7 Vacuum Equipment Selection Example

● Transfer of Semiconductor Chips

Selection conditions:

(1) Workpiece: Semiconductor chips
Dimensions: 8 mm x 8 mm x 1 mm, Mass: 1 g
(2) Vacuum piping length: 1 m
(3) Adsorption response time: 300 msec or less

1. Vacuum Pad Selection

(1) Based on the workpiece size, the pad diameter is 4 mm (1 pc.).

(2) Using the formula on page 880, confirm the lifting force.

W = P x S x 0.1 x 1/t
0.0098 = P x 0.13 x 0.1 x 1/4
P = 3.0 kPa

W = 1 g = 0.0098 N
S = $\pi/4 \times (0.4)^2 = 0.13$ cm^2
t = 4 (Horizontal lifting)

According to the calculation, –3.0 kPa or more of vacuum pressure can adsorb the workpiece.

(3) Based on the workpiece shape and type, select:
Pad type: Flat with groove
Pad material: Silicone rubber

(4) According to the results above, select a vacuum pad part number ZP3-04UMS.

2. Vacuum Ejector Selection

(1) Find the vacuum piping capacity.
Assuming that the tube I.D. is 2 mm, the piping capacity is as follows:

$$V = \pi/4 \times D^2 \times L \times 1/1000 = \pi/4 \times 2^2 \times 1 \times 1/1000 = 0.0031 \text{ L}$$

(2) Assuming that leakage (Q_L) during adsorption is 0, find the average suction flow rate to meet the adsorption response time using the formula on page 884.

$$Q = (V \times 60)/T_1 + Q_L = (0.0031 \times 60)/0.3 + 0 = 0.62 \text{ L}$$

From the formula on page 884, the maximum suction flow rate Q_{max} is

$$Q_{max} = (2 \text{ to } 3) \times Q = (2 \text{ to } 3) \times 0.62 = 1.24 \text{ to } 1.86 \text{ L/min (ANR)}$$

According to the maximum suction flow rate of the vacuum ejector, a nozzle with a 0.5 diameter can be used.
If the vacuum ejector ZX series is used, representative model ZX105□ can be selected.
(Based on the operating conditions, specify the complete part number for the vacuum ejector used.)

3. Adsorption Response Time Confirmation

Confirm the adsorption response time based on the characteristics of the vacuum ejector selected.

(1) The maximum suction flow rate of the vacuum ejector ZX105□ is 5 L/min (ANR). From the formula on page 885, the average suction flow rate Q_1 is as follows:

$$Q_1 = (1/2 \text{ to } 1/3) \times \text{Ejector max. suction flow rate} = (1/2 \text{ to } 1/3) \times 5 = 2.5 \text{ to } 1.7 \text{ L/min (ANR)}$$

(2) Next, find the maximum flow rate Q_2 of the piping. The conductance **C is 0.22** from the Selection Graph (3).
From the formula on page 885, the maximum flow rate is as follows:

$$Q_2 = C \times 55.5 = 0.22 \times 55.5 = 12.2 \text{ L/min (ANR)}$$

(3) Since Q_2 is smaller than Q_1, $Q = Q_1$.
Thus, from the formula on page 885, the adsorption response time is as follows:

$$T = (V \times 60)/Q = (0.0031 \times 60)/1.7 = 0.109 \text{ seconds} = 109 \text{ msec}$$

It is possible to confirm that the calculation result satisfies the required specification of 300 msec.