

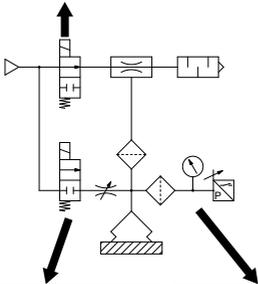
## 6 Precautions on Vacuum Equipment Selection and SMC's Proposal

### ● Safety Measures

- Make sure to provide a safe design for a vacuum pressure drop due to a disruption of power supply, or a lack of supply air. Drop prevention measures must be taken in particular when dropping a workpiece presents some degree of danger.

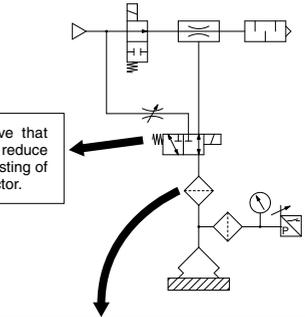
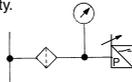
### ● Precautions on Vacuum Equipment Selection

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



For the 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 and transfer 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 optimal for the adsorption and transfer of small parts using a suction nozzle with a small diameter.
- Install a filter (Series ZFA, ZFB, ZFC) before the pressure switch if the ambient air is of low quality.



### ● Vacuum Ejector or Pump and Number of Vacuum Pads

Ejector and number of pads		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 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. <ul style="list-style-type: none"> <li>• Adjust the needle valve to minimize the pressure fluctuation between adsorption and non-adsorption operations.</li> <li>• Provide a vacuum switching valve to each individual pad to minimize the influences on other pads if an adsorption error occurs.</li> </ul>	Ideally, one pad should be used for each line.	When more than one pad is attached to a single vacuum line, take the countermeasures listed below. <ul style="list-style-type: none"> <li>• Adjust the needle valve to minimize the pressure fluctuation between adsorption and non-adsorption operation.</li> <li>• Include a tank and a vacuum pressure reduction valve (vacuum pressure regulator valve) to stabilize the source pressure.</li> <li>• Provide a vacuum switching valve to each individual pad to minimize the influences on other pads if an adsorption error occurs.</li> </ul>

ZK2

ZQ

ZR

ZA

ZX

ZM

ZMA

ZL

ZH

ZU

ZYY

ZYX

ZFA

ZFB

ZFC

ZP3

ZP2

ZP2V

ZP

ZPT

ZPR

XT661

SP

ZCUK

AMJ

AMV

ZH

-X185

Related

Equipment

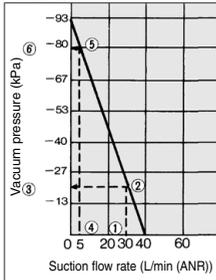
# Model Selection

## ● Vacuum Ejector Selection and Handling Precautions

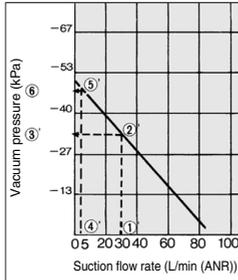
### Ejector Selection

There are 2 types of ejector flow-rate characteristics: the high vacuum type (S type) and the high flow type (L type). During the selection, pay particular attention to the vacuum pressure when adsorbing workpieces that leak.

#### High Vacuum Type Flow-rate Characteristics/ ZH13□S



#### High Flow Type Flow-rate Characteristics/ ZH13□L



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  $-20 \text{ kPa}$  (1)  $\rightarrow$  (2)  $\rightarrow$  (3), and for the L type it is  $-33 \text{ kPa}$  (1')  $\rightarrow$  (2')  $\rightarrow$  (3'). If the leakage volume is 5 L/min (ANR), the vacuum pressure of the S type is  $-80 \text{ kPa}$  (4)  $\rightarrow$  (5)  $\rightarrow$  (6), and for the L type it is  $-47 \text{ kPa}$  (4')  $\rightarrow$  (5')  $\rightarrow$  (6'). Thus, if the leakage volume is 30 L/min (ANR) the L type can attain a higher vacuum pressure, and if the leakage volume is 5 L/min (ANR), the S type can attain a higher vacuum pressure.

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

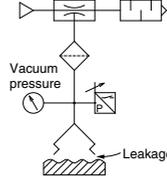
- If the vacuum ejector makes an intermittent noise (abnormal noise) from exhaust at a certain supply pressure, the vacuum pressure will not be stable. It will not be any problem if the vacuum ejector is used under this condition. However, if the noise is disturbing or might affect the operation of the vacuum pressure switch, lower or raise supply pressure a little at a time, and use in an air pressure range that does not produce the intermittent noise.

## ● Supply Pressure of Vacuum Ejector

- Use the vacuum ejector at the standard supply pressure.

The maximum vacuum pressure and suction flow rate can be obtained when the vacuum ejector is used at the standard supply pressure, and as a result, adsorption response time also improves. From the viewpoint of energy-saving, it is the most effective to use the ejector at the standard supply pressure. Since using it at the excessive supply pressure causes a decline in the ejector performance, do not use it at a supply pressure exceeding the standard supply.

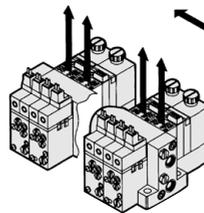
### Ejector Nozzle Diameter Selection



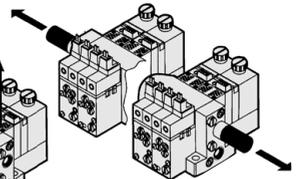
If a considerable amount of leakage occurs between the workpiece and the pad, resulting in incomplete adsorption, or to shorten the adsorption and transfer time, select an ejector nozzle with a larger diameter from the ZH, ZM, ZR, or ZL series.

### Manifold Use

#### Individual exhaust



#### Centralized 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.

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.

## ● Timing for Vacuum Generation and Suction Verification

### A. Timing for Vacuum Generation

The time for opening/closing the valve will be counted if a vacuum is generated after the adsorption pad descends to adsorb a workpiece. Also, there is a timing delay risk for the generating vacuum since the operational pattern for the verification switch, which is used for detecting the descending vacuum pad, is not even.

To solve this issue, we recommend that vacuum be generated in advance, before the vacuum pad begins to descend to the workpiece. Adopt this method after confirming that there will be no misalignment resulting from the workpiece's light mass.

### B. Suction Verification

When lifting the vacuum pad after absorbing a workpiece, confirm that there is a suction verification signal from the vacuum pressure switch, before the vacuum pad is lifted. If the vacuum pad is lifted, based on the timing of a timer, etc., there is a risk that the workpiece may be left behind.

In general adsorption transfer, the time for adsorbing a workpiece is slightly different since the position of the vacuum pad and the workpiece are different after every operation. Therefore, program a sequence in which the suction completion is verified by a vacuum pressure switch, etc. before moving to the next operation.

### C. Set Pressure for Vacuum Pressure Switch

Set the optimum value after calculating the required vacuum pressure for lifting a workpiece.

If a higher pressure than required is set, there is a possibility of being unable to confirm the suction even though the workpiece is adsorbed. This will result in a suction error.

When setting vacuum pressure switch set values, you should set using a lower pressure, with which a workpiece can be adsorbed, only after considering the acceleration or vibration when a workpiece is transferred. The set value of the vacuum pressure switch shortens the time to lift a workpiece. Since the switch detects whether the workpiece is lifted or not, the pressure must be set high enough to detect it.

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

When adsorbing and transferring a workpiece, verify at the vacuum pressure switch as much as possible (In addition, visually verify the vacuum gauge, especially when handling a heavy or a hazardous item.).

#### Approx. $\phi 1$ adsorption nozzle

The difference in pressure between ON and OFF becomes small depending on the capacity of the ejector and vacuum pump. In such a case, it will be necessary to use ZSP1 that can detect a small hysteresis or a flow switch.

Note) • A vacuum generator with a large suction capacity will not be detected properly, so an ejector with an appropriate capacity must be selected.

• Since the hysteresis is small, vacuum pressure must be stabilized.



Suction verification switch  
ZSP1



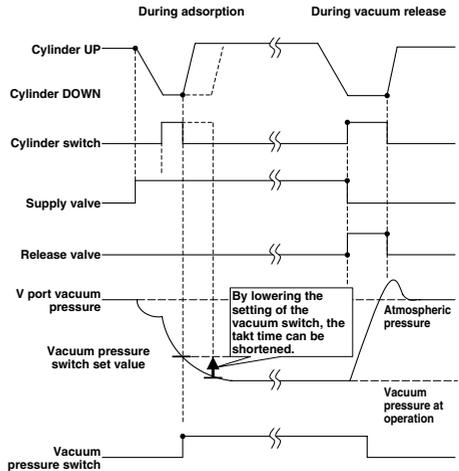
Flow sensor  
PFMV



Vacuum pressure gauge  
GZ46

Refer to the Best Pneumatics No. 6 for details.

#### Timing Chart Example



ZK2
ZQ
ZR
ZA
ZX
ZM
ZMA
ZL
ZH
ZU
ZYY
ZYX
ZFA
ZFB
ZFC
ZP3
ZP2
ZP2V
ZP
ZPT
ZPR
XT661
SP
ZCUK
AMJ
AMV
ZH
X185
Related Equipment

# Model Selection

## ● Dust Handling of Vacuum Equipment

- When the vacuum equipment is used, not only the workpiece, but also dust in the surrounding environment is taken in the equipment. Preventing the intrusion of dust is required more than for any other pneumatic equipment. Some of SMC's vacuum equipment comes with a filter, but when there is a large amount of dust, an additional filter must be installed.
- When vaporized materials such as oil or adhesive are sucked into the equipment, they accumulate inside, which may cause problems.
- It is important to prevent dust from entering the vacuum equipment as much as possible.
  - (1) Make sure to keep the working environment and surrounding area of the workpiece clean so that dust will not be sucked in the equipment.
  - (2) Check the amount and types of dust before using the equipment and install a filter, etc., in the piping when necessary. In particular, equipment used to capture dust, such as a vacuum cleaner, require a special filter.
  - (3) Conduct a test and make sure that operating conditions are cleared before using the equipment.
  - (4) Perform filter maintenance depending on the amount of dirt.
  - (5) Filter clogging generates a pressure difference between the adsorption and ejector parts. This requires attention, since clogging can prevent proper adsorption from being achieved.

### Air Suction Filter (Series ZFA, ZFB, ZFC)

- To protect the switching valve and the ejector from becoming clogged, a suction filter in the vacuum circuit is recommended.
- When using an ejector in a dusty environment, the unit's filter will become clogged quickly, so it is recommended that the ZFA, ZFB or ZFC series be used concurrently.

### Vacuum Line Equipment Selection

Determine the volume of the suction filter and the conductance of the switching valve in accordance with the maximum suction flow rate of the ejector and the vacuum pump. Make sure that the conductance 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 conductances must be combined.)

$$C = \frac{Q_{\max}}{55.5}$$

C: Conductance [dm<sup>3</sup>/(s·bar)]  
Q<sub>max</sub>: Max. suction flow rate L/min (ANR)