

Vacuum Gripper - Holding Force and Suction Cup Sizing

Sample document with complete example values. It shows the report the purchased export produces for YOUR input - it is not itself a report for any part.

Project: Sample project

Part/Position: no real part

Prepared by: Sample, not released

Required number of suction cups $n = 3$ ($F_{th} = 75.4$ N per cup)

Inputs

Suction cup diameter d	40 mm
Vacuum Δp	0.6 bar
Workpiece mass m	10 kg
Acceleration a	5 m/s ²
Load case	I - suction cup horizontal, force vertical
Safety factor S	1.5
Available number of suction cups n	4

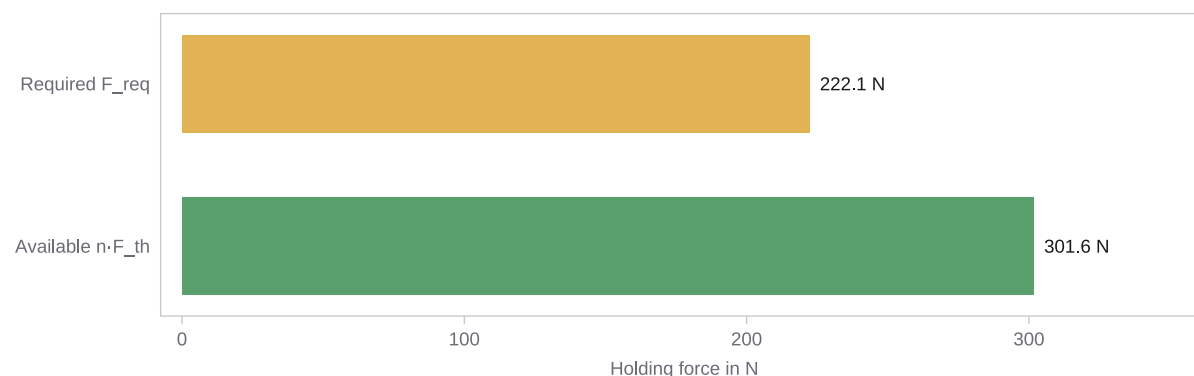
Result

Effective suction area A	12.566 cm ²
Theoretical holding force per cup F_{th}	75.4 N
Required holding force F_{req} (incl. S)	222.1 N
Required number of suction cups n (rounded up)	3
Required number of suction cups n (exact)	2.95
Available holding force $n \cdot F_{th}$	301.6 N
Available safety factor S_{avail}	2.04

Assessment

Criterion	Value	Limit	Status
Available holding force versus required holding force	301.6 N	222.1 N	● OK

Force comparison



Calculation basis

The theoretical holding force per suction cup is $F_{th} = A \cdot \Delta p$ with the effective suction area $A = \pi/4 \cdot d^2$ and the vacuum Δp . The required holding force follows from the selected load case (Schmalz): I - suction cup horizontal, force vertical $F_{req} = m \cdot (g+a) \cdot S$; II - suction cup horizontal, force horizontal $F_{req} = m \cdot (g+a/\mu) \cdot S$; III - suction cup vertical, force vertical or rotating $F_{req} = (m/\mu) \cdot (g+a) \cdot S$. The required number of suction cups is $n \geq F_{req}/F_{th}$ (rounded up).

Per the German UVV accident-prevention regulation, the safety factor S is at least 1.5 for smooth, sealed surfaces, at least 2.0 for critical or porous materials, and at least 2.5 when slewing. The theoretical value assumes a sealed, flat surface and full vacuum; leakage, roughness, bellows compliance and dynamic tilting moments must be accounted for via the safety factor and the arrangement of the suction cups.

About this sample

All values on these pages come from a freely chosen example calculation and belong to no real part. The purchased export contains the same sections with your input, your header data (project, part, prepared by) and as searchable text. Pricing and scope: maschinenbaurechner.de/en/pricing

Note: The results are design and orientation aids. They do not replace independent verification, calculation and approval by a qualified person. The terms of use at maschinenbaurechner.de apply.