Vacuum Equipment

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Vacuum Module: **ZR** .......... P. 13-3-4
Vacuum Ejector: **ZM** .......... P. 13-4-2
Vacuum Ejector with Solid State Timer: **ZMA** .......... P. 13-4-23
Vacuum Ejector: **ZH** .......... P. 13-5-2
In-line Vacuum Ejector: **ZU** .......... P. 13-6-3
Vacuum Ejector: **ZL** .......... P. 13-7-4
Ejector Valve Unit: **ZY**/**ZYX** .......... P. 13-8-4
Compact Vacuum Ejector: **ZQ** .......... P. 13-9-2
Air Suction Filter: **ZFA** .......... P. 13-10-1
Air Suction Filter with One-touch Fittings: **ZFB** .......... P. 13-10-4
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Vacuum Pad: **ZPT** .......... P. 13-11-2
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Large Size Bellows Type (ø40 to ø125): **ZPT/ZPX** .......... P. 13-11-86
Ball Joint Type (ø10 to ø50): **ZPT/ZPR** .......... P. 13-11-104
Free Mount Cylinder for Vacuum: **ZCUK** .......... P. 13-12-2
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Misc.
## Vacuum Equipment

**Vacuum Modular/Vacuum Ejector/Air Suction Filter**

**Air Suction Filter with One-touch Fitting/Vacuum Switch**

**Vacuum Pad/Free Mount Cylinder for Vacuum**

<table>
<thead>
<tr>
<th>Technical Data</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Adsorption transfer system by ejector • Adsorption transfer system by vacuum pump</td>
<td></td>
</tr>
<tr>
<td>• Vacuum equipment model selection/pads, ejectors, and vacuum switching valves</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vacuum Module</th>
<th>Series ZX</th>
<th>• Optimal for electronic parts or small precision parts weighing up to 100 g • Supports the ejector system and the vacuum pump system • Modular design • Adaptable for manifold applications</th>
<th>13-2-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vacuum Module</td>
<td>Series ZR</td>
<td>• Necessary functions can be combined through modular design • Adaptable for manifold applications • Functions such as a digital vacuum switch or a solenoid valve can be selected • Supports the ejector system and the vacuum pump system • Double solenoids provide a self-holding function</td>
<td>13-3-4</td>
</tr>
<tr>
<td>Vacuum Ejector</td>
<td>Series ZM</td>
<td>• Valve and switch are unitized • Adaptable for manifold applications • Maximum suction flow rate increased 40% • Max. vacuum pressure –84 kPa (≈630 mmHg)</td>
<td>13-4-2</td>
</tr>
<tr>
<td>Vacuum Ejector with Solid State Timer</td>
<td>Series ZMA</td>
<td>• Incorporates solid state timer function for release valve control (timer setting with PLC is unnecessary) • Allows sharing of switch/valve power supply. and single line for suction signal (valve wiring is unnecessary) • Timer can be easily adjusted without programming</td>
<td>13-4-23</td>
</tr>
<tr>
<td>Vacuum Ejector</td>
<td>Series ZH</td>
<td>• Nozzle diameter: ø0.5, ø0.7, ø1.0, ø1.3, ø1.5, ø1.8, ø2.0 • Composite resin nozzle and body • Available in 2 types: box type and direct piping type</td>
<td>13-5-2</td>
</tr>
<tr>
<td>In-line Vacuum Ejector</td>
<td>Series ZU</td>
<td>• Nozzle diameter: ø0.5, ø0.7 • Vacuum port and supply port are located collinearly to facilitate piping • Built-in One-touch fitting (Copper free)</td>
<td>13-6-3</td>
</tr>
<tr>
<td>Vacuum Ejector</td>
<td>Series ZL</td>
<td>• Suction flow rate increased by a 3 stage diffuser construction • Functions such as a digital vacuum switch or a vacuum pressure gauge can be selected</td>
<td>13-7-4</td>
</tr>
<tr>
<td>Ejector Valve</td>
<td>Series ZYY/ZYX</td>
<td>• Ejector valve unit suitable for vacuum adsorption systems • A combination of solenoid valve for cylinder drive, etc + vacuum ejector</td>
<td>13-8-4</td>
</tr>
<tr>
<td>Air Suction Filter</td>
<td>Series ZFA</td>
<td>• Prevents problems related to vacuum circuits or airborne contaminants • Provides a large filter element surface</td>
<td>13-10-1</td>
</tr>
<tr>
<td>Air Suction Filter</td>
<td>Series ZFB</td>
<td>• Prevents problems related to vacuum circuits or airborne contaminants • Piping tube can be connected and disconnected with one touch</td>
<td>13-10-4</td>
</tr>
<tr>
<td>Air Suction Filter In-line Type with One-touch Fittings</td>
<td>Series ZFC</td>
<td>• IN/OUT straight piping • One-touch fittings for easy installation and removal • Lightweight molded resin parts Cartridge type element replacement</td>
<td>13-10-7</td>
</tr>
<tr>
<td>Product Type</td>
<td>Series</td>
<td>Features</td>
<td>Part Number</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>----------</td>
<td>---------------------------------------------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Vacuum Pad</td>
<td>ZP</td>
<td>- A variety of models accommodate a wide range of applications</td>
<td>13-11-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Pad type: Flat, Flat with ribs, Deep, Bellows</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Pad diameter: ø2 to ø125, Made to Order = ø150 to ø250</td>
<td></td>
</tr>
<tr>
<td>Vacuum Pad Large/Heavy Duty Type</td>
<td>ZPT/ZPX</td>
<td>- Ideal for heavy weight material or objects with a large surface area</td>
<td>13-11-72</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Example: CRT, Car body</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Pad diameter: ø40, ø50, ø63, ø80, ø100, ø125</td>
<td></td>
</tr>
<tr>
<td>Vacuum Pad Large Size Bellows Type</td>
<td>ZPT/ZPX</td>
<td>- Ideal for loads with a curved surface, heavy weight loads and</td>
<td>13-11-86</td>
</tr>
<tr>
<td></td>
<td></td>
<td>loads with large surface area</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Pad diameter: ø40, ø50, ø63, ø80, ø100, ø125</td>
<td></td>
</tr>
<tr>
<td>Vacuum Pad Ball Joint Type</td>
<td>ZPT/ZPR</td>
<td>- Ball joint type ideal for adsorption on slanted work surface</td>
<td>13-11-104</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Pad diameter: ø10, ø13, ø16, ø20, ø25, ø32, ø40, ø50</td>
<td></td>
</tr>
<tr>
<td>Free Mount Cylinder for Vacuum</td>
<td>ZCUK</td>
<td>- In the rectangular, compact cylinder Series CU with a high level of</td>
<td>13-12-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>mounting precision, a vacuum passage is provided to facilitate the</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>mounting of a vacuum pad and to save space</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Standard vacuum pads (ø2 to ø50) can be mounted</td>
<td></td>
</tr>
<tr>
<td>Drain Separator for Vacuum</td>
<td>AMJ</td>
<td>- Remove water droplets from air by simply installing in vacuum</td>
<td>13-13-3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>equipment connection line. Effective for removing water droplets</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>from the air sucked into vacuum pumps and ejectors, etc.</td>
<td></td>
</tr>
<tr>
<td>Vacuum Switch</td>
<td>ZS</td>
<td>- Refer to Best Pneumatics Vol.16 for more details on vacuum switches.</td>
<td></td>
</tr>
</tbody>
</table>

Vacuum System Peripherals: Related Products: 13-14-2

Manifold Specification Sheet 13-14-17
### Design & Selection

**Warning**

1. Safe designs should be developed, which account for the possibility of accidents resulting from a drop in vacuum pressure due to power failure or trouble with the air supply, etc.

   If vacuum pressure drops and there is a loss of vacuum pad adsorption force, workpieces being carried may fall, causing human injury or damage to machinery. Safety measures should be implemented such as the installation of drop prevention guides.

2. Follow vacuum specifications for vacuum switching valves and vacuum breakers.

   If valves are installed in vacuum piping which do not follow vacuum specifications, vacuum leakage will occur. Be certain to use vacuum specification valves.

3. Select ejectors which have a suitable suction flow rate.

   - When there is a vacuum leak from the workpiece or the piping: If the ejector's suction flow rate is too low, this will cause poor adsorption.
   - When piping is long or of large diameter: The adsorption response time will increase due to the increased volume of the piping.

   Select ejectors with a suitable suction flow rate by referring to their technical data.

4. If the suction flow rate is too high, setting of vacuum switches will become difficult.

   In the case of adsorbing a small workpiece of only a few millimeters, if an ejector is selected which has a high suction flow rate, the pressure difference when adsorbing and releasing the workpiece is small, and sometimes setting of the vacuum switch becomes difficult. Therefore, an appropriate ejector should be selected.

5. When two or more pads are piped to one ejector, if one pad releases its workpiece, the other pads will also release.

   When one pad is removed from its workpiece, there is a drop in vacuum pressure which causes the other pads to release their workpieces also.

6. Use piping with an adequate effective sectional area.

   Select piping for the vacuum side which has an adequate effective sectional area, so that the ejector's maximum suction flow rate can be accommodated by the piping.

   Also, make sure that there are no unnecessary restrictions or leaks, etc., along the course of the piping.

   The piping on the air supply side must be designed so that it corresponds to each ejector's air consumption. The effective sectional area of tubing, fittings and valves, etc., should be sufficiently large, and the pressure drop reaching the ejector should be kept to a minimum.

   Furthermore, design of the air supply should be performed while taking into consideration the ejector's maximum air consumption and the air consumption of other pneumatic circuits.

**Caution**

1. For information on related items, such as directional control equipment and drive equipment, refer to the caution sections in each respective catalog.

2. If there is vibration, the needle for flow adjustment of valve may be loosened. To prevent from loosing, a lock nut type is available. Confirm the part number.

### Mounting

**Warning**

1. Do not obstruct the exhaust port of the ejector.

   If the exhaust port is obstructed when mounted, a vacuum will not be generated.

### Piping

**Caution**

1. Avoid disorganized piping.

   Piping which is direct and of the shortest possible length should be used for both the vacuum and supply sides, and disorganized piping should be avoided. Unnecessary length increases the piping volume, and thus increases the response time.

2. Use piping with a large effective sectional area on the exhaust side of the ejector.

   If the exhaust piping is restrictive, there will be a decline in the ejector's performance.

3. Make sure that there are no crushed areas in the piping due to damage or bending.

### Operating Environment

**Warning**

1. Do not operate in atmospheres of corrosive gases, chemicals, sea water, water or steam.

2. Do not operate in explosive areas.

3. Do not operate in locations where vibration or impact occurs. Confirm the specifications for each series.

4. In locations which receive direct sunlight, provide a protective cover, etc.

5. In locations near heat sources, protect against radiated heat.

6. In locations where there is contact with spatter from water, oil or solder, etc., implement suitable protective measures.

7. In cases where the vacuum unit is surrounded by other equipment, etc., or the unit is energized for an extended time, implement measures to exhaust excess heat, so that temperatures remain within the range of the vacuum unit's specifications.

### Maintenance

**Warning**

1. Clean suction filters and silencers on a regular basis. (Refer to specifications.)

   The performance of ejectors will deteriorate due to clogging in filters and silencers. Large flow filters should be used, especially in dusty locations.
Adsorption Transfer System by Ejector

Ejector Module System

Equipment (ejector supply valve, vacuum release valve, throttle valve, vacuum pressure switch, and filter) that is needed for the ejector adsorption transfer system has been integrated to achieve efficient assembly work and a compact design.

Ejector module/Circuit

Ejector module/ZX/ZM/ZR

Supply valve

Refrigerated air dryer
Series IDF

Compressor

Air filter
Series AF

Mist separator
Series AM

Regulator
Series AR

Pressure gauge
Series GZ

Ejector System Component Equipment

Vacuum module
Series ZX

Ejector nozzle dia. (mm)
ø0.5 to ø1.0

Can also accommodate a vacuum pump for the adsorption conveyance of small items such as electronic parts.

Vacuum ejector
Series ZM

Ejector nozzle dia. (mm)
ø0.5 to ø1.3

Using an ejector with a 2-stage nozzle, the ejector system can be used most efficiently.

Large vacuum module
Series ZR

Ejector nozzle dia. (mm)
ø1.0 to ø2.0

Double solenoids provide a self-holding function. Necessary functions can be combined through modular design. Can also accommodate a vacuum pump.

Single Unit Equipment

Series Vacuum ejector
Features

Nozzle diameter ø0.5 to 1.3 mm
Can be connected with the combination of a one-touch and a screw-in connection.

Multi-stage ejector
Series ZL

Suction flow rate increased by a 3-stage diffuser construction.

Ejector valve
Series ZH

Vacuum pressure gauge or a vacuum pressure gauge can be selected.

Vacuum pressure gauge
Series ZM

Solenoid valve for operating cylinder, etc.

Vacuum module
Series ZR

Double solenoids provide a self-holding function.

Vacuum switch
Series ZS

A variety of models (with or without a buffer), pad shapes (flat, flat with ribs, deep, and bellows shapes), pad diameters (ø2 to ø250), ø150 and above on special order.

Digital pressure switch
Series ZSE

Diaphragm type pressure switch
Series ZSM1

Adsorption confirmation switch for small diameter
Series ZSP1
Single Unit System

Equipment such as an ejector is configured as an individual unit. Thus, it is possible to create a flexible system configuration in which the circuit composition and the mounting locations can be selected as desired.

Other Equipment

<table>
<thead>
<tr>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other equipment for vacuum system</td>
<td>13-14-2</td>
</tr>
<tr>
<td>Vacuum regulator/Electronic vacuum regulator/Directional control equipment/Pressure gauge for vacuum/Fitting &amp; Tubing/Flow control equipment/Vacuum accessory equipment</td>
<td></td>
</tr>
<tr>
<td>Related products</td>
<td>13-14-7</td>
</tr>
<tr>
<td>Air filter/Regulator/Filter regulator/Mist separator</td>
<td></td>
</tr>
</tbody>
</table>
Equipment (vacuum switching valve, vacuum release valve, throttle valve, vacuum pressure switch, and filter) that is needed for controlling the vacuum pressure has been integrated to achieve efficient assembly work and a compact design.
**Vacuum Pump System Component Equipment**

**Control unit/Circuit**

- Control unit
- Vacuum pump
- Vacuum release valve
- Vacuum switch valve
- Filter
- Pad side

**Vacuum Pump System Component Equipment**

<table>
<thead>
<tr>
<th>Control unit</th>
<th>Application</th>
<th>Component equipment</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Series ZX100</td>
<td>• Effective area of vacuum switch valve is 3 mm². • Necessary functions can be combined through modular design.</td>
<td></td>
<td>13-2-40</td>
</tr>
<tr>
<td>Series ZR100</td>
<td>• Double solenoids provide a self-holding function. • Effective area of vacuum switch valve is 8.2 mm². • Necessary functions can be combined through modular design.</td>
<td></td>
<td>13-3-32</td>
</tr>
</tbody>
</table>

**Other Equipment**

<table>
<thead>
<tr>
<th>Description</th>
<th>Application</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vacuum regulator</td>
<td>Direct operated vacuum pressure adjustment valve that regulates the vacuum pressure.</td>
<td>13-14-2</td>
</tr>
<tr>
<td>Series IRV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electro-pneumatic regulator</td>
<td>Controls the vacuum pressure in accordance with external electric signals.</td>
<td>13-14-3</td>
</tr>
<tr>
<td>Series ITV209</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
When an ejector and a vacuum pump are used for picking a workpiece, the picking (and discharge) response times and the vacuum pressures during adsorption vary in accordance with piping conditions and the types of workpieces. Thus, an effective utilization of the vacuum system can be achieved by selecting the proper vacuum equipment.

**Selection Step**

1. **Pad selection**
   1-A Theoretical lifting force
   1-B Calculation method: Pad diameter

2. **Ejector/Vacuum switch valve selection**
   2-A Calculation method: Adsorption response time
   2-B Leakage at work adsorption
   2-C Size of ejector and vacuum supply valve (With leakage)
   2-D Size of ejector and vacuum supply valve (Without leakage)

---

**Selection Step 1 Pad Selection**

The pad diameter is found by means of a pad lift calculation. The calculated value should be used for reference and confirmed by actual adsorption tests when necessary. In the lift calculation, consideration should be given to the weight of the workpiece, forces due to acceleration during movement (lifting, stopping, turning, etc.) and a sufficient safety margin should be allowed. An additional margin should also be allowed when determining the number and arrangement of pads.

**1-A Theoretical Lifting Force**

The theoretical lifting force of a pad can be found by calculation or from the theoretical lifting force table.

**Calculation**

\[
W = P \times S \times 0.1 \times \frac{1}{t}
\]

- **W**: Lifting force (N)
- **P**: Vacuum pressure (kPa)
- **S**: Pad area (cm\(^2\))
- **t**: Safety factor
  - Horizontal lifting: 4 or more
  - Vertical lifting: 8 or more

**Theoretical Lifting Force**

The theoretical lifting force (not including the safety factor) is found from the pad diameter and vacuum pressure. The required lifting force is then found by dividing the theoretical lifting force by the safety factor.

\[
\text{Lifting force} = \frac{\text{Theoretical lifting force}}{t}
\]

---

**1) Theoretical Lifting Force (Theoretical lifting force = P \times S \times 0.1) (N)**

<table>
<thead>
<tr>
<th>Pad diameter (mm)</th>
<th>200</th>
<th>350</th>
<th>400</th>
<th>500</th>
<th>600</th>
<th>800</th>
<th>1000</th>
<th>1200</th>
<th>1600</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pad area (cm(^2))</td>
<td>0.07</td>
<td>0.21</td>
<td>0.36</td>
<td>0.031</td>
<td>0.126</td>
<td>0.283</td>
<td>0.503</td>
<td>0.785</td>
<td>1.33</td>
<td>2.01</td>
</tr>
<tr>
<td>Vacuum pressure (kPa)</td>
<td>0.08</td>
<td>0.19</td>
<td>0.36</td>
<td>0.031</td>
<td>0.126</td>
<td>0.283</td>
<td>0.503</td>
<td>0.785</td>
<td>1.33</td>
<td>2.01</td>
</tr>
<tr>
<td>-85</td>
<td>0.60</td>
<td>1.78</td>
<td>3.06</td>
<td>0.264</td>
<td>1.07</td>
<td>2.41</td>
<td>4.28</td>
<td>6.67</td>
<td>11.3</td>
<td>17.1</td>
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<tr>
<td>-80</td>
<td>0.56</td>
<td>1.68</td>
<td>2.88</td>
<td>0.248</td>
<td>1.01</td>
<td>2.26</td>
<td>4.02</td>
<td>6.28</td>
<td>10.6</td>
<td>16.1</td>
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<tr>
<td>-75</td>
<td>0.53</td>
<td>1.57</td>
<td>2.70</td>
<td>0.233</td>
<td>0.945</td>
<td>2.12</td>
<td>3.77</td>
<td>5.89</td>
<td>9.98</td>
<td>15.1</td>
</tr>
<tr>
<td>-70</td>
<td>0.49</td>
<td>1.47</td>
<td>2.52</td>
<td>0.217</td>
<td>0.882</td>
<td>1.96</td>
<td>3.52</td>
<td>5.50</td>
<td>9.31</td>
<td>14.1</td>
</tr>
<tr>
<td>-65</td>
<td>0.46</td>
<td>1.36</td>
<td>2.34</td>
<td>0.202</td>
<td>0.819</td>
<td>1.84</td>
<td>3.27</td>
<td>5.10</td>
<td>8.65</td>
<td>13.1</td>
</tr>
<tr>
<td>-60</td>
<td>0.42</td>
<td>1.26</td>
<td>2.16</td>
<td>0.186</td>
<td>0.756</td>
<td>1.70</td>
<td>3.02</td>
<td>4.71</td>
<td>7.98</td>
<td>12.1</td>
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<tr>
<td>-55</td>
<td>0.39</td>
<td>1.15</td>
<td>1.98</td>
<td>0.171</td>
<td>0.693</td>
<td>1.56</td>
<td>2.77</td>
<td>4.32</td>
<td>7.32</td>
<td>11.1</td>
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<tr>
<td>-50</td>
<td>0.35</td>
<td>1.05</td>
<td>1.80</td>
<td>0.155</td>
<td>0.630</td>
<td>1.42</td>
<td>2.52</td>
<td>3.93</td>
<td>6.65</td>
<td>10.1</td>
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<tr>
<td>-45</td>
<td>0.32</td>
<td>0.94</td>
<td>1.62</td>
<td>0.140</td>
<td>0.567</td>
<td>1.27</td>
<td>2.26</td>
<td>3.53</td>
<td>5.99</td>
<td>9.05</td>
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<tr>
<td>-40</td>
<td>0.28</td>
<td>0.84</td>
<td>1.44</td>
<td>0.124</td>
<td>0.504</td>
<td>1.13</td>
<td>2.01</td>
<td>3.14</td>
<td>5.32</td>
<td>8.04</td>
</tr>
</tbody>
</table>

This type of application should basically be avoided.
1-B Finding the Pad Diameter

A pad diameter which accounts for a safety factor based upon the workpiece lifting method (horizontal or vertical), can be selected by using the calculation formula or the selection graphs (graphs 1, 2 below).

**Calculation**

\[ \text{Pad diameter (mm)} = \sqrt{\frac{4}{3.14} \times \frac{n}{W} \times L} \times 1000 \]

- \( \text{Pad diameter (mm)} \): Pad diameter (mm)
- \( n \): Number of pads per workpiece
- \( W \): Lifting force (N)
- \( L \): Vacuum pressure (kPa)
- \( t \): Safety factor horizontal lifting: 4 or more
- \( \text{vertical lifting: 8 or more} \)

**Selection Graph**

After establishing the workpiece weight, number of pads to be used, and the vacuum pressure when adsorbing the workpiece, the pad diameters for horizontal lifting and vertical lifting can be found by means of using graphs (1) and (2).

**Selection Graph (1)-1 Pad Diameter Selection Graph by Lifting Force Horizontal Lifting (ø2 to ø50)**

**Selection Graph (1)-2 Pad Diameter Selection Graph by Lifting Force Horizontal Lifting (ø50 to ø250)**

**Selection Graph (2)-1 Pad Diameter Selection Graph by Lifting Force Vertical Lifting (ø2 to ø50)**

**Selection Graph (2)-2 Pad Diameter Selection Graph by Lifting Force Vertical Lifting (ø50 to ø250)**

**How to read the graph**

Example: Workpiece weight 1 kg (Lifting force: 9.8 N)

- Conditions/Number of pads: 5 pcs.
- Vacuum pressure –60 kPa
- Horizontal lifting

**<Selection procedure>**

From the conditions at the left, the lifting force per pad: 9.8 N ÷ 5 pcs. = 2 N, and for horizontal lifting, selection is made from graph (1)-1. Then, extending the intersection point of the lifting force 2 N and with a vacuum pressure of –60 kPa to the left, a pad diameter of 13 mm is obtained. Therefore, a pad diameter of 13 mm or greater should be selected.
When a pad is used for the adsorption transport of a workpiece, the approximate adsorption response time can be obtained (the length of time it takes for the pad’s internal vacuum pressure to reach the pressure that is required for adsorption after the supply valve (vacuum switching valve) has been operated). An approximate adsorption response time can be obtained through formulas and selection graphs (3) and (4).

**Vacuum System Circuit**

![Diagram of vacuum system circuit]

**Vacuum Pressure and Response Time after Supply Valve (switching valve) is Operated**

<table>
<thead>
<tr>
<th>Supply valve (Switching valve) operation</th>
<th>ON</th>
<th>OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vacuum pressure (P)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PV × 63%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PV × 95%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1: Arrival time to 63% of last vacuum pressure PV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T2: Arrival time to 95% of last vacuum pressure PV</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Calculation**

Adsorption response times T1 and T2 can be obtained through the formulas given below.

Adsorption response time  \( T_1 = \frac{V \times 60}{Q} \)

Adsorption response time  \( T_2 = 3 \times T_1 \)

Piping capacity  \( V = \frac{3.14D^2 \times L \times \frac{1}{1000 \text{ (l)}}}{4} \)

How to read the graph

Example: For obtaining the volume of tubing with bore size of ø5 mm and 1 meter length.

**Selection Procedure**

By extending leftward from the point at which the 1 meter tubing length on the horizontal axis intersects the line for a tubing’s bore size of ø5 mm, the piping volume approximately equivalent to 0.02 l can be obtained, on the vertical axis.

**Effective area of tubing**

How to read the graph

Example: Tubing size ø8/ø6, 1 m

**Selection Procedure**

From the point of intersection of tubing length 1 m of lateral axis and tubing I.D. ø6 mm, the equivalent effective area at vertical axis can be found as approx. 18 mm². Equivalent effective area: ≈ 18 mm²
3. Obtaining the adsorption response times

By operating the supply valve (switching valve) that controls the ejector (vacuum pump), the adsorption response times \( T_1 \) and \( T_2 \) that elapsed before the prescribed vacuum pressure is reached can be obtained from the selection graph (4).

### Selection Graph (4) (Adsorption Response Time)

![Graph showing adsorption response time](image)

- Conversely, the size of the ejector or the size of the switching valve of the vacuum pump system can be obtained from the adsorption response time.

**How to read the graph**

**Example 1:** For obtaining the adsorption response time until the pressure in the piping system with a piping volume of 0.02 m³ is discharged to 63% \((T_1)\) of the final vacuum pressure through the use of the vacuum ejector ZH07□S with a maximum suction flow rate of 12 l/min (ANR).

**Selection Procedure**

From the point at which the vacuum ejector’s maximum vacuum suction flow rate of 12 l/min (ANR) and the piping volume of 0.02 m³ intersect, the adsorption response time \( T_1 \) that elapses until 63% of the maximum vacuum pressure is reached can be obtained. (Sequence in selection graph (4), \( 2 \rightarrow 3 \)) \( T_1 \approx 0.3 \) seconds.

**Example 2:** For obtaining the discharge response time until the internal pressure in the 5 m³ tank is discharged to 95% \((T_2)\) of the final vacuum pressure through the use of a valve with an effective area of 18 mm².

**Selection Procedure**

From the point at which the valve’s effective area of 18 mm² and the piping volume of 5 m³ intersect, the discharge response time \( T_2 \) that elapses until 95% of the final vacuum pressure is reached can be obtained. (Sequence in selection graph (4), \( 3 \rightarrow 4 \)) \( T_2 \approx 12 \) seconds.

2-B Leakage at Work Adsorption

**Leakage**

Even if the pad picks up a workpiece, air could be drawn in depending on the type of workpiece. As a result, the vacuum pressure in the pad becomes reduced and the amount of vacuum that is necessary for adsorption cannot be attained.

When this type of workpiece must be handled, it is necessary to select the proper size of the ejector and the vacuum switching valve by taking into consideration the amount of air that could leak through the workpiece.

**Leakage from Effective Area of Work**

Leakage \( Q_L = 11.1 \times S_L \)

- \( Q_L \): Leakage l/min (ANR)
- \( S_L \): Effective area between work and pad, and work opening area \((\text{mm}^2)\)

**Leakage from Adsorption Test**

As described in the illustration below, pick up the workpiece with the ejector, using an ejector, pad and a vacuum gauge.

At this time, read vacuum pressure \( P_1 \), obtain the suction flow rate from the flow characteristics graph for the ejector that is being used, and render this amount as the leakage of the workpiece.

**Exercise:** Using a supply pressure of 0.45 MPa, when the ejector (ZH07□S) picks up a workpiece that leaks air, the vacuum gauge indicated a pressure of –53 kPa. Calculate the leakage volume from the workpiece.

**Selection Procedure**

When the suction flow rate of –53 kPa is obtained from the ZH07□S flow characteristics graph, the leakage volume is 5 l/min (ANR). (\( A \rightarrow B \rightarrow C \))

**Leakage:** Adsorption flow (5 l/min) (ANR)

**ZH07BS/ZH07DS**

**Exhaust Characteristics**

**Flow Characteristics**

![Exhaust and Flow Characteristics](image)
2-C Sizing Ejector and Vacuum Switching Valve (with Leakage)

If there is leakage through a workpiece, the necessary size of the ejector and the vacuum switching valve can be obtained by adding the leakage volume to the maximum suction flow rate.

**Calculation**

1. Average adsorption flow to achieve adsorption response time

\[
Q = \frac{V}{T_1} + Q_L
\]

\[T_1 = 3 \times T_s\]

- \(Q\): Average suction flow rate \(l/min\) (ANR)
- \(V\): Piping capacity \(l/min\)
- \(T_1\): Arrival time to stable \(P_v\) 63% after adsorption (sec.)
- \(T_s\): Arrival time to stable \(P_v\) 95% after adsorption (sec.)
- \(Q_L\): Leakage at work adsorption \(l/min\) (ANR)

2. Max. suction flow rate

\[
Q_{max} = (2 \text{ to } 3) \times Q
\]

**Selection Procedure**

- **Ejector**
  Select the ejector with the greater maximum suction flow rate from the \(Q_{max}\) indicated above.

- **Direct operation valve**
  Effective area \(S = \frac{Q_{max}}{11.1} \text{ (mm}^2\) \)
  Select a valve (solenoid valve) having an effective area that is greater than that of the effective area formula given above from the related equipment (P. 13-14).

**Selection Graph**

1. Tubing capacity
   Using selection graph (3) (P. 13-1-12) "Tubing I.D. Piping Capacity", make a selection in the same manner as indicated in "When no leakage occurs when picking up a workpiece".

2. Max. adsorption flow \(Q_{max}\)
   Using selection graph (4) "Response Time", obtain the maximum suction flow rate \(Q\) that does not contain the leakage amount \(Q_L\), based on the set adsorption response times \(T_1, T_s\) and the tubing volume.

\[
\text{Max. adsorption flow } Q_{max} = Q + (3 \times Q_L)
\]

**Selection Procedure**

- **Ejector**
  Select an ejector having a greater maximum suction flow rate than that of \(Q_{max}\) given above. During the selection, verify the pad's lift force because the vacuum pressure after adsorption will be lower than the maximum vacuum pressure due to the leakage volume \(Q_L\) \(l/min\) (ANR).

**Example: ZH10 Static**

(Supply pressure 0.45 MPa)
If the leakage volume \(Q_L\) is \(5 \text{ l/min}\) (ANR), the vacuum pressure after adsorption will be \(-73\) kPa. (8-9)

- **Vacuum switch valve**

Using selection graph (4) (P. 13-1-13), move the maximum suction flow rate \(Q_{max}\) point parallel to the graduation line of the effective area \(S\) of the left valve; then, obtain the effective area of the vacuum switching valve from the intersecting point.

**Flow Characteristics**

- **Vacuum switch valve**

Using valve selection graph (4), move the maximum suction flow rate \(Q_{max}\) point parallel to the graduation line of the effective area \(S\) of the left valve; then, obtain the effective area of the vacuum switching valve from the intersecting point.

2-D Sizing Ejector and Vacuum Switch Valve (without Leakage)

**Calculation**

1. Average suction flow rate

\[
Q = \frac{V \times 60}{T_1} + Q_L
\]

\[T_1 = 3 \times T_s\]

- \(Q\): Average suction flow rate \(l/min\) (ANR)
- \(V\): Piping capacity \(l/min\)
- \(T_1\): Arrival time to stable \(P_v\) 63% after adsorption (sec.)
- \(T_s\): Arrival time to stable \(P_v\) 95% after adsorption (sec.)
- \(Q_L\): Leakage at work adsorption \(l/min\) (ANR)

2. Max. adsorption flow

\[
Q_{max} = (2 \text{ to } 3) \times Q
\]

**Selection Procedure**

- **Ejector**
  Select the ejector with the greater maximum suction flow rate from the \(Q_{max}\) max. indicated above.

- **Vacuum switch valve**
  Effective area \(S = \frac{Q_{max}}{11.1} \text{ (mm}^2\) \)
  Select a valve (solenoid valve) having an effective area that is greater than that of the effective area formula given above from the related equipment (P. 13-14).

**Selection Graph**

1. Tubing capacity
   Using tubing capacity selection graph (3) (P. 13-1-12) "Tubing I.D. Piping Capacity", make a selection in the same manner as indicated in "When no leakage occurs when picking up a workpiece".

2. Max. adsorption flow \(Q_{max}\)
   Using selection graph (4) "Response Time", obtain the maximum suction flow rate \(Q\) based on the set adsorption response times \(T_1, T_s\) and the tubing volume.

**Selection Procedure**

- **Ejector**
  Select an ejector having a greater maximum suction flow rate than that of \(Q_{max}\) given above.

- **Vacuum switch valve**
  Using valve selection graph (4), move the maximum suction flow rate \(Q_{max}\) point parallel to the graduation line of the effective area \(S\) of the left valve; then, obtain the effective area of the vacuum switching valve from the intersecting point.
## Precautions on Vacuum Equipment Selection

### Caution

As a countermeasure for power outages, select a supply valve that is normally open or one that is equipped with a self-holding function.

Select a vacuum switching valve that has an effective area that does not reduce the composite effective area consisting of the areas from the pad to the ejector.

For the vacuum release valve, select a 2-3 port valve with a low vacuum specification. Also, use a needle valve to regulate the release flow rate.

During the adsorption transport of a workpiece, verification of the vacuum switch is recommended.
- In addition, visually verify the vacuum gauge when handling a heavy or a hazardous item.
- The ZSP1 type is the optimal type for the adsorption/transport of small parts using a suction nozzle with a small diameter.
- Install a filter (Series ZFA-ZFB) before the pressure switch if the ambient air is of low quality.

Use a suction filter (Series ZFA-ZFB) to protect the switching valve and to prevent the ejector from becoming clogged. Also a suction filter must be used with the Series ZX, ZR, and Series ZM in a dusty environment. If only the unit's filter is used, it will become clogged quickly.

## Precautions on Matching with Vacuum Circuit

### Ejector and number of pads

Ideally, one pad should be used for each ejector.

When more than one pad is attached to a single ejector, if one of the workpieces becomes detached, the vacuum pressure will drop, causing other workpieces to become detached. Therefore, the countermeasures listed below must be taken.
- Adjust the needle valve to minimize the pressure fluctuation between adsorption and non-adsorption operations.
- Provide a vacuum switching valve to each individual pad to minimize the influences on other pads if an adsorption error occurs.

### Vacuum pump and number of pads

Ideally, one pad should be used for each ejector.

When more than one pad is attached to a single vacuum line, take the countermeasures listed below.
- Adjust the needle valve to minimize the pressure fluctuation between adsorption and non-adsorption operation.
- Include a tank and a vacuum pressure reduction valve (vacuum pressure regulator valve) to stabilize the source pressure.
- Provide a vacuum switching valve to each individual pad to minimize the influences on other pads if an adsorption error occurs.
Caution

Ejector Selection

There are 2 types of ejector flow rate characteristics: the high vacuum (S type) and the high flow rate (L type).

During the selection, pay particular attention to the vacuum pressure when adsorbing workpieces that leak.

High Vacuum Type Flow Characteristics/ZH13□S

The vacuum pressure varies in accordance with the leakage volumes indicated in the above diagrams.

If the leakage volume is 30 l/min (ANR), the vacuum pressure of the S type is –20 kPa and for the L type it is –33 kPa.

If the leakage volume is 5 l/min (ANR), the vacuum pressure of the S type is –80 kPa and for the L type it is –47 kPa.

Thus, during the selection process, make sure to take the flow characteristics of the high vacuum type (S type) and the high flow rate type (L type) into consideration in order to select the type that is optimal for your application.

High Flow Type Flow Characteristics/ZH13□L

Pad Selection

(Set the operating pressure below the pressure that has been stabilized after adsorption.) Determine the pad diameter in accordance with the operating pressure.

During the selection of a pad, keep in mind that the vacuum pressure during the adsorption of a workpiece that leaks becomes lower than the maximum vacuum pressure.

Vacuum Line Equipment Selection

Determine the volume of the suction filter and the effective area of the switching valve in accordance with the maximum suction flow rate of the ejector and the vacuum pump. Make sure that the effective area is greater than the value that has been obtained through the formula given below. (If the devices are connected in series in the vacuum line, their effective areas must be combined.)

\[ S = \frac{Q_{\text{max}}}{11.1} \]

\( S \): Effective area (mm²)

\( Q_{\text{max}} \): Max. adsorption l/min (ANR)

Vacuum Switch (Series ZS), Vacuum Gauge (Series GZ)

When adsorbing and transporting a workpiece, verify at the vacuum switch as much as possible (In addition, visually verify the vacuum gauge, especially when handling a heavy or a hazardous item.). When picking an electronic part or a small precision part, if the suction nozzle is approximately ø1, the difference in pressure between ON and OFF becomes small (although this will also depend on the capacity of the ejector and the vacuum pump). In such a case, it will be necessary to use the adsorption verification switch ZSP1, which has a small hysteresis and high precision. Conversely, it cannot be detected by an ejector with a large suction capacity. Therefore, use an appropriate pressure switch. Furthermore, it will become necessary to stabilize the pressure of the ejector and the vacuum pump.

Air Suction Filter (Series ZFA, ZFB)

- To protect the switching valve and the ejector from becoming clogged, a suction filter in the vacuum circuit is recommended.
- When using the Series ZX, ZR, and ZM in a dusty environment, the unit’s filter will become clogged quickly, so it is recommended that the Series ZFA and ZFB be used concurrently.

Ejector Nozzle Diameter Selection

If a considerable amount of leakage occurs between the workpiece and the pad, resulting in incomplete adsorption, or to shorten the adsorption transport time, select an ejector nozzle with a larger diameter from the Series ZH, ZM, ZR, or ZL.

Manifold Use

Individual exhaust

If there are a large number of ejectors that are linked on a manifold and operate simultaneously, use the built-in silencer type or the port exhaust type.

Centralized exhaust

If there are a large number of ejectors that are linked on a manifold, which exhaust collectively, install a silencer at both ends. If the exhaust must be discharged outdoors through piping, make sure that the diameter of the piping is large enough that its back pressure will not affect the operation of the ejectors.
Vacuum Pad Selection

Safety
Because suction is applied to an object during a vacuum adsorption transport, there is a possibility of dropping the object depending on the conditions. Thus, everything should be designed with safety as the number one priority in order to achieve a system design with an excellent margin of safety.

Mounting Position
As a rule, the unit must be installed horizontally. Although a diagonal or a vertical installation should be avoided whenever possible, if the unit must be installed in such a manner, be certain to guarantee absolute safety.

Impact to Pad
When pushing a pad to a workpiece, make sure not to apply an impact or a large force which would lead to premature deformation, cracking, or wearing of the pad. Therefore, the pad should be pushed against the workpiece to the extent that its skirt portion deforms or that its ribbed portion comes into slight contact with the workpiece. Especially, when using a smaller diameter pad, make sure to locate it correctly.

Balance of Pad and Work
Make sure that the pad's suction surface is not larger than the surface of the workpiece to prevent vacuum leakage and unstable picking.

Unsteady Distance between Pad and Work
If the pad and the workpiece cannot be positioned properly, such as when picking a workpiece having an uneven height, use a built-in spring type pad with a buffer. This type of pad acts as a cushion between the pad and the workpiece. If it is necessary to further position the pad and the workpiece, use a non-rotating buffer.

Loading by acceleration and wind pressure lifting

- Lifting direction
- Pad positioning
- Avoid high acceleration and deceleration

Porous Work
To pick a permeable workpiece such as paper, select a pad with a small diameter that is sufficient to lift the workpiece. Because a large amount of air leakage could reduce the pad's suction force, it may be necessary to increase the capacity of the vacuum pump or enlarge the effective area of the piping passage.

Flat Plate Work
When a workpiece with a large surface area such as sheet glass or PCB is suspended, the workpiece could move in a wavelike motion if a large force is applied by wind pressure or by an impact. Therefore, it is necessary to ensure the proper allocation and size of pads.

Pad Form Selection by Work
To use an appropriate pad, select the shape of the pad in accordance with the shape and the material of the workpiece.

Flat
For a workpiece that has a flat surface and free of deformation.

Flat with ribs
For a workpiece that is susceptible to deformation.

Deep
For a workpiece with a curved surface.

Bellows
For a workpiece that does not have a space for a buffer, or for a workpiece with a diagonal surface.

Soft Work
If a soft workpiece such as vinyl, paper, or thin sheet is picked up, the vacuum pressure could cause the workpiece to deform or wrinkle. In such a case, it will be necessary to use a small pad or a ribbed pad and reduce the vacuum pressure.

Guide for drop prevention
Provide an auxiliary device (example: a guide for preventing the workpieces from dropping) as necessary.
Vacuum Pad/Example of Work Transfer

<table>
<thead>
<tr>
<th>Material</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>NBR</td>
<td>Transport of general work, Corrugated board, Veneer plate, Iron plate and others</td>
</tr>
<tr>
<td>Silicon rubber</td>
<td>Semiconductor, Removing from die-casting, Thin work, Food processor</td>
</tr>
<tr>
<td>Urethane rubber</td>
<td>Corrugated board, Iron plate, Veneer plate</td>
</tr>
<tr>
<td>Fluoro rubber</td>
<td>Chemical work</td>
</tr>
<tr>
<td>Conductive NBR</td>
<td>General work of semiconductor (Static electricity resistance)</td>
</tr>
<tr>
<td>Conductive silicon rubber</td>
<td>Semiconductor (Static electricity)</td>
</tr>
</tbody>
</table>

### Pad Type

<table>
<thead>
<tr>
<th>Pad form</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat</td>
<td>To be used when adsorption surface of work is flat and not deformed.</td>
</tr>
<tr>
<td>Flat with ribs</td>
<td>To be used when work is likely to deform or in the case of releasing work certainly.</td>
</tr>
<tr>
<td>Deep</td>
<td>To be used when work is curved shape.</td>
</tr>
<tr>
<td>Bellows</td>
<td>To be used when there is not enough space to install buffer or adsorption surface of work is slanted.</td>
</tr>
<tr>
<td>Elliptic</td>
<td>To be used when work has limited adsorption surface or long in length and work is required to locate precisely.</td>
</tr>
<tr>
<td>Ball joint type</td>
<td>To be used when adsorption surface of work is not horizontal.</td>
</tr>
<tr>
<td>Long stroke buffer</td>
<td>To be used when work height is not even or cushioning toward work is required.</td>
</tr>
<tr>
<td>Large size buffer</td>
<td>To be used when work is heavy weight.</td>
</tr>
<tr>
<td>Conductive pad</td>
<td>As one of the countermeasures against the static electricity, rubber material with reduced resistance is used. For antistatic measures</td>
</tr>
</tbody>
</table>

### Glossary of Terms

<table>
<thead>
<tr>
<th>Terms</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Max.) Adsorption flow</td>
<td>Volume of air taken in by the ejector. The maximum volume is the flow rate of the air that is taken in without having anything connected to the vacuum port.</td>
</tr>
<tr>
<td>Maximum vacuum pressure</td>
<td>The maximum value of the vacuum pressure that is generated by the ejector.</td>
</tr>
<tr>
<td>Air consumption</td>
<td>The volume of compressed air that is consumed by the ejector.</td>
</tr>
<tr>
<td>Standard supply pressure</td>
<td>The optimal supply pressure for operating the ejector.</td>
</tr>
<tr>
<td>Exhaust characteristics</td>
<td>The relation between the vacuum pressure and the suction flow rate when the supply pressure to the ejector has been changed.</td>
</tr>
<tr>
<td>Flow characteristics</td>
<td>The relation between the vacuum pressure and the suction flow rate with the standard supply pressure supplied to the ejector.</td>
</tr>
<tr>
<td>Vacuum pressure switch</td>
<td>The pressure switch that is used for verifying the adsorption of a workpiece.</td>
</tr>
<tr>
<td>Adsorption confirmation switch</td>
<td>The switch, based on an air pressure bridge, that is used for verifying the adsorption of a workpiece. It is used when the adsorption pad and the nozzle are extremely small.</td>
</tr>
<tr>
<td>(Air) Supply valve</td>
<td>The valve that supplies compressed air to the ejector.</td>
</tr>
<tr>
<td>(Vacuum) Release valve</td>
<td>The valve that supplied positive pressure or air to break the vacuum state of the adsorption pad.</td>
</tr>
<tr>
<td>Flow adjustment valve</td>
<td>The valve that supplied positive pressure or air that regulates the flow of the air to break the vacuum.</td>
</tr>
<tr>
<td>Release pressure</td>
<td>Pressure that is used for breaking the vacuum.</td>
</tr>
<tr>
<td>Pilot pressure</td>
<td>Pressure that is used for operating the ejector valve.</td>
</tr>
<tr>
<td>External release</td>
<td>The action of breaking the vacuum using externally supplied air instead of using the ejector unit.</td>
</tr>
<tr>
<td>Vacuum port</td>
<td>Port for generating vacuum.</td>
</tr>
<tr>
<td>Exhaust port</td>
<td>Port for exhausting the air, which was used by the ejector, and the air taken in by vacuum port.</td>
</tr>
<tr>
<td>Supply port</td>
<td>Port for supplying the air, which is used by the ejector.</td>
</tr>
<tr>
<td>Back pressure</td>
<td>Pressure inside the exhaust port.</td>
</tr>
<tr>
<td>Leakage</td>
<td>The entry of air into the vacuum passage, such as from an area between a workpiece and a pad, or between a joint and tubing. The vacuum pressure decreases when leakage occurs.</td>
</tr>
<tr>
<td>Response speed</td>
<td>The length of time that elapses from when the supply valve or the switching valve is activated until the pressure switch turns ON. It is also called the adsorption time.</td>
</tr>
<tr>
<td>Average suction flow rate</td>
<td>The suction flow rate of the ejector or the pump, which is used for calculating the response speed. It is 1/2 to 1/3 of the maximum suction flow rate.</td>
</tr>
<tr>
<td>Conductive pad</td>
<td>A pad with a low electrical resistance that is used as an electrostatic prevention measure.</td>
</tr>
<tr>
<td>Vacuum pressure</td>
<td>Any pressure below the atmospheric pressure. When the atmospheric pressure is used as a reference, the pressure is presented by kPa (G), and when the absolute pressure is used as a reference, the pressure is represented by kPa. When referencing a piece of vacuum equipment such as an ejector, the pressure is generally represented by –kPa.</td>
</tr>
<tr>
<td>Ejector unit</td>
<td>A device that generates vacuum by means of discharging the compressed air from a nozzle at a high speed, thus utilizing the phenomenon in which the pressure is reduced when the air around the nozzle is sucked.</td>
</tr>
<tr>
<td>Air suction filter</td>
<td>The vacuum filter that is provided in the vacuum passage in order to prevent the intrusion of dust into the ejector, the vacuum pump, or peripheral equipment.</td>
</tr>
</tbody>
</table>
## Effective Diameter of Vacuum Pad

Effective diameter at adsorption is as follows.

### Vacuum Area Diameter (Vacuum pressure: –84 kPa) after Vacuum Suction by Vacuum Pad

**(mm)**

<table>
<thead>
<tr>
<th>Part no.</th>
<th>Type</th>
<th>Flat U</th>
<th>Flat with ribs C</th>
<th>Bellows B</th>
<th>Deep D</th>
<th>Large size H</th>
<th>Large size bellows HB</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>NBR</td>
<td>Silicon rubber</td>
<td>NBR</td>
<td>Silicon rubber</td>
<td>NBR</td>
<td>Silicon rubber</td>
</tr>
<tr>
<td>ZP02**</td>
<td>2</td>
<td>ø2</td>
<td>ø2</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>ZP04**</td>
<td>4</td>
<td>ø4</td>
<td>ø4</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>ZP06**</td>
<td>6</td>
<td>ø5</td>
<td>ø4</td>
<td>—</td>
<td>—</td>
<td>ø5</td>
<td>ø5</td>
</tr>
<tr>
<td>ZP08**</td>
<td>8</td>
<td>ø7</td>
<td>ø7</td>
<td>—</td>
<td>—</td>
<td>ø7</td>
<td>ø5</td>
</tr>
<tr>
<td>ZP10**</td>
<td>10</td>
<td>ø10</td>
<td>ø9</td>
<td>ø9</td>
<td>e8</td>
<td>ø7</td>
<td>ø7</td>
</tr>
<tr>
<td>ZP13**</td>
<td>13</td>
<td>ø11</td>
<td>ø11</td>
<td>ø11</td>
<td>ø8</td>
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<td>ø13</td>
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<td>32</td>
<td>ø13</td>
<td>ø11</td>
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<td>ø20</td>
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<td>63</td>
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<td>—</td>
<td>—</td>
<td>—</td>
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---

*(mm)*
Vacuum Ejector
Box Type (Built-in Silencer)/Body Ported Type
Series ZH

Nozzle diameter: Ø0.5, Ø0.7, Ø1.0, Ø1.3, Ø1.5, Ø1.8, Ø2.0
Type S: Standard type
L: Large flow type

Compact and lightweight
The nozzle and the body, which have been made into a composite resin construction, are compact and lightweight. Nozzle diameter Ø0.5—28 g

Box type
(Built-in silencer)
Body ported
Two types are available in the series: the box type with a silencer exhaust, and the body ported type, with an individual exhaust.

One-touch and screw-in connections can be combined.
To suit the operating conditions, port connections can be combined with a choice of One-touch and screw-in connections.

Body can be mounted and secured.
The body ported type is also provided with mounting holes for securing the body.
Vacuum Ejector
Box Type (Built-in Silencer)/Body Ported Type

**Series ZH**

### How to Order

Note Refer to “Table (1)” and “(2)” for the combination available for SUP, VAC and EXH port connection.

#### Nozzle diameter

<table>
<thead>
<tr>
<th>Nozzle diameter</th>
<th>05</th>
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<tr>
<td></td>
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<td></td>
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<td>1.3 mmø</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>1.5 mmø</td>
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<tr>
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<td>1.6 mmø</td>
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#### Maximum vacuum pressure

<table>
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<tr>
<th>Symbol</th>
<th>S</th>
<th>L</th>
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</thead>
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<tr>
<td></td>
<td>–88 kPa</td>
<td>–48 kPa</td>
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#### SUP. port size

<table>
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<tr>
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<td>ø6</td>
<td>One-touch</td>
</tr>
<tr>
<td>08</td>
<td>ø8</td>
<td>One-touch</td>
</tr>
<tr>
<td>10</td>
<td>ø10</td>
<td>One-touch</td>
</tr>
<tr>
<td>12</td>
<td>ø12</td>
<td>One-touch</td>
</tr>
<tr>
<td>01</td>
<td>Rc ½</td>
<td>Screw-in</td>
</tr>
<tr>
<td>02</td>
<td>Rc ¾</td>
<td>Screw-in</td>
</tr>
<tr>
<td>03</td>
<td>Rc ½</td>
<td>Screw-in</td>
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</tbody>
</table>

#### VAC. port size

<table>
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<td>10</td>
<td>ø10</td>
<td>One-touch</td>
</tr>
<tr>
<td>12</td>
<td>ø12</td>
<td>One-touch</td>
</tr>
<tr>
<td>01</td>
<td>Rc ½</td>
<td>Screw-in</td>
</tr>
<tr>
<td>02</td>
<td>Rc ¾</td>
<td>Screw-in</td>
</tr>
<tr>
<td>03</td>
<td>Rc ½</td>
<td>Screw-in</td>
</tr>
<tr>
<td>04</td>
<td>Rc ½</td>
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#### EXH. port size

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<td>08</td>
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<td>10</td>
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<td>12</td>
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<tr>
<td>16</td>
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<td>One-touch</td>
</tr>
<tr>
<td>01</td>
<td>Rc ½</td>
<td>Screw-in</td>
</tr>
<tr>
<td>02</td>
<td>Rc ¾</td>
<td>Screw-in</td>
</tr>
<tr>
<td>03</td>
<td>Rc ½</td>
<td>Screw-in</td>
</tr>
<tr>
<td>04</td>
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<td>Screw-in</td>
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#### Table (1) Combination of Connection

<table>
<thead>
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<th>Body type</th>
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<th>VAC</th>
<th>EXH</th>
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<tr>
<td>Box type (Built-in silencer)</td>
<td>1</td>
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<td>One-touch</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>One-touch</td>
<td>Screw-in</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Screw-in</td>
<td>One-touch</td>
</tr>
<tr>
<td>Body ported type (Without silencer)</td>
<td>1</td>
<td>One-touch</td>
<td>One-touch</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>One-touch</td>
<td>Screw-in</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Screw-in</td>
<td>Screw-in</td>
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</table>

#### Table (2) Port Size

<table>
<thead>
<tr>
<th>Model</th>
<th>Connection (One-touch/Screw-in)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SUP</td>
</tr>
<tr>
<td>ZH05B</td>
<td>ø6/Rc ½</td>
</tr>
<tr>
<td>ZH07B</td>
<td>ø6/Rc ½</td>
</tr>
<tr>
<td>ZH10B</td>
<td>ø6/Rc ½</td>
</tr>
<tr>
<td>ZH13B</td>
<td>ø6/Rc ½</td>
</tr>
<tr>
<td>ZH05D</td>
<td>ø6/Rc ½</td>
</tr>
<tr>
<td>ZH07D</td>
<td>ø6/Rc ½</td>
</tr>
<tr>
<td>ZH10D</td>
<td>ø6/Rc ½</td>
</tr>
<tr>
<td>ZH13D</td>
<td>ø6/Rc ½</td>
</tr>
<tr>
<td>ZH15D</td>
<td>ø10/Rc ½</td>
</tr>
<tr>
<td>ZH18D</td>
<td>ø12/Rc ½</td>
</tr>
<tr>
<td>ZH20D</td>
<td>ø12/Rc ½</td>
</tr>
</tbody>
</table>
### Model

<table>
<thead>
<tr>
<th>Model</th>
<th>Nozzle diameter (mm)</th>
<th>Body type</th>
<th>Max. vacuum pressure (kPa)</th>
<th>Maximum suction flow rate (l/min (ANR))</th>
<th>Air consumption (l/min (ANR))</th>
<th>Connection (One-touch/Screw-in)</th>
<th>Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZH05B</td>
<td>0.5</td>
<td>Box type (Built-in silencer)</td>
<td>–88</td>
<td>–48</td>
<td>5</td>
<td>8</td>
<td>13</td>
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<tr>
<td>ZH07B</td>
<td>0.7</td>
<td>Body ported type (Without silencer)</td>
<td>–88</td>
<td>–48</td>
<td>12</td>
<td>20</td>
<td>23</td>
</tr>
<tr>
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<td>1.0</td>
<td>Box type (Built-in silencer)</td>
<td>–88</td>
<td>–48</td>
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<td>34</td>
<td>46</td>
</tr>
<tr>
<td>ZH13B</td>
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<td>Body ported type (Without silencer)</td>
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<td>–53</td>
<td>40</td>
<td>70</td>
<td>78</td>
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<tr>
<td>ZH05D</td>
<td>0.5</td>
<td>Box type (Built-in silencer)</td>
<td>–88</td>
<td>–48</td>
<td>5</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td>ZH07D</td>
<td>0.7</td>
<td>Body ported type (Without silencer)</td>
<td>–88</td>
<td>–48</td>
<td>12</td>
<td>20</td>
<td>23</td>
</tr>
<tr>
<td>ZH10D</td>
<td>1.0</td>
<td>Box type (Built-in silencer)</td>
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<td>–48</td>
<td>24</td>
<td>34</td>
<td>46</td>
</tr>
<tr>
<td>ZH13D</td>
<td>1.3</td>
<td>Body ported type (Without silencer)</td>
<td>–88</td>
<td>–53</td>
<td>40</td>
<td>70</td>
<td>78</td>
</tr>
<tr>
<td>ZH15D</td>
<td>1.5</td>
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<td>–53</td>
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<td>75</td>
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<tr>
<td>ZH18D</td>
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<td>–53</td>
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<td>110</td>
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<td>–88</td>
<td>–53</td>
<td>85</td>
<td>135</td>
<td>185</td>
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</table>

* Supply pressure: 0.45 MPa.

### Construction

- **Box type (Built-in silencer)**
  - [Diagram of Box type (Built-in silencer)]

- **Body ported type (Without silencer)**
  - [Diagram of Body ported type (Without silencer)]

### Precautions

- **Be sure to read before handling. Refer to pages 13-15-3 to 13-15-4 for Safety Instructions and Common Precautions on the products mentioned in this catalog, and refer to page 13-1-5 for Precautions on every series.**

### Caution

- **Mounting**
  - Make sure that an excessive amount of load or moment is not applied to the ejector body due to pipe connections or installation.

- **Exhaust piping**
  - On the ZH□□□□□□□□ models, keep exhaust ports open on at least one side. Make sure that the back pressure of the exhaust pipe on the ZH□□□□□□□□ models is 0.005 MPa or less. (Reference: Using tubing with an applicable diameter, its length must be 0.5 m or less.)

  (Port indication: P: supply port; V: vacuum port; E: exhaust port.)

- **Matching the ejector to the vacuum circuit**
  - Refer to technical data on page 13-1-10 to 19 for precautions on the vacuum circuit.
Exhaust Characteristics/Flow Characteristics

- **ZH05□S**
  - Max. vacuum pressure: -88 kPa
- **ZH05□L**
  - Max. vacuum pressure: -48 kPa
- **ZH07□S**
  - Max. vacuum pressure: -88 kPa
- **ZH07□L**
  - Max. vacuum pressure: -48 kPa
- **ZH10□S**
  - Max. vacuum pressure: -88 kPa
- **ZH10□L**
  - Max. vacuum pressure: -48 kPa
- **ZH13□S**
  - Max. vacuum pressure: -88 kPa
- **ZH13□L**
  - Max. vacuum pressure: -48 kPa

The flow characteristics correspond to a supply pressure of 0.45 MPa.
Exhaust Characteristics/Flow Characteristics

The flow characteristics correspond to a supply pressure of 0.45 MPa.

How to Read Flow Characteristics Graph

Flow characteristics are expressed in ejector vacuum pressure and suction flow. If suction flow rate changes, a change in vacuum pressure will also be expressed. Normally this relationship is expressed in ejector standard use.

In graph, Pmax is max. vacuum pressure and Qmax is max. suction flow. The valves are specified according to catalog use.

Changes in vacuum pressure are expressed in the order below.
1. When ejector suction port is covered and made airtight, suction flow becomes 0 and vacuum pressure is at maximum value (Pmax).
2. When suction port is opened gradually, air can flow through, (air leakage), suction flow increases, but vacuum pressure decreases. (condition P1 and Q1)
3. When suction port is opened further, suction flow moves to maximum value (Qmax), but vacuum pressure is near 0. (atmospheric pressure).

When vacuum port (vacuum piping) has no leakage, vacuum pressure becomes maximum, and vacuum pressure decreases as leakage increases. When leakage value is the same as max. suction flow, vacuum pressure is near 0.

When ventitative or leaky work must be adsorbed, please note that vacuum pressure will not be high.
### Series ZH

**Box Type (Built-in silencer): ZH□□□□□□**

#### One-touch connection

<table>
<thead>
<tr>
<th>Model</th>
<th>A</th>
<th>øB</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
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</thead>
<tbody>
<tr>
<td>ZH05BS-06-06</td>
<td>60</td>
<td>6</td>
<td>22</td>
<td>16</td>
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<td>28</td>
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<td>47</td>
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<td>ZH05BL-06-06</td>
<td>60</td>
<td>6</td>
<td>22</td>
<td>16</td>
<td>12.8</td>
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<td>47</td>
</tr>
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<td>ZH07BS-06-06</td>
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<td>6</td>
<td>22</td>
<td>16</td>
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#### One-touch and screw-in connection

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<th>øN</th>
<th>O</th>
<th>P</th>
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<th>øK</th>
<th>L</th>
<th>øM</th>
<th>øN</th>
<th>O</th>
<th>P</th>
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---

**Applicable tubing diameter øB**

**Applicable tubing diameter øM**

**Model**

**Series ZH**

**13-5-6**

---

**Box Type (Built-in silencer): ZH□□□□□□**

**One-touch connection**

**One-touch and screw-in connection**

**Screw-in connection**
**Vacuum Ejector:**
*Box Type (Built-in Silencer)/Body Ported Type Series ZH*

### Body Ported Type (Without silencer): ZH05DSₗ₋₋₋ to ZH15DSₗ₋₋₋

#### One-touch connection

![Diagram](image1)

**Applicable tubing diameter øN**

<table>
<thead>
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<th>D</th>
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#### One-touch and screw-in connection

![Diagram](image2)

**Applicable tubing diameter øJ**

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<th>K</th>
<th>L</th>
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#### Screw-in connection

![Diagram](image3)

**Applicable tubing diameter øJ**

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</table>
Series ZH

Body Ported Type (Without silencer): ZH18DS\textsuperscript{S}L-□-□-□, ZH20DS\textsuperscript{S}L-□-□-□

One-touch connection

One-touch and screw-in connection

Screw-in connection
Example of Application Circuit

<table>
<thead>
<tr>
<th>Basic Type</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>

## Caution

Handling of application circuits

1. **Countermeasures for power outages**
   - Select a supply valve for the ejector that is normally open or one that is equipped with a self-holding function.

2. **Using a small-diameter picking nozzle**
   - For picking electronic parts or small precision parts, if the picking nozzle is approximately ø1 mm in diameter, the vacuum remains high by being restricted by the nozzle. As a result, it will not be possible to verify it with the vacuum switch. In such a case, it is necessary to use an ejector that is suited to the nozzle and to select a vacuum switch with a favorable hysteresis and precision.

3. **Considerable leakage from the suction surface**
   - If a workpiece is made of porous material or if there is air leakage from the area between the pad and the workpiece, use a nozzle with a large diameter and a large suction flow volume.
   - If the amount of leakage is known based on the effective sectional area of the side with the leakage, the vacuum pressure can be estimated in accordance with the ejector’s flow volume characteristics.

4. **Suction filter**
   - To protect the ejectors and valves from dust, the use of a suction filter (Series ZFA, ZFB) is recommended.

5. **Use of a vacuum switch**
   - It is recommended that verification be made with a vacuum switch as much as possible.

6. **Vacuum release valve**
   - To serve as a vacuum release valve, use a 2 port or 3 port valve. As for the performance of the valve, select a valve for a low vacuum. In addition, add a needle valve that can regulate the flow volume of the vacuum releasing air. Use the atmospheric pressure or a positive pressure for the vacuum releasing pressure.

Diagrams (a) to (d) show the combination with peripherals.
These safety instructions are intended to prevent a hazardous situation and/or equipment damage. These instructions indicate the level of potential hazard by labels of "Caution", "Warning" or "Danger". To ensure safety, be sure to observe ISO 4414 Note 1), JIS B 8370 Note 2) and other safety practices.

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

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

⚠️ Danger : in extreme conditions, there is a possible result of serious injury or loss of life.

---

Note 1) ISO 4414: Pneumatic fluid power--General rules relating to systems.
Note 2) JIS B 8370: General Rules for Pneumatic Equipment

---

⚠️ Warning

1. The compatibility of pneumatic equipment is the responsibility of the person who designs the pneumatic system or decides its specifications.
   Since the products specified here are used in various operating conditions, their compatibility for the specific pneumatic system must be based on specifications or after analysis and/or tests to meet your specific requirements. The expected performance and safety assurance will be the responsibility of the person who has determined the compatibility of the system. This person should continuously review the suitability of all items specified, referring to the latest catalog information with a view to giving due consideration to any possibility of equipment failure when configuring a system.

2. Only trained personnel should operate pneumatically operated machinery and equipment.
   Compressed air can be dangerous if an operator is unfamiliar with it. Assembly, handling or repair of pneumatic systems should be performed by trained and experienced operators.

3. Do not service machinery/equipment or attempt to remove components until safety is confirmed.
   1. Inspection and maintenance of machinery/equipment should only be performed once measures to prevent falling or runaway of the driver objects have been confirmed.
   2. When equipment is to be removed, confirm the safety process as mentioned above. Cut the supply pressure for this equipment and exhaust all residual compressed air in the system.
   3. Before machinery/equipment is restarted, take measures to prevent shooting-out of cylinder piston rod, etc.

4. Contact SMC if the product is to be used in any of the following conditions:
   1. Conditions and environments beyond the given specifications, or if product is used outdoors.
   2. Installation on equipment in conjunction with atomic energy, railway, air navigation, vehicles, medical equipment, food and beverages, recreation equipment, emergency stop circuits, clutch and brake circuits in press applications, or safety equipment.
   3. An application which has the possibility of having negative effects on people, property, or animals, requiring special safety analysis.
Common Precautions
Be sure to read before handling.
For detailed precautions on every series, refer to main text.

Selection

⚠️ Warning
1. Confirm the specifications.
   Products represented in this catalog are designed for use in compressed air applications only (including vacuum), unless otherwise indicated.
   Do not use the product outside their design parameters.
   Please contact SMC when using the products in applications other than compressed air (including vacuum).

Mounting

⚠️ Warning
1. Instruction manual
   Install the products and operate them only after reading the instruction manual carefully and understanding its contents.
   Also keep the manual where it can be referred to as necessary.
2. Securing the space for maintenance
   When installing the products, please allow access for maintenance.
3. Tightening torque
   When installing the products, please follow the listed torque specifications.

Piping

⚠️ Caution
1. Before piping
   Make sure that all debris, cutting oil, dust, etc., are removed from the piping.
2. Wrapping of pipe tape
   When screwing piping or fittings into ports, ensure that chips from the pipe threads or sealing material do not get inside the piping. Also, when the pipe tape is used, leave 1.5 to 2 thread ridges exposed at the end of the threads.

Air Supply

⚠️ Warning
1. Operating fluid
   Please consult with SMC when using the product in applications other than compressed air (including vacuum).
   Regarding products for general fluid, please ask SMC about applicable fluids.
2. Install an air dryer, aftercooler, etc.
   Excessive condensate in a compressed air system may cause valves and other pneumatic equipment to malfunction.
   Installation of an air dryer, after cooler etc. is recommended.
3. Drain flushing
   If condensate in the drain bowl is not emptied on a regular basis, the bowl will over flow and allow the condensate to enter the compressed air lines.
   If the drain bowl is difficult to check and remove, it is recommended that a drain bowl with the auto-drain option be installed.
   For compressed air quality, refer to “Air Preparation Equipment” catalog.

4. Use clean air
   If the compressed air supply is contaminated with chemicals, synthetic materials, corrosive gas, etc., it may lead to break down or malfunction.

Operating Environment

⚠️ Warning
1. Do not use in environments where the product is directly exposed to corrosive gases, chemicals, salt water, water or steam.
2. Do not expose the product to direct sunlight for an extended period of time.
3. Do not use in a place subject to heavy vibrations and/or shocks.
4. Do not mount the product in locations where it is exposed to radiant heat.

Maintenance

⚠️ Warning
1. Maintenance procedures are outlined in the operation manual.
   Not following proper procedures could cause the product to malfunction and could lead to damage to the equipment or machine.
2. Maintenance work
   If handled improperly, compressed air can be dangerous. Assembly, handling and repair of pneumatic systems should be performed by qualified personnel only.
3. Drain flushing
   Remove drainage from air filters regularly. (Refer to the specifications.)
4. Shut-down before maintenance
   Before attempting any kind of maintenance make sure the supply pressure is shut off and all residual air pressure is released from the system to be worked on.
5. Start-up after maintenance and inspection
   Apply operating pressure and power to the equipment and check for proper operation and possible air leaks. If operation is abnormal, please verify product set-up parameters.
6. Do not make any modifications to the product.
   Do not take the product apart.
Reliable quality of products in the global market

To enable our customers throughout the world to use our products with even greater confidence, SMC has obtained certification for international standards “ISO 9001” and “ISO 14001”, and created a complete structure for quality assurance and environmental controls. SMC products pursue to meet its customers’ expectations while also considering company’s contribution in society.

**Quality management system**
**ISO 9001**
This is an international standard for quality control and quality assurance. SMC has obtained a large number of certifications in Japan and overseas, providing assurance to our customers throughout the world.

**Environmental management system**
**ISO 14001**
This is an international standard related to environmental management systems and environmental inspections. While promoting environmentally friendly automation technology, SMC is also making diligent efforts to preserve the environment.
SMC Product Conforming to Inter

SMC products complying with EN/ISO, CSA/UL standards are supporting

The CE mark indicates that machines and components meet essential requirements of all the EC Directives applied.
It has been obligatory to apply CE marks indicating conformity with EC Directives when machines and components are exported to the member Nations of the EU.
Once “A manufacturer himself” declares a product to be safe by means of CE marking (declaration of conformity by manufacturer), free distribution inside the member Nations of the EU is permissible.

CE Mark
SMC provides CE marking to products to which EMC and Low Voltage Directives have been applied, in accordance with CETOP (European hydraulics and pneumatics committee) guide lines.

As of February 1998, the following 18 countries will be obliged to conform to CE mark legislation
Iceland, Ireland, United Kingdom, Italy, Austria, Netherlands, Greece, Liechtenstein, Sweden, Spain, Denmark, Germany, Norway, Finland, France, Belgium, Portugal, Luxembourg

EC Directives and Pneumatic Components
• Machinery Directive
The Machinery Directive contains essential health and safety requirements for machinery, as applied to industrial machines e.g. machine tools, injection molding machines and automatic machines. Pneumatic equipment is not specified in Machinery Directive. However, the use of SMC products that are certified as conforming to EN Standards, allows customers to simplify preparation work of the Technical Construction File required for a Declaration of Conformity.

• Electromagnetic Compatibility (EMC) Directive
The EMC Directive specifies electromagnetic compatibility. Equipment which may generate electromagnetic interference or whose function may be compromised by electromagnetic interference is required to be immune to electromagnetic affects (EMS/immunity) without emitting excessive electromagnetic affects (EMI/emission).

• Low Voltage Directive
This directive is applied to products, which operate above 50 VAC to 1000 VAC and 75 VDC to 1500 VDC operating voltage, and require electrical safety measures to be introduced.

• Simple Pressure Vessels Directive
This directive is applied to welded vessels whose maximum operating pressure (PS) and volume of vessel (V) exceed 50 bar/L. Such vessels require EC type examination and then CE marking.
SMC Product Conforming to International Standards

national Standards

you to comply with EC directives and CSA/UL standards.

■ CSA Standards & UL Standards
UL and CSA standards have been applied in North America (U.S.A. and Canada) symbolizing safety of electric products, and are defined to mainly prevent danger from electric shock or fire, resulting from trouble with electric products. Both UL and CSA standards are acknowledged in North America as the first class certifying body. They have a long experience and ability for issuing product safety certificate. Products approved by CSA or UL standards are accepted in most states and governments beyond question.
Since CSA is a test certifying body as the National Recognized Testing Laboratory (NRTL) within the jurisdiction of Occupational Safety and Health Administration (OSHA), SMC was tested for compliance with CSA Standards and UL Standards at the same time and was approved for compliance with the two Standards. The above CSA NRTL/C logo is described on a product label in order to indicate that the product is approved by CSA and UL Standards.

■ TSSA (MCCR) Registration Products
TSSA is the regulation in Ontario State, Canada. The products that the operating pressure is more than 5 psi (0.03 MPa) and the piping size is bigger than 1 inch. fall into the scope of TSSA regulation.

Products conforming to CE Standard

With CE symbol for simple visual recognition
In this catalog each accredited product series is indicated with a CE mark symbol. However, in some cases, every available models may not meet CE compliance. Please visit our web site for the latest selection of available models with CE mark.

http://www.smcworld.com
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