Vacuum suction pads

Selection

Suction pad selection

The selection of the suction pad always depends on the actual application (the operating conditions and the material). For this reason, various physical values must be calculated and determined before the correct suction pad can be selected.

Coefficient of friction
It is not possible to specify generally valid values of the coefficient of friction "μ" between the suction pad and the workpiece. This means that this value must be determined beforehand by means of suitable tests (see also the table of typical values).

Table of typical values

Workpiece surface	approx. μ
Glass, stone, plastic (dry)	approx. 0.5
Sandpaper (dry)	1.1
Moist or oily surface	0.1 – 0.4

Calculation of the holding forces
The calculated holding forces can never be more than theoretical values. In practical applications, many factors, such as the size and shape of the suction pad, the surface finish and the rigidity of the workpiece (deformation) play a decisive role. For this reason, we recommend that you include a safety factor S of at least 2. The German accident-prevention regulations demand a minimum safety factor of 1.5.

If you intend to swivel or turn over the workpiece, you should use a safety factor of 2.5 or higher in order to cope with the resulting turning forces.

The holding force of a suction pad is calculated with the formula
F = p x A

Suction pad diameter
The diameter of the suction pad is important for the absolute holding force and also depends on the finish of the workpiece surface. The required diameter can be determined with the aid of the following formula.

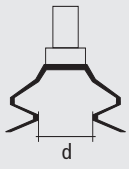
With the force applied horizontally:

$$d = 1.12 \cdot \sqrt{\frac{m \cdot S}{P_U \cdot n}}$$

With the force applied vertically:

$$d = 1.12 \cdot \sqrt{\frac{m \cdot S}{P_U \cdot n \cdot \mu}}$$

d = suction-pad diameter in cm,
(with double lip ≈ internal diameter,
for bellows suction pad = internal diameter of the sealing lip)



m = mass of the workpiece in kg
P_U = vacuum in bar
n = number of suction pads
S = safety factor
μ = coefficient of friction

An example:

Plastic sheet:	m = 50 kg
Vacuum:	P_U = – 0.4 bar
Number of suction pads:	n = 4
Measured coefficient of friction:	μ = 0.5
Safety factor:	S = 2

$$d = 1.12 \cdot \sqrt{\frac{50 \cdot 2}{0.4 \cdot 4 \cdot 0.5}}$$

d = 12.5 cm

A good solution in this case is the suction pad PFYN 150 with a nominal diameter of 150 mm.

Suction capacity [V̇]
The desired vacuum value and the volume flow rate used to achieve this vacuum are decisive for calculation of the necessary suction capacity. The workpiece material is the decisive factor which determines the necessary suction capacity. The table shows typical values for the volume flow rate and the suction capacity for various suction pad diameters.

Important:
For porous parts, you should always carry out suction tests!

Typical value (with smooth, air-tight surfaces)

Suction pad Ø	Suction area A [cm²]	Volume flow V̇ [m³/h]	[l/min]
up to 60 mm	28	0.5	8.3
up to 120 mm	113	1.0	16.6
up to 215 mm	363	2.0	33.3
up to 450 mm	1540	4.0	66.6