5 min</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Interval time</td>
<td>55 min</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sampling air flow</td>
<td>75 l</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Evaluation method**

To obtain the measured values of particle concentration, the accumulated value of particles captured every 5 minutes, by the laser dust monitor, is converted into the particle concentration in every 1 m³.

When determining particle generation grades, the 95% upper confidence limit of the average particle concentration (average value), when each specimen is operated at a specified number of cycles is considered.

The plots in the graphs indicate the 95% upper confidence limit of the average particle concentration of particles with a diameter within the horizontal axis range.

Note 1) Sampling air flow rate: Number of particles contained in 75 l of air
Note 2) Actuator: 1 million cycles
Solenoid valve: 2 million cycles
### Comparison of Cleanliness Standards

<table>
<thead>
<tr>
<th>Standard</th>
<th>Fed.Std.209E</th>
<th>ISO 14644-1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cleanliness classes</td>
<td>British unit: Class 1 to 100,000</td>
<td>ISO Cass 1 to 9</td>
</tr>
<tr>
<td></td>
<td>SI unit: Class M1 to M7</td>
<td>Intermediate classes available</td>
</tr>
<tr>
<td></td>
<td>U descriptor: Particles diameter smaller than 0.1 µm</td>
<td>U descriptor: Particles smaller than 0.1 µm</td>
</tr>
<tr>
<td></td>
<td>M descriptor: Particles larger than 5.0 µm</td>
<td>M descriptor: Particles larger than 5.0 µm</td>
</tr>
<tr>
<td></td>
<td>Corresponding class indication</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(British unit)</td>
<td>(SI unit)</td>
</tr>
<tr>
<td>1</td>
<td>M1.5</td>
<td>ISO Class 1</td>
</tr>
<tr>
<td>10</td>
<td>M2.5</td>
<td>ISO Class 2</td>
</tr>
<tr>
<td>100</td>
<td>M3.5</td>
<td>ISO Class 3</td>
</tr>
<tr>
<td>1000</td>
<td>M4.5</td>
<td>ISO Class 4</td>
</tr>
<tr>
<td>10000</td>
<td>M5.5</td>
<td>ISO Class 5</td>
</tr>
<tr>
<td>100000</td>
<td>M6.5</td>
<td>ISO Class 6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ISO Class 7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ISO Class 8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ISO Class 9</td>
</tr>
<tr>
<td></td>
<td>Cleanliness class</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The number of particles diameter larger than 0.5 µm in an air volume of 1m³ is expressed in 10M or coefficient Nc.</td>
<td>The number of particles larger than 0.1 µm in an air volume of 1m³ is expressed in 10⁻³.</td>
</tr>
<tr>
<td></td>
<td>Cleanliness class: Nc or M</td>
<td>ISO Class N: Occupancy state: Considered particle size</td>
</tr>
<tr>
<td>Calculation of the maximum permitted concentration of particulate cleanliness classes</td>
<td>British unit: Number of particles/m³ = Nc x (0.5/D)³⁵⁵</td>
<td>Cn = 10ⁿ × (0.1/D)¹⁰¹⁶</td>
</tr>
<tr>
<td></td>
<td>SI unit: Number of particles/m³ = 10M x (0.5/D)³⁵⁵</td>
<td></td>
</tr>
<tr>
<td>Evaluation method using a simple sampling</td>
<td>¹ Number of sampling locations: 2 to 9</td>
<td>¹ Number of sampling locations: 2 to 9</td>
</tr>
<tr>
<td></td>
<td>95% UCL of the mean and the mean of the averages</td>
<td>95% UCL of the mean and the mean of the averages</td>
</tr>
<tr>
<td></td>
<td>² Number of sampling locations: 10 or more</td>
<td>² Number of sampling locations: 1, or 10 or more</td>
</tr>
<tr>
<td></td>
<td>The mean</td>
<td>The mean</td>
</tr>
<tr>
<td>Number of sampling locations</td>
<td>¹ Non-unidirectional airflow: at least two locations</td>
<td>Derive it from the area of the cleanroom or clean air controlled space.</td>
</tr>
<tr>
<td></td>
<td>Nc = A x 64/(10M)¹²⁵</td>
<td>The number of sampling locations Nc = (A)¹²⁵</td>
</tr>
<tr>
<td></td>
<td>Smaller value between Nc=A/2.32 and Nc=A x 64/(10M)¹²⁵</td>
<td>At least one location</td>
</tr>
<tr>
<td>Min. sampling airflow volume</td>
<td>2 litters or a sufficient volume of air that a minimum of 20 particles could be counted if the particle concentration were at the class limit.</td>
<td>2 litters or a sufficient volume of air that a minimum of 20 particles could be counted if the particle concentration were at the class limit.</td>
</tr>
<tr>
<td></td>
<td>Min. sampling volume: 2 litters or a sufficient volume of air that a minimum of 20 particles could be counted if the particle concentration were at the class limit.</td>
<td>Min. sampling time: 1 minute</td>
</tr>
<tr>
<td>Number of samplings</td>
<td>Total number of samplings in each clean zone: 5 times or more</td>
<td>Where only one sampling location is required, take a minimum of three single sample volumes at that location.</td>
</tr>
<tr>
<td>Sampling method</td>
<td>5.0 µm and larger: Constant velocity and suction in the same direction of the air flow</td>
<td>Suction in the same direction as the airflow</td>
</tr>
<tr>
<td></td>
<td>0.5 to 5 µm: Correction possible when it is sucked at a nonconstant velocity</td>
<td>If the direction of the airflow is not predictable, the inlet of the sampling probe shall be directed vertically upward.</td>
</tr>
</tbody>
</table>

### Airborne particle concentration, Cn (particles/m³)

- **Particle diameter, D (µm):**
  - 0.1 to 10
  - ISO Class 1 to 9

### Maximum concentration limit (particles/m³)

<table>
<thead>
<tr>
<th>Cleanliness class (N)</th>
<th>Considered particle diameter (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.1</td>
</tr>
<tr>
<td>ISO Class 1</td>
<td>10</td>
</tr>
<tr>
<td>ISO Class 2</td>
<td>100</td>
</tr>
<tr>
<td>ISO Class 3</td>
<td>1000</td>
</tr>
<tr>
<td>ISO Class 4</td>
<td>10000</td>
</tr>
<tr>
<td>ISO Class 5</td>
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<tr>
<td>ISO Class 6</td>
<td>100000</td>
</tr>
<tr>
<td>ISO Class 7</td>
<td>3520000</td>
</tr>
<tr>
<td>ISO Class 8</td>
<td>3520000</td>
</tr>
<tr>
<td>ISO Class 9</td>
<td>3520000</td>
</tr>
</tbody>
</table>

**Note:** Concentration data with no more than three significant figures be used in determining the classification level.

\[ C_n = 10^n \times (0.1/D)^{1.66} \]

- **Cn:** The maximum permitted concentration of airborne particles that are equal to or larger than the considered particle size (D). Cn is rounded down to the nearest whole number, using no more than three significant figures.
- **N:** Class no.(1 to 9), Intermediate class (1.1 to 8.9)
- **D:** Measured particle diameter (µm)
- **0.1:** Constant number (µm)
How to Order

<table>
<thead>
<tr>
<th>Clean series</th>
<th>MXS 12</th>
<th>50</th>
<th>M9N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper, fluorine and silicon-free + low particle generation</td>
<td>MXS 12</td>
<td>50</td>
<td>M9N</td>
</tr>
<tr>
<td>Symmetric type</td>
<td>MXS 12</td>
<td>50</td>
<td>M9N</td>
</tr>
<tr>
<td>Bore size (Stroke (mm))</td>
<td>MXS 12</td>
<td>50</td>
<td>M9N</td>
</tr>
<tr>
<td>Adjuster option</td>
<td>MXS 12</td>
<td>50</td>
<td>M9N</td>
</tr>
<tr>
<td>Functional option</td>
<td>MXS 12</td>
<td>50</td>
<td>M9N</td>
</tr>
</tbody>
</table>

Auto switch specifications (Refer to Best Pneumatics catalog for detailed specifications and auto switches not in the following table.)

<table>
<thead>
<tr>
<th>Type</th>
<th>Special function</th>
<th>Electrical entry</th>
<th>Indicator light</th>
<th>Wiring (Output)</th>
<th>Load voltage</th>
<th>Auto switch model</th>
<th>Lead wire length (m)</th>
<th>Applicable load</th>
<th>PLC: Programmable Logic Controller</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reed switch</td>
<td>—</td>
<td>Grommet</td>
<td>Yes</td>
<td>2-wire</td>
<td>24V, 12V, 100V</td>
<td>A93 (Nil)</td>
<td>0.5 (Nil), 3 (L)</td>
<td>—</td>
<td>Relay, PLC</td>
</tr>
<tr>
<td>Solid state switch</td>
<td>—</td>
<td>Grommet</td>
<td>Yes</td>
<td>3-wire (NPN)</td>
<td>24V, 12V, 100V</td>
<td>M9N</td>
<td>—</td>
<td>—</td>
<td>Relay, PLC</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>M9B</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
</tbody>
</table>

* Lead wire length symbols: 0.5m — Nil (Example) A93L
  3 m — L (Example) A93L

Refer to page 182 for a list of applicable auto switches.
Specifications

<table>
<thead>
<tr>
<th>Bore size (mm)</th>
<th>Fluid</th>
<th>Action</th>
<th>Operating pressure</th>
<th>Proof pressure</th>
<th>Ambient and fluid temperature</th>
<th>Piston speed</th>
<th>Cushion</th>
<th>Lubrication</th>
<th>Stroke length tolerance</th>
<th>Grease</th>
</tr>
</thead>
<tbody>
<tr>
<td>6, 8, 12</td>
<td>Air</td>
<td>Double acting</td>
<td>0.15 to 0.7 MPa</td>
<td>1.05 MPa</td>
<td>–10 to 60°C (No freezing)</td>
<td>50 to 300 mm/s</td>
<td>Rubber bumper (Standard, With stroke adjuster)</td>
<td>Non-lube</td>
<td>0.1 mm</td>
<td>13-/: Fluorine grease</td>
</tr>
<tr>
<td>16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>22-/: Lithium soap based grease</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

Suction flow rate of vacuum suction type (Reference values)

<table>
<thead>
<tr>
<th>Bore size</th>
<th>Suction flow rate $\phi$/min (ANR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6, 8, 12</td>
<td>1</td>
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<tr>
<td>16</td>
<td>2</td>
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<tr>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>25</td>
<td>5</td>
</tr>
</tbody>
</table>

Adjuster option stroke adjustment range

<table>
<thead>
<tr>
<th>Stroke end</th>
<th>Stroke adjustment range 0 to 5 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extension end (AS)</td>
<td>Retraction end (AT)</td>
</tr>
<tr>
<td>Both ends (A)</td>
<td></td>
</tr>
</tbody>
</table>

Auto switches / Proper mounting position at stroke end detection

Reed switch: D-A93

<table>
<thead>
<tr>
<th>Model</th>
<th>Stroke (mm)</th>
<th>Stroke (mm)</th>
<th>Auto switch operation range</th>
</tr>
</thead>
<tbody>
<tr>
<td>13-/22-MXS6</td>
<td>5.9</td>
<td>5.6</td>
<td>1.5</td>
</tr>
<tr>
<td>13-/22-MXS8</td>
<td>7.6</td>
<td>5.6</td>
<td>1.5</td>
</tr>
<tr>
<td>13-/22-MXS12</td>
<td>11.6</td>
<td>8.4</td>
<td>1.5</td>
</tr>
<tr>
<td>13-/22-MXS16</td>
<td>16.3</td>
<td>8.7</td>
<td>1.5</td>
</tr>
<tr>
<td>13-/22-MXS20</td>
<td>18.9</td>
<td>12.6</td>
<td>1.5</td>
</tr>
<tr>
<td>13-/22-MXS25</td>
<td>23</td>
<td>17.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Solid state switch: D-M9B, D-M9N

<table>
<thead>
<tr>
<th>Model</th>
<th>Stroke (mm)</th>
<th>Stroke (mm)</th>
<th>Auto switch operation range</th>
</tr>
</thead>
<tbody>
<tr>
<td>13-/22-MXS6</td>
<td>10</td>
<td>9.6</td>
<td>1.5</td>
</tr>
<tr>
<td>13-/22-MXS8</td>
<td>11.6</td>
<td>9.9</td>
<td>1.5</td>
</tr>
<tr>
<td>13-/22-MXS12</td>
<td>15.6</td>
<td>12.4</td>
<td>1.5</td>
</tr>
<tr>
<td>13-/22-MXS16</td>
<td>20.3</td>
<td>17.7</td>
<td>1.5</td>
</tr>
<tr>
<td>13-/22-MXS20</td>
<td>22.9</td>
<td>16.6</td>
<td>1.5</td>
</tr>
<tr>
<td>13-/22-MXS25</td>
<td>27</td>
<td>21.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>
Dimensions: MXS6

Axial piping type (ø6): MXS6-P

* Other dimensions are the same as those of basic style.
Dimensions: 13-22-MXS6L / Symmetric type

Air slide table 13-22 MXS

Vacuum suction port M5 x 0.8

Operating port 2-M3 x 0.5

Stroke adjuster at extension end

2-M3 x 0.5 thread depth 5

(With stroke adjuster at extension end)

Stroke adjuster at retraction end

N-M3 x 0.5 thread depth 4
(Insert)

Max. 10.5 (With stroke adjuster at retraction end)

2-M2.5 x 0.45 thread depth 3

4-M2.5 x 0.45 thread depth 3.5

2-M2.5 x 0.45 thread depth 3

ø3H9 +0.025 depth 2.5

ø3H9 +0.025 depth 2.5

ø3H9 +0.025 depth 2.5

ø3H9 +0.025 depth 2.5

ø3H9 +0.025 depth 2.5

ø3H9 +0.025 depth 2.5

ø3H9 +0.025 depth 2.5

ø3H9 +0.025 depth 2.5

ø3H9 +0.025 depth 2.5

(With stroke adjuster at extension end)

(Insert)

Section AA

Section BB

<table>
<thead>
<tr>
<th>Model</th>
<th>F</th>
<th>N</th>
<th>G</th>
<th>H</th>
<th>NN</th>
<th>GA</th>
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<th>I</th>
<th>J</th>
<th>K</th>
<th>M</th>
<th>Z</th>
<th>ZZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>13-22-MXS6L-10</td>
<td>20</td>
<td>4</td>
<td>6</td>
<td>25</td>
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<td>11</td>
<td>20</td>
<td>10</td>
<td>17</td>
<td>22.5</td>
<td>42</td>
<td>41.5</td>
<td>64</td>
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<tr>
<td>13-22-MXS6L-20</td>
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<td>11</td>
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<td>7</td>
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<td>62</td>
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<td>84</td>
</tr>
<tr>
<td>13-22-MXS6L-40</td>
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<td>13</td>
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<td>84</td>
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<td>106</td>
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<tr>
<td>13-22-MXS6L-50</td>
<td>38</td>
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<td>17</td>
<td>24</td>
<td>4</td>
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<td>25</td>
<td>60</td>
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<td>100</td>
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</tr>
</tbody>
</table>
Dimensions: 13-22-MXS8

Basic style

Vacuum suction port M5x0.8

Operating port 2-M5 x 0.8

Max. 9.5 (Stroke adjuster at retraction end)

Stroke adjuster at extension end

Stroke adjuster at retraction end

Air slide table

<table>
<thead>
<tr>
<th>Model</th>
<th>F</th>
<th>N</th>
<th>G</th>
<th>H</th>
<th>NN</th>
<th>GA</th>
<th>HA</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>KA</th>
<th>NA</th>
<th>M</th>
<th>Z</th>
<th>ZZ</th>
</tr>
</thead>
<tbody>
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<td>13-22-MXS8-10</td>
<td>25</td>
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<td>13</td>
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<td>2</td>
<td>49</td>
<td>48.5</td>
<td>74</td>
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<td>13-22-MXS8-75</td>
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<td>151</td>
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<td>176</td>
</tr>
</tbody>
</table>

(Stroke adjuster at extension end)

Section AA

Section BB

Air cylinder

Rotary actuator

Air gripper

Directional control valve

Flow control equipment

Filter, Pressure control equipment

Air preparation equipment

Clean gas filter

Pressure switch
Dimensions: 13-22-MXS8

Axial piping type (ø8): 13-22-MXS8-P

* Other dimensions are the same as those of basic style.
Dimensions: 13/22-MXS8L / Symmetric type

<table>
<thead>
<tr>
<th>Model</th>
<th>F</th>
<th>N</th>
<th>G</th>
<th>H</th>
<th>NN</th>
<th>GA</th>
<th>HA</th>
<th>I</th>
<th>J</th>
<th>K</th>
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<th>M</th>
<th>Z</th>
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</thead>
<tbody>
<tr>
<td>13/22-MXS8L-10</td>
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<td>43</td>
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<td>151</td>
<td>150.5</td>
<td>176</td>
</tr>
</tbody>
</table>

Air slide table

Air cylinder

Rotary actuator

Air gripper

Directional control valve

Flow control equipment

Fittings & Tubing

Air preparation equipment

Filter, Pressure control equipment

Clean gas filter

Pressure switch

Air cylinder

Rotary actuator

Air gripper

Directional control valve

Flow control equipment

Fittings & Tubing

Air preparation equipment

Filter, Pressure control equipment

Clean gas filter

Pressure switch
Air slide table **MXS**

**Dimensions: MXS12**

### Basic style

**Diagram with dimensions and labels**

- **Vacuum suction port**: 2-M4 x 0.7 thread depth 5
- **Operating port**: 2-M5 x 0.8
- **Max. 11 (With stroke adjuster at retraction end)**
- **Stroke adjuster at extension end**
- **Stroke adjuster at retraction end**

**Table of dimensions (mm)**

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Vacuum suction port M5 x 0.8

Operating port 2-M5 x 0.8

Max. 11 (With stroke adjuster at retraction end)

Stroke adjuster at extension end

Stroke adjuster at retraction end

(Model)
Dimensions / 12-22-MXS12

Axial piping (ø12) 13-22-MXS12-□□□P

* Other dimensions are the same as those of basic style.
Dimensions / MXS12L / Symmetric type

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Air slide table 13-12 MXS

Stroke adjuster at extension end
Stroke adjuster at retraction end
Vacuum suction port M5 x 0.8
Operating port 2-M5 x 0.8
N-M4 x 0.7 thread depth 5.5
(Insert)
Maximum 11 (With stroke adjuster at retraction end)
2-M4 x 0.7 thread depth 5
2-M5 x 0.8 thread depth 8
4-M4 x 0.7 thread depth 6

Section AA
Section BB
Dimensions / 13-22-MXS16

Basic style

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(Mm)
Dimensions / MXS16

Axial piping (ø16) MXS16-P

* Other dimensions are the same as those of basic style.
### Dimensions / 13-MXS16L / Symmetric type

![Diagram of Air slide table](image)

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- **Model** refers to the model number of the air slide table.
- **F, N, G, H, NN, GA, HA, I, J, K, KA, NA, M, Z, ZZ** are dimensions in millimeters (mm).
Air slide table 13-22 MXS

Dimensions / 13-22 MXS20

Basic style

Vacuum suction port Rc, G, NPT1/8

2-M6 x 1 thread depth 6.5

Operating port 2-Rc, G, NPT1/8

Maximum 14.5 (With stroke adjuster at retraction end)

Stroke adjuster at extension end

N-M5 x 0.8 thread depth 10

(Insert)

6-M5 x 0.8 thread depth 8

With stroke adjuster at extension end

With stroke adjuster at retraction end

Section AA

Section BB

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Dimensions / MXS 20

Axial piping (ø20) MXS20-□□□P

Other dimensions are the same as those of basic style.
## Dimensions / 13-22-MXS20L / Symmetric type

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### Notes
- **Air slide table 13-22-MXS**: Symmetric type
- **Dimensions**
- **Table Values (mm)**
- **Model Numbers**
- **Maximum 14.5 (With stroke adjuster at retraction end)**
- **Vacuum suction port Rc, G, NPT1/8**
- **2-M6 x 1 thread depth 13**
- **Stroke adjuster at extension end**
- **Stroke adjuster at retraction end**
- **Operating port 2-Rc, G, NPT1/8**
- **M5 x 0.8 thread depth 10**
- **Stroke adjuster at extension end**
- **Stroke adjuster at retraction end**
- **Section AA**
- **Section BB**

---

### Diagram

1. **Air slide table 13-22-MXS**
2. **Dimensions / 13-22-MXS20L / Symmetric type**
3. **Model numbers**
4. **Table with dimensions in millimeters (mm)**
5. **Operating port**
6. **Vacuum suction port**
7. **Thread details**
8. **Stroke adjuster details**
9. **Section AA**
10. **Section BB**

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### Additional Notes
- **Thread depth specifications**
- **Thread types**
- **Model variations**
- **Stroke adjustment locations**
- **Extension and retraction parameters**

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**SMC**: Manufacturer of pneumatic and automation products.
Dimensions / 13/22-MXS25

Basic style

Operating port 2-Rc, G, NPT1/8

Maximum 16.5 (With stroke adjuster at retraction end)

Vacuum suction port Rc, G, NPT1/8

NA-M8 x 1.25 thread depth 8.5

Fittings & Tubing

Pressure switch

Clean gas filter Flow control equipment

Air cylinder

Rotary actuator

Air gripper

Directional control valve

Air preparation equipment

Filter, Pressure control equipment

Flow control equipment

13/22-MXS25-10
F 50
FF 40
N 4
G 22
H 45
NN 2
GA 2
I 2
J 47
K 35
KA —
M 2
Z 90.5
ZZ 133.5

13-22-MXS25-20
F 50
FF 40
N 4
G 22
H 45
NN 2
GA 2
I 2
J 47
K 35
KA —
M 2
Z 90.5
ZZ 133.5

13-22-MXS25-30
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N 4
G 22
H 45
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K 35
KA —
M 2
Z 90.5
ZZ 133.5

13-22-MXS25-40
F 60
FF 50
N 4
G 22
H 55
NN 2
GA 2
I 2
J 57
K 65
KA —
M 2
Z 100
ZZ 143.5

13-22-MXS25-50
F 35
FF 35
N 6
G 20
H 35
NN 3
GA 3
I 55
K 35
KA —
M 2
Z 115
ZZ 156.5

13-22-MXS25-75
F 60
FF 50
N 6
G 26
H 35
NN 4
GA 4
I 61
K 33
KA —
M 2
Z 154
ZZ 197.5

13-22-MXS25-100
F 70
FF 60
N 6
G 32
H 35
NN 5
GA 5
I 102
K 70
KA —
M 2
Z 197
ZZ 238.5

13-22-MXS25-125
F 75
FF 75
N 8
G 40
H 38
NN 6
GA 6
I 154
K 76
KA —
M 2
Z 255
ZZ 296.5

13-22-MXS25-150
F 80
FF 80
N 8
G 30
H 40
NN 7
GA 7
I 190
K 80
KA —
M 2
Z 295
ZZ 336.5
Dimensions / MXS25

Axial piping (ø25) MXS25-P

* Other dimensions are the same as those of basic style.
Dimensions / 13-22-MXS25L / Symmetric type

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**Made to Order**

Use of fluoro rubber for dust cover and dust plug -X52

13-MXS Refer to standard products How to Order -X52

Material used for the dust cover and dust plug has been changed from silicone rubber to fluoro rubber.

Note 1) Dimensions are the same as those of standard type.

---

**Specific Product Precautions**

Be sure to read before handling.

**Precautions**

**Caution**

Plug the port after removing the stroke adjuster at the extension end. Otherwise particle generation may occur because the prepared hole of the mounting screw penetrates the body. Contact SMC for more information.

**Cylinder bore size (mm)**

<table>
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<th>Cylinder bore size (mm)</th>
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<tr>
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In case of without extension end adjuster type, port is plugged with a hexagon socket head screw at the time of shipment.
### Precaution on designing

#### Warning

1. **There is a possibility of dangerous sudden action by air cylinders if sliding parts of machinery are twisted due to external forces, etc.**
   In such cases, personal injury by catching hands or feet in the machinery, or damage to the machinery itself may occur. Therefore, the machine should be adjusted to operate smoothly and designed to avoid such dangers.

2. **A protective cover is recommended to minimize the risk of personal injury.**
   If a driven object and moving parts of a cylinder are in close proximity, personal injury may occur. Design the structure to avoid contact with the human body.

3. **Securely tighten all stationary and connected parts so that they will not become loose.**
   Particularly when a cylinder operates at a high frequency or is installed in a place where there is a lot of vibration, ensure that all parts remain secure.

4. **A deceleration circuit may be required.**
   When a driven object is operated at high speed or the load is heavy, a cylinder's cushion will not be sufficient to absorb the impact. Install a deceleration circuit to reduce the speed before cushioning to relieve the impact.

5. **Consider a possible drop in circuit pressure due to a power outage.**
   When a cylinder is used in a clamping mechanism, there is a danger of workpiece dropping if there is a decrease in clamping force due to a drop in circuit pressure caused by a power outage, etc. Therefore, safety equipment should be installed to prevent damage to machinery and personal injury. Suspension mechanisms and lifting devices also require consideration for drop prevention.

6. **Consider a possible loss of power source.**
   Measures should be taken to avoid personal injury and equipment damage in the event that there is a loss of power to equipment controlled by pneumatics, electricity, or hydraulics.

7. **Design circuitry to prevent the sudden lurching of driven objects.**
   When a cylinder is driven by an exhaust center type directional control valve or when it is started up after residual pressure is exhausted from the circuit, etc., the piston and its driven object will lurch when the cylinder is operated at high speed if pressure is applied to one side of the cylinder, due to the absence of air pressure inside the cylinder. Therefore, equipment should be selected and circuits should be designed to prevent this sudden lurching, because there is a danger of personal injury and/or damage to equipment when this occurs.

8. **Consider emergency stops.**
   Design the machinery so that personal injury and/or damage to machinery and equipment will not occur when the machinery is stopped by a safety device under abnormal conditions, such as a power outage or a manual emergency stop.

9. **Consider the action when operation is restarted after an emergency stop or abnormal stop.**
   Design the machinery so that personal injury or equipment damage will not occur upon restart of operation. When the cylinder has to be reset at the start position, install safety manual control equipment.

### Selection

#### Warning

1. **Confirm the specifications.**
   The products featured in this catalog are designed for use in industrial compressed air systems. If the products are used in conditions where pressure and/or temperature are outside the range of specifications, damage and/or malfunctions may occur. Do not use in these conditions. (Refer to the specifications). Please consult with SMC if you use a fluid other than compressed air.

2. **Intermediate Stops**
   With a 3-position closed center type valve, it is difficult to accurately and precisely stop a piston at the required position in the same way as can be done with hydraulic pressure due to the compressibility of air. Furthermore, since valves and cylinders, etc. are not guaranteed for zero air leakage, it may not be possible to hold a stopped position for an extended period of time. Please contact with SMC when it is necessary to hold a stopped position for an extended period of time.

#### Caution

1. **Operate within the limits of the maximum feasible stroke.**
   Operation that exceeds the maximum stroke may damage a piston rod. Refer to the air cylinder model selection procedures for the maximum feasible strokes.

2. **Operate a cylinder within a range such that collision damage will not occur to a piston at the stroke end.**
   Operate a cylinder within a range so that a piston having inertial force will not be damaged when it collides against the cover at the stroke end. Refer to the air cylinder model selection procedures for the maximum feasible strokes.

3. **Use a speed controller to adjust the cylinder speed, gradually increasing from a low speed to the desired speed setting.**

4. **Provide intermediate supports for long stroke cylinders.**
   An intermediate support should be provided in order to prevent damage to a long stroke cylinder, due to problems such as sagging of the rod, deflection of the cylinder tube, vibration and external load.
Actuator / Common Precautions 2
Be sure to read before handling. Refer to the main text for precautions for each series.

**Mounting**

**Caution**
1. Be certain to match the rod shaft center with the load and direction of movement when connecting.
   When not properly matched, problems may arise with the rod and tube, and damage may be caused due to friction on areas such as the inner tube surface, bushings, rod surface, and seals.

2. Do not scratch or gouge the sliding portion of the cylinder tube or the piston rod by striking it with an object, or squeezing it.
   The tube bore is manufactured under precise tolerances. Thus, even a slight deformation could lead to a malfunction. Moreover, scratches or gouges, etc. in the piston rod may lead to damaged seals and cause air leakage.

3. Do not use until you verify that the equipment can operate properly.
   After mounting, repairs, or modification, etc., connect the air supply and electric power, and then confirm proper mounting by means of appropriate function and leak tests.

4. Do not use until you verify that the equipment can operate properly.
   After mounting, repairs, or modification, etc., connect the air supply and electric power, and then confirm proper mounting by means of appropriate function and leak tests.

5. Instruction manual
   Install the products and operate them only after reading the instruction manual carefully and understanding its contents.
   Also keep the manual where it can be referred to as necessary.

**Air Supply**

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

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

2. Install an aftercooler, air dryer, or water separator (Drain Catch).
   Compressed air that includes excessive drainage may cause malfunction of valves and other pneumatic equipment. To prevent this, install an air dryer, aftercooler or water separator (drain catch), etc.

3. Use the product within the specified range of fluid and ambient temperature.
   Take measures to prevent freezing at temperature below 5°C, since moisture in circuits may freeze and cause damage to seals and lead to malfunctions.

**Cushion**

**Caution**
1. Readjust with a cushion needle.
   Cushions are adjusted at the time of shipment; however, the cushion needle on the cover should be readjusted, when the product is put into service based on factors such as the size of the load and the operating speed. When the cushion needle is turned clockwise, the restriction becomes smaller and the cushion’s effectiveness is increased. Tighten the lock nut securely after adjustment is performed.

2. Do not operate the actuator with the cushion needle fully closed.
   This could damage the seals.
Operating Environment

⚠️ Warning
1. Do not use in atmospheres or locations where corrosion hazards exist. Refer to the construction drawings regarding cylinder materials.
2. In locations where ultrapure water or cleaning solvent, etc. splashes on the equipment, take suitable measures to protect the rod.

Maintenance

⚠️ Warning
1. Perform maintenance procedures as shown in the instruction manual. Improper handling may result in malfunction and damage of machinery or equipment.
2. Removal of equipment, and supply / exhaust of compressed air
   Before any machinery or equipment is removed, first ensure that the appropriate measures are in place to prevent the fall or erratic movement of driven objects and equipment, then cut off the electric power and release the compressed air in the system. When machinery is restarted, proceed with caution after confirming that appropriate measures are in place to prevent cylinders from sudden movement.

⚠️ Caution
1. Drain flushing
   Remove drainage from air filters regularly.
Auto switch / Common Precautions 1
Be sure to read before handling. Refer to the main text for precautions for each series.

⚠️ Warning

1. Confirm the specifications.
   Read the specifications carefully and use this product appropriately. The product may be damaged or malfunction if it is used outside the specifications of current voltage, temperature or impact.

2. Use caution when multiple cylinders are used in close proximity to each other.
   When two or more auto switch cylinders are lined up in close proximity to each other, magnetic field interference may cause the switches to malfunction. Maintain a minimum cylinder separation of 40mm. (When the allowable interval is specified for each cylinder series, use the indicated value.)

3. Use caution to the ON time of a switch at the intermediate position of stroke.
   When an auto switch is placed at an intermediate position of the stroke and a load is driven at the time the piston passes, the auto switch will operate, but if the speed is too fast, the operating time will be shortened and the load may not operate properly. The maximum detectable piston speed is:

   \[ V (\text{mm/s}) = \frac{\text{Auto switch operation range (mm)}}{\text{Load operating time (ms)}} \times 1000 \]

   In cases of high piston speed, the use of an auto switch (D-F5NT, F7NT, G5NT and M5□T) with a built-in OFF delay timer (approx. 200ms) makes it possible to extend the load operating time.

4. Wiring should be kept as short as possible.
   <Reed switch>
   As the length of the wiring to a load gets longer, the rush current at switching ON becomes greater, and this may shorten the product's life. (The switch will stay ON all the time).
   1) For an auto switch without a contact protection circuit, use a contact protection box when the wire length is 5m or longer.
   2) Even if an auto switch has a built-in contact protection circuit, when the wiring is more than 30m long, it is not able to adequately absorb the rush current and its life may be reduced. It is again necessary to connect a contact protection box in order to extend its life. Please contact SMC in this case.
   <Solid state switch>
   3) Although wire length should not affect switch function, use a wire 100m or shorter.

5. Use caution to internal voltage drop of a switch.
   <Reed switch>
   1. Switches with an indicator light (except D-A56/A76H/ A96/A96 V/C76/E76A/Z76)
      * If auto switches are connected in series as shown below, please note that there will be a large voltage drop because of internal resistance in the light emitting diodes. (Refer to internal voltage drop in the auto switch specifications.)
      * The voltage drop will be \( n \) times larger when \( n \) auto switches are connected.
      The load may be ineffective even though the auto switch function is normal.
      • Similarly, when operating below a specified voltage, it is possible that the load may be ineffective even though the auto switch function is normal. Therefore, the formula below should be satisfied after confirming the minimum operating voltage of the load.

   \[ \text{Power voltage} - \text{Internal voltage drop of switch} > \text{Minimum operating voltage of load} \]

   2) If the internal resistance of a light emitting diode causes a problem, select a switch without an indicator light (D-A6□, A80, A80H, A90, A90V, C80, R80, 90, E80A, Z80).
   <Solid state switch>
   3) Generally, the internal voltage drop will be greater with a 2-wire solid state auto switch than with a reed switch. Take the same precautions as in 1).
   Also please note that a 12VDC relay is not applicable.

6. Use caution to the leakage current.
   <Solid state switch>
   With a 2-wire solid state auto switch, current (leakage current) flows to the load to operate the internal circuit even when in the OFF state.

   Current to operate load (OFF condition) > Leakage current
   If the condition given in the above formula is not met, it will not reset correctly (stays ON). Use a 3-wire switch if this specification cannot be satisfied.

   Moreover, leakage current flow to the load will be \( n \) times larger when \( n \) auto switches are connected in parallel.

7. Do not use a load that generates surge voltage.
   <Reed switch>
   When driving a load such as a relay that generates a surge voltage, use a switch with a built-in contact protection circuit or a contact protection box.
   <Solid state switch>
   Although a zener diode for surge protection is connected to the output side of a solid state auto switch, damage may still occur if the surge is applied repeatedly. When a load, such as a relay or solenoid, which generates surge is directly driven, use a type of switch with a built-in surge absorbing element.

8. Cautions for use in an interlock circuit
   When an auto switch is used for an interlock signal requiring high reliability, devise a double interlock system to avoid trouble by providing a mechanical protection function, or by also using another switch (sensor) together with the auto switch. Also perform periodic maintenance inspections and confirm proper operation.

9. Ensure sufficient space for maintenance activities.
   When designing an application, be sure to allow sufficient space for maintenance and inspection.
Auto switch / Common Precautions 2
Be sure to read before handling. Refer to the main text for precautions for each series.

⚠️ Warning

1. Do not drop or bump.
   - Do not drop, bump, or apply excessive impacts (300m/s² or more for reed switches and 1000m/s² or more for solid state switches) while handling. Although the body of the switch may not be damaged, the inside of the switch could be damaged and cause a malfunction.

2. Do not carry a cylinder by the auto switch lead wires.
   - Never carry a cylinder by its lead wires. This may not only cause broken lead wires, but it may cause internal elements of the switch to be damaged by the stress.

3. Mount switches using the proper tightening torque.
   - When a switch is tightened beyond the range of tightening torque, the mounting screws or switch may be damaged. On the other hand, tightening below the range of tightening torque may allow the switch to slip out of position.

4. Mount a switch at the center of the operating range.
   - Adjust the mounting position of an auto switch so that the piston stops at the center of the operating range (the range in which a switch is ON). (The mounting positions shown in the catalog indicate the optimum position at the stroke end). If mounted at the end of the operating range (around the borderline of ON and OFF), the operation will be unstable.

   - Applications where an auto switch is used to detect intermediate stopping positions (Detecting time is prolonged).
   - Applications where at the end, the stopping position shifting range is larger than the operation range
   - e.g. Workpiece pushing, pressing into a hole, or clamping
   - Applications where an auto switch is used to detect intermediate stopping positions (Detecting time is shortened).

As indicated above, mount a switch at the center of the operating range.

⚠️ Wiring

5. Do not allow short circuiting of loads.
   - <Reed switch>
     - If the power is turned on with a load in a short circuited condition, the switch will be instantly damaged because of excess current flow into the switch.
   - <Solid state switch>
     - Models M-F9(L)(V), F9(W)(V), J51, G5NB and all models of PNP output switches do not have built-in short circuit prevention circuits. If loads are short circuited, the switches will be instantly damaged.
     - Use caution to avoid reverse wiring with the brown power supply line and the black output line on 3-wire type switches.

6. Avoid incorrect wiring.
   - <Reed switch>
     - A 24VDC switch with indicator light has polarity. The brown lead wire or terminal No.1 is (+), and the blue lead wire or terminal No.2 is (–).
     - [In the case of model D-97, the side without indicator is (+) and the blue line side is (–).]
     - 1) If connections are reversed, a switch will operate, however, the light emitting diode will not light up.
       - Also please note that a current greater than the maximum specified one will damage a light emitting diode and make it inoperable.
       - Applicable models
         - D-A73, A73H, A73C, C73, C73C, E73A, Z73, R73
         - D-97, 93A, A93, A93V
         - D-A33, A33A, A34A, A44, A44A
         - D-A53, A54, B53, B54
     - 2) However, when using a 2 color indication auto switch (D-A79W, A59W, B59W), be aware that the switch will constantly remain ON if the connections are reversed.

   - <Solid state switch>
     - 1) If connections are reversed on a 2-wire type switch, the switch will not be damaged if protected by a protection circuit, but the switch will always stay in an ON state. However, it is still necessary to avoid reversed connections, since the switch could be damaged by a load short circuit in this condition.
     - 2) If connections are reversed (power supply line (+) and power supply line (–) on a 3-wire type switch, the switch will be protected by a protection circuit. However, if the power supply line (+) is connected to the blue wire and the power supply line (–) is connected to the black wire, the switch will be damaged.

D-M9□ does not have built-in short-circuit prevention circuits. Reverse connection of power supply line (+) and (–) may damage the switch.
Auto switch / Common Precautions 3
Be sure to read before handling. Refer to the main text for precautions for each series.

⚠️ Warning

1. Never use in the presence of explosive gases.
   Our auto switches are not explosion proof. Never use them in the presence of explosive gas, as this may cause a serious explosion.

2. Do not use in an area where a magnetic field is generated.
   Auto switches will malfunction or magnets inside cylinders will become demagnetized. (Please consult with SMC regarding the availability of a magnetic field resistant auto switch.)

3. Do not use in environments where the auto switches will be constantly exposed to water.
   Although switches except D-A3□/A44□/G39□/K39□ satisfy the IEC standard IP67 structure (JIS C 0920: anti-immersion structure), do not use switches in applications where continually exposed to water splash or spray. Poor insulation or swelling of the potting resin inside switches may cause malfunction.

4. Do not use in environments with oil or chemicals.
   Please consult with SMC if auto switches will be used in an environment with coolants, cleaning solvents, various oils or chemicals. If auto switches are used under these conditions for even a short time, they may be adversely affected by improper insulation, a malfunction due to swelling of the potting resin, or hardening of the lead wires.

5. Do not use in environments with temperature cycles.
   Please consult with SMC if switches are to be used where there are temperature cycles other than normal temperature changes, as they may be adversely affected internally.

6. Do not use in environments where there is excessive impact shock.
   <Reed switch>
   When excessive impact (300 m/s² or more) is applied to a reed switch during operation, the contact point may malfunction and generate or cut off a signal momentarily (1ms or less). Please consult with SMC regarding the need to use a solid state switch depending on the environment.

7. Do not use in locations where surges are generated.
   <Solid state switch>
   When there are units (solenoid type lifter, high frequency induction furnaces, motors, etc.) which generate a large amount of surge in the area around cylinders with solid state auto switches, this may cause deterioration or damage to the switches. Avoid sources of surge generation and crossed lines.

8. Avoid close contact with magnetic substances.
   When a magnetic substance (substance attracted by a magnet) is brought into close proximity with an auto switch cylinder, it may cause the auto switches to malfunction due to a loss of the magnetic force inside the cylinder.

⚠️ Warning

1. Perform the following maintenance periodically in order to prevent possible danger due to unexpected auto switch malfunction.
   1) Securely tighten switch mounting screws.
      If screws become loose or the mounting position is dislocated, retighten screws securely after readjusting the mounting position.
   2) Confirm that there is no damage to lead wires.
      To prevent faulty insulation, replace switches or repair lead wires if damage is discovered.
   3) Confirm that the green light on the 2-color indicator type switch lights up.
      Confirm that the green LED is ON when stopped at the set position. If the red LED is ON when stopped at the set position, the mounting position is not appropriate. Readjust the mounting position until the green LED lights up.

⚠️ Warning

1. Please consult with SMC concerning water resistance, elasticity of lead wires, etc.

*Lead wire color changes*

<table>
<thead>
<tr>
<th>2-wire system</th>
<th>3-wire system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output (+)</td>
<td>Old Red</td>
</tr>
<tr>
<td>Output (-)</td>
<td>Black Blue</td>
</tr>
<tr>
<td>Solid state with diagnostic output</td>
<td>Old Brown</td>
</tr>
<tr>
<td>Power supply +</td>
<td>Red Brown</td>
</tr>
<tr>
<td>Power supply GND</td>
<td>Black Blue</td>
</tr>
<tr>
<td>Output</td>
<td>White Black</td>
</tr>
<tr>
<td>Diagnostic output</td>
<td>Yellow Orange</td>
</tr>
</tbody>
</table>

⚠️ Caution

1. When stripping the cable clad, take care with the orientation of the cable being stripped. The insulator may accidentally be torn or damaged depending on the orientation. (D-M9□ only)

Recommended tools are shown below.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Model name</th>
<th>Model no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>VESSEL</td>
<td>Wire stripper</td>
<td>No 3000G</td>
</tr>
<tr>
<td>TOKYO IDEAL</td>
<td>Strip master</td>
<td>45-089</td>
</tr>
</tbody>
</table>

*Stripper for round cable (ø2.0) can be used for a 2-wire type cable.*
## Cylinder Applicable auto switch list

<table>
<thead>
<tr>
<th>Cylinder series</th>
<th>CD2</th>
<th>CD_M</th>
<th>CD_B2</th>
<th>CD_G1</th>
<th>CD_A2</th>
<th>CD_JU</th>
<th>CD_Q2</th>
<th>CD_Q2_E</th>
<th>CE</th>
<th>CXS</th>
<th>MG</th>
<th>MP</th>
<th>FM</th>
<th>MX</th>
<th>CP</th>
<th>CDQX</th>
<th>CDQZ</th>
<th>CD_M2X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bore size</td>
<td>ø6</td>
<td>ø10 to ø16</td>
<td>ø20 to ø40</td>
<td>ø20 to ø63</td>
<td>ø90 ø100</td>
<td>ø12 to ø63</td>
<td>ø6 to ø10</td>
<td>ø12 to ø25</td>
<td>ø6 to ø40</td>
<td>ø6 to ø10</td>
<td>ø6 to ø25</td>
<td>ø6 to ø10</td>
<td>ø6 to ø25</td>
<td>ø6 to ø16</td>
<td>ø6 to ø25</td>
<td>ø6 to ø25</td>
<td>ø6 to ø25</td>
<td>ø6 to ø40</td>
</tr>
</tbody>
</table>

**D-C7/C8**
- D-C73/C80C
- D-B5/B6
- D-B59W
- D-A3/A4
- D-A3. /A44A
- D-A3. C/A44C
- D-A7/A8
- D-A7. H/A80H
- D-A73C/A80C
- D-A79W
- D-A5/A6
- D-A59W
- D-A9
- D-A9. V
- D-27/28
- D-H7
- D-H7C
- D-H7BAL
- D-H7. F
- D-H7. W
- D-G5/K5
- D-G5BAL
- D-G5F
- D-G5NTL
- D-G5. /WKS9W
- D-G39/K39
- D-G39A/K39A
- D-F7/J7
- D-J7C
- D-F7. F
- D-F7BAL
- D-F7BAVL
- D-F7. V
- D-F7NTL
- D-F7. W (V)
- D-F5/G5
- D-F5BAL
- D-F5. W/J59W
- D-F5. F
- D-F5NTL
- D-G39C/K39C
- D-M9
- D-M9. V
- D-F9. W
- D-F9. WV
- D-F9BAL
- D-F9BAL
- D-F9G/H
- D-Y7. W
- D-Y7. WV
- D-Y7BAL
- D-P5. WL
- D-G5NBL
- D-P5.

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Please refer to the next page for applicable auto switches and cylinders in the fields marked with asterisks (*).
Safety Instructions

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), Japan Industrial Standards (JIS)*1 and other safety regulations*2.

*1) ISO 4414: Pneumatic fluid power – General rules relating to systems.
ISO 4413: Hydraulic fluid power – General rules relating to systems.
IEC 60204-1: Safety of machinery – Electrical equipment of machines. (Part 1: General requirements)
JIS B 8370: General rules for pneumatic equipment.
JIS B 8361: General rules for hydraulic equipment.
JIS B 9960-1: Safety of machinery – Electrical equipment of machines. (Part 1: General requirements)
etc.

*2) Labor Safety and Sanitation Law, etc.

1. The compatibility of the product is the responsibility of the person who designs the equipment or decides its specifications.
Since the product specified here is used under various operating conditions, its compatibility with specific equipment must be decided by the person who designs the equipment or decides its specifications based on necessary analysis and test results. The expected performance and safety assurance of the equipment will be the responsibility of the person who has determined its compatibility with the product. This person should also continuously review all specifications of the product referring to its latest catalog information, with a view to giving due consideration to any possibility of equipment failure when configuring the equipment.

2. Only personnel with appropriate training should operate machinery and equipment.
The product specified here may become unsafe if handled incorrectly. The assembly, operation and maintenance of machines or equipment including our products must be performed by an operator who is appropriately trained and experienced.

3. Do not service or attempt to remove product and machinery/equipment until safety is confirmed.
1. The inspection and maintenance of machinery/equipment should only be performed after measures to prevent falling or runaway of the driven objects have been confirmed.
2. When the product is to be removed, confirm that the safety measures as mentioned above are implemented and the power from any appropriate source is cut, and read and understand the specific product precautions of all relevant products carefully.
3. Before machinery/equipment is restarted, take measures to prevent unexpected operation and malfunction.

4. Contact SMC beforehand and take special consideration of safety measures if the product is to be used in any of the following conditions.
1. Conditions and environments outside of the given specifications, or use outdoors or in a place exposed to direct sunlight.
2. Installation on equipment in conjunction with atomic energy, railways, air navigation, space, shipping, vehicles, military, medical treatment, combustion and recreation, or equipment in contact with food and beverages, emergency stop circuits, clutch and brake circuits in press applications, safety equipment or other applications unsuitable for the standard specifications described in the product catalog.
3. An application which could have negative effects on people, property, or animals requiring special safety analysis.
4. Use in an interlock circuit, which requires the provision of double interlock for possible failure by using a mechanical protective function, and periodical checks to confirm proper operation.

Caution: Operator error could result in injury or equipment damage.

Warning: Operator error could result in serious injury or loss of life.

Danger: In extreme conditions, there is a possibility of serious injury or loss of life.
## Safety Instructions

### Caution

The product is provided for use in manufacturing industries. The product herein described is basically provided for peaceful use in manufacturing industries. If considering using the product in other industries, consult SMC beforehand and exchange specifications or a contract if necessary. If anything is unclear, contact your nearest sales branch.

## Limited Warranty and Disclaimer/Compliance Requirements

The product used is subject to the following “Limited Warranty and Disclaimer” and “Compliance Requirements”. Read and accept them before using the product.

### Limited Warranty and Disclaimer

1. The warranty period of the product is 1 year in service or 1.5 years after the product is delivered. *3)
   Also, the product may have specified durability, running distance or replacement parts. Please consult your nearest sales branch.
2. For any failure or damage reported within the warranty period which is clearly our responsibility, a replacement product or necessary parts will be provided.
   This limited warranty applies only to our product independently, and not to any other damage incurred due to the failure of the product.
3. Prior to using SMC products, please read and understand the warranty terms and disclaimers noted in the specified catalog for the particular products.
   * 3) Vacuum pads are excluded from this 1 year warranty.
      A vacuum pad is a consumable part, so it is warranted for a year after it is delivered.
      Also, even within the warranty period, the wear of a product due to the use of the vacuum pad or failure due to the deterioration of rubber material are not covered by the limited warranty.

### Compliance Requirements

When the product is exported, strictly follow the laws required by the Ministry of Economy, Trade and Industry (Foreign Exchange and Foreign Trade Control Law).
Clean series: Common Precautions 1
Be sure to read before handling.
Refer to the main text for detailed precautions on every series.

Air Supply

Caution
System Configuration
Refer to the “Air Preparation System” below for the quality of compressed air before configuring the system.

Piping
1. Provide an inclination of 1cm per meter in the direction of the air flow to the main piping.
2. If there is a line branching from the main piping, provide an outlet of compressed air on top using a tee so that drainage accumulated in the piping will not flow out.
3. Provide a drainage mechanism at every recessed point or dead end to prevent drain accumulation.
4. For future piping extensions, plug the end of the piping with a tee.
5. Before piping
Before piping, the piping should be thoroughly blown out with air (flushed) or washed to remove chips, cutting oil and other debris from inside the pipe.
6. Wrapping of pipe tape
When screwing piping or fittings into ports, ensure that chips from the pipe threads or sealing material do not get inside the valve. Also, when pipe tape is used, leave 1.5 to 2 thread ridges exposed at the end of the threads.

7. If air with a low dew point (–40°C or less) is required, do not use nylon tube or resin fitting (except for fluorine resin) for the outlet side of the membrane air dryer or heatless air dryer. Nylon tubing could be affected by the ambient air and it thus might not be possible to achieve the prescribed low dew point at the end of the tube. Therefore, for low dew point air, use stainless steel or fluorine tube.

Maintenance
1. If the heatless air dryer Series ID is left unused for a long period, the absorbent may be moistened. Prior to use, close the valve on the outlet side of the dryer for regeneration and drying.

Caution on Design
Employ a safe design, so that the following unexpected conditions will not occur.

Warning
1. Provide a design that prevents high-temperature compressed air from flowing into the outlet side of the cooling equipment.
If the flow of the coolant water in a water-cooled aftercooler is stopped or if the fan motor of an air cooled aftercooler is stopped, the high-temperature compressed air will flow to the outlet side of the cooling equipment, causing the equipment on the outlet side (such as the AFF, AM, AD, or IDF series) to be damaged or to malfunction.
2. Provide a design in which interruptions in the supply of compressed air are taken into consideration.
3. Design a layout in which the leakage of the coolant water and the dripping of condensation are taken into consideration. A water-cooled aftercooler that uses coolant water could lead to water leakage due to freezing. Depending on the operating conditions, the refrigerated air dryer and its downstream pipes could create a dripping of water droplets due to condensation formed by supercooling.

4. Provide a design that prevents back pressure and backflow. The generation of back pressure and backflow could lead to equipment damage. Take appropriate safety measures, including the proper installation methods.

5. Depending on the model and operating conditions, the life span of air cylinders may be shortened when they are used in an environment of super dry air (atmospheric pressure dew point: -50°C) or high-purity nitrogen gas or when such super dry air or high-purity nitrogen gas is used as the fluid. Please contact with SMC for further details on applicable series, models, operating conditions and life spans.

6. Blowing system
Even a small amount of dust can be a problem for blowing systems. Install Clean Gas Filter Series SF to the end of the blowing line.
Clean series: Common Precautions 2

Be sure to read before handling.
Refer to the main text for detailed precautions on every series.

Piping: Inside of Clean Room

⚠️ Caution

1. Do not make the piping for the air cylinder relief port and regulator breathing vent piping common with solenoid valve exhaust piping.
   This can cause malfunctions in the air cylinder or regulator pressure change.

2. Arrange the piping so that the exhaust air of the solenoid valves is exhausted outside of the clean room.

3. Air filter drain piping
   Exhaust drainage outside the clean room through piping from the drain guide of the air filter.

4. Arrange the membrane dryer air purge piping using a standard size tubing so that air is exhausted outside the clean room.

5. Take precautions so that the threaded portion of the piping connection or the tubing connection will not be loosened.
   Take sufficient precautions against the piping shaking along with the vibration of the equipment.

6. Use polyurethane tubing containing no plasticizer.

Handling

⚠️ Caution

1. The inner bag of a double-packed clean series package should be opened in a clean room or clean environment.

2. When standard pneumatic equipment is brought into a clean room, spray high-purity air upon it and remove dust thoroughly by wiping the external surfaces of the cylinder tube, solenoid valves and air line equipment with alcohol.

3. To replace parts or disassemble the product in a clean room, first exhaust the compressed air inside the piping to the outside of the clean room before the work.

4. Do not use rotation type mounting brackets such as clevises, trunnions, etc.. They will generate a considerable amount of particulate matter due to the sliding friction between the metal parts.

Lubrication / In the Case of Actuator

⚠️ Warning

Be sure to wash your hands after handling fluororesin grease. The grease itself is not hazardous but it can produce a hazardous gas at temperatures exceeding 260°C.

⚠️ Caution

1. Do not use any greases but those specified by SMC.
   Use of greases not specified will cause malfunctions or particle generation.

2. Do not lubricate the products since they are of a nonlubricant type.
   As the clean series actuators are lubricated at the factory with fluororesin grease, the product specifications may not be satisfied if turbine oil or other such lubricants are applied.

Piston speed

⚠️ Caution

The cylinder speed upper limit that retains the particle generation grade is 400 mm/s.
Clean series: Common Precautions 3
Be sure to read before handling.
Refer to the main text for detailed precautions for every series.

Suction flow rate of vacuum suction types

⚠️ Caution
For the vacuum suction types (Series 11-/13-/22-), perform vacuum suction at the vacuum port to retain the particle generation grade.
The optimum suction flow rate varies depending on series and sizes. Refer to “Suction flow rate of vacuum suction type (Reference values)” for each series. (The vacuum pressure will be approximately -27 kPa at around 1 m from the vacuum suction port.) Please consult SMC for further details.

Adjust the measured vacuum pressure using a regulator to be the value in the graphs below.

<table>
<thead>
<tr>
<th>Piping length (m)</th>
<th>Vacuum pressure (MPa)</th>
</tr>
</thead>
</table>
| 1  | -0.027
| 2  | -0.028
| 3  | -0.029
| 4  | -0.030
| 5  | -0.031
| 6  | -0.032

<table>
<thead>
<tr>
<th>Piping length (m)</th>
<th>Vacuum pressure (MPa)</th>
</tr>
</thead>
</table>
| 1  | -0.001
| 2  | -0.002
| 3  | -0.003
| 4  | -0.004
| 5  | -0.005
| 6  | -0.006
| 7  | -0.007
| 8  | -0.008
| 9  | -0.009
| 10 | -0.010

Location where vacuum pressure is measured
Vacuum source

Back matter 6