SMC Pneumatic
Clean Room Equipment

**Clean Series**

Suitable for clean environment. Prevents particle generation in clean room.

**Applicable equipment**
- Actuators (Cylinders, Rotary actuators, Air grippers), Directional control equipment, Flow control equipment, Filters, Pressure control equipment, Fittings/Tubing, Air preparation equipment, Pressure switches
- Note) The 11-, 12-, and 13- series are only applicable to actuators.

**Special Clean Series**

Adheres to an even higher standard of cleanliness than the Clean Series.
The development of this line of products, from structure and materials to assembly environment, are all determined for clean environment use.

**Applicable equipment**
- Clean rodless cylinders, Clean regulators, Clean One-touch fittings, Clean tubing, Clean gas filters, Clean air filters

**Copper, Fluorine, Silicone-free, Low-particle Generation**

Suitable for environments where the presence of copper, fluorine or silicone materials is restricted.
Structures are identical to the Clean Series. (Grease and packaging are different from the Clean Series.)

**Applicable equipment**
- Actuators (Cylinders, Rotary actuators, Air grippers), Directional control valves, Flow control equipment, Pressure control equipment, Fittings
- Note) The 22- series is only applicable to actuators.
Dust is kept from the clean room.

- After inspection, the product is blown with high purity air (of ISO Class 5 equivalent clean bench) in a clean environment.
- Products are sealed and shipped in antistatic double bags.

The 21- and 22-series are given standard packaging (assembly, inspection, packing, and shipping carried out in a standard workshop.) Please contact SMC for clean packaging.
## Basic Specifications of Actuators

<table>
<thead>
<tr>
<th>Construction</th>
<th>Series 10-</th>
<th>Series 11-</th>
<th>Series 12-</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Constructions</strong></td>
<td>• Double seal type/ release to atmosphere</td>
<td>• Single seal type/ vacuum suction</td>
<td>• Compact guide cylinder</td>
</tr>
<tr>
<td></td>
<td>Relief port</td>
<td>Bushing</td>
<td>Vacuum port (vacuum suction)</td>
</tr>
<tr>
<td></td>
<td>Rod seal</td>
<td>Rod seal</td>
<td>Bushing</td>
</tr>
<tr>
<td>Restricted material</td>
<td>None</td>
<td>Fluorine grease</td>
<td>General environments (assembly and inspection in a workshop)</td>
</tr>
<tr>
<td>Grease</td>
<td></td>
<td>General environments (assembly and inspection in a workshop)</td>
<td></td>
</tr>
<tr>
<td>Assembly environment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Packaging</td>
<td>Clean packaging: Products are sealed in antistatic double bags after</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Basic Specifications of Other Equipment

<table>
<thead>
<tr>
<th>Construction</th>
<th>Series 10-</th>
<th>Special</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Constructions</strong></td>
<td>• Directional control valve</td>
<td>• Compressed air cleaning filter series</td>
</tr>
<tr>
<td></td>
<td>Main valve and pilot valve common exhaust</td>
<td>• Modular F.R.</td>
</tr>
<tr>
<td></td>
<td>Fittings, speed controllers, pressure switches, etc. have the same structure as those of standard.</td>
<td>With female thread</td>
</tr>
<tr>
<td>Restricted material</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Grease</td>
<td>Fluorine grease</td>
<td></td>
</tr>
<tr>
<td>Assembly environment</td>
<td>General environments (assembly and inspection in a workshop)</td>
<td>Parts are</td>
</tr>
<tr>
<td>Packaging</td>
<td>Clean packaging: Products are sealed in antistatic double bags</td>
<td></td>
</tr>
</tbody>
</table>
### Clean Series

<table>
<thead>
<tr>
<th>Parts</th>
<th>Series 13-</th>
<th>Special Clean Series</th>
<th>Series 21-</th>
<th>Series 22-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metals</td>
<td>• Compact guide cylinder</td>
<td>• Clean rodless cylinder</td>
<td>• Double seal type/ release to atmosphere</td>
<td>• Single seal type/ vacuum suction</td>
</tr>
<tr>
<td></td>
<td>• Air slide table</td>
<td>P.939</td>
<td>P.773</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Single seal type/ vacuum suction</td>
<td>No contact between the cylinder tube exterior and the slider interior</td>
<td>Relief port</td>
<td>Bushing</td>
</tr>
<tr>
<td></td>
<td>(11- series equivalent) and specially treated guide</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ball bushing guide</td>
<td>Linear guide</td>
<td>Rod seal</td>
<td>Rod seal</td>
</tr>
<tr>
<td></td>
<td>Linear guide</td>
<td>Special treatment</td>
<td></td>
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<tr>
<td></td>
<td>None</td>
<td>Copper, fluorine and silicone-free</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Fluorine grease</td>
<td>Lithium soap based grease</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
|        | Parts are washed and assembled in a clean room. | | General environments (assembly and inspection in a workshop) | Standard packaging^{Note}
|        | blow to the surface with clean air. | | | |

### Series 21-

- **Clean One-touch fittings (for driving air piping)** P.1225
- **Clean speed controller** P.1291
- **Clean gas filter** P.1055
- **Clean air filter** P.1039
- **Clean exhaust filter** P.1060
- **Clean exhaust valve** P.36
- **Modular F.R.** P.1068
- **Clean speed controller** P.1291

- **Directional control valve** P.36
- **Clean One-touch fittings (for driving air piping)** P.1225
- **Clean speed controller** P.1291

- **The same construction as the 10- series**
- **No sealant on thread parts**
- **UNI thread is also applicable.** (Made to Order)

- **Clean air module** P.1039

### Special Packaging

- P.1280
- P.1281
- P.1282
- P.1300
- P.1301
- P.1302
- P.1303

Note: Please contact SMC for clean packaging.

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### Clean Rodless Cylinder

- **Directional control valve** P.36
- **Modular F.R.** P.1068
- **Clean speed controller** P.1291

<table>
<thead>
<tr>
<th>Parts</th>
<th>Series 21-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metals</td>
<td>None</td>
</tr>
<tr>
<td>Metals</td>
<td>Copper, fluorine and silicone-free</td>
</tr>
<tr>
<td>Metals</td>
<td>Lithium soap based grease</td>
</tr>
</tbody>
</table>

- **Clean One-touch fittings (for driving air piping)** P.1225
- **Clean speed controller** P.1291

- **Clean gas filter** P.1055
- **Clean air filter** P.1039
- **Clean exhaust filter** P.1060
- **Clean exhaust valve** P.36
- **Modular F.R.** P.1068
- **Clean speed controller** P.1291

- **Directional control valve** P.36
- **Clean One-touch fittings (for driving air piping)** P.1225
- **Clean speed controller** P.1291

- **The same construction as the 10- series**
- **No sealant on thread parts**
- **UNI thread is also applicable.** (Made to Order)

- **Clean air module** P.1039

### Clean One-touch fittings

- **Polypropylene resin**
- **Metal parts**
  - Brass (Electroless nickel plated)
  - Stainless steel 304

- **Clean One-touch fittings (for driving air piping)**
  - P.1225
- **Clean speed controller**
  - P.1291

- **Clean gas filter**
  - From P.1011

- **Clean air filter**
  - From P.1011

- **Clean exhaust filter**
  - P.1060

- **Clean exhaust valve**
  - P.36

- **Modular F.R.**
  - P.1068

- **Clean speed controller**
  - P.1291

- **Directional control valve**
  - P.36

- **Clean One-touch fittings (for driving air piping)**
  - P.1225

- **Clean speed controller**
  - P.1291

- **Clean air module**
  - P.1039

- **Clean exhaust valve**
  - P.36

- **Modular F.R.**
  - P.1068

- **Clean speed controller**
  - P.1291

- **Directional control valve**
  - P.36

- **Clean One-touch fittings (for driving air piping)**
  - P.1225

- **Clean speed controller**
  - P.1291

- **Clean air module**
  - P.1039

- **Clean exhaust valve**
  - P.36

- **Modular F.R.**
  - P.1068

- **Clean speed controller**
  - P.1291

- **Directional control valve**
  - P.36

- **Clean One-touch fittings (for driving air piping)**
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- **Clean speed controller**
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- **Clean exhaust valve**
  - P.36

- **Modular F.R.**
  - P.1068

- **Clean speed controller**
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- **Directional control valve**
  - P.36

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- **Clean air module**
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- **Clean exhaust valve**
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- **Modular F.R.**
  - P.1068

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  - P.1291

- **Directional control valve**
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  - P.1068

- **Clean speed controller**
  - P.1291

- **Directional control valve**
  - P.36
The following are the actuator driving system and circuit configuration of the 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**
  - Series 10-/12-/21- (Atmospheric release type)
  - Series 11-/13-/22- (Vacuum suction type)

- **Exhaust piping for solenoid valve**
- **Breathing piping for regulator**
- **Drain piping**
- **Exhaust cleaner for clean room/AMP series**
- **Clean exhaust filter/SFE series**

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, or connect the clean exhaust filter SFE series to relief port piping.

**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, or connect the clean exhaust filter SFE series to relief port piping.

**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 used locally.

* The symbol for the cylinder is an original SMC symbol.
Clean Blow System

Example of equipment to suit each clean blow grade

Line A: For clean blow
Line B: For clean blow (with clean gas filter or with clean air filter)
Line C: For N₂ blow

![Graph showing particle generation with time]

Example of Air Line Equipment

- Line A
- Line B

Fittings: Clean One-touch fittings
Piping: Polyolefine tubing
Clean: Oil-free, Assembled in clean room

Example of N₂ Equipment

- Line C

Feature (Line C)

Excellent corrosion resistance
(Body: Stainless steel 316L)
Integrated fitting
Seal material: Fluoropolymer or Stainless steel
Precision cleaning, Assembled in clean room
The position of the pneumatic equipment to the workpiece is determined by the degree of particle generation.

Particle generation grade no. of pneumatic equipment ≤ Particle concentration grade no. around workpiece

### Selection Procedure

1. **Required clean room cleanliness?**
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 1 to 3 above.**  
   (Refer to Table 1.)
5. **Select the equipment to be used.**  
   (Refer to pages 18 to 29.)

### Table 1: Particle Concentration Grade around the Workpiece (Guide)

<table>
<thead>
<tr>
<th>Cleanliness required on the workpiece</th>
<th>Air flow</th>
<th>Installation location of equipment</th>
<th>Cleanliness Class (Reference)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 3</td>
<td>A: Air flow is blocked/B: Convection currents are frequently generated</td>
<td>Upper area of the workpiece</td>
<td>ISO Class 3 (JIS Class 3)</td>
</tr>
<tr>
<td>Class 4</td>
<td>A: Air flow is blocked/B: Convection currents are frequently generated</td>
<td>Lower area of the workpiece</td>
<td>M1.5 (ISO 14644-1)</td>
</tr>
<tr>
<td>Class 5</td>
<td>A: Air flow is blocked/B: Convection currents are frequently generated</td>
<td>Upper area of the workpiece</td>
<td>M2.5 (ISO 14644-1)</td>
</tr>
<tr>
<td>Class 6</td>
<td>A: Air flow is blocked/B: Convection currents are frequently generated</td>
<td>Lower area of the workpiece</td>
<td>M3.5 (ISO 14644-1)</td>
</tr>
</tbody>
</table>

Note: Fed.Std.209E was abolished in Nov. 2001, so these figures are for reference only.

ISO Class 3
ISO Class 4
ISO Class 5
ISO Class 6
ISO Class 7
ISO Class 8

Series 10-
(Series 12-, 21-)

Standard product

Series 11-
(Series 13, 22-)

Standard product

Series 10-
(Series 12, 21-)

Standard product

Series 10-
(Series 12, 21-)

Standard product

Series 10-
(Series 12, 21-)

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(Series 12, 21-)

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(Series 12, 21-)

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Series 10-
(Series 12, 21-)

Standard product

Series 10-
(Series 12, 21-)}}
## Cleanliness Class

### Directional Control Valves

<table>
<thead>
<tr>
<th>Description</th>
<th>Series</th>
<th>Cleanliness class (ISO class)</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Standard</td>
<td>10-</td>
</tr>
<tr>
<td>4/5 Port Solenoid Valve</td>
<td>10-SY3000/5000/7000/9000</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>10-SV1000/2000/3000/4000</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>10-SYJ3000/5000/7000</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>10-SZ3000</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>10-S0700</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>10-VQ1000/2000</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>10-SQ1000/2000</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>10-VQD1000</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>3 Port Solenoid Valve</td>
<td>10-V100</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>10-SYJ300/500/700</td>
<td>5</td>
<td>3</td>
</tr>
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<td></td>
<td>10-SY100</td>
<td>5</td>
<td>3</td>
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<td></td>
<td>10-S070</td>
<td>5</td>
<td>3</td>
</tr>
</tbody>
</table>

Note 1) ISO classes apply to threaded port connection type. Different classes apply to the One-touch fittings. For details, refer to page 1385.

Note 2) Please consult with SMC separately for SY connector type.

Values in show ISO classes. No class applies to blanks.
## Cleanliness Class

### Air Cylinders

<table>
<thead>
<tr>
<th>Description</th>
<th>Series</th>
<th>Cleanliness class (ISO class)</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Air Cylinder Standard</strong></td>
<td>10-/11- CJ2</td>
<td>5 4 3</td>
<td>From P.685</td>
</tr>
<tr>
<td></td>
<td>10-/11- CJ2-Z</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10-/11- CJ2W-Z</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct mount type</td>
<td>10-/11- CJ2RA-Z</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Air Cylinder Standard</strong></td>
<td>10-/11- CM2-Z</td>
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<td>10-/11- CUJ</td>
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<td>Free Mount Cylinder</td>
<td>10-/11- CDU</td>
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<td><strong>Magnetically Coupled Rodless Cylinder: Basic Type</strong></td>
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Values in | show ISO classes.
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## Air Cylinders

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<tr>
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Values in blue show ISO classes. No class applies to blanks.

MXP6 without adjuster is not available.
Clean room specifications are not available for MXP8.
### Air Cylinders

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<tr>
<td><strong>Compact Guide Cylinder</strong></td>
<td>12-MGPL-Z</td>
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<td>21-MGPL</td>
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<td><strong>Guide Table Cylinder</strong></td>
<td>10-MGF</td>
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<td><strong>Dual Rod Cylinder</strong></td>
<td>Ball bushing</td>
<td>11-CXSJL 5 3 4 5 3</td>
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<td>11-CXSJM 6 3 6</td>
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<td>10-CXSL 5 4 3 4 5 3</td>
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**CXSJ**

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**CXS**

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### Rotary Actuators

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<tbody>
<tr>
<td>Vane</td>
<td>10-21-CRB1</td>
<td>6 4 4</td>
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<td>Rack &amp; Pinion</td>
<td>11-CRA1-Z</td>
<td>5 4</td>
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<td>Rotary Table</td>
<td>11-22-MSQ</td>
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### Air Grippers

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<tbody>
<tr>
<td>2 Finger Air Gripper</td>
<td>11-22-MHZ2</td>
<td>6 4</td>
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<td>2 Finger Parallel Type</td>
<td>11-22-MHL2</td>
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<td>Wide Opening Air Gripper</td>
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<td>Rotary Actuated Air Gripper</td>
<td>2 finger</td>
<td>11-22-MHR2</td>
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<td>3 finger</td>
<td>11-22-MHR3</td>
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Values in show ISO classes.
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# Cleanliness Class

## Air Preparation Equipment

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<td>Membrane Air Dryer</td>
<td>10-IDG□A</td>
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<td>10-IDG</td>
<td>5 3</td>
<td>P.950</td>
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<tr>
<td>Main Line Filter</td>
<td>10-AFF2C to 22C, 10-AFF37B, 75B</td>
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<tr>
<td>Mist Separator</td>
<td>10-AM150C to 550C, 10-AM650, 850</td>
<td>5 3</td>
<td>P.966</td>
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<td>Micro Mist Separator</td>
<td>10-AMD150C to 550C, 10-AM650, 850</td>
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<td>P.973</td>
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<tr>
<td>Micro Mist Separator with Pre-filter</td>
<td>10-AMH150C to 550C, 10-AMH650, 850</td>
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<td>Super Mist Separator</td>
<td>10-AME150C to 550C, 10-AME650, 850</td>
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<td>Odor Removal Filter</td>
<td>10-AMF150C to 550C, 10-AMF650, 850</td>
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<td>Clean Gas Filter: Cartridge Type</td>
<td>SFA100/200/300</td>
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<td>Clean Gas Filter: Cartridge Type</td>
<td>SFB100</td>
<td>3</td>
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<td>Clean Gas Strainer: Cartridge Type</td>
<td>SFB200</td>
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<td>Clean Gas Filter: Disposable Type</td>
<td>SFB300</td>
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## Cleanliness Class

### Air Preparation Equipment

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<td>SFD100</td>
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<td>Clean Air Filter: Cartridge Type</td>
<td>SFD101/102</td>
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<td>Clean Air Filter: Cartridge Type</td>
<td>SFD200</td>
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<td>Clean Air Module</td>
<td>LLB</td>
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<td>Exhaust Cleaner for Clean Room</td>
<td>AMP220 to 420</td>
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<td>Clean Exhaust Filter Male thread type</td>
<td>SFE1/3/4/5/7</td>
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<td>Clean Exhaust Filter Plug-in type</td>
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Values in [ ] show ISO classes.
## Modular F.R.

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<td>10^-21- AF20 to 60-A</td>
<td>5 3 3</td>
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<td>Mist Separator</td>
<td>10^-21- AFM20 to 40-A</td>
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<td>Micro Mist Separator</td>
<td>10^-21- AFD20 to 40-A</td>
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<td>Regulator</td>
<td>10^-21- AR20 to 60-B</td>
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<td>Regulator with Backflow Function</td>
<td>10^-21- AR20K to 60K-B</td>
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<td>Filter Regulator</td>
<td>10^-21- AW20 to 60-B</td>
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<td>Filter Regulator with Backflow Function</td>
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<td>Mist Separator Regulator</td>
<td>10^-21- AWM20 to 40</td>
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## Pressure Control Equipment

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<td>10-21- ARP20 to 40</td>
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<td>Direct Operated Precision Regulator with Backflow Function</td>
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<td>Precision Regulator</td>
<td>10-IR1000 to 3000</td>
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<td>Vacuum Regulator</td>
<td>10-IRV10/20</td>
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<td>Clean Regulator</td>
<td>SRH3000/4000</td>
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## Fittings & Tubing

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<td>10-KQ2</td>
<td>6 5</td>
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<td>Insert Fittings</td>
<td>10-KF</td>
<td>5 3</td>
<td>P.1190</td>
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<td>Miniature Fittings</td>
<td>10-M</td>
<td>5 3</td>
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<td>Rectangular Multi-connector</td>
<td>10-KDM</td>
<td>6 5</td>
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<td>Stainless Steel One-touch Fittings</td>
<td>10-KG</td>
<td>6 5</td>
<td>P.1206</td>
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<td>Stainless Steel Miniature Fittings</td>
<td>10-MS</td>
<td>5 3</td>
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<td>For blowing</td>
<td>KP</td>
<td>3</td>
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<td>For driving air piping</td>
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<td>Polyurethane Tubing</td>
<td>10-TU</td>
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<td>Polyurethane Flat Tubing</td>
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Values in blue show ISO classes.
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## Cleanliness Class

### Flow Control Equipment

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<td>With Indicator: Elbow Type/Universal Type</td>
<td>10-AS-FS</td>
<td><img src="chart" alt="ISO Class" /></td>
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<tr>
<td>Speed Controller: Elbow Type/Universal Type</td>
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<td>10-AS</td>
<td><img src="chart" alt="ISO Class" /></td>
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<tr>
<td>Dual Speed Controller</td>
<td>10-ASD</td>
<td><img src="chart" alt="ISO Class" /></td>
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<tr>
<td>Push-lock (Stainless steel): Elbow Type/Universal Type</td>
<td>10-AS-FG</td>
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<td>With Indicator (Stainless steel): Elbow Type/Universal Type</td>
<td>10-AS-FSG</td>
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<td>Stainless Steel Speed Controller: Elbow Type/Universal Type</td>
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<td>Stainless Steel Dual Speed Controller</td>
<td>10-ASD-FG</td>
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<tr>
<td>Speed Controller: Metal Elbow Type</td>
<td>10-AS1200 to 4200</td>
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<td>Speed Controller: In-line Type</td>
<td>10-AS1000 to 5000</td>
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<td>(21-)AS-FPQ</td>
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<td>Clean Speed Controller</td>
<td>(21-)AS-FPG</td>
<td><img src="chart" alt="ISO Class" /></td>
<td>P.1291</td>
</tr>
<tr>
<td>Speed Controller for Low Speed Operation: Elbow Type/Universal Type</td>
<td>10-AS-FM</td>
<td><img src="chart" alt="ISO Class" /></td>
<td>P.1294</td>
</tr>
</tbody>
</table>

Values in | show ISO classes.

No class applies to blanks.
### Cleanliness Class

#### Flow Control Equipment

<table>
<thead>
<tr>
<th>Description</th>
<th>Series</th>
<th>Cleanliness class (ISO class)</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Standard 10- 21-</td>
<td></td>
</tr>
<tr>
<td>Speed Controller for Low Speed Operation: In-line Type</td>
<td>10-AS-FM</td>
<td>6 5</td>
<td>P.1298</td>
</tr>
<tr>
<td>Dual Speed Controller for Low Speed Operation</td>
<td>10-ASD-FM</td>
<td>6 5</td>
<td>P.1301</td>
</tr>
</tbody>
</table>

#### Pressure Switches/Pressure Sensors

<table>
<thead>
<tr>
<th>Description</th>
<th>Series</th>
<th>Cleanliness class (ISO class)</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Standard 10- 21-</td>
<td></td>
</tr>
<tr>
<td>2-Color Display High-Precision Digital Pressure Switch</td>
<td>10-ZSE30A(F)/ISE30A</td>
<td>5 4</td>
<td>P.1312</td>
</tr>
<tr>
<td>2-Color Display High-Precision Digital Pressure Switch</td>
<td>10-ZSE40A(F)/ISE40A</td>
<td>5 4</td>
<td>P.1323</td>
</tr>
<tr>
<td>2-Color Display Digital Pressure Switch for General Fluids</td>
<td>10-ZSE80/ISE80</td>
<td>5 4</td>
<td>P.1340</td>
</tr>
<tr>
<td>For compact pneumatics</td>
<td>10-PSE530</td>
<td>5 4</td>
<td>P.1353</td>
</tr>
<tr>
<td>For compact pneumatics</td>
<td>10-PSE540</td>
<td>5 4</td>
<td>P.1355</td>
</tr>
<tr>
<td>For low differential pressure</td>
<td>10-PSE550</td>
<td>5 4</td>
<td>P.1357</td>
</tr>
<tr>
<td>For general fluids</td>
<td>10-PSE560</td>
<td>5 4</td>
<td>P.1359</td>
</tr>
<tr>
<td>Remote Type Pressure Sensor Controller/Multi-Channel</td>
<td>10-PSE200</td>
<td>3 3</td>
<td>P.1361</td>
</tr>
<tr>
<td>Remote Type 2-Color Display Digital Pressure Sensor Controller</td>
<td>10-PSE300</td>
<td>3 3</td>
<td>P.1366</td>
</tr>
</tbody>
</table>

#### Flow Switches

<table>
<thead>
<tr>
<th>Description</th>
<th>Series</th>
<th>Cleanliness class (ISO class)</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Standard 10- 21-</td>
<td></td>
</tr>
<tr>
<td>2-Color Display Digital Flow Switch</td>
<td>PFM7-X300 PFMB7-X300</td>
<td>4</td>
<td>Web Catalog</td>
</tr>
</tbody>
</table>

Values in show ISO classes. No class applies to blanks.
The particle generation data for SMC Clean Series is measured with the following test method.

**Test Method (Example)**
Place the test sample 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 (28.3 x 10^{-3} m^3/min). Measure the changes in the particle concentration over time until the number of cycles reaches the specified point. The chamber is placed in an ISO Class 5 equivalent clean bench.

**Measuring Conditions**

<table>
<thead>
<tr>
<th>Chamber</th>
<th>Internal volume</th>
<th>28.3 x 10^{-3} m^3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Supply air quality</td>
<td>Same quality as the supply air</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measuring instrument</th>
<th>Description</th>
<th>Automatic particle counter using light-scattering method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum measurable particle diameter</td>
<td>0.1 µm</td>
<td></td>
</tr>
<tr>
<td>Suction flow rate</td>
<td>28.3 x 10^{-3} m^3/min</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Setting conditions</th>
<th>Sampling time</th>
<th>30 min</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Interval time</td>
<td>30 min</td>
</tr>
<tr>
<td></td>
<td>Sampling air flow</td>
<td>850 x 10^{-3} m^3</td>
</tr>
</tbody>
</table>

**Evaluation Method**
To obtain the measured values of particle concentration, the accumulated value Note 1) of particles captured every 30 minutes by the laser dust monitor, is converted into the particle concentration every 1 m^3. When determining particle generation classes, the 95% upper confidence limit of the average particle concentration (average value) when each test sample is operated at a specified number of cycles Note 2) 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.

**Particle Generation Characteristics** (The particle generation data is representative and not guaranteed.)

**Series CQ2-Z**

**Series CM2-Z**

*The symbol for the cylinder is an original SMC symbol.*

Note 1) Sampling air flow rate: Number of particles contained in 850 x 10^{-3} m^3 of air
Note 2) Actuator: 1 million cycles
Solenoid valve: 10 million cycles
Particle Generation Measuring Method

- **Particle Generation Characteristics** (The particle generation data is representative and not guaranteed.)

**Series CXSL**

<table>
<thead>
<tr>
<th>Particle concentration (particles/m³)</th>
<th>Particle diameter (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10,000,000</td>
<td>10,000,000</td>
</tr>
<tr>
<td>1,000,000</td>
<td>1,000,000</td>
</tr>
<tr>
<td>100,000</td>
<td>100,000</td>
</tr>
<tr>
<td>10,000</td>
<td>10,000</td>
</tr>
<tr>
<td>1,000</td>
<td>1,000</td>
</tr>
<tr>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

**Series MGPL-Z**

<table>
<thead>
<tr>
<th>Particle concentration (particles/m³)</th>
<th>Particle diameter (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard product</td>
<td>1,000,000</td>
</tr>
<tr>
<td>12-MGPL</td>
<td>1,000,000</td>
</tr>
<tr>
<td>13-MGPL</td>
<td>1,000,000</td>
</tr>
</tbody>
</table>

**Series MHZ2**

<table>
<thead>
<tr>
<th>Particle concentration (particles/m³)</th>
<th>Particle diameter (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard product</td>
<td>100,000</td>
</tr>
<tr>
<td>11-MHZ2</td>
<td>100,000</td>
</tr>
</tbody>
</table>

**Series MHL2**

<table>
<thead>
<tr>
<th>Particle concentration (particles/m³)</th>
<th>Particle diameter (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard product</td>
<td>100,000</td>
</tr>
<tr>
<td>11-MHL2</td>
<td>100,000</td>
</tr>
</tbody>
</table>
Particle Generation Measuring Method

**Particle Generation Characteristics** (The particle generation data is representative and not guaranteed.)

- **Series MHR2**
  - Particle generation data for 11-MHR2
  - Particle concentration (particles/m³) vs. particle diameter (µm)

- **Series MHR3**
  - Particle generation data for 11-MHR3
  - Particle concentration (particles/m³) vs. particle diameter (µm)

- **Series CRB1**
  - Particle generation data for 10-CRB
  - Particle concentration (particles/m³) vs. particle diameter (µm)

- **Series MSQ**
  - Particle generation data for 11-MSQ
  - Particle concentration (particles/m³) vs. particle diameter (µm)
Particle Generation Measuring Method

**Particle Generation Characteristics** (The particle generation data is representative and not guaranteed.)

**Series MXQ**

![Image of Series MXQ]

**Series MXS**

![Image of Series MXS]

**Series SY**

![Image of Series SY]
### Comparison of Cleanliness Standards (Reference)

<table>
<thead>
<tr>
<th>Standard</th>
<th>ISO 14644-1</th>
<th>JIS B 9920</th>
<th>Fed.Std.209E (Note)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleanliness class</td>
<td>ISO Class 1 to 9</td>
<td>JIS Class 1</td>
<td>(British unit)</td>
</tr>
<tr>
<td>Corresponding class</td>
<td>ISO Class 2</td>
<td>JIS Class 2</td>
<td>(SI unit)</td>
</tr>
<tr>
<td></td>
<td>ISO Class 3</td>
<td>JIS Class 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ISO Class 4</td>
<td>JIS Class 4</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>ISO Class 5</td>
<td>JIS Class 5</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>ISO Class 6</td>
<td>JIS Class 6</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>ISO Class 7</td>
<td>JIS Class 7</td>
<td>10000</td>
</tr>
<tr>
<td></td>
<td>ISO Class 8</td>
<td>JIS Class 8</td>
<td>100000</td>
</tr>
<tr>
<td></td>
<td>ISO Class 9</td>
<td>JIS Class 9</td>
<td></td>
</tr>
<tr>
<td>Cleanliness class definition</td>
<td>The number of particles diameter 0.1 μm or larger in an air volume of 1 m³ is expressed as 10^N.</td>
<td>The number of particles diameter 0.5 μm or larger in an air volume of 1 m³ is expressed as 10 M or coefficient Nc.</td>
<td></td>
</tr>
<tr>
<td>Calculation of max permitted concentration of particulates for cleanliness classes</td>
<td>Cn = 10^N x (0.1/D)^2.08</td>
<td>British unit: Number of particles/ft³ = Nc x (0.5/D)^2.2</td>
<td></td>
</tr>
<tr>
<td>Evaluation method using simple sampling</td>
<td>① Number of sampling locations: 2 to 9 95% UCL of the mean and the mean of the averages ② Number of sampling locations: 1, or 10 or more The mean</td>
<td>① Number of sampling locations: 2 to 9 95% UCL of the mean and the mean of the averages ② Number of sampling locations: 10 or more The mean</td>
<td></td>
</tr>
<tr>
<td>Number of sampling locations</td>
<td>Derive from the area of the clean room or clean air controlled space. Number of sampling locations Nl = (A)^0.5 At least one location</td>
<td>① Non-unidirectional air flow: at least two locations Nl = A x 64/(10 M)^0.5 ② Unidirectional air flow: at least two locations Smaller value between Nl = A/2.32, Nl = A x 64/(10 M)^0.5</td>
<td></td>
</tr>
<tr>
<td>Min. sampling air flow volume</td>
<td>2 liters or a sufficient volume of air that a minimum of 20 particles can be counted if the particle concentration were at the class limit. Min. sampling time: 1 minute</td>
<td>2 liters or a sufficient volume of air that a minimum of 20 particles can be counted if the particle concentration were at the class limit.</td>
<td></td>
</tr>
<tr>
<td>Number of samplings</td>
<td>Where only one sampling location is required, take a minimum of three single sample volumes at that location.</td>
<td>Total number of samplings in each clean zone: 5 times or more</td>
<td></td>
</tr>
<tr>
<td>Sampling method</td>
<td>Suction in the same direction as the air flow If the direction of the air flow is not predictable, the inlet of the sampling probe shall be directed vertically upward.</td>
<td>5.0 μm or larger: Constant velocity and suction in the same direction of the air flow 0.5 to 5 μm: Correction possible when it is sucked at a nonconstant velocity</td>
<td></td>
</tr>
</tbody>
</table>

Note) Fed.Std.209E was abolished in Nov. 2001, so these figures are for reference only.
### ISO Standard (ISO 14644-1)/JIS Standard (JIS B 9920)

<table>
<thead>
<tr>
<th>Cleanliness class</th>
<th>Maximum concentration limit (particles/m³)</th>
<th>Fed.Std.209E equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sampling particle diameter (µm)</td>
<td>(British unit)</td>
</tr>
<tr>
<td></td>
<td>0.1 µm</td>
<td>0.2 µm</td>
</tr>
<tr>
<td>Class 1</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Class 2</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Class 3</td>
<td>1,000</td>
<td>10⁷</td>
</tr>
<tr>
<td>Class 4</td>
<td>10,000</td>
<td>10⁸</td>
</tr>
<tr>
<td>Class 5</td>
<td>100,000</td>
<td>10⁹</td>
</tr>
<tr>
<td>Class 6</td>
<td>1,000,000</td>
<td>10¹⁰</td>
</tr>
<tr>
<td>Class 7</td>
<td>—</td>
<td>10¹⁰</td>
</tr>
<tr>
<td>Class 8</td>
<td>—</td>
<td>10¹⁰</td>
</tr>
<tr>
<td>Class 9</td>
<td>—</td>
<td>10¹⁰</td>
</tr>
</tbody>
</table>

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

### U.S. Federal Standard (Fed.Std.209E: British unit)

<table>
<thead>
<tr>
<th>Cleanliness class</th>
<th>Maximum concentration limit (particles/ft³)</th>
<th>Sampling particle diameter (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.1 µm</td>
<td>0.2 µm</td>
</tr>
<tr>
<td>Class 1</td>
<td>35</td>
<td>8</td>
</tr>
<tr>
<td>Class 10</td>
<td>350</td>
<td>75</td>
</tr>
<tr>
<td>Class 100</td>
<td>3,500</td>
<td>750</td>
</tr>
<tr>
<td>Class 1,000</td>
<td>35,000</td>
<td>7,500</td>
</tr>
<tr>
<td>Class 10,000</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Class 100,000</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

### U.S. Federal Standard (Fed.Std.209E: SI unit)

<table>
<thead>
<tr>
<th>Cleanliness class</th>
<th>Maximum concentration limit (particles/m³)</th>
<th>Sampling particle diameter (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.1 µm</td>
<td>0.2 µm</td>
</tr>
<tr>
<td>Class M1</td>
<td>350</td>
<td>76</td>
</tr>
<tr>
<td>Class M1.5</td>
<td>1,240</td>
<td>265</td>
</tr>
<tr>
<td>Class M2</td>
<td>3,900</td>
<td>757</td>
</tr>
<tr>
<td>Class M2.5</td>
<td>12,400</td>
<td>2,650</td>
</tr>
<tr>
<td>Class M3</td>
<td>35,000</td>
<td>7,570</td>
</tr>
<tr>
<td>Class M3.5</td>
<td>—</td>
<td>26,500</td>
</tr>
<tr>
<td>Class M4</td>
<td>—</td>
<td>75,700</td>
</tr>
<tr>
<td>Class M4.5</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Class M5</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Class M5.5</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Class M6</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Class M6.5</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

Note: Number of particles 0.1 µm or larger contained in 1 m³ (particles/m³)

### Cleanliness class

- ISO: ISO Class 1 to 35
- JIS: Class No. 1 to 10
- U.S.: Fed.Std.209E

### Particle Concentration Equation

\[ C_n = 10^{0.1} \times (0.1/D)^{2.08} \]

- \( C_n \): The maximum permitted concentration of airborne particles that are equal to or larger than the sampling particle diameter (D).
- \( C_n \) 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)
- \( D \): Sampling particle diameter (µm)
- 0.1: Constant number (µm)

### Table: Concentration Data

<table>
<thead>
<tr>
<th>Sampling particle diameter (µm)</th>
<th>0.1 µm</th>
<th>0.2 µm</th>
<th>0.3 µm</th>
<th>0.5 µm</th>
<th>1 µm</th>
<th>5 µm</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1 µm</td>
<td>10</td>
<td>10</td>
<td>2</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>0.2 µm</td>
<td>100</td>
<td>100</td>
<td>24</td>
<td>10</td>
<td>4</td>
<td>—</td>
</tr>
<tr>
<td>0.3 µm</td>
<td>1,000</td>
<td>10⁷</td>
<td>237</td>
<td>102</td>
<td>35</td>
<td>8</td>
</tr>
<tr>
<td>0.5 µm</td>
<td>10,000</td>
<td>10⁸</td>
<td>2,370</td>
<td>1,020</td>
<td>352</td>
<td>83</td>
</tr>
<tr>
<td>1 µm</td>
<td>100,000</td>
<td>10⁹</td>
<td>23,700</td>
<td>10,200</td>
<td>3,520</td>
<td>832</td>
</tr>
<tr>
<td>5 µm</td>
<td>1,000,000</td>
<td>10¹⁰</td>
<td>237,000</td>
<td>102,000</td>
<td>35,200</td>
<td>8,320</td>
</tr>
</tbody>
</table>

**Note:** Number of particles 0.1 µm or larger contained in 1 m³ (particles/m³)

**Note:** Number of particles 0.5 µm or larger contained in 1 ft³ (particles/ft³)
Clean Series Precautions 1
Be sure to read this before handling products. 
Refer to the main text for detailed precautions for every series.

Air Supply

Caution

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

Main line

1. Provide an inclination of 1 cm 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 flushed out with air or washed to remove chips, cutting oil and other debris from inside the pipe.
6. Winding of sealant 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 sealant tape is used, leave approx. 1 thread ridge exposed at the end of the threads.
7. After piping
   After piping, the piping should be thoroughly flushed out with air, and dust generated when piping should be removed.

8. If air with a low dew point (–40°C or less) is required, do not use nylon tubes or resin fittings (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 thus may not be able to achieve the prescribed low dew point at the end of the tube. Therefore, for low dew point air, use stainless steel or fluorine tubes and fittings.

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

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. There are cases in which compressed air cannot flow due to freezing of the refrigerated air dryer or a malfunction (heatless dryer) in the switching valve.

⚠️ Caution

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 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. When super dry air is used as the fluid, equipment reliability (service life) may be adversely affected due to deteriorating lubrication properties inside the equipment. Please consult SMC in such cases.

6. Blowing system
Even a small amount of dust can be a problem for blowing systems. Install Clean Gas Filter or Clean Air Filter Series SF to the end of the blowing line.
Clean Series Precautions 2
Be sure to read this before handling products.
Refer to the main text for detailed precautions for every series.

**Piping: Inside of Clean Room**

⚠️ Caution

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

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 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 piping shaking along with vibration of the equipment.

6. Use polyurethane tubing containing no plasticizer.

7. In case of the One-touch fitting 10-KQ (that includes built-in One-touch fitting solenoid valve manifolds, and speed controllers with One-touch fittings), changes in internal pressure may cause the collet chuck to slide very slightly. This may result in particle generation, so please avoid using this item in ISO Class 3 or ISO Class 4 areas. However, there is no need for similar caution in the case of insert fittings (KF), miniature fittings (M/MS), clean One-touch fittings (KP/KPQ/KPG), or speed controllers with clean One-touch fittings (AS-FPQ/FPG).

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**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 onto 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.

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**Lubrication for Actuators**

⚠️ 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.
Clean Series Precautions 3
Be sure to read this before handling products.
Refer to the main text for detailed precautions for every series.

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**Lubrication for Actuators**

⚠️ **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 non-lubricant 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.

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**Piston Speed**

⚠️ **Caution**

The air cylinder speed upper limit that retains the particle generation grade is 400 mm/s. When the maximum operating speed for the standard type is 400 mm/s or slower, operate the series within the operating speed range.

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**Suction Flow Rate of Vacuum Suction Types**

⚠️ **Caution**

For vacuum suction types (11-/13-/22-Series), perform vacuum suction at the vacuum port to retain the particle generation grade.

The optimum suction flow rate varies depending on the series and size. 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.

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*The symbol for the cylinder is an SMC original symbol.*