VACUUM PADS

1. Advantages of vacuum pad

Materials' handling with vacuum pads is very simple low cost and reliable.
It is therefore a solution worth using before considering more complicated handling techniques.
Vacuum pads can lift, and hold objects from a few grams up to several kg.

▶Advantages

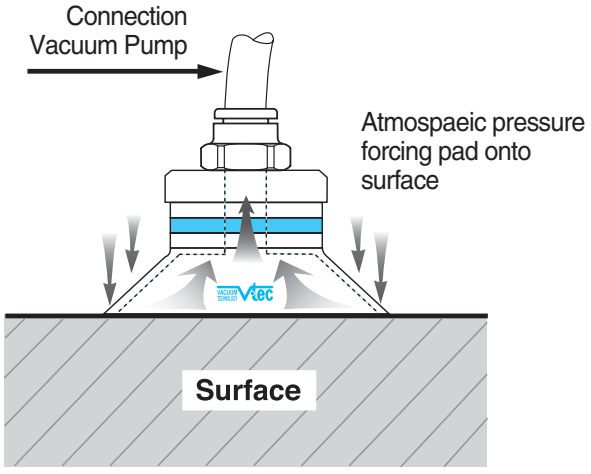
- Easy installation
- low service requirement
- low price
- Does not damage the goods
- Fast attachment and detachment

▶Limitations

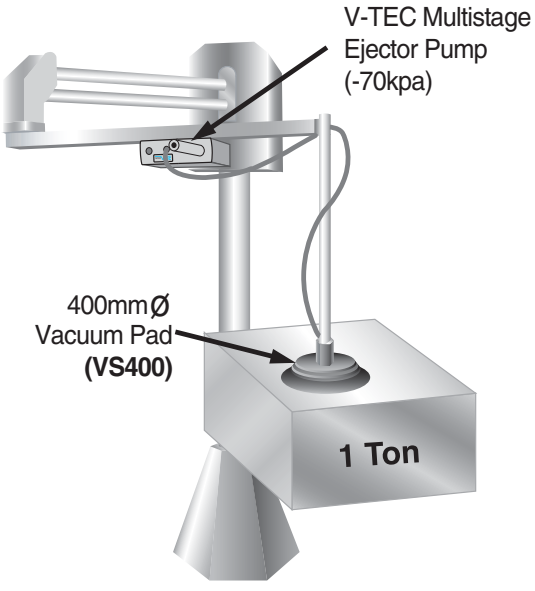
- Limited forces
- (atmospheric pressure)
- Positioning accuracy

2. The principle of vacuum pad

Why does a vacuum pad suck onto the surface it's placed on. It's quite simple and is all to do with atmospheric pressure. Atmospheric pressure can generally be defined as the weight of the air above us on earth. When a lower pressure is created (vacuum) than atmospheric pressure (1 bar), forces are produced; these forces are required to enable vacuum pads to work. As a vacuum is drawn through the pad, the atmospheric pressure outside the pad is greater than that inside the pad, thus creating a holding force between the pad and the surface, the larger the pad and deeper the vacuum then the greater the holding force.



How a vacuum pad works.



Weights that can be lifted with vacuum pads.

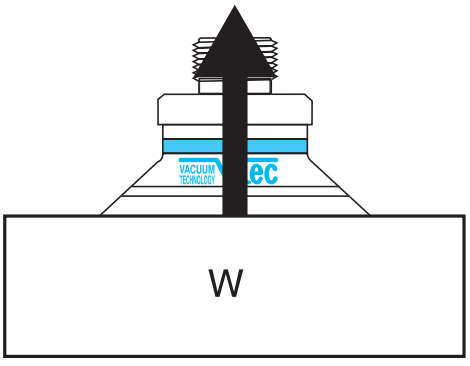
3. How to select the vacuum pad

$$D = 113X \sqrt{\frac{m \times n}{U \times s}}$$

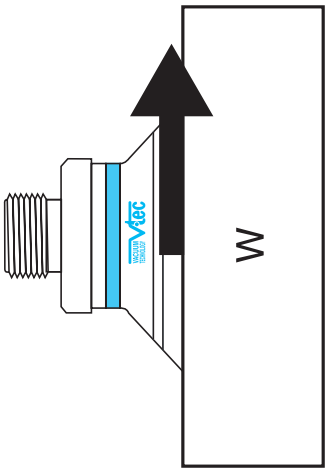
D : Vacumm pad dia. (mm)
m : Mass to lift (kg)
u : Vacuum level (-kpa)
n : Safety factor (2 or 3)
s : Quantity of cup

4. Calculating achievable perpendicular / parallel lifting force (-60Kpa=-450mmHg)

Perpendicular



Parallel



Lift : Formula

W : Lifting force (N)
P : Vacuum level (-Kpa)
S : he size of vacuum pad (㎠)
n : Safety factor { Perpendicular : insert 2 or 3
Parallel : 3 insert or 4

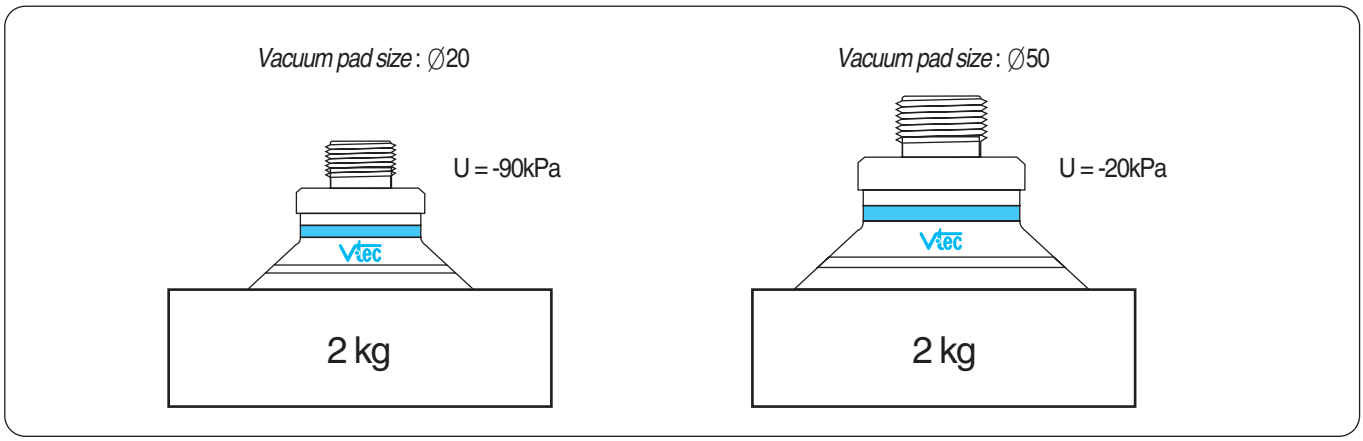
$$W = P \times S \times 0.1 \times \frac{1}{n}$$

5. Recommended vacuum level to use (-60Kpa -450mmHg)

There are several reasons why –60Kpa is the optimum vacuum level to use with vacuum pads. The energy required creating –60Kpa is low in comparison to that required generating –90Kpa. The additional lifting force that can be achieved between these two levels is not that high, considering that it takes approx ten times as much energy to create the –90Kpa level. If a vacuum circuit is designed to run at –90Kpa then clearly there is very little capacity left in the pump performance, thus no margin for error. Lastly vacuum pads running at –90Kpa adhere to the surface with far more contact force, hence stressing the pad much more, which will result in premature wear of the pad itself.

For example

Object	Vacuum level	Pad size
2 kg	–90kPa	Ø=20
	–60kPa	Ø=30
	–20kPa	Ø=50



Lifting force comparison table for pad size

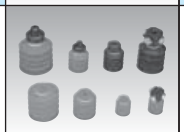
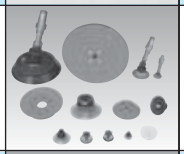
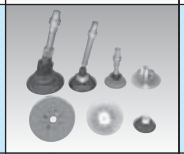
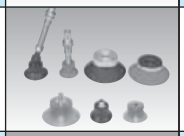
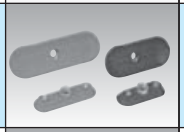
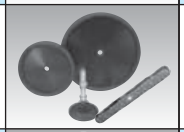
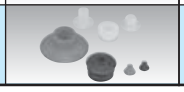
Pad Size (mm)	-60kPa Lifiting force(kg) Perpendicular				-60kPa Lifiting force(kg) Parallel			
	Safety factor force(kg)		force(kg)		Safety factor force(kg)		force(kg)	
	min	max	min	max	min	max	min	max
Ø2–8	0~0.005	0~0.145	0~0.01	0~0.295	0~0.002	0~0.098	0~0.008	0~0.295
Ø10–15	0~0.17	0~0.43	0~0.34	0~0.86	0~0.14	0~0.23	0~0.44	0~0.71
Ø20–25	0~0.31	0~1.25	0~0.63	0~2.5	0~0.27	0~0.83	0~0.81	0~2.5
Ø30–35	0~0.81	0~2.55	0~1.63	0~5.1	0~0.33	0~1.08	0~1	0~3.26
Ø40	0~1.12	0~2.9	0~2.24	0~5.81	0~0.74	0~1.66	0~2.24	0~5
Ø50–60	0~2.19	0~7.65	0~4.38	0~15.3	0~1.25	0~2.89	0~3.77	0~8.67
Ø75–80	0~8.16	0~10.2	0~16.32	0~20.4	0~3.74	0~6.8	0~11.22	0~20.4
Ø100–115	0~17.5	0~22.9	0~35	0~45.9	0~7.99	0~8.5	0~23.97	0~25.51
Ø150	0~35.0	0~43.3	0~70	0~86.7		0~20.4		0~61.22
Ø200–300	0~96.9	0~219.3	0~193.8	0~438.7	0~45.88		0~137.64	

6. Applications for vacuum pads

Vtec vacuum pads are available in a wide range of shapes, sizes, materials and configurations. The standard pads range from 2mm to 400mm in diameter, with lifting forces of up to 1300KG at-90Kpa. Many types of object and materials can be lifted, flat, curved, smooth, coarse, dense and porous.
All the pads are manufactured to very high standards, and pads can be ordered separately or complete with fitting.

How to select a vacuum pad

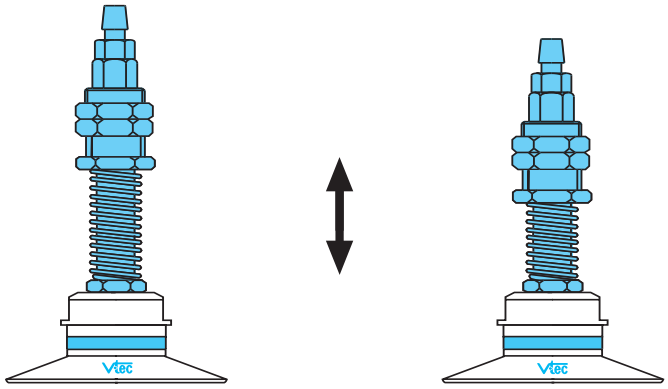
1. Choose the model depending on the shape of object to lift
2. Choose the size of the pad based on the weight of the object to lift
3. Choose the material of the pad based on the working environment and surface texture
4. Select the fitting size to suit the application
5. Select the accessory depending on the application i.e., level spring or ball joint.

Type		Description	Some Applications
VB (Bellows)		The bellows cup is very good at compensating for a degree of difference in level and curvature of the work piece	Sheet Veneer Plastic Sheets Thin Film Sheets Cardboard Boxes and Electronic components
VB-M (Direct Fitting Bellows)		Same general advantages to that of the normal bellows cups but can be fitted directly onto a piece of pipe, thus making installation very simple and reducing pad costs to a minimum, very suitable for integration to packaging machines.	Sheet Veneer · Plastic Sheets Cardboard boxes Cardboard Packaging Materials Thin Film Sheets
VBF (Bellows & Flat)		Good lifting force can be achieved with this cup in the vertical plane. Prevent transformation when lifting metal thin plate.	· Vaneer sheets · Sheet metal · Automotive body panels and door · Plastic sheets · plywood · Glass
VBL (Long Bellows)		Similar advantages to that of the normal bellows cups but can cope with an increased degree of height compensation and is particularly good for handling fragile objects	Fragile Objects · Eggs General Foodstuffs · Bread Glass
VU (Universal)		Good lifting forces can be achieved with this cup, is best suited to flat stable surfaces, but can cope with a small degree of curvature.	Small Components Semiconductor Chips Packaging Materials Sheet Metal
VF (Flat)		Again good lifting forces can be achieved with this pad; optimum-lifting forces can be achieved with this cup in the horizontal plane, but is also good in the vertical plane.	Sheet Metal Veneer Sheets Plastic Sheet Material Electronic Components
VFC (Flat Curve)		This pad is specifically designed to cope with both flat and curved surfaces, which means that multiple objects can be handled with the same vacuum pad	Automotive Windscreens Shaped Sheet Metal Panels Sheet Metal
VD (Deep flat)		Features and strengths This is best suited to curved or irregular surfaces Also, it is deep and grip around corners and edges.	Plastic sheets Sheet veneer Sheet metal Shaped sheet metal panels
VOC (Long Flat)		Feature and strengths This pad is best suitable for gandling long objects With flat or curved surgaces. Specially, paralle to the surgace of the object it has a thick and durable lip.	Long objects with flat Curved surfaces Shaped sheet metal panels
VS (Sponge)		Used for handling rough and uneven surfaces and when used with ball joint option and level spring option can accommodate very unlevel and uneven surfaces.	Handling thin Film with adjustable support Rough Wood Paving Slabs Masonry Bricks
KPS (Plastic Bag Opening)		Developed to be used for opening plastic bags this pad gives good adhesive to thin plastic and film type materials.	Thin film sheet and plastic bags, Plastic Bag Opening, paper Bag Handling Thin Film Materials

7. Accessories

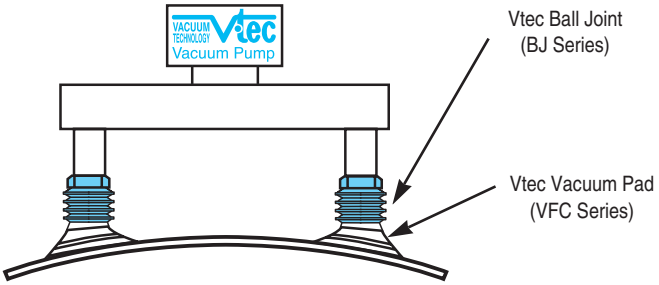
Level Springs

The Vtec level spring is used to compensate for differences in height on the surface of the material that is to be lifted. The advantage being a more reliable and less precise pick up position when handling product that may be less consistent in its shape, size and position. The level spring also provides a degree of shock absorption should this be required. The level springs come in configurations with varying sizes of spring and stroke.



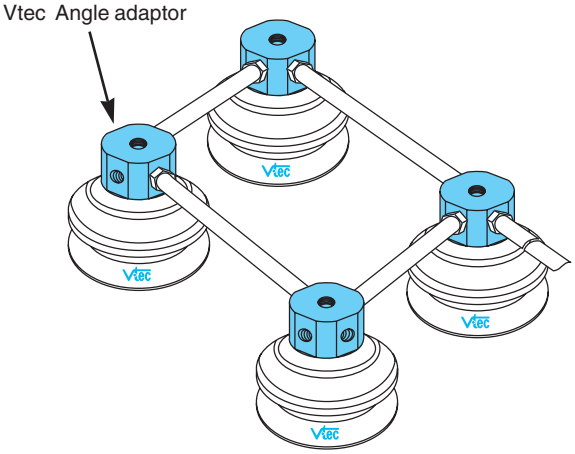
Ball Joints

The Vtec Ball Joint or sometimes referred to as a universal joint is for use when a degree of angular compliance is required, more commonly used with flat type cups which unlike bellows do not allow for much angular compliance as part of there design. The vacuum port is integral through the center of the joint thus providing a neat and compact solution.



Angle Adaptor

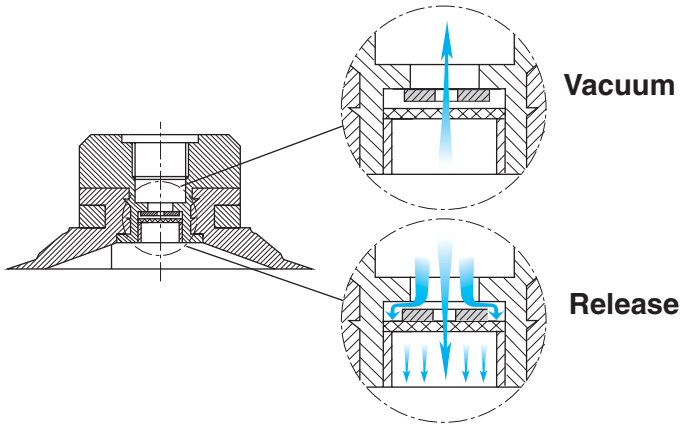
Angle adaptors are an option specified for the fitting type for the vacuum pad. It provides the facility to use the fitting of each cup as a miniature manifold or connection block, thus providing a neat compact installation when using multiple cups. Each adaptor has five ports for connection and is available in a number of port sizes.

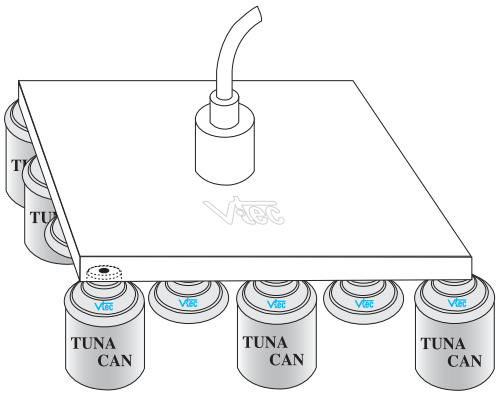


7. Acessary

Vacuum Efficiency valve(EV)

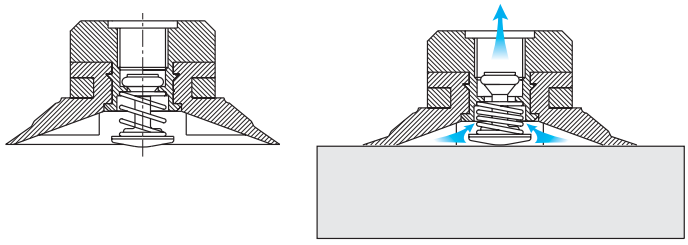
The Vtec level spring is used to compensate for differences in height on the surface of the material that is to be lifted. The advantage being a more reliable and less precise pick up position when handling product that may be less consistent in its shape, size and position. The level spring also provides a degree of shock absorption should this be required. The level springs come in configurations with varying sizes of spring and stroke.





Button Valve : BV

When the suction cup is not in contact with the object, the valve closes the opening in the fitting. No air can flow through the suction cup and the pump does not need to compensate for leakage.
The system is not disturbed and vacuum is maintained up to the fitting.
The valve first opens when the suction cup makes contact with the object.
The air can then flow through the fitting and vacuum is created in the cup.



8. Material and characteristic of vacuum pad

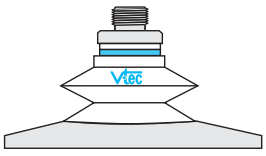
Material	Temperature	Durability	Oil Resitance	Weather & ozone
N - NBR	-40℃ to +110℃	Excellent	Excellent	Very good
S - Silicon	-70℃ to +200℃	Good	unsuitable	Excellent
C.S - Conductive Silicon	-55℃ to +120℃	Good	unsuitable	Excellent
U - Urethane	-20℃ to +80℃	Excellent	Excellent	Excellent
PU- Poly Urethane	-20℃ to +80℃	Excellent	Excellent	Excellent
E - EPDM	-40℃ to +100℃	Very good	unsuitable	Excellent

9. How to select vacuum pad

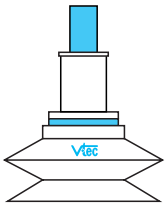
Vacuum pad	Shape			Requirements									
	Flat	Slightly surface	Concave surface	Smooth surface	Uneven surface	Varying surface levels	Thin flexible materials	Good stability	Mark free	Safety	Parallel lift	Without fitting	Opening plastic bag
VB	★★★	★★★		★★★		★★★	★★★	★	★★★	★★★	★		★★
VB-M	★★★	★★★		★★★		★★★	★★★	★	★★★	★★★	★	★★★	★★
VBF	★★★	★★★	★	★★★		★★★	★★★	★★★	★★★	★★★	★★★		
VBL	★★★	★★★		★★★		★★★	★★★			★★			
VU	★★★	★★★	★★★	★★★				★★		★★★	★★		★★
VF	★★★			★★★				★★★	★★★	★★★	★★★		
VFC	★★★	★★★		★★★	★			★★★	★★★	★★★	★★★		★
VD	★★	★★★		★★★		★		★★	★★★	★★★	★★		
VOC	★★★	★★★		★★★		★		★★★		★★★	★★★		
VS	★★★			★★★	★★★		★★★			★★★	★		
KPS	★★★			★★★								★★★	★★★

★★★ Excerllent ★★ Very good ★ good

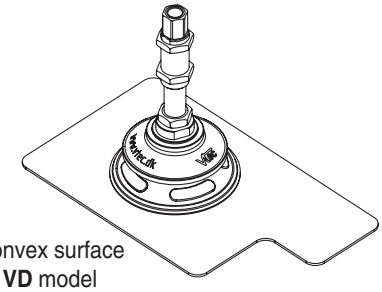
Slightly curved surface
VB model



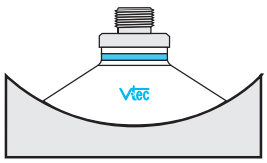
Without fitting
VB-M model



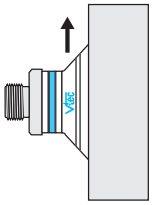
Sheet metal
VBF model



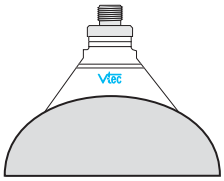
Concave surface
VU model



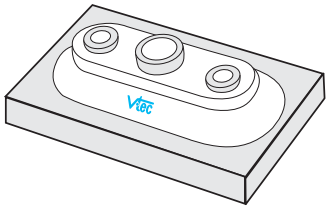
Transfering to parallel
VF, VFC model



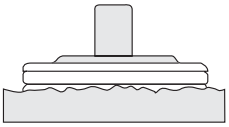
Convex surface
VD model



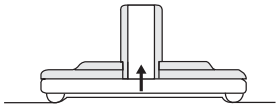
Long flat
VOC model



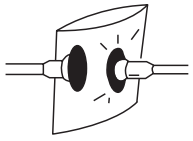
Uneven surface
VS model



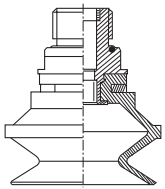
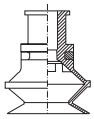
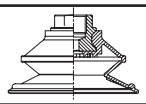
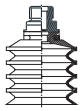
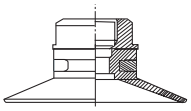
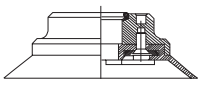
Thin surface,
adjustable support
VS model



Opening plastic bag
KPS model

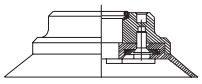
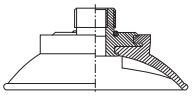
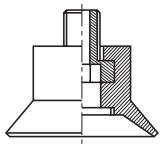
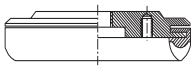
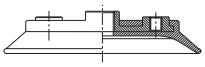
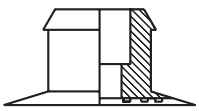


10. Vacuum pad specifications

	Model	Ø Dimension	Volume (cm³)	Material						Lifting force (Kg) Perpendicular			Lifting force (Kg) Parallel		
				N	S	CS	U	PU	E	-20kPa	-60kPa	-90kPa	-20kPa	-60kPa	-90kPa
	VB 5	5.6	0.1	●	●	●				0.03	0.08	0.1			
	VB 6X	7	0.1	●	●	●				0.05	0.11	0.14			
	VB 8	8.8	0.2	●	●	●				0.08	0.16	0.25			
	VB 10	11	0.5	●	●	●	●			0.15	0.34	0.5			
	VB 15	15.5	1.1	●	●	●	●	●		0.29	0.6	0.9			
	VB 17	18.5	1.5	●	●	●	●			0.4	0.8	1			
	VB 20	22	2.7	●	●	●	●	●		0.6	1	1.42			
	VB 30	34	10	●	●	●	●	●		1.22	2.24	2.75			
	VB 40	43	15	●	●	●	●	●		2.24	3.97	5			
	VB 50	53	32	●	●	●	●	●		3.36	6.63	8.36			
	VB 75	78	110	●	●	●	●	●		7.65	17.04	23.06			
	VB 110	115	310	●	●	●	●			13.97	35	47.04			
	VB 150	155	650	●	●	●	●			30	70	90.1			
	VB 20M	22	2.7	●	●	●	●	●		0.7	1.2	1.6			
	VB 30M	34	10	●	●	●	●	●		1.5	2.1	3.9			
	VB 40M	42	15					●		2.6	4.7	5.9			
	VB 50M	53	32	●	●	●	●	●		3.2	7.9	10.5			
	VBF 60	64	22					●		8.94	16.26	18.54	6.84	12.84	16.92
	VBF 80	84	59.5					●		11.92	21.68	24.72	9.12	17.12	22.56
	VBF 100	103	103.5					●		14.9	27.1	30.9	11.4	21.4	28.2
	VBL 20	20	4	●	●	●	●			0.03	0.06				
	VBL 30	30	13	●	●	●	●			0.06	0.16				
	VBL 35M	35	21	●	●	●	●			0.08	0.19				
	VBL 40	40	27	●	●	●	●			0.11	0.22				
	VBL 50	50	55	●	●	●	●			0.17	0.43				
	VU 1.5X	1.9	0.0015	●	●	●				0.0008	0.003	0.004			
	VU 2	2.6	0.0025	●	●	●				0.003	0.01	0.015			
	VU 2X	2.6	0.003	●	●	●				0.003	0.01	0.015			
	VU 3	3.8	0.01	●	●	●				0.009	0.04	0.06			
	VU 3k	3.5	0.018	●	●	●				0.014	0.06	0.09			
	VU 4	5	0.03	●	●	●				0.02	0.09	0.13	0.02	0.08	0.10
	VU 4X	4.6	0.03	●	●	●				0.02	0.09	0.13	0.02	0.08	0.10
	VU 6	7	0.05	●	●	●				0.05	0.17	0.25	0.03	0.15	0.20
	VU 8	9	0.1	●	●	●				0.1	0.29	0.39	0.1	0.29	0.34
	VU 10	11	0.2	●	●	●	●			0.15	0.44	0.70	0.15	0.44	0.50
	VU 15	16.5	0.5	●	●	●	●			0.35	0.85	1.12	0.35	0.55	0.60
	VU 20	22	1	●	●	●	●			0.6	1.22	1.63	0.6	0.89	1.00
	VU 25	27	1.5	●	●	●	●			0.91	1.98	2.5	0.7	0.95	1.05
	VU 30	32	2	●	●	●	●			1.22	2.55	3.06	0.79	1.00	1.12
	VU 40	42	5.5	●	●	●	●			2.04	3.97	5.0	1.42	2.24	2.8
	VU 50	53	12	●	●	●	●			3.57	7.44	9.38	2.04	3.77	4.48
	VU 80	80	32	●	●	●	●			7.77	19.8	25.21	4.53	12.7	16.94
	VF 15	16.5	0.4	●	●	●	●			0.35	0.86	1.12	0.35	0.66	0.76
	VF 20	22	1.0	●	●	●	●			0.61	1.47	1.93	0.51	0.81	0.86
	VF 25	27	1.1	●	●	●	●			0.91	1.98	2.55	0.81	0.91	1.02
	VF 30	32	2	●	●	●	●	●		1.22	2.55	3.16	1.12	1.63	2.04
	VF 40	42	4.8	●	●	●	●	●		2.04	4.08	5.10	1.53	2.55	3.06
	VF 50	53	10	●	●	●	●	●		3.67	7.55	9.79	2.44	4.08	5.10
	VF 50X2	53	10	●	●	●	●			3.67	7.55	9.79	2.44	4.08	5.10
	VF 75	77	20	●	●	●	●	●		8.16	20.40	27.55	6.12	11.22	14.28

※ Above data of force are not included the safety factor.

10. Vacuum pad specifications

	Model	Ø Dimension	Volume (cm³)	Material						Lifting force (Kg) Perpendicular			Lifting force (Kg) Parallel		
				N	S	CS	U	PU	E	-20kPa	-60kPa	-90kPa	-20kPa	-60kPa	-90kPa
	VF 90	92	50					●		10.2	27.84	37.41	8.84	15.98	19.72
	VF 110	112	70	●	●	●	●			14.28	42.85	57.14	14.28	25.51	30.61
	VF 150	152	160	●	●	●	●			30.61	86.73	112.24	25.51	61.22	81.63
	VF 200	200	460	●	●	●	●			76.53	193.87	275.51	38.3	96.9	137.5
	VF 300	304	820	●	●	●	●			163	438	653	135	307	476
	VFC 50	50	10	●	●	●	●	●		3.57	8.67	12.75	3.57	8.67	11.22
	VFC 60	60	20	●	●	●	●	●		5.5	14	18.5	5.4	14	18.9
	VFC 60X	60	20	●	●	●	●			5.5	14	18.5	5.4	14	18.9
	VFC 75	75	30	●	●	●	●	●		7.65	19.38	25.51	8.16	20.40	27.55
	VFC 75X1	75	30	●	●	●	●			7.65	19.38	25.51	8.16	20.40	27.55
	VFC 75X2	75	30	●	●	●	●			7.65	19.38	25.51	8.16	20.40	27.55
	VFC 90	90	60					●		9.35	24.82	32.65	9.52	21.59	27.89
	VFC 100	100	80	●	●	●	●	●		12.75	35.71	46.93	12.24	23.97	28.57
	VD 30	30	4.5	●	●	●	●	●		1.22	2.55	3.06	0.73	1.53	1.83
	VD 40	40	7	●	●	●	●	●		2.04	3.97	5.0	1.22	2.38	3.00
	VD 50	50	13.5	●	●	●	●	●		3.57	7.44	9.38	2.14	4.46	5.62
	VD 60	61	22	●	●	●	●	●		5.50	14	18.5	3.3	8.4	11.1
	VD 70	72	38					●		7.15	18.8	24.9	4.2	11.6	16.2
	VD 85	85	60	●	●	●	●			10	28	39	6.0	16.8	23.4
	VD 85X	88	68	●	●	●	●			10	28	39	6.0	16.8	23.4
	VS 35	35	6						●	2.04	5.10	7.14			
	VS 60	60	20						●	6.12	15.3	22.44			
	VS 100	100	55						●	18.36	45.9	67.34			
	VS 150	150	125						●	38	97	138			
	VS 200	200	543						●	76.53	193.87	275.51			
	VS 300	300	1285						●	163.26	438.77	653.06			
	VS 400	400	2285						●	326	876	1300			
	VOC 11 x 23	11x23	2.0	●	●	●	●			1.21	2.5	3.1	1.1	1.6	2
	VOC 35 x 90	35x90	20	●	●	●	●			5	13.4	17.4	6.9	16.4	21
	VOC 35 x 110	35x110	25	●	●	●	●			6.25	16.7	21.7	8.6	20.5	26
	VOC 60 x 140	60x140	52	●	●	●	●			13.4	38.0	53.0	18.9	38.0	52
	VOC 60 x 180	60x180	67	●	●	●	●			19.1	54.2	75.7	27	54.2	74
	KPS-1	34	14.5	●	●		●			1.22	2.24	2.75			
	KPS-2	28	2	●	●					0.7	1.53	1.83			
	KPS-3	13	0.5	●	●					0.35	0.85	1.12			
	KPS-4	16	1.0	●	●					0.6	1.22	1.63			
	KPS-5	28	2.5	●	●					0.7	1.53	1.83			
	KPS-5-15	15	1.1	●	●					0.4	1.11	1.23			
	KPS-6	30	2	●	●					0.8	1.7	2.05			
	KPS-7	68	20	●	●					5.5	14	18.5			
	KPS-8	25	1.4	●	●					0.5	1.15	1.25			
	VU-30-X	30	1.8	●	●					0.75	1.6	1.85			

※ Above data of force are not included the safety factor.