Static Electricity Prevention Equipment

Antistatic Equipment
- Don’t charge static electricity (Conductivity)
- Fittings
- Pad
- Speed Controller

Electrostatic Removal Equipment
- Eliminates static electricity (Electrostatic removal)
- Tubing
- Ionizer
- Electrostatic Sensor

Measurement Equipment
- Confirms (Confirmation)
- Electrostatic Sensor
SMC eliminates a variety of static

Prevents adhesion of foreign materials such as dust. (Dust or particle removal)

Prevents electrostatic breakdown of electric parts. (ESD)

Prevents discomfort due to electric shock. (Electric shock)

Measurement Equipment (Handheld)
Confirming electrostatic charge and removal of electricity
Handheld Electrostatic Meter  P.27

Electrostatic Removal Equipment
Removing electricity by ionizer
Ionizer  P.18
Related Equipment  P.24

Front matter 1
Antistatic Equipment

- Fittings P.3
- Tubing P.8
- Speed Controller with One-touch Fitting P.10
- Vacuum Pad P.12
- Antistatic Air Cylinder P.17

Measurement Equipment (for FA Devices)

Measuring amount of electrostatic charge of a workpiece.
- Confirming electrostatic condition of a workpiece.
- Checking quality

Electrostatic Sensor P.25
Examples of Static Electricity Generated Problems

Absorbing multiple sheets

Electrostatic breakdown of substrate and IC chips

Clogging of parts feeders

Failures while ejecting workpieces from unloaders

Discomfort due to electrical shocks at workplace

Uneven painting
Antistatic Equipment

Lineup of products with conductivity prevention

Friction, contact and detachment cause the build up of static electricity. Static electricity can be instantaneously removed from metals with low volume resistance (conductors) by grounding. Resin and rubber (insulators) which have high volume resistance, however, build up static electricity as it is not eliminated even through grounding. Charged substances cause various problems such as the destruction of devices by electrical discharge, dust adhesion, and the like. Hence, SMC has a lineup of products to which conductive resin and rubber are applied in order to remove static electricity.

SMC’s conductive resin and rubber incorporates the following volume resistance materials.

**Volume Resistance (Ω·m) for Reference**

<table>
<thead>
<tr>
<th>Materials</th>
<th>Electric resistance</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resin, Rubber (Insulator)</td>
<td>$10^{12}$ to $10^{18}$ Ω·m</td>
<td>Some static electricity does not attenuate after charging. Grounding is not useful.</td>
</tr>
<tr>
<td>Conductive resin, Conductive rubber</td>
<td>$10^{11}$ Ω·m or less</td>
<td>It is possible to remove static electricity by seconds after grounding.</td>
</tr>
<tr>
<td>Metal (Conductor)</td>
<td>$10^{0}$ Ω·m or less</td>
<td>Static electricity can be instantaneously removed by grounding.</td>
</tr>
</tbody>
</table>

For reference: The following table shows the electric resistance and characteristics of major materials.
Antistatic Equipment INDEX

1 Fittings
- Antistatic One-touch Fittings Series KA ........................................... P. 3
- Miniature Fittings Series M/MS (Stainless steel 316) ......................... P. 6

2 Tubing
- Antistatic Tubing Series TAS/TAU .................................................. P. 8
- Antistatic Color Tubing TAU-X100 .................................................. P. 9

3 Speed Controller with One-touch Fitting
- Antistatic Speed Controller ......................................................... P. 11
  (In-line type/Elbow type)
  AS-X260

4 Vacuum Pad
- Vacuum Pad Series ZP ............................................................. P. 12
- Vacuum Pad Made to Order ..................................................... P. 13

5 Antistatic Air Cylinder
- Antistatic Air Cylinder .......................................................... P. 17
  CM2-X1051
• Possible to use from vacuum (−100 kPa)
• Can be used in copper-free application.
• Surface resistance $10^4$ to $10^7 \, \Omega$
• Conductive resin is used for body and seals in fittings and tubing.

Antistatic One-touch Fittings  Series KA

Seal
Can be used for a wide range of pressures from low vacuum up to a pressure of 1.0 MPa.
The use of a special profile ensures sealing and reduces resistance when the tube is inserted.

Chuck
Large retaining force
Has large retaining force while holding force is increased by the collet.

Body (Black)

Stud
Effective when piping in a confined space.
The body and the threaded portion can rotate (to the degree for positioning).

Release Button (Black)
Light force for removal
When the fitting is removed from the tubing, the check and collet are released, thus preventing them from biting into the tube excessively.

Main Parts Material

<table>
<thead>
<tr>
<th>Main Parts</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body</td>
<td>C3604BD, PBT</td>
</tr>
<tr>
<td>Stud</td>
<td>C3604BD</td>
</tr>
<tr>
<td>Chuck</td>
<td>Stainless steel 304</td>
</tr>
<tr>
<td>Guide</td>
<td>Stainless steel 304, C3604BD, PBT</td>
</tr>
<tr>
<td>Collet, Release button</td>
<td>PBT</td>
</tr>
<tr>
<td>Seal, O-ring</td>
<td>NBR</td>
</tr>
</tbody>
</table>

Grounding Method

When UNI thread screws are used metal contact occurs between female and male threads and the fittings do not become electro-statically charged.
(With taper threaded screws it is necessary to apply a sealant to the thread, which electrically insulates the fittings causing it to become charged.)

Caution
Chamfering bore øD (Recommended value)
Chamfering in accordance with the following table improves thread workability and prevents the occurrence of burrs.

<table>
<thead>
<tr>
<th>Female thread size</th>
<th>Chamfering bore øD (Recommended value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ø1/8</td>
<td>10.2 to 11.5</td>
</tr>
<tr>
<td>ø1/4</td>
<td>13.6 to 14.5</td>
</tr>
<tr>
<td>ø3/8</td>
<td>17.1 to 18.5</td>
</tr>
<tr>
<td>ø1/2</td>
<td>21.4 to 22.5</td>
</tr>
</tbody>
</table>

Applicable Tubing

<table>
<thead>
<tr>
<th>Tubing material</th>
<th>Antistatic soft nylon, Antistatic polyurethane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tubing O.D.</td>
<td>ø3.2, ø4, ø6, ø8, ø10, ø12</td>
</tr>
</tbody>
</table>

Specifications

<table>
<thead>
<tr>
<th>Fluid</th>
<th>Air</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating pressure range</td>
<td>−100 kPa to 1 MPa</td>
</tr>
<tr>
<td>Proof pressure</td>
<td>3 MPa</td>
</tr>
<tr>
<td>Ambient and fluid temperature</td>
<td>0 to 40°C</td>
</tr>
<tr>
<td>Thread</td>
<td>JIS B0205, Class 2 (Metric coarse thread)</td>
</tr>
<tr>
<td>Seal (Thread portion)</td>
<td>Gasket</td>
</tr>
<tr>
<td>Copper-free</td>
<td>Brass parts are all electroless nickel plated.</td>
</tr>
<tr>
<td>Surface resistance</td>
<td>$10^4$ to $10^7$ , \Omega</td>
</tr>
</tbody>
</table>
### Male Connector KAH

Used to pipe in the same direction from female threaded portion
Most common type

<table>
<thead>
<tr>
<th>Applicable tubing O.D. (mm)</th>
<th>Connection thread</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M5 x 0.8</td>
<td>KAH23-M5, KAH06-M5, KAH08-U01, KAH10-U01, KAH12-U02</td>
</tr>
<tr>
<td></td>
<td>M6 x 1</td>
<td>U01</td>
</tr>
<tr>
<td></td>
<td>Uni ½</td>
<td>U02</td>
</tr>
<tr>
<td></td>
<td>Uni ⅜</td>
<td>U03</td>
</tr>
</tbody>
</table>

#### Male Elbow KAL

Used to pipe in the same direction from female threaded portion
Most common type

<table>
<thead>
<tr>
<th>Applicable tubing O.D. (mm)</th>
<th>Connection thread</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M5 x 0.8</td>
<td>KAL23-M5, KAL06-M5, KAL08-U01, KAL10-U01, KAL12-U02</td>
</tr>
<tr>
<td></td>
<td>M6 x 1</td>
<td>U01</td>
</tr>
<tr>
<td></td>
<td>Uni ½</td>
<td>U02</td>
</tr>
<tr>
<td></td>
<td>Uni ⅜</td>
<td>U03</td>
</tr>
</tbody>
</table>

### Male Branch Tee KAT

Used for branching from a female threaded portion at 90° on both sides

<table>
<thead>
<tr>
<th>Applicable tubing O.D. (mm)</th>
<th>Connection thread</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M5 x 0.8</td>
<td>KAT23-M5, KAT06-M5, KAT08-U01, KAT10-U01, KAT12-U02</td>
</tr>
<tr>
<td></td>
<td>M6 x 1</td>
<td>U01</td>
</tr>
<tr>
<td></td>
<td>Uni ½</td>
<td>U02</td>
</tr>
<tr>
<td></td>
<td>Uni ⅜</td>
<td>U03</td>
</tr>
</tbody>
</table>

#### Male Run Tee KAY

Used for branching into the same direction and at 90° either from female threaded portion

<table>
<thead>
<tr>
<th>Applicable tubing O.D. (mm)</th>
<th>Connection thread</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M5 x 0.8</td>
<td>KAY23-M5, KAY06-M5, KAY08-U01, KAY10-U01, KAY12-U02</td>
</tr>
<tr>
<td></td>
<td>M6 x 1</td>
<td>U01</td>
</tr>
<tr>
<td></td>
<td>Uni ½</td>
<td>U02</td>
</tr>
<tr>
<td></td>
<td>Uni ⅜</td>
<td>U03</td>
</tr>
</tbody>
</table>

---

<UNI thread>
Male Branch Y KAU
Used for branching from a female threaded portion into the same direction

<table>
<thead>
<tr>
<th>Applicable tubing O.D. (mm)</th>
<th>Connection thread</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.2</td>
<td>M5 x 0.8</td>
<td>KAU23-M5</td>
</tr>
<tr>
<td></td>
<td>M6 x 1</td>
<td>M6-01</td>
</tr>
<tr>
<td></td>
<td>Uni 1/8</td>
<td>-U01</td>
</tr>
<tr>
<td>4</td>
<td>M5 x 0.8</td>
<td>KAU04-M5</td>
</tr>
<tr>
<td></td>
<td>M6 x 1</td>
<td>M6-01</td>
</tr>
<tr>
<td></td>
<td>Uni 1/8</td>
<td>-U01</td>
</tr>
<tr>
<td></td>
<td>Uni 1/4</td>
<td>-U02</td>
</tr>
<tr>
<td>6</td>
<td>M5 x 0.8</td>
<td>KAU06-M5</td>
</tr>
<tr>
<td></td>
<td>M6 x 1</td>
<td>M6-01</td>
</tr>
<tr>
<td></td>
<td>Uni 1/8</td>
<td>-U01</td>
</tr>
<tr>
<td></td>
<td>Uni 1/4</td>
<td>-U02</td>
</tr>
<tr>
<td></td>
<td>Uni 1/2</td>
<td>-U03</td>
</tr>
<tr>
<td>8</td>
<td>Uni 1/8</td>
<td>KAU08-U01</td>
</tr>
<tr>
<td></td>
<td>Uni 1/4</td>
<td>-U02</td>
</tr>
<tr>
<td></td>
<td>Uni 1/2</td>
<td>-U03</td>
</tr>
<tr>
<td>10</td>
<td>Uni 1/4</td>
<td>KAU10-U02</td>
</tr>
<tr>
<td></td>
<td>Uni 1/6</td>
<td>-U04</td>
</tr>
<tr>
<td></td>
<td>Uni 1/2</td>
<td>-U03</td>
</tr>
<tr>
<td></td>
<td>Uni 1/4</td>
<td>KAU12-U02</td>
</tr>
<tr>
<td></td>
<td>Uni 1/2</td>
<td>-U04</td>
</tr>
<tr>
<td></td>
<td>Uni 1/6</td>
<td>-U03</td>
</tr>
</tbody>
</table>

Union Tee KAT
Used for branch connections of tubes into two directions at 90° on both sides

<table>
<thead>
<tr>
<th>Applicable tubing O.D. (mm)</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.2</td>
<td>KAT23-00</td>
</tr>
<tr>
<td>4</td>
<td>KAT04-00</td>
</tr>
<tr>
<td>6</td>
<td>KAT06-00</td>
</tr>
<tr>
<td>8</td>
<td>KAT08-00</td>
</tr>
<tr>
<td>10</td>
<td>KAT10-00</td>
</tr>
<tr>
<td>12</td>
<td>KAT12-00</td>
</tr>
</tbody>
</table>

Union Y KAU
Used to branch a tubing in the same direction

<table>
<thead>
<tr>
<th>Applicable tubing O.D. (mm)</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.2</td>
<td>KAU23-00</td>
</tr>
<tr>
<td>4</td>
<td>KAU04-00</td>
</tr>
<tr>
<td>6</td>
<td>KAU06-00</td>
</tr>
<tr>
<td>8</td>
<td>KAU08-00</td>
</tr>
<tr>
<td>10</td>
<td>KAU10-00</td>
</tr>
<tr>
<td>12</td>
<td>KAU12-00</td>
</tr>
</tbody>
</table>

Different Dia. Straight Union KAH
Used to connect different size tubes

<table>
<thead>
<tr>
<th>Applicable tubing O.D. (mm)</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.2</td>
<td>KAH23-00</td>
</tr>
<tr>
<td>4</td>
<td>KAH04-00</td>
</tr>
<tr>
<td>6</td>
<td>KAH06-00</td>
</tr>
<tr>
<td>8</td>
<td>KAH08-00</td>
</tr>
<tr>
<td>10</td>
<td>KAH10-00</td>
</tr>
<tr>
<td>12</td>
<td>KAH12-00</td>
</tr>
</tbody>
</table>

Elbow KAL
Used to connect tubes at right angles

<table>
<thead>
<tr>
<th>Applicable tubing O.D. (mm)</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.2</td>
<td>KAL23-00</td>
</tr>
<tr>
<td>4</td>
<td>KAL04-00</td>
</tr>
<tr>
<td>6</td>
<td>KAL06-00</td>
</tr>
<tr>
<td>8</td>
<td>KAL08-00</td>
</tr>
<tr>
<td>10</td>
<td>KAL10-00</td>
</tr>
<tr>
<td>12</td>
<td>KAL12-00</td>
</tr>
</tbody>
</table>

Plug-in Reducer KAR
Used to change the diameter of one-touch fitting

<table>
<thead>
<tr>
<th>Applicable tubing O.D. (mm)</th>
<th>Applicable fitting size</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.2</td>
<td>4</td>
<td>KAR23-04</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
<td>KAR04-06</td>
</tr>
<tr>
<td>6</td>
<td>8</td>
<td>KAR06-08</td>
</tr>
<tr>
<td>8</td>
<td>10</td>
<td>KAR08-10</td>
</tr>
<tr>
<td>10</td>
<td>12</td>
<td>KAR10-12</td>
</tr>
<tr>
<td>12</td>
<td>12</td>
<td>KAR12-12</td>
</tr>
</tbody>
</table>
Miniature Fittings  Series M/MS  (Stainless steel 316)

**Hose nipple**, **Barb fitting**

**Barb**
Configuration for easy insertion into the tube
Holds the tube tightly.

**Body**

**Tube**
Applicable for soft nylon and polyurethane tubing

**Cap Nut**
Certainly hold the tube by manual clamping
Easy removal of tube by loosening

**Gasket**
Low tightening torque
Tight seal

---

**Compact piping space**
Hose nipple tubing connection/disconnection is simple while keeping a large retaining force.

**Line up various styles**
For air connection in confined areas

**Hose nipple, Hose elbow**
Applicable for soft nylon and polyurethane tubing

---

**Specifications**

<table>
<thead>
<tr>
<th>Applicable tubing material</th>
<th>Soft nylon Note1</th>
<th>Polyurethane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applicable tubing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M3</td>
<td>ø3.18/ø2.18</td>
<td>ø3.18/ø2</td>
</tr>
<tr>
<td>M5-R 1/8</td>
<td>ø4/ø2.5</td>
<td>ø4/ø2.5</td>
</tr>
<tr>
<td></td>
<td>ø4/ø2.5</td>
<td>ø6/ø4</td>
</tr>
<tr>
<td></td>
<td>ø3.18/ø2</td>
<td>ø4/ø2.5, ø6/ø4, ø2 x ø1.2</td>
</tr>
<tr>
<td>Max. operating pressure (at 20°C)</td>
<td>1 MPa</td>
<td>0.8 MPa</td>
</tr>
<tr>
<td>Connection size</td>
<td>M3, M5, R 1/8</td>
<td></td>
</tr>
<tr>
<td>Thread</td>
<td>Metric thread (JIS B0205 Class 2); Pipe thread (JIS B0203)</td>
<td>Air, Water Note2)</td>
</tr>
<tr>
<td>Fluid</td>
<td>Water: 0 to 40°C (with no freezing)</td>
<td></td>
</tr>
<tr>
<td>Ambient and fluid temperature</td>
<td>~50 to 60°C</td>
<td></td>
</tr>
</tbody>
</table>

**Main Parts Material**

<table>
<thead>
<tr>
<th>Material</th>
<th>Body</th>
<th>Gasket</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C3604BD (Nipple M-3N, M-5N: Stainless steel 303)</td>
<td>PVC, Stainless steel 304, NBR</td>
</tr>
</tbody>
</table>

---

**Series MS**  (Stainless steel 316)

**Specifications**

<table>
<thead>
<tr>
<th>Applicable tubing O.D./I.D.</th>
<th>Soft nylon Note1</th>
<th>Polyurethane</th>
</tr>
</thead>
<tbody>
<tr>
<td>ø3.18/ø2.18</td>
<td>ø4/ø2.5</td>
<td>ø3.18/ø2</td>
</tr>
<tr>
<td></td>
<td>ø6/ø4</td>
<td>ø4/ø2.5, ø6/ø4</td>
</tr>
<tr>
<td>Max. operating pressure (at 20°C)</td>
<td>1 MPa</td>
<td>0.8 MPa</td>
</tr>
<tr>
<td>Connection size</td>
<td>M5 (JIS B0205 Class 2; Metric coarse thread)</td>
<td>Air, Water Note2)</td>
</tr>
<tr>
<td>Fluid</td>
<td>Water: 0 to 40°C (with no freezing)</td>
<td></td>
</tr>
<tr>
<td>Ambient and fluid temperature</td>
<td>~50 to 60°C</td>
<td></td>
</tr>
</tbody>
</table>

**Main Parts Material**

<table>
<thead>
<tr>
<th>Material</th>
<th>Body</th>
<th>Gasket</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stainless steel 316</td>
<td>PVC</td>
</tr>
</tbody>
</table>

---

Note 1) Water is not available with soft nylon tubing.
Note 2) Available with hose nipple type only
## Caution

Although there are other miniature fittings in the General Catalog, they are not designed for antistatic applications. Only the following are available.

<table>
<thead>
<tr>
<th>Series</th>
<th>Model</th>
<th>Description</th>
<th>Application</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Series M</strong></td>
<td>M-3AU-2</td>
<td>Barb fitting for soft tubing</td>
<td>For polyurethane tubing</td>
<td>ø2/ø1.2 x M3</td>
</tr>
<tr>
<td></td>
<td>M-3AU-3</td>
<td>Barb fitting for soft tubing</td>
<td>For soft nylon tubing</td>
<td>ø3.18/2 x M3</td>
</tr>
<tr>
<td></td>
<td>M-3AU-4</td>
<td>Barb fitting for soft tubing</td>
<td>For soft nylon and polyurethane tubing</td>
<td>ø4/2.5 x M3</td>
</tr>
<tr>
<td></td>
<td>M-3N</td>
<td>Nipple</td>
<td>Fitting to workpiece and fitting to fitting connection</td>
<td>M3 male x M3 male</td>
</tr>
<tr>
<td></td>
<td>M-3P</td>
<td>Plug</td>
<td>Use to plug unused M3 port.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M-5AU-2</td>
<td>Barb fitting for soft tubing</td>
<td>For polyurethane tubing</td>
<td>ø2/ø1.2 x M5</td>
</tr>
<tr>
<td></td>
<td>M-5AU-3</td>
<td>Barb fitting for soft tubing</td>
<td>For soft nylon tubing</td>
<td>ø3.18/2 x M5</td>
</tr>
<tr>
<td></td>
<td>M-5AU-4</td>
<td>Barb fitting for soft tubing</td>
<td>For soft nylon and polyurethane tubing</td>
<td>ø4/2.5 x M5</td>
</tr>
<tr>
<td></td>
<td>M-5N</td>
<td>Nipple</td>
<td>Fitting to workpiece and fitting to fitting connection</td>
<td>M5 male x M5 male</td>
</tr>
<tr>
<td></td>
<td>M-5UN</td>
<td>Universal nipple</td>
<td>Body rotates at 360° around the stud axis.</td>
<td>M5 male x M5 male PAT.</td>
</tr>
<tr>
<td><strong>Series MS</strong></td>
<td>MS-5AU-3</td>
<td>Barb fitting for soft tubing</td>
<td>For polyurethane tubing</td>
<td>ø3.18 x ø1.2 x M5</td>
</tr>
<tr>
<td></td>
<td>MS-5AU-4</td>
<td>Barb fitting for soft tubing</td>
<td>For for soft nylon and polyurethane tubing</td>
<td>ø4/ø2.5 x M5</td>
</tr>
<tr>
<td></td>
<td>MS-5AU-6</td>
<td>Barb fitting for soft tubing</td>
<td>For soft nylon and polyurethane tubing</td>
<td>ø6/ø4 x M5</td>
</tr>
<tr>
<td></td>
<td>MS-5H-4</td>
<td>Hose nipple</td>
<td>For soft nylon and polyurethane tubing</td>
<td>ø4/ø2.5 x M5</td>
</tr>
<tr>
<td></td>
<td>MS-5H-6</td>
<td>Hose nipple</td>
<td>For soft nylon and polyurethane tubing</td>
<td>ø6/ø4 x M5</td>
</tr>
<tr>
<td></td>
<td>MS-5P</td>
<td>Plug</td>
<td>Use to plug unused M5 port.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MS-5E</td>
<td>Bulkhead union</td>
<td>Panel mount connection</td>
<td>M5 female x M5 female</td>
</tr>
<tr>
<td></td>
<td>MS-5ER</td>
<td>Bulkhead reducer</td>
<td>Reduction from Rc 1/8 to M5 including panel or bracket mounting</td>
<td>Rc 1/8 x M5 female</td>
</tr>
<tr>
<td></td>
<td>MS-5M</td>
<td>Manifold</td>
<td>For reducing Rc 1/8 female be diverted to up to 9, M5 stations, including panel or bracket mounting</td>
<td>Rc 1/8 x M5 female (9 stations)</td>
</tr>
<tr>
<td></td>
<td>MS-5P</td>
<td>Plug</td>
<td>Use to plug unused M5 port.</td>
<td></td>
</tr>
</tbody>
</table>
Antistatic Tubing  Series TAS/TAU

Antistatic Soft Nylon Tubing / Series TAS

Flame resistant
(equivalent to UL 94 Standard V-0)
$10^4$ to $10^7 \Omega$

<table>
<thead>
<tr>
<th>Model</th>
<th>TAS3222</th>
<th>TAS0425</th>
<th>TAS0604</th>
<th>TAS0805</th>
<th>TAS1065</th>
<th>TAS1208</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tubing O.D. (mm)</td>
<td>3.2</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>Tubing I.D. (mm)</td>
<td>2.2</td>
<td>2.5</td>
<td>4</td>
<td>5</td>
<td>6.5</td>
<td>8</td>
</tr>
</tbody>
</table>

Black (B)

Specifications
- Max. operating pressure (at 20°C): 1.2 MPa
- Burst pressure: Refer to the burst pressure characteristics curve.
- Min. bending radius (mm): 12, 12, 15, 19, 27, 32
- Operating temperature: 0 to 40°C
- Material: Conductive nylon + Flame resistant nylon (equivalent to UL 94 Standard V-0)
- Surface resistance: 10$^4$ to 10$^7$ Ω

Burst Pressure
Characteristics Curve and Operating Pressure

How to Order

TAS1065 B 100

Color: B Black

Symbol | Color | Length per roll
---|------|------------------
B | Black | 20 m roll
100 | 100 m reel

Made to Order

 Coil tubing
Antistatic Polyurethane Tubing / Series TAU

Soft type
$10^4$ to $10^7 \Omega$

Burst Pressure
Characteristics Curve and Operating Pressure

Max. operating pressure (MPa) vs. Operating temperature (°C)

<table>
<thead>
<tr>
<th>Burst pressure (MPa)</th>
<th>Operating temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>40</td>
</tr>
</tbody>
</table>

Specifications

<table>
<thead>
<tr>
<th>Fluid</th>
<th>Max. operating pressure (at 20°C)</th>
<th>Ambient and fluid temperature</th>
<th>Material</th>
<th>Surface resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>0.8 MPa</td>
<td>0 to 40°C</td>
<td>Antistatic polyurethane</td>
<td>$10^9$ Ω</td>
</tr>
</tbody>
</table>

Recommended fittings
Antistatic one-touch fittings: Series KA
Miniature fittings: Series M/MMS (Note)

How to Order

TAU1065B 100

Color
Symbol: B
Color: Black
Length per roll
Symbol: 100
Length: 100 m reel

Made to Order

Coil tubing
Flat tubing

Antistatic Polyurethane Tubing / –X100

• 5 colors
• Surface resistance $10^9 \Omega$

Specifications

<table>
<thead>
<tr>
<th>Fluid</th>
<th>Max. operating pressure (at 20°C)</th>
<th>Ambient and fluid temperature</th>
<th>Material</th>
<th>Surface resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>0.8 MPa</td>
<td>0 to 40°C</td>
<td>Antistatic polyurethane</td>
<td>$10^9$ Ω</td>
</tr>
</tbody>
</table>

Recommended fittings
Antistatic one-touch fittings: Series KA
Miniature fittings: Series M/MMS (Note)

How to Order

TAU0604BU 20 X100

Color
Symbol: BU
Color: Blue
Display: C
Color: Transparent

Tube roll length (m)
Symbol: 20
Length: 20 m roll

Note) Miniature fittings: The following models of the M/MMS series are only available.
Antistatic Speed Controller
(In-line type/Elbow type)

AS-X260
Made to Order

Electrostatic prevention measures for semiconductor manufacturing devices, etc.

It is possible to prevent products from being electro-statically charged by applying conductive materials (using conductive NBR seal) and grounding UNI thread structure\(^1\) (Gasket seal method).

\(^1\) Ensure that the female thread connected to the speed controller is grounded. If not grounded, there is a possibility that the controller and tube may remain charged. Antistatic tubes should also be used.

**Feature 1: Surface Resistance** \(10^4\) to \(10^7\) \(\Omega\) (Conductive material is applied to the body seal of the controller.)

**Features 2: Antistatic UNI Thread Structure** (Gasket seal method)

**Grounding Method**

When UNI thread screws are used metal contact occurs between female and male threads and the controller does not become electro-statically charged. (With taper threaded screws it is necessary to apply a sealant to the thread, which electrically insulates the controller causing it to become charged.)

**Specifications**

**Common Specifications**

<table>
<thead>
<tr>
<th>Type</th>
<th>Elbow</th>
<th>In-line</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>AS2201F-□-X260</td>
<td>AS0000F-□-X260</td>
</tr>
<tr>
<td>Fluid</td>
<td>Air</td>
<td></td>
</tr>
<tr>
<td>Proof pressure</td>
<td>1.5 MPa</td>
<td>1 MPa</td>
</tr>
<tr>
<td>Maximum operating pressure</td>
<td>1 MPa</td>
<td>0.7 MPa</td>
</tr>
<tr>
<td>Minimum operating pressure</td>
<td>0.1 MPa</td>
<td></td>
</tr>
<tr>
<td>Ambient and fluid temperature</td>
<td>-5 to 60°C (with no freezing)</td>
<td></td>
</tr>
<tr>
<td>Number of needle rotations</td>
<td>10 rotations</td>
<td>8 rotations</td>
</tr>
<tr>
<td>Applicable tubing material</td>
<td>Antistatic soft nylon tubing (Series TAS)</td>
<td>Antistatic polyurethane tubing (Series TAU)</td>
</tr>
<tr>
<td>Surface resistance</td>
<td>(10^4) to (10^7) (\Omega)</td>
<td></td>
</tr>
</tbody>
</table>

\(^2\) 8 rotations for AS12□1F-M5-04-X260 and AS12□1F-M5-06-X260

**Series Variation**

<table>
<thead>
<tr>
<th>Type</th>
<th>Model</th>
<th>Port size</th>
<th>Applicable tubing O.D.</th>
<th>Applicable cylinder bore size (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meter-out</td>
<td>Meter-in</td>
<td>4</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Elbow</td>
<td>AS1201F-M5</td>
<td>AS1211F-M5</td>
<td>M5 x 0.8</td>
<td>●</td>
</tr>
<tr>
<td>AS2201F-U01</td>
<td>AS2211F-U01</td>
<td>Uni1/8</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>AS2201F-U02</td>
<td>AS2211F-U02</td>
<td>Uni1/4</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>In-line</td>
<td>AS1000F</td>
<td>—</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

\(^3\) Contact SMC for models other than the above.

\(^4\) Manufactured upon receipt of order.
### Dimensions

#### Elbow type

![Diagram of Elbow type]

<table>
<thead>
<tr>
<th>Model</th>
<th>Applicable tubing O.D. ød</th>
<th>T</th>
<th>H</th>
<th>D1</th>
<th>D2</th>
<th>L1</th>
<th>L2</th>
<th>L3</th>
<th>L4</th>
<th>A(+)</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS1201F-M5-04-X260</td>
<td></td>
<td>4</td>
<td>10.4</td>
<td>9.6</td>
<td>20.6</td>
<td>25.4</td>
<td>12.2</td>
<td>28.8</td>
<td>26</td>
<td>25.2</td>
<td>22.4</td>
</tr>
<tr>
<td>AS1201F-M5-06-X260</td>
<td></td>
<td>6</td>
<td>12.8</td>
<td>14.2</td>
<td>23.1</td>
<td>30.2</td>
<td>14.3</td>
<td>36.4</td>
<td>31.4</td>
<td>31</td>
<td>26</td>
</tr>
<tr>
<td>AS2201F-U01-04-X260</td>
<td>Uni1/8</td>
<td>12</td>
<td>13.2</td>
<td>14.2</td>
<td>23.9</td>
<td>31</td>
<td>14.3</td>
<td>36.4</td>
<td>31.4</td>
<td>31</td>
<td>26</td>
</tr>
<tr>
<td>AS2201F-U01-08-X260</td>
<td>Uni1/8</td>
<td>12</td>
<td>15.2</td>
<td>14.2</td>
<td>25.3</td>
<td>32.4</td>
<td>16.1</td>
<td>20.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS2201F-U01-10-X260</td>
<td>Uni1/4</td>
<td>17</td>
<td>15.2</td>
<td>14.3</td>
<td>25.2</td>
<td>34.4</td>
<td>17.2</td>
<td>39.6</td>
<td>34.6</td>
<td>33</td>
<td>28</td>
</tr>
<tr>
<td>AS2201F-U02-04-X260</td>
<td>Uni1/4</td>
<td>17</td>
<td>15.2</td>
<td></td>
<td>27.2</td>
<td>36.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS2201F-U02-06-X260</td>
<td>Uni1/4</td>
<td>17</td>
<td>15.2</td>
<td></td>
<td>27.2</td>
<td>36.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS2201F-U02-08-X260</td>
<td>Uni1/4</td>
<td>17</td>
<td>15.2</td>
<td></td>
<td>27.2</td>
<td>36.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS2201F-U02-10-X260</td>
<td>Uni1/4</td>
<td>17</td>
<td>15.2</td>
<td></td>
<td>27.2</td>
<td>36.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*)Reference thread dimensions after installation.

#### In-line type

![Diagram of In-line type]

<table>
<thead>
<tr>
<th>Model</th>
<th>Applicable tubing O.D. ød</th>
<th>D1</th>
<th>D2</th>
<th>L1</th>
<th>L2</th>
<th>L3</th>
<th>L4</th>
<th>L5</th>
<th>L6</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS1000F-04-X260</td>
<td></td>
<td>4</td>
<td>3.2</td>
<td>10.4</td>
<td>44</td>
<td>13</td>
<td>25</td>
<td>14</td>
<td>11</td>
<td>15.8</td>
</tr>
<tr>
<td>AS1000F-06-X260</td>
<td></td>
<td>6</td>
<td>12.8</td>
<td>46</td>
<td>13.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.8</td>
</tr>
</tbody>
</table>

**For the safe use of the controller, be sure to read “Safety Precautions” in our company's Best Pneumatics General Catalog before handling.**
### Pad material
- Conductive NBR (Black with one white mark), Conductive silicon rubber (Black with two white marks)

### Pad shape
(Compatible with all models)

<table>
<thead>
<tr>
<th>Pad size</th>
<th>ø2 to 8: stroke 6, 10, 15, 25 mm</th>
<th>ø10 to 32: stroke 10, 20, 30, 40, 50 mm</th>
<th>ø40/50: stroke 10, 20, 30, 50 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
</tr>
<tr>
<td>Flat with ribs</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
</tr>
<tr>
<td>Deep</td>
<td>–</td>
<td>⬤</td>
<td>⬤</td>
</tr>
<tr>
<td>Bellows</td>
<td>–</td>
<td>⬤</td>
<td>⬤</td>
</tr>
<tr>
<td>Thin flat</td>
<td>–</td>
<td>⬤</td>
<td>⬤</td>
</tr>
</tbody>
</table>

### Model

**Vacuum entry**
- **Series ZPT**
  - Vertical vacuum entry
    - Male thread (Common)
    - Female thread (Common)

- **Series ZPR**
  - Lateral vacuum entry with one-touch fitting
    - With one-touch fitting
      - Male thread
      - Female thread

- **Series ZPY**
  - Lateral vacuum entry with barb fitting
    - With barb fitting
      - Male thread
      - Female thread

### Without buffer
- **Vacuum entry**
  - **Connection**
    - VAC

### With buffer
- **Vacuum entry**
  - **Connection**
    - VAC
    - Female thread
    - Buffer body
    - With barb fitting
    - Buffer body
    - With one-touch fitting
    - Buffer body
    - One-touch fitting

### Pad shape (Compatible with all models)
- Flat (U)
- Flat with ribs (C)
- Deep (D)
- Bellows (B)
- Thin flat (UT)
- Thin with ribs (CT)

### Pad size
- ø50
- ø40
- ø32
- ø25
- ø20
- ø16
- ø13
- ø10
- ø8
- ø6
- ø4
- ø2

### Pad material
- Pad shape and material:
  - Serious NBR (Black with one white mark)
  - Conductive silicon rubber (Black with two white marks)

### Pad material
- Pad material:
  - Conductive NBR (Black with one white mark)
  - Conductive silicon rubber (Black with two white marks)

### Pad size
- ø4 to 9: stroke 6, 10, 15, 25 mm
- ø10 to 32: stroke 10, 20, 30, 40, 50 mm
- ø40/50: stroke 10, 20, 30, 50 mm

### Pad shape
- Pad shape:
  - Flat (U)
  - Flat with ribs (C)
  - Deep (D)
  - Bellows (B)
  - Thin flat (UT)
  - Thin with ribs (CT)

### Pad size
- ø50
- ø40
- ø32
- ø25
- ø20
- ø16
- ø13
- ø10
- ø8
- ø6
- ø4
- ø2

### Pad material
- Pad shape and material:
  - Flat (U)
  - Flat with ribs (C)
  - Deep (D)
  - Bellows (B)
  - Thin flat (UT)
  - Thin with ribs (CT)

### Pad size
- ø4 to 9: stroke 6, 10, 15, 25 mm
- ø10 to 32: stroke 10, 20, 30, 40, 50 mm
- ø40/50: stroke 10, 20, 30, 50 mm

### Pad material
- Pad shape and material:
  - Flat (U)
  - Flat with ribs (C)
  - Deep (D)
  - Bellows (B)
  - Thin flat (UT)
  - Thin with ribs (CT)

### Pad size
- ø50
- ø40
- ø32
- ø25
- ø20
- ø16
- ø13
- ø10
- ø8
- ø6
- ø4
- ø2

### Pad material
- Pad shape and material:
  - Flat (U)
  - Flat with ribs (C)
  - Deep (D)
  - Bellows (B)
  - Thin flat (UT)
  - Thin with ribs (CT)

### Pad size
- ø50
- ø40
- ø32
- ø25
- ø20
- ø16
- ø13
- ø10
- ø8
- ø6
- ø4
- ø2

### Pad material
- Pad shape and material:
  - Flat (U)
  - Flat with ribs (C)
  - Deep (D)
  - Bellows (B)
  - Thin flat (UT)
  - Thin with ribs (CT)

### Pad size
- ø50
- ø40
- ø32
- ø25
- ø20
- ø16
- ø13
- ø10
- ø8
- ø6
- ø4
- ø2

### Pad material
- Pad shape and material:
  - Flat (U)
  - Flat with ribs (C)
  - Deep (D)
  - Bellows (B)
  - Thin flat (UT)
  - Thin with ribs (CT)

### Pad size
- ø50
- ø40
- ø32
- ø25
- ø20
- ø16
- ø13
- ø10
- ø8
- ø6
- ø4
- ø2

### Pad material
- Pad shape and material:
  - Flat (U)
  - Flat with ribs (C)
  - Deep (D)
  - Bellows (B)
  - Thin flat (UT)
  - Thin with ribs (CT)

### Pad size
- ø50
- ø40
- ø32
- ø25
- ø20
- ø16
- ø13
- ø10
- ø8
- ø6
- ø4
- ø2

### Pad material
- Pad shape and material:
  - Flat (U)
  - Flat with ribs (C)
  - Deep (D)
  - Bellows (B)
  - Thin flat (UT)
  - Thin with ribs (CT)

### Pad size
- ø50
- ø40
- ø32
- ø25
- ø20
- ø16
- ø13
- ø10
- ø8
- ø6
- ø4
- ø2

### Pad material
- Pad shape and material:
  - Flat (U)
  - Flat with ribs (C)
  - Deep (D)
  - Bellows (B)
  - Thin flat (UT)
  - Thin with ribs (CT)

### Pad size
- ø50
- ø40
- ø32
- ø25
- ø20
- ø16
- ø13
- ø10
- ø8
- ø6
- ø4
- ø2

### Pad material
- Pad shape and material:
  - Flat (U)
  - Flat with ribs (C)
  - Deep (D)
  - Bellows (B)
  - Thin flat (UT)
  - Thin with ribs (CT)

### Pad size
- ø50
- ø40
- ø32
- ø25
- ø20
- ø16
- ø13
- ø10
- ø8
- ø6
- ø4
- ø2
Vacuum Pad Made to Order

Antistatic Pad

With the use of antistatic urethane rubber, the pad can eliminate the static electricity more slowly compared to the conductive rubber. $10^9$ to $10^{11}$ $\Omega \cdot$cm

How to Order

INO — 3769 — 1968 — 10 C

Pad diameter

$\varnothing 10$ $\varnothing 10$

Pad shape

C Flat with ribs

Pad material

N NBR
S Silicone rubber
U Urethane rubber
UF Antistatic urethane rubber
F Fluoro rubber
GN Conductive NBR
GS Conductive silicone rubber

How to Order

INO — 3769 — 1561

Pad Part Number

INO — 3769 — 1369 — G

Rubber Specifications

<table>
<thead>
<tr>
<th>Material</th>
<th>Antistatic urethane rubber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume resistivity value</td>
<td>$10^9$ to $10^{11}$ $\Omega \cdot$cm</td>
</tr>
<tr>
<td>Durometer</td>
<td>80±5</td>
</tr>
</tbody>
</table>

Dimensions (mm)

*Interchangeable with standard (Ø10 to Ø16) adapter.*
**How to Order**

ZP — A0035XTJAC — DBJ00315

**Metal Pad with Buffer**

- Improved accuracy for suction point.
- Impact to the work is reduced by buffer.
- Prevent detachment failure due to static electricity, and avoid work damage.
- As metal is used for rubber end, static electricity can be instantly eliminated.

**How to Order**

INO—3769—2450—SG 06

**Sponge Pad**

- Conductive silicon and conductive CR sponge are adopted.
- Applicable to BGA ball surface, electric substrate, uneven work surface
- Rubber is used for the adapter end surface to reduce impact when contacting the work.

**How to Order**

INO—3769—2665—SG 10

**Dimensions**

<table>
<thead>
<tr>
<th>Sponge Pad Specifications</th>
<th>SG Sponge</th>
<th>ø6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hexagon width across flats</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

**Buffer Specifications**

<table>
<thead>
<tr>
<th>Rotation stopper</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stroke</td>
<td>2 mm</td>
</tr>
</tbody>
</table>

If glue is not applied to the threads the screw may become loose.

- When you need buffer only, use the following part numbers to order.
  - Buffer part number: ZP-CZZZZ9ZJAC-DBJ00315

- When you need sponge or adapter only, use the following part number to order.
  - Sponge part number: INO-3769-2380-G
  - Adapter part number: INO-3769-2450-A

- When you need sponge or adapter only, use the following part number to order.
  - Sponge part number: INO-3769-1839-S10-G
  - Adapter part number: INO-3769-2665-AD
With the use of conductive PEEK material attachment on the bellows rubber pad, static electricity can be prevented, and oil will not be left on the work.

- Prevent the work from contacting the rubber material, and stop transition of the oil oozing out of the rubber material. (Note: Please consult SMC for details.)
- With combination with bellows pad, scratches on the work can be decreased.
- Applications: Suction process of semiconductor and FPD devices

Variations

<table>
<thead>
<tr>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ø6, Ø8, Ø10, Ø13, Ø16, Ø20, Ø25, Ø32</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material</th>
<th>Conductive PEEK (Volume resistivity: $10^5$ to $10^6$ Ω·cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applicable pad</td>
<td>Bellows vacuum pad</td>
</tr>
</tbody>
</table>

Attachment

<table>
<thead>
<tr>
<th>Standard pad diameter</th>
<th>Conductive PEEK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ø6</td>
<td>ZP-E201-DBH00142</td>
</tr>
<tr>
<td>Ø8</td>
<td>ZP-E202-DBH00142</td>
</tr>
<tr>
<td>Ø10</td>
<td>ZP-E203-DBH00142</td>
</tr>
<tr>
<td>Ø13</td>
<td>ZP-E204-DBH00142</td>
</tr>
<tr>
<td>Ø16</td>
<td>ZP-E205-DBH00142</td>
</tr>
<tr>
<td>Ø20</td>
<td>ZP-E206-DBH00142</td>
</tr>
<tr>
<td>Ø25</td>
<td>ZP-E207-DBH00142</td>
</tr>
<tr>
<td>Ø32</td>
<td>ZP-E208-DBH00142</td>
</tr>
</tbody>
</table>

Ex. ZPT06B9NJ10-B5-A8  ZP-E201-DBH00142

How to Order (attachment and pad together)

- As shown below, add * for the attachment part number beneath the vacuum pad number. But please note that they are not assembled.
- This attachment can be mounted to SMC standard bellows pad only.
- For conductive PEEK attachment, use the pad made of conductive material.

Note) Part number in above table shows the number for the attachment only. If pad is ordered together, please refer followings.
Dimensions

<Caution>

• Clean the attachment before usage.

This product is not cleaned after machining. Do not use the attachment out of the package, or residual subject on the attachment is transferred to the work.

Please consult SMC if any question occurs.

Cleaning method (Reference)

1) Use vinyl gloves which do not generate particle, and hold the pad except vacuuming part.

2) Supply 2-Propanol (isopropyl alcohol) for electronic industry (Purity > 99.5%) to a cloth which does not generate particle.

3) Wipe lightly the attachment vacuum surface and the part which may contact with the work.

4) Wipe it again with a dry cloth which generates no particle.

• If the contact with hard material becomes a problem, do not use the attachment.

<table>
<thead>
<tr>
<th>Model</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZP06B</td>
<td>6</td>
<td>7</td>
<td>1.6</td>
<td>0.5</td>
<td>3</td>
<td>13.5</td>
<td>0.5</td>
</tr>
<tr>
<td>ZP08B</td>
<td>8</td>
<td>9</td>
<td>3</td>
<td></td>
<td>3.5</td>
<td>16.5</td>
<td></td>
</tr>
<tr>
<td>ZP10B</td>
<td>10</td>
<td>12</td>
<td>3.5</td>
<td></td>
<td>5.5</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>ZP13B</td>
<td>13</td>
<td>15</td>
<td>4</td>
<td></td>
<td>6</td>
<td>20.5</td>
<td></td>
</tr>
<tr>
<td>ZP16B</td>
<td>16</td>
<td>18</td>
<td>8</td>
<td>1</td>
<td>8.5</td>
<td>24.5</td>
<td></td>
</tr>
<tr>
<td>ZP20B</td>
<td>20</td>
<td>22</td>
<td>8</td>
<td>1</td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ZP25B</td>
<td>25</td>
<td>27</td>
<td>10</td>
<td></td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ZP32B</td>
<td>32</td>
<td>34</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Removing the film covering the contacting foot brackets (anodization), causes the cylinder to become conductive from the piston rod end to the foot brackets.

How to Order

Antistatic Air Cylinder  CM2-X1051

Made to Order

CM2 L 40 150 X1051

Mounting

I Axial foot
F Rod end flange
G Head end flange
C Single clevis
D Double clevis
T Head end trunnion

Cylinder stroke (mm)

<table>
<thead>
<tr>
<th>Bore size</th>
<th>Stroke</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>25, 50, 75, 100, 125, 150</td>
</tr>
<tr>
<td>25</td>
<td>25, 50, 75, 100, 125, 150</td>
</tr>
<tr>
<td>32</td>
<td>25, 50, 75, 100, 125, 150, 200</td>
</tr>
<tr>
<td>40</td>
<td>25, 50, 75, 100, 125, 150, 200, 250</td>
</tr>
</tbody>
</table>

Bore size

<table>
<thead>
<tr>
<th>Bore size</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>20 mm</td>
</tr>
<tr>
<td>25</td>
<td>25 mm</td>
</tr>
<tr>
<td>32</td>
<td>32 mm</td>
</tr>
<tr>
<td>40</td>
<td>40 mm</td>
</tr>
</tbody>
</table>

It is possible to eliminate static electricity from the mounted brackets without moving the ground wire attached to the flexible part.

Surface resistance value: $10^{-1} \, \Omega$ or less
Electrostatic removal equipment generate ions by corona discharge to eliminate (neutralize) static electricity.

**An ionizer is useful under the following conditions:**

- Grounding is not possible.
- Humidity levels cannot be controlled.
- Workpiece comprises insulated materials such as rubber.
- Conductive materials cannot be applied.

Electrostatic removal equipment generate positive or negative ions by utilizing corona discharge etc. Ions sent to the workpiece adjust the ion balance of positively or negatively charged workpieces, making them electrically balanced and eliminating static electricity.

**Electrostatic removal equipment generate ions.**

---

**Corona discharge**

An ionizer generates ions by applying high voltage to an electrode needle. When a positive voltage is applied, positive ions are generated. When negative voltage is applied, negative ions are generated.

**Basic mechanism of electrostatic removal using ions** (Ion balance)

1. **Positive charging**
2. **Making up for a deficiency of electrons**
3. **Completion of electrostatic removal**
Ionizer Series IZS31

Discharge time 0.3 seconds
Discharge time was reduced by improving the efficiency of the basic specifications for the feedback sensor, air purge pressure, and high frequency etc.

Conditions / Static buildup decreased from 1000 V to 100 V
Discharged object: Charged plate monitor
(150 mm x 150 mm, capacitance 20 pF)
Installation distance: 200 mm
(Tungsten electrode with air purge)

Rapid elimination of static electricity using a feedback sensor

- The speed of static electricity removal has been increased by reading the workpiece’s electrostatic potential with the feedback sensor and continuously emitting ions of a reverse polarity.

Energy saving run mode: Stops generating ions after static electricity removal to reduce power consumption.
Air consumption can also be reduced by controlling the pneumatic valve with a static electricity removal completion signal.
Note) The pneumatic valve must separately be procured.

Continuous static electricity removal run mode: After static electricity removal, the ionizer changes to pulse DC operation and continues to remove static electricity to make it approach 0 V even if the ion balance is below 30 V.

Automatic ion balance adjustment and reduction in ion balance adjustment man-hours using an auto-balance sensor

- In the pulse DC mode, the ion balance can be automatically adjusted using an auto-balance sensor.
- The object is not affected by the height of installation or any disturbance interference since the ionizer is designed to adjust the ion balance near the auto-balance sensor.

- The auto-balance sensor may be connected only when adjusting the ion balance.
Available for workpieces moving at high speed

- Switching over frequency: Max 60 Hz

Ions are discharged at high density at workpieces moving at high speed. This reduces the range of surface potential fluctuations for short installation distances after static electricity removal. Note) The range of surface potential fluctuations varies depending on the object’s material, etc.

Electrode cartridge 40 mm pitch: -X15
(Standard: 80 mm pitch) (Supported length: 1260 mm max.)
Note) Air purge nozzles are arranged at an 80 mm pitch.

• Electricity removal variation prevented

Electrode cartridge 40 mm pitch: -X15 (Standard: 80 mm pitch) (Supported length: 1260 mm max.)
Note) Air purge nozzles are arranged at an 80 mm pitch.

Effective for short range static electricity elimination

- Electricity removal variation prevented
Electrode cartridge 40 mm pitch: -X15
(Standard: 80 mm pitch) (Supported length: 1260 mm max.)
Note) Air purge nozzles are arranged at an 80 mm pitch.

Applicable for air purge supply pressure: 0.7 MPa

- Effective for removal of foreign matter during long range elimination of static electricity
Air purge: Yes With sensor: (1 Hz/60 Hz)

DC mode: According to the setting of the frequency trimmer, any polarity can be fixed for consecutive emission.

- Can be used to eliminate static electricity from high speed, high electric potential workpieces.
**Display function**

- Visualization of charging condition  
  (During sensing DC mode)
- Visualization of ion balance  
  (When pulse DC mode or auto-balance sensor are used.)

<table>
<thead>
<tr>
<th>Workplace electric polarity</th>
<th>LED</th>
<th>Workplace electric charge voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>1</td>
<td>+400 V or higher</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>+100 V to +400 V</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>+30 V to +100 V</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>±30 V to ±100 V</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>−100 V to −400 V</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>−400 V or lower</td>
</tr>
<tr>
<td>Static electricity removal completed</td>
<td>Blinking at 4 Hz</td>
<td>Light OFF</td>
</tr>
</tbody>
</table>

**Detected the electric potential difference and outputs in an analog voltage.**  
(During sensing DC mode)

- Outputs measured data at a 1 to 5 V level when a feedback sensor is used.  
  By outputting the data to a PLC, etc., it is possible to control static electricity.

- Detects the electric potential difference and outputs in an analog voltage.  
  (During sensing DC mode)

- **Option**
  - 3 types electrode needle material
    - Tungsten (Ion balance: ±30 V)
    - Monocrystal silicon  
      (Ion balance: ±30 V Applicable to environments sensitive to metal contamination)
    - Stainless steel (Ion balance: ±100 V)

- **Safety function**
  - Electrode cartridge drop prevention
    - Locking by double-action
  - Security cover  
    Can even more reliably prevent electrode cartridges from dropping off.

**Non-standard bar length compliant:**
IZS31-XXXX-X10 (Made to Order)

<table>
<thead>
<tr>
<th>Standard</th>
<th>300, 380, 620, 780, 1100, 1260, 1520, 1900, 2300</th>
</tr>
</thead>
<tbody>
<tr>
<td>-X10</td>
<td>460, 540, 700, 860, 940, 1020, 1180, 1340, 1420, 1580, 1660, 1740, 1820, 1980, 2060, 2140, 2220</td>
</tr>
</tbody>
</table>
Examples of Applications

Eliminating static electricity on PET bottles
• Trip-resistance during conveying.
• Prevents adhesion of dust.

Eliminating static electricity on a film
• Prevents adhesion of dust.
• Prevents winding failure due to wrinkles, etc.

Eliminating static electricity on mold goods
• Improves detachability of mold goods from a die.

Eliminating static electricity on film mold goods
• Prevents attaching to conveyer.
• Prevents dispersion of finished goods.

Eliminating static electricity on PET bottles
• Trip-resistance during conveying.
• Prevents adhesion of dust.

Eliminating static electricity on an electric substrate
• Prevents element disruption due to discharge.
• Prevents adhesion of dust.

Eliminating static electricity on a glass substrate
• Prevents breakage due to adhesion and discharge.
• Prevents adhesion of dust.

Removal of static electricity from packing films
• Prevents the filled substance from adhering to the packing film.
• Reduces packing mistakes.

Eliminating static electricity wafer transfer
• Prevents breakage due to discharge between wafers and hands.
Specifications

<table>
<thead>
<tr>
<th>Ionizer model</th>
<th>IZS31-□□□□ (NPN specification)</th>
<th>IZS31-□□□□P (PNP specification)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ion generation method</td>
<td>Corona discharge type</td>
<td>Sensing DC, Pulse DC, DC</td>
</tr>
<tr>
<td>Method of applying voltage</td>
<td>±7000 V</td>
<td>±30 V (Stainless electrode needle: ±100 V)</td>
</tr>
<tr>
<td>Output for emitting electricity</td>
<td>≤0.7 MPa or less</td>
<td>24 VDC ±10%</td>
</tr>
<tr>
<td>Air purge</td>
<td>Operating pressure</td>
<td>Effective discharge distance</td>
</tr>
<tr>
<td>Power supply voltage</td>
<td>50 to 2000 mm (Sensing DC mode: 200 to 2000 mm)</td>
<td></td>
</tr>
</tbody>
</table>

Note 1) In case where air purge is performed between a charged object and an ionizer at a distance of 300 mm.

How to Order

**Ionizer**

IZS31-780

- Made to Order
  - Refer to the below table.
  - Sensor
    - Nil
    - F With feedback sensor
    - G With auto-balance sensor
  - Bracket (End bracket, Center bracket)
    - Nil
    - B With bracket (Note)
  - Number of Brackets
    - Bar length (mm)
      - End bracket
      - Center bracket
      - 300, 380, 620, 780
      - 1100, 1260, 1500
      - 1900, 2300
  - Power supply cable
    - Nil
    - Z With power supply cable (3 m)
    - N None

Made to Order

**Ionizer / Series IZS31**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Contents</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>-X10</td>
<td>Non-standard bar length compliant (80 mm pitch)</td>
<td>460, 540, 700, 860, 940, 1020, 1180, 1340, 1420, 1580, 1660, 1740, 1820, 1980, 2060, 2140, 2220</td>
</tr>
<tr>
<td>-X14</td>
<td>Model with electrode cartridge security cover</td>
<td>The main unit is shipped fitted with an electrode cartridge security cover available as an option.</td>
</tr>
<tr>
<td>-X15</td>
<td>Model with 40 mm pitch electrode cartridges</td>
<td>This model comes fitted with electrode cartridges arranged at a 40 mm pitch (standard pitch: 80 mm). Note) Maximum bar length is 1260 mm. The air purge nozzles are arranged at an 80 mm pitch.</td>
</tr>
</tbody>
</table>

Refer to the catalog ES100-68 for details.
SMC can provide all the equipment required to supply air to the ionizer. Consider the equipment below not only for providing an “opportunity to decrease maintenance” and “preventing damage” but also for an “energy-saving countermeasure”.

**Recommended pneumatic circuit diagram**

1. **Air Dryer / Series IDF**
   - Decreases the dew point of compressed air.
   - Limits moisture generation which can lead to damage.

2. **Air Filter / Series AF**
   - Eliminates solid foreign matters such as power particles in the compressed air.

3. **Mist Separator / Series AFM**
   - Eliminates oil mist which is difficult to eliminate with an air filter.

4. **Digital Flow Switch / Series PF2A**
   - Decreases the air consumption by flow control.

5. **2-Color Display Digital Flow Switch / Series PFM**

6. **Digital Pressure Switch / Series ISE30**
   - The pressure control prevents the ability of static electricity removal from being reduced in accordance with the reduction of air pressure.

7. **2 Port Solenoid Valve / Series VX**
   - Regulates to the appropriate air volume depending upon the installation condition. Decreases the air consumption.

8. **Throttle Valve / AS-X214**

9. **Clean Air Filter / Series SFD**
   - Built-in hollow fiber elements Filtration: 0.01μm
   - Adopted hollow fiber elements with over 99.99% filtering efficiency don’t contaminate workpieces.
Confirmation of “actual status” is important in controlling static electricity.

- Potential measurement: $\pm 20 \text{ kV}$ (detected at a 50 mm distance) $\pm 0.4 \text{ kV}$ (detected at a 25 mm distance)
- Detects the electrostatic potential and outputs in an analog voltage.
  - Output voltage: 1 to 5 V (output impedance: Approx. 100 $\Omega$)
- Possible to measure electrostatic potential

**Electrostatic Sensor** *Series IZD10*

**Dimensions (actual size)**

**Installation Distance and Detection Range**

<table>
<thead>
<tr>
<th>Installation distance (mm)</th>
<th>Detection range (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IZD10-110 ($\pm 0.4 \text{ kV}$)</td>
<td>10 to 50</td>
</tr>
<tr>
<td>IZD10-510 ($\pm 20 \text{ kV}$)</td>
<td>25 to 75</td>
</tr>
</tbody>
</table>

**How to Order**

IZD 10 - 1 10

- Model: Electrostatic sensor
- Potential measurement: $=0.4 \text{ kV}$ $=20 \text{ kV}$
Electrostatic Sensor Monitor Series IZE11

- Output: Switch output x 2 + Analog output (1 to 5 V, 4 to 20 mA)
- Minimum unit setting: 0.001 kV (at 0.4 kV), 0.1 kV (at 20 kV)
- Display accuracy: ±0.5%F.S. ±1 digit or less
- Detection distance correction function (adjustable in 1 mm increments)
- Range switching supports two sensors. (±0.4 kV, ±20 kV)

How to Order

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Nil (None)</td>
</tr>
<tr>
<td>1</td>
<td>With connector for sensor connection, ZS-28-C</td>
</tr>
<tr>
<td>2</td>
<td>With connector for sensor connection, ZS-28-A</td>
</tr>
</tbody>
</table>

Output specifications

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>NPN open collector 2 outputs + Analog output (1-5 V)</td>
</tr>
<tr>
<td>1</td>
<td>NPN open collector 2 outputs + Analog output (4-20 mA)</td>
</tr>
<tr>
<td>2</td>
<td>PNP open collector 2 outputs + Analog output (1-5 V)</td>
</tr>
<tr>
<td>3</td>
<td>PNP open collector 2 outputs + Analog output (4-20 mA)</td>
</tr>
</tbody>
</table>

Options / Part No.

<table>
<thead>
<tr>
<th>Description</th>
<th>Part no.</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connector cable for power supply / output</td>
<td>ZS-28-A</td>
<td></td>
</tr>
<tr>
<td>Bracket</td>
<td>ZS-28-B</td>
<td>With M3 x 5L (2 pcs.)</td>
</tr>
<tr>
<td>Connector for sensor connection</td>
<td>ZS-28-C</td>
<td>1 pc.</td>
</tr>
<tr>
<td>Panel mount adapter</td>
<td>ZS-27-C</td>
<td>With M3 x 8L (2 pcs.)</td>
</tr>
<tr>
<td>Panel mount adapter + Front protective cover</td>
<td>ZS-27-D</td>
<td>With M3 x 8L (2 pcs.)</td>
</tr>
</tbody>
</table>

Note) The options are not attached but packed together with product for shipment.
Confirmation of “actual status” is important in controlling static electricity.

Easy-to-use handheld electrostatic meter

- Measuring range: ±20.0 kV
- Minimum display unit: 0.1 kV (±1.0 to ±20.0 kV)
- 0.01 kV (0 to ±0.99 kV)
- Compact and Lightweight: 85 g
  (excluding dry cell batteries)
- Backlight for reading in the dark
- LOW battery indicator
- Peak & Bottom display function
- Zero-out function
- Auto power-off function

How to Order

IZH10 - Option

| Nil | None   | H | High voltage measuring handle |

Accessories and Options / Part Numbers for Individual Parts

<table>
<thead>
<tr>
<th>Ground wire (1.5 m) / Accessories IZH-A-01</th>
<th>Soft case / Accessories IZH-B-01</th>
<th>High voltage measuring handle / Option IZH-C-01</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Ground wire" /></td>
<td><img src="image" alt="Soft case" /></td>
<td><img src="image" alt="High voltage measuring handle" /></td>
</tr>
</tbody>
</table>

* The ground wire and soft case are attached to the IZH series.
1. Types of Static Electricity Generation

There are various types and names of static electric generation. Basically, static electricity is generated when objects come into contact with one another or when they are separated.

- **Contact Charging**: Static electricity generated when two objects come into contact.
- **Separation Charging**: Static electricity that occurs when two objects that were in contact with each other are separated.
- **Frictional Charging**: Static electricity generates when two objects are rubbed together.
- **Clash Charging**: Static electricity generated when objects (particles or the like) collide with strong impact.
- **Vapor Charging**: Static electricity generates in liquid when water coming out of nozzle becomes misty.
- **Rolling Charging**: Static electricity generated when objects roll over other objects.
- **Induction Charging**: When an electro-statically charged object approaches another object, static electricity occurs on the opposite side of that object.
- **Charging from External Ion**: Static electricity occurs!
2. Static Electricity

Why is static electricity generated?

1 Principle of static electricity
When looking closely, you can see that all matter is composed of atoms. An atom has protons and electrons that are in electrical balance. Electrons may become separated from or attached to the atom with a small force. Disruption of the balance between protons and electrons leads to static electricity.

<table>
<thead>
<tr>
<th>No static electricity (0 V)</th>
<th>Positively charged (+)</th>
<th>Negatively charged (–)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protons (+) and electrons (–) are balanced and no static electricity is generated.</td>
<td>When an electron (–) separates from the atom, the number of protons (+) exceeds the number of electrons (–), resulting in a positively charged state.</td>
<td>When an electron (–) attaches to an atom, the number of protons (+) exceeds that of electrons (–), resulting in a negatively charged state.</td>
</tr>
</tbody>
</table>

Note) 3 electrons are mentioned in the figure, but the number of electrons varies depending on the atom.

Causes of generating static electricity

1 Contact charging
When 2 objects come in contact with each other, electrons can move between the objects. When the objects are suddenly separated under this condition, the atoms are polarized and static electricity is generated.

- A workpiece with a small work function
  Both objects (workpieces) have the same number of protons and electrons and are electrically balanced. Neither object generates an electric potential (static electricity).

- A workpiece with a large work function
  When one object (workpiece) comes into contact with another object (workpiece), electrons (–) move from the workpiece with the small work function to the workpiece with the large work function.
  < Work function: The minimum amount of energy required to remove an electron from the surface of a metal. Each substance has all eigenvalues. >

- Positive charging
  When objects are suddenly separated, the distribution of electrons becomes polarized, resulting in negative or positive charging depending on the number of electrons.

- Negative charging
Electric Polarity and the Amount of Electric Charge

**Triboelectric series**
The “electric polarity” and “amount of electric charge” when 2 objects come into contact with each other, are shown in the *triboelectric series*.

- Human body
- Glass
- Mica
- Nylon
- Wool
- Silk
- Aluminum
- Polyester
- Paper
- Cotton
- Steel
- Copper
- Rubber
- Polyurethane
- Polypropylene
- Vinyl chloride
- Silicon
- Fluororesin

**How to read the triboelectric series**

1: Electric polarity
   The materials mentioned in the upper part of the triboelectric series are charged positively and those mentioned in the lower part are charged negatively.
   - Example 1: Glass (+) Polyester (–)
   - Example 2: Polyester (+) Fluororesin (–)

2: Electric charge
   As the distance between 2 materials becomes greater, the amount of charge becomes larger.
   - Example 1: Amount of charge between the human body and nylon (Small)
   - Example 2: Amount of charge between the human body and polyurethane (Large)

**Induction charging**
Induction charging is static electricity that is generated when a charged object gets close to another object without contacting it. This static electricity is difficult to detect because the objects do not come into contact with each other.

- When protons and electrons are balanced, an electrostatic meter does not detect static electricity.
- When a charged object gets close to another object, electrons are attracted and polarized and the electrostatic meter indicates positive. **When the charged object touches another object under this condition, it discharges.** When the charged object is separated, it returns to its original state.
Examples of Failures due to Induction Charging

1) An uncharged device has no electrical polarization.

2) When a vacuum pad that has been charged due to repeated operations gets close to the device, static induction occurs. This figure shows that electrons move toward the electrode: the chip and its surroundings are positively charged.

3) When the device is mounted on a circuit board, electrostatic discharge occurs. In this case, a conductive rubber pad needs to be used.

4) If the device is insulated, it becomes negatively charged when the operator leaves the device due to the remaining electrons.

5) When the device is once again grounded, electrostatic discharge occurs again. Electrons (–) flow out.

Device Breakdown 2
Ion charging

Equipment using ultraviolet light etc. may generate ions. When those ions become attached to workpieces, workpieces become charged.

What is an ion?

- An ion is an electrically charged atom or molecule.
- The ionizer positively or negatively ionizes molecular oxygen (oxygen atoms) and molecular nitrogen (nitrogen atoms) in the air.
3. Countermeasures against Static Electricity

● Prevents static electricity from being generated.

1. Proper selection of materials that come into contact with each other (Utilizing the triboelectric series)

2. Reduction of the contact area
   Generation of static electricity increases as the contact area increases. Equipment designs with less contact area are required.

3. Reduction in the frequency with which objects come into contact with each other
   Static electricity accumulates when objects come into contact with each other repeatedly. Reduce the frequency with which objects come into contact with each other to reduce the generation of static electricity.

4. Control of capacitance
   Static electricity voltage fluctuates with capacitance. Capacitance needs to be controlled to prevent static electricity from increasing unnecessarily.

Static electricity voltage and capacitance

● Static electricity voltage
   Static electricity voltage can be calculated using the formula below.

   \[
   \text{Voltage (V)} = \frac{\text{Quantity of Electric Charge (Q)}}{\text{Capacitance (C)}}
   \]

   When the quantity of electric charge is constant, the voltage fluctuates with capacitance.
   Example: When capacitance decreases, voltage increases.

● Capacitance (C)
   The capacity to store static electricity between two objects. The capacitance between flat plates increases in proportion to the area (S) and decreases when the distance (d) between the flat plates becomes larger.

   Example: The static electricity voltage of a workpiece on the table increases when the workpiece is lifted with a lifter because the capacitance becomes smaller.
Prevent objects from being charged with static electricity.

Even if static electricity is generated, prevent objects from being charged to the extent that problems may result. Appropriate measures need to be taken, depending on the applications.

1. **Grounding**
   Grounding is a fundamental countermeasure against static electricity. However, grounding is sometimes not complete due to insulation from lubricating oils, and that grounding is not deep enough in the ground, therefore, it is necessary to confirm the grounding.

2. **Humidity control**
   Humidity is controlled by humidifiers and such. Caution: Humidifiers may not be effective for devices that obtain a high temperature.

3. **Conductive products**
   Caution: Conductive products cannot discharge static electricity without grounding.

4. **Removing static electricity with ionizers, etc.**

   - **Difference in materials**
     
     **Conductive materials**
     Conductive materials can discharge static electricity immediately with grounding. When surface treatments such as anodization and the like are applied, conductive materials will become insulated and grounding will be ineffective.

     **Insulated materials**
     Insulated materials cannot discharge static electricity even if they are grounded. To discharge static electricity, switch to using conductive materials, use humidity control or a surface active agent, or install an ionizers, etc.

   - **Electrostatic features of conductive and insulated materials**

     ![Electrostatic features diagram]

     - **Conductor**
       - Conductive (Rapid electrostatic removal)
       - Charged evenly
       - Neutralized by grounding

     - **Insulator**
       - Non-conductive (Requires time for electrostatic removal)
       - Charged unevenly. (Ion spots)
       - Not neutralized by grounding

     In an object, some parts of the object may be positively charged and other parts may be negatively charged.