Parker

Vacuum components

For economic, safe and efficient handling

Catalogue PDE2507TCUK-ab

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Important!

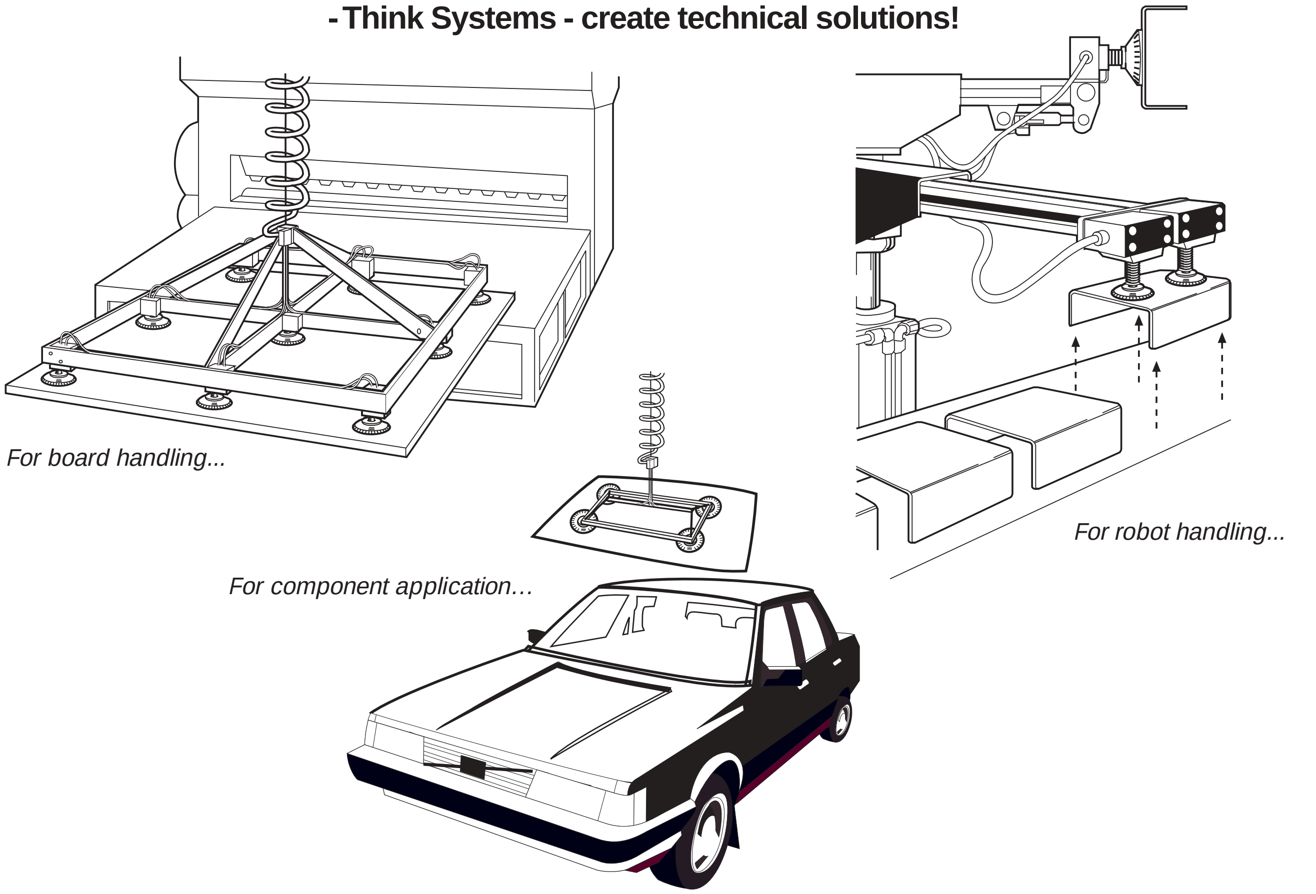
Before carrying out any work on the vacuum system, ensure that all vacuum and compressed air have been released. Remove the primary air supply hose for positive interruption of possible air supply, and briefly blow compressed air into all holding valves to ensure that all parts are released. Do not remove any components until all this has been done.

Important!

Holding valves must not be regarded as 'safety' valves, as there will always be a slight inward leakage of air into a vacuum system. This means that, sooner or later, parts held by vacuum will be released.

Vacuum components

- Think Systems - create technical solutions!



A complete programme of vacuum components

Suction cups

About 100 suction cups of varying material and shapes, with attachments for handling and exposing in varying environments - with lifting forces varying from 0.1 to 2600 N - are always in stock.

For example, bellows cups for level adjustment on components of varying shape and for separation of thin components, oval suction cups for lifting rough and narrow components and flat suction cups for horizontal/vertical lifting of flat or gently curved surfaces.

Accessories, connections and attachments

Our wide range of connections and accessories gives the greatest possible flexibility and simplifies attachment of suction cups.

The range includes sprung anchorages with integrated springs, which damp and compensate for level differences, jointed attachments which counteract problems during acceleration and deceleration.

Flow valves, quick release couplings, vacuum gauges, union nipples, adaptors and filters are other accessories for increased efficiency.

Generators

Our generators are designed to reach a high vacuum level quickly and thus offer better machine cycle times.
The programme includes everything from small generators for direct connection to suction cups, to generators with built-in latching and blow-off functions and Multi-Function units with built in automatic air economizers, which save up to 98% of air consumption.

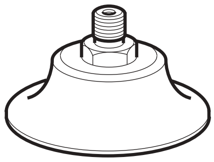
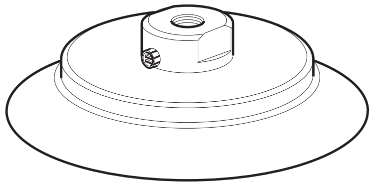
Evacuation times for 1 litre volume to 75% vacuum vary from 0.25 s to 15 s and air consumption at 4 bar varies between 12 - 720 l/min, depending on the generator chosen.

Working units

You can easily build up complete working units to suit your own specific requirements, using the various basic units.
A simple working unit could consist of just the small, easily installed Mini Single or Mini Compact mini-generators and a suction cup or sprung attachment which functions together with a suction cup. In other installations, where the degree of mechanisation is higher and where more advanced solutions are required, a Multi-Function generator could be selected. The built-in solenoids are responsible for both the air supply to the generator and for the blow-off function of the component or workpiece. Everything to give the quickest precise lifting and disconnection possible.

The Multi-Function generator also has a latching function, which gives very high security and offers considerable savings in compressed air. An external vacuum monitor keeps track of the vacuum level and sends signals to the compressed air supply.

A high-technology version of the Multi-Function generator is also available, with independently adjustable connection (55%) and disconnection (70%) levels and an alarm signal (40%) for the lowest vacuum level needed to avoid dropping objects. Suitable for very high safety requirements, such as press lines in the motor industry.

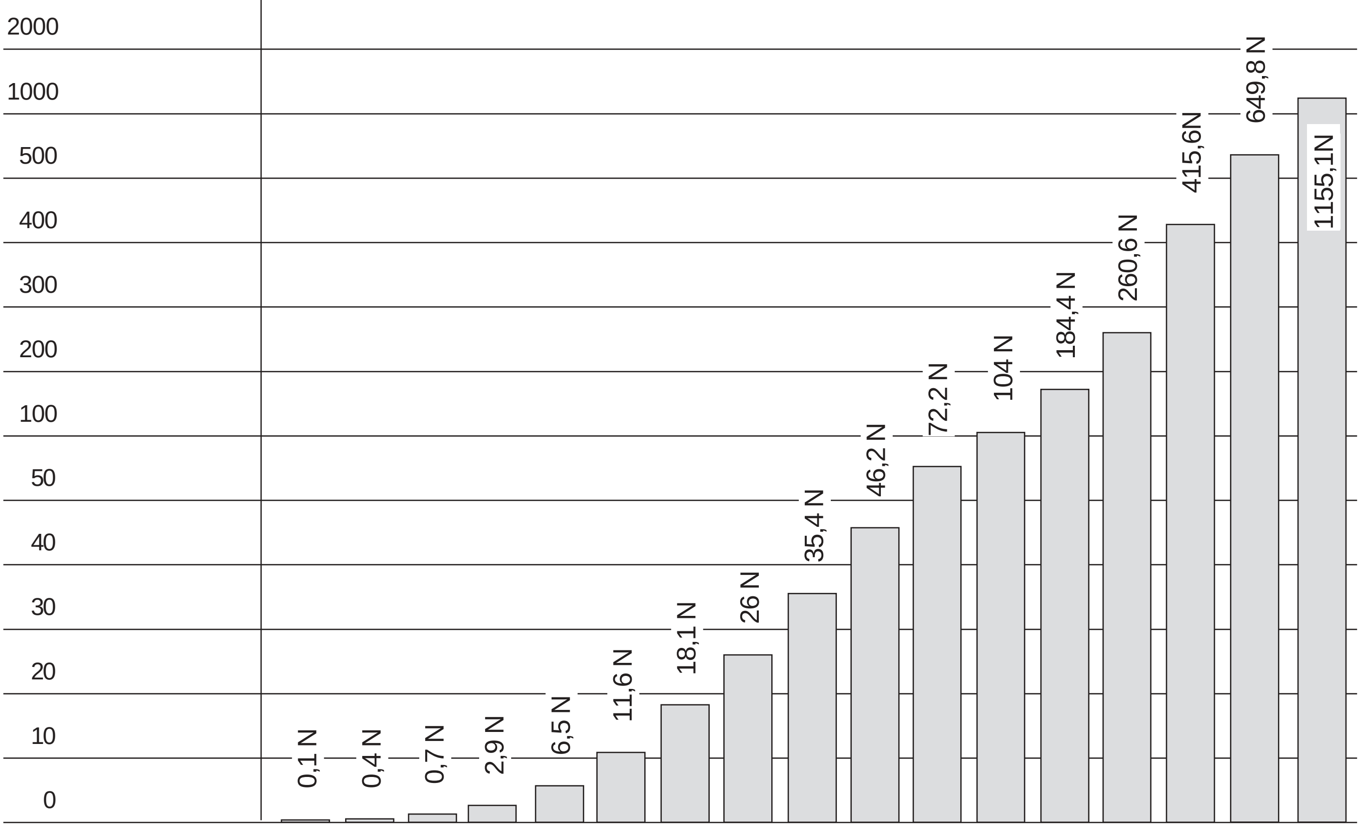
Flat - Simple	Flat - Ribbed
	
PFG/PFTM/PFTF	PFG/PFTM/PFTF

Diameter Ø mm		2	3,5	5	10	15	20	25	30	35	40	50	60	80	95	120	150	200
Port size,	Male	M5	M5	M5	M5	G1/8	G1/8	G1/8	G1/8	G1/8	G1/8	G1/8	G1/4	G1/4	G1/4	-	-	-
(Fitting)	Female	-	-	-	-	G1/8	G1/8	G1/8	G1/8	G1/8	G1/8	G1/8	G1/4	G1/4	G1/4	G1/2	G1/2	G1/2
	Male	-	-	-	-	-	-	G1/4	G1/4	G1/4	G1/4	G1/4	-	-	-	-	-	-
	Female	-	-	-	-	-	-	G1/4	G1/4	G1/4	G1/4	G1/4	-	-	-	-	-	-
Standard material:																		
Nitrile, NBR		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Silicone, SI		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Urethane, U																		
Special material		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

Lifting force in N

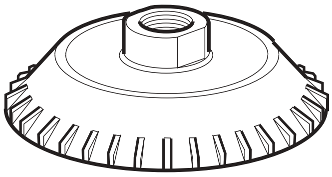
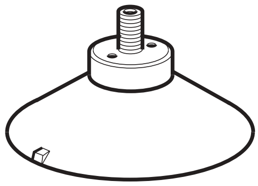
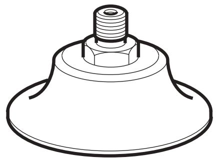
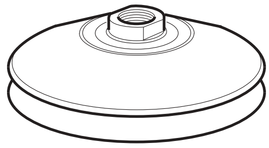
Lifting force = Pressure x Area / Safety factor
75% vacuum on a dry surface, safety factor = 2

Please see page 20 for detailed information

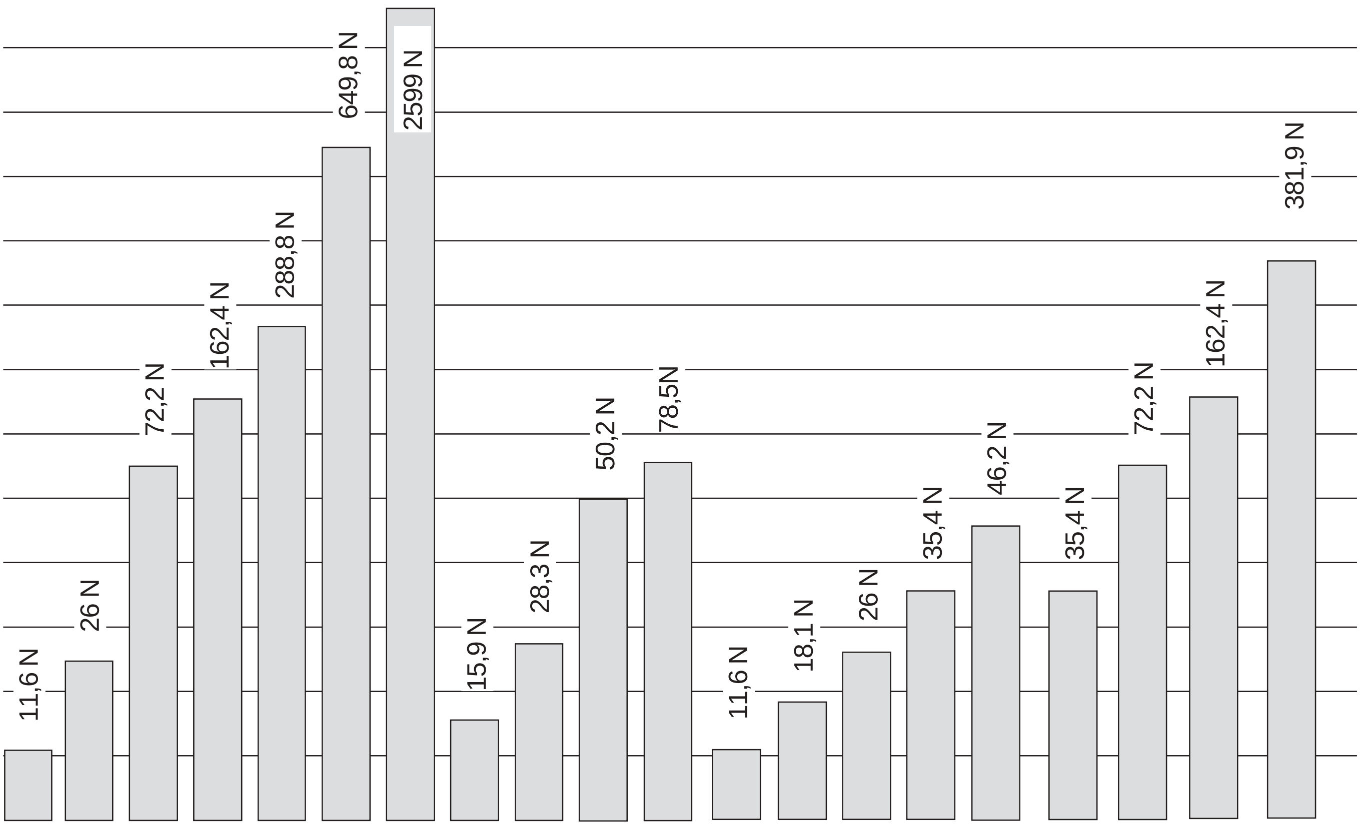


Refer to page	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21

Flat - Strong							Flat - Profiled				Flat - Anti-Slip					Bellows - Anti-Slip			

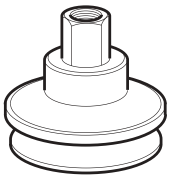





P5V-CFS							P5V-CFA				PFOG/PFOTM/ PFOTF					PBOG			
20	30	50	75	100	150	300	45	60	80	100	20	25	30	35	40	35	50	75	110
-	-	-	-	-	-	-	M10	M10	M10	M10	G1/8	G1/8	G1/8	G1/8	G1/8	-	-	-	-
M5	M5	G1/8	G1/4	G3/8	G1/2	G1/2	-	-	-	-	G1/8	G1/8	G1/8	G1/8	G1/8	G1/8	G1/8	G1/4	G3/8
-	-	-	-	-	-	-	G1/4	G1/4	G1/4	G1/4	-	G1/4	G1/4	G1/4	G1/4	-	-	-	-
-	-	-	-	-	-	G1	-	-	-	-	-	G1/4	G1/4	G1/4	G1/4	-	-	-	-
●	●	●	●	●	●	●					●	●	●	●	●	●	●	●	●
											●	●	●	●	●	●	●	●	●
							●	●	●	●									



24	24	24	24	24	24	24	26	26	26	26	28	28	28	28	28	31	31	31	31

Bellows - Short



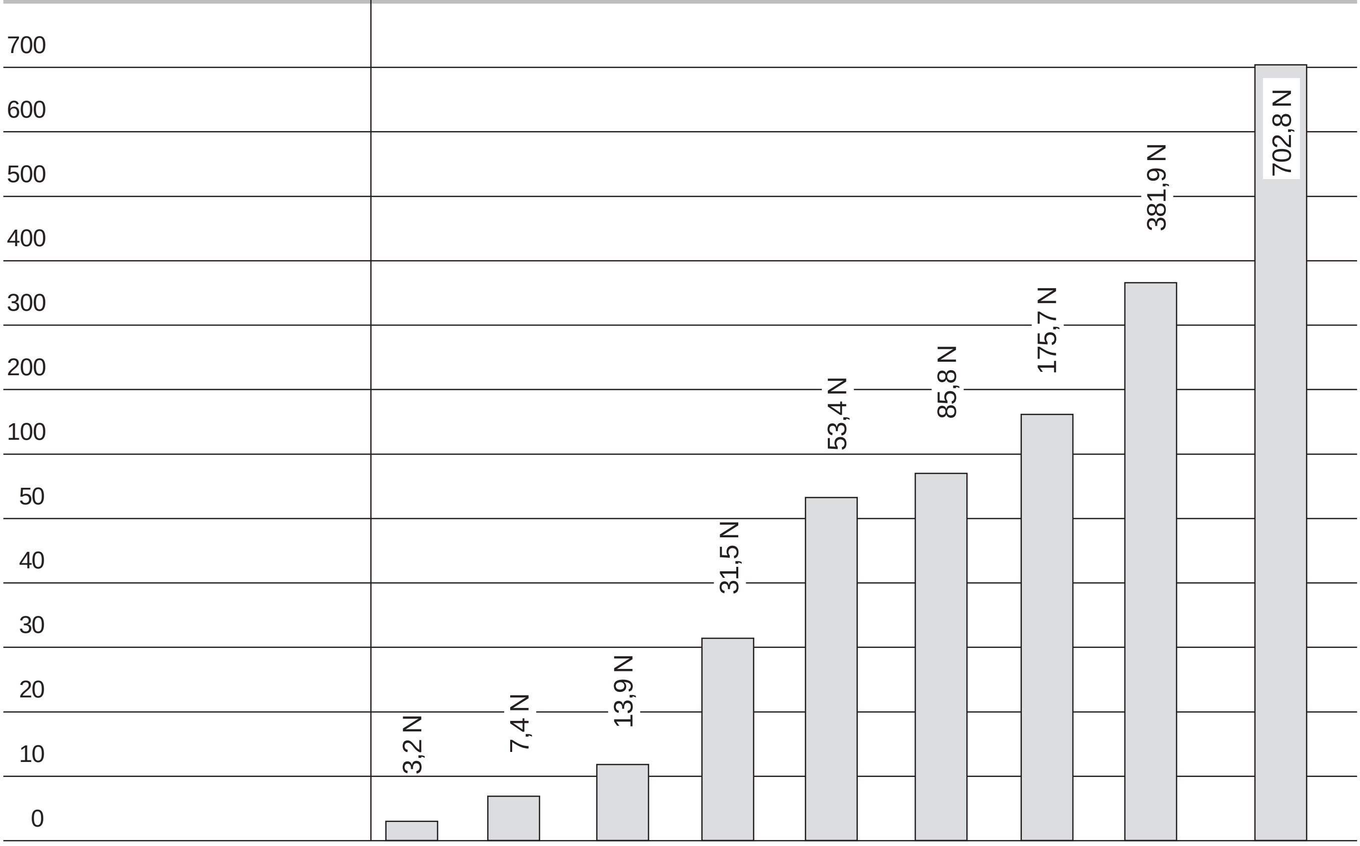
PBTM/PBTF

Diameter Ø mm		10	15	20	30	40	50	75	110	150
Port size, (Fitting)	Male	M5	M5	G1/8	G1/8	G1/8	G1/8	G1/4	-	-
	Female	-	-	G1/8	G1/8	G1/8	G1/8	-	G1/2	G1/2
	male	-	-	-	G1/4	G1/4	G1/4	-	-	-
	Female	-	-	-	G1/4	G1/4	G1/4	-	-	-
Standard material:										
Nitrile, NBR		●	●	●	●	●	●	●	●	●
Silicone, SI		●	●	●	●	●	●	●	●	●
Special material		●	●	●	●	●	●	●	●	●

Lifting force in N

Lifting force = Pressure x Area / Safety factor
75% vacuum on a dry surface, safety factor = 2

Please see page 20 for detailed information



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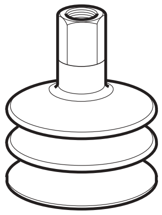
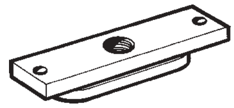
Bellows - Long

Oval - Space Saver

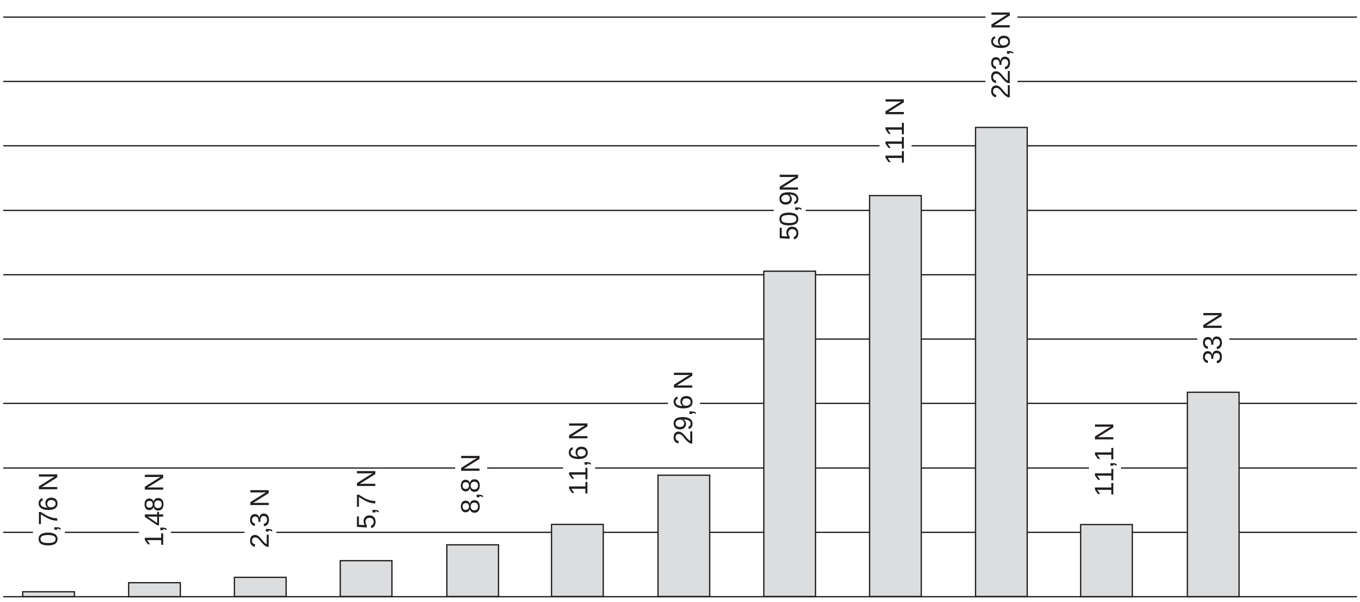




PCG/PCTM/PCTF

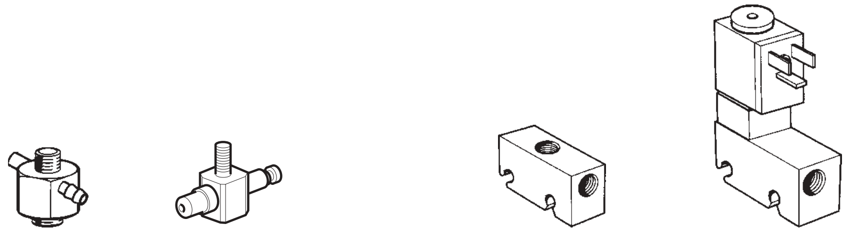
P5V-CVS

5	7	9	14	18	20	32	42	62	88	60x20	100x32
G1/8	G1/8	M5	M5	M5	M5	G1/8	G1/8	G1/8	G1/4	-	-
-	-	M6 (male)	M6 (male)	M6 (male)	M6 (male)	G1/8	G1/8	G1/8	-	G1/8	G1/4
-	-	G1/8	G1/8	G1/8	G1/8	G1/4	G1/4	G1/4	-	-	-
-	-	G1/8	G1/8	G1/8	G1/8	G1/4	G1/4	G1/4	-	-	-
●	●	●	●	●	●	●	●	●	●	●	●
●	●	●	●	●	●	●	●	●	●		



32	32	32	32	32	32	32	32	32	32	37	37

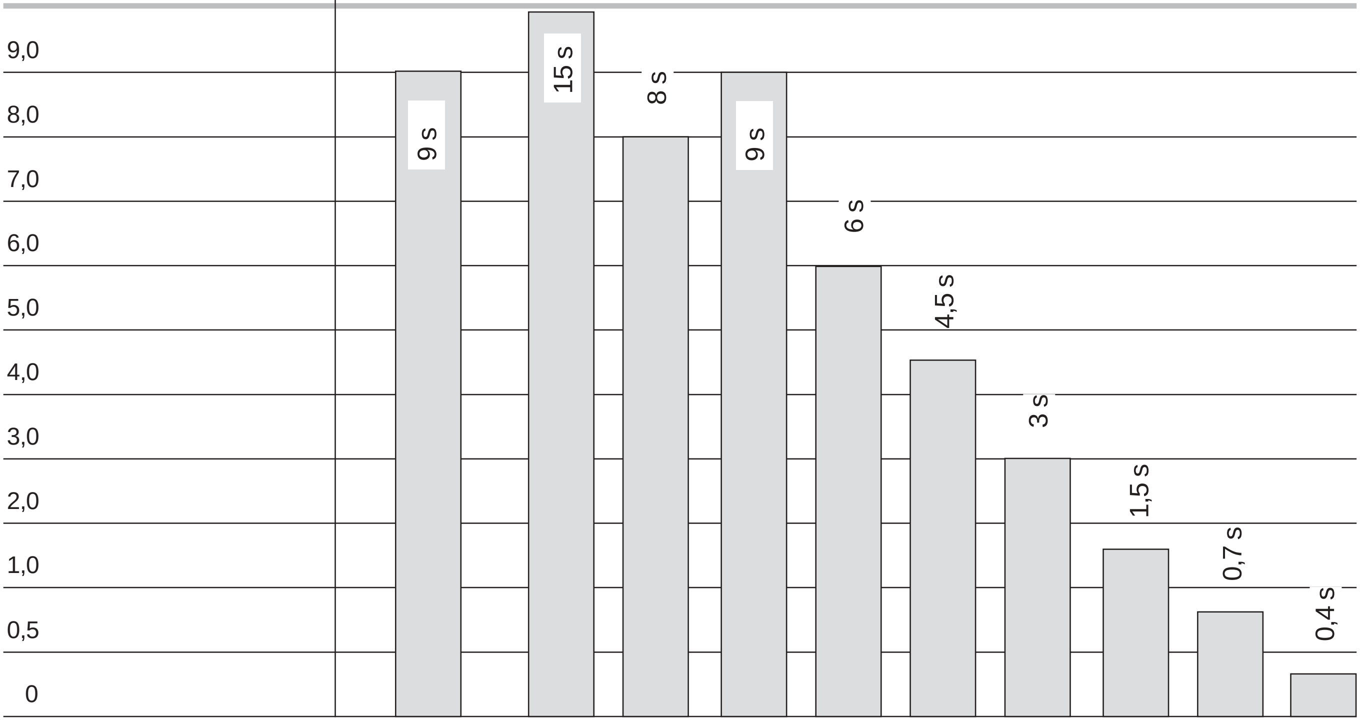
Mini Single	Mini Compact	Compact - Profiled



P5V-GS P5V-GC P5V-GP

Air consumption at 4 bar in Nl/min		20	12	20	20	30	40	60	120	240	420
Vacuum port size	Male	G1/8	-	-	-	-	-	-	-	-	-
	Female	G1/8	G1/8	G1/4	G1/8	G1/4	G1/4	G1/4	G3/8	G1/2	G1/2
	Male	G1/4	-	-	-	-	-	-	-	-	-
	Female	-	-	-	-	-	-	G3/8	-	-	-
Air pressure supply, bar		4	4	4	4	4	4	4	4	4	4
Max vacuum level, %		90	80	80	90	90	90	90	90	90	90
Rapid release (R)					●	●	●	●	●	●	●
Solenoid						●		●			
Solenoid + R						●					
Holding valve											

Time to evacuate 1litre to 75% vacuum, s



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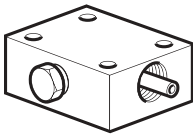
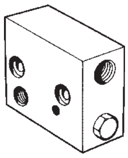
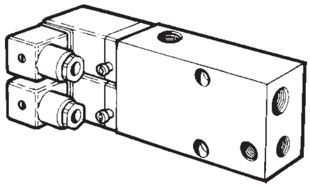
Compact - Solid	Compact - AirSaver	Multi-Function



P5V-GA

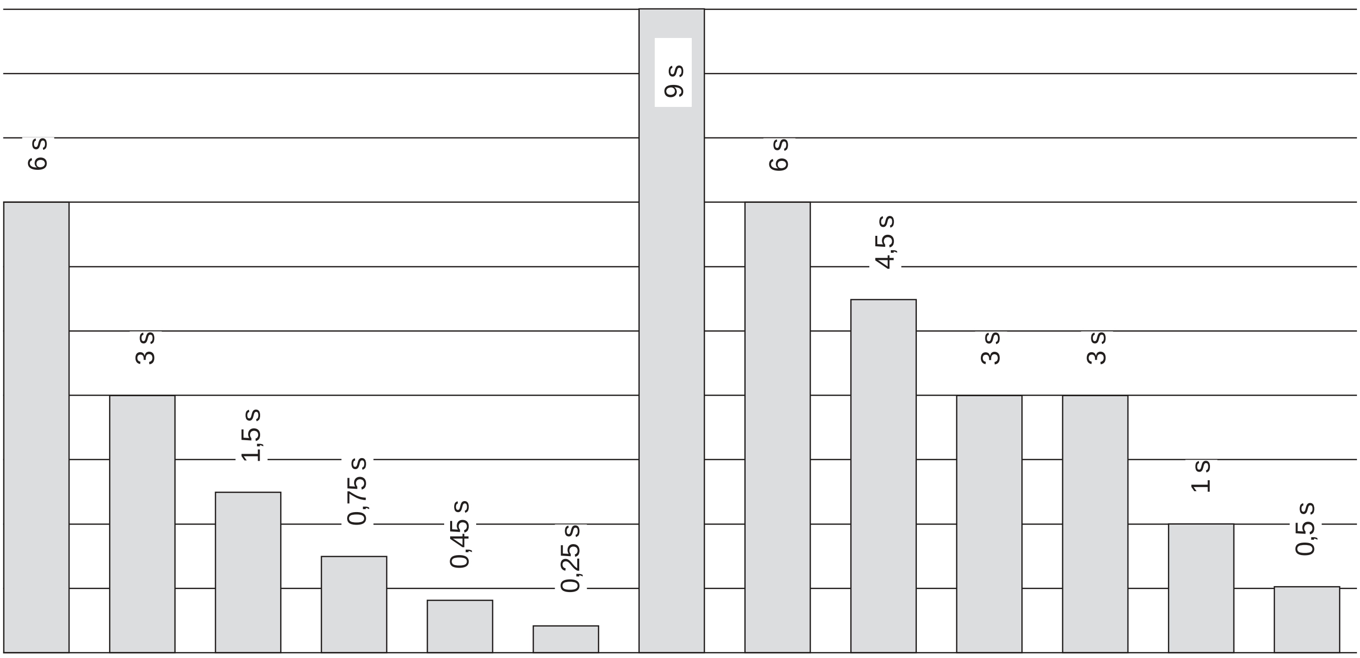


P5V-GW



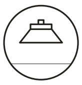
P5V-GM

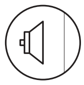
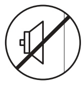
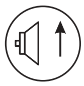
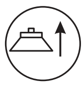
30	60	120	240	420	720	20	30	40	60	60	180	360
-	-	-	-	-	-	-	-	-	-	-	-	-
G1/4	G1/2	G1/2	G1/2	G3/4	G1/2	G1/2	G1/2	G1/2	G1/2	G1/2	G1/2	G1/2
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
4	4	4	4	4	4	4	4	4	4	4,2	4,8	5,5
92	92	92	92	92	92	90	90	90	90	90	90	90
●	●	●	●	●		●	●	●	●	●	●	●
										●	●	●
										●	●	●
	●	●	●	●		●	●	●	●	●	●	●



44	44	44	44	44	44	46	46	46	46	47	47	47

Index of Vacuum Component Symbols

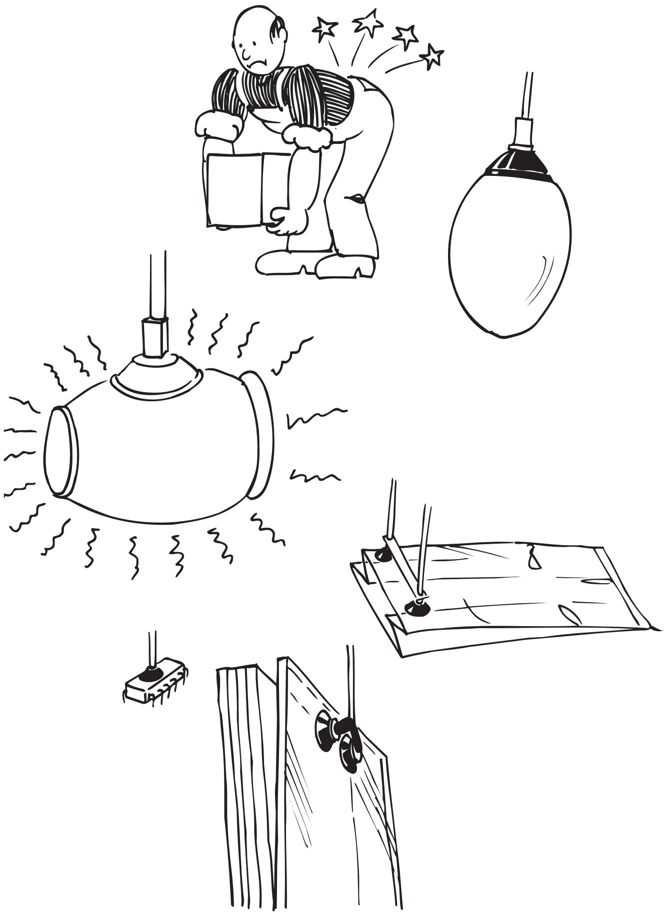
Symbol	Description
Suction cup icons	
	Flat surface thin section
	Flat surface any section
	Soft porous material thin section
	Soft porous material any section
	Slightly bowed surface thin section
	Slightly bowed surface any section
	Bowed surface thin surface
	Bowed surface any surface
	Soft material
	Metal sheet handling
	Corrugated sheet handling

Symbol	Description
Suction cup icons	
	Differences in heights and levels
	Vertical lift
	Not for vertical lift
	Rough and/or abrasive surfaces
	Thin or narrow item handling
	Oil resistant
	Weather resistant i.e. uv, ozone, ...
	High lifting force
	Lifting force vertical
	Lifting force horizontal

Vacuum applications

Probably the greatest number of vacuum applications is to be found in industry, where they are limited only by cost and imagination.

Typical applications are for holding items to be lifted or worked on: a number of such applications are shown below.



- *Heavy lifting - saves backs*
- *Careful lifting - saves eggs*
- *Hot lifts - using silicone suction cups*
- *Clean lifts - opening bags*
- *Small lifts - electronic components and other small items*
- *Perfect lifts - sheets of glass*

When designing vacuum systems, it is important to define the required system performance and features correctly and to select the correct basic concept for the installation.

Consider the following factors when deciding on the necessary system features and requirements:
- The effect of the operating environment on the components
- The effect of the components on their environment
- Necessary lifting forces
- Response times
- Permeability of the materials to be lifted
- How the materials are to be gripped
- Distance between components
- Costs

When selecting components for a vacuum installation, it is generally simplest to proceed in the following order:
- Selection of suction cups
- Selection of generators
- Selection of main control valves
- Selection of hoses
- Selection of valves and fittings
- Selection of lifting yokes, mounting devices etc. and ancillary components

Suction cups

Two main methods are used when holding parts:

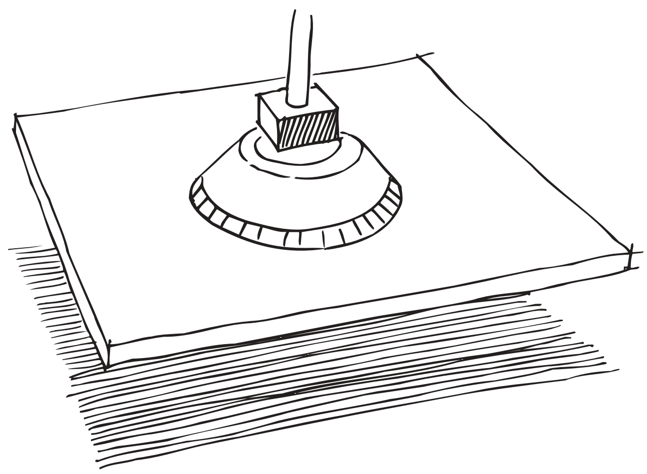
- a mechanical grip, e.g. with a mechanical wedge grip
- securing the part by means of vacuum in a vacuum cup

Advantages of mechanical gripping include simple determination of the necessary and available gripping force, and the fact that the area that is gripped in relatively small.
Drawbacks include the fact that the part being held can be damaged if the gripper is not correctly sized, if the dimensions of the part vary or if it is made of a fragile material. A further drawback of mechanical gripping devices is that they are often expensive to buy, install and maintain.

A major advantage of suction cups as gripping devices is that they do not damage the part. Other advantages that can be mentioned include low purchase price, low service requirements and quick attachment and release.

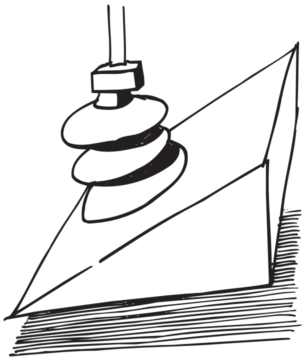
Disadvantages include the fact that, as it is the pressure of the surrounding atmosphere that provides the lifting force, we cannot hold the part with a greater force than that provided by the atmosphere, which means that larger gripping areas are required when using suction cups than when using mechanical gripping devices. In addition, operating costs are often higher than those of mechanical gripping devices, as suction cups in industrial applications are generally powered by vacuum generators. However, this cost can be reduced by using generators with automatic air conservation features.

Suction cups can be constructed in many variants, depending on their applications. However, as far as their general design is concerned, they can be divided into three main types.



Standard suction cup. The commonest type, for use with flat or slightly curved surfaces.

Standard suction cups can be produced in a wide range of types, depending on their potential applications. Examples of the parameters that can be varied include size, materials, double sealing lips, friction grooves, reinforcing springs etc.

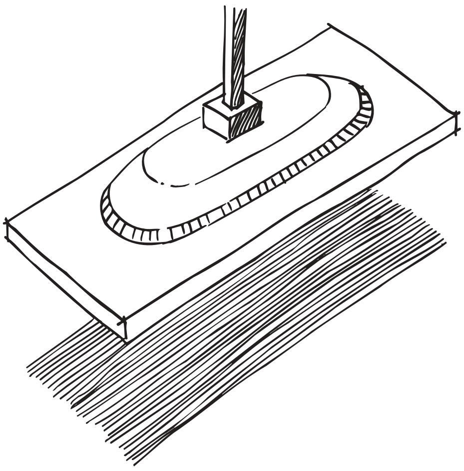


Bellows suction cup. This type of suction cup is intended primarily for applications requiring adjustment to different heights/ levels.

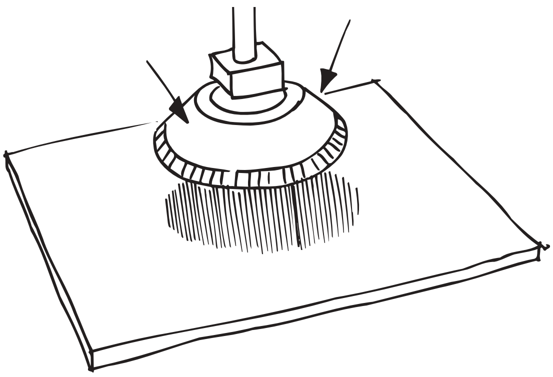
Several bellows suction cups can be fitted to a lifting yoke for handling items with a number of planes and varying shapes, e.g. corrugated sheet. Bellows suction cups also provide a certain degree of flexibility in lifting, which can be utilised to separate thin parts. Bellows cups are produced either as single or double bellows.

Bellows suction cups can also be used in applications where there is a risk of compressing the part to be lifted, as the cup can be positioned so that it does not press against the base and yet can sto lift the part. This can also be done with standard suction cups, but tolerances in positioning them are much tighter.

The design of the bellows suction cup means that it is not suitable for applications involving lifting vertical surfaces.

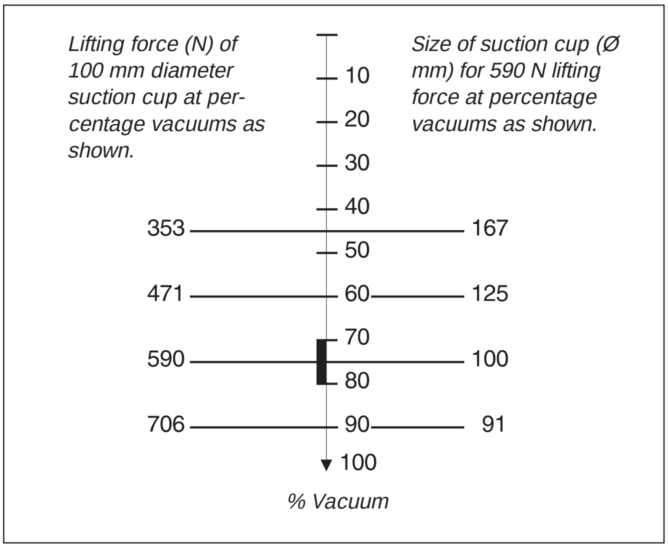


A suction box. This type of suction cup can be oval, square or rectangular, depending on the shape of the part to be lifted.



It is air pressure that presses the suction cup against the surface.

As mentioned previously, it is the air pressure that presses the suction cup against the material. This means that, in order to keep the suction area as small as possible, it is important to use as high a vacuum as possible.

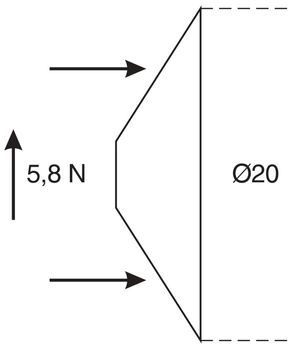


This diagram illustrates why as high a vacuum as 75 % should be employed.

A high vacuum has the following advantages:

– High lifting force for a given area
– Reduced diameter for the same lifting force

The choice of vacuum level can then be determined by consideration of the material of the part and its air permeability.



In the case of vertical load surfaces, it is only the friction force that can be regarded as holding the item.

In tables of holding forces exerted by suction cups, it can be seen that holding forces when lifting vertical surfaces are very much lower than those quoted when lifting horizontal surfaces. As an example, a 20 mm diameter suction cup has a holding force of 11.6 N when lifting a horizontal surface, but only 5.8 N when lifting a vertical surface. The reason for this is of course that the holding force when lifting a vertical surface is converted to a frictional force, and it is only the frictional force that can be employed for lifting the material. For the same reason, a suction cup having internal friction grooves is best suited for applications lifting vertical surfaces.

The values of vertical surface lifts are calculated for dry steel sheet. As a result, the actual holding force for lifting vertical surfaces will vary, depending on the surface friction of the materials to be gripped.

See the section on suction cups for further details.

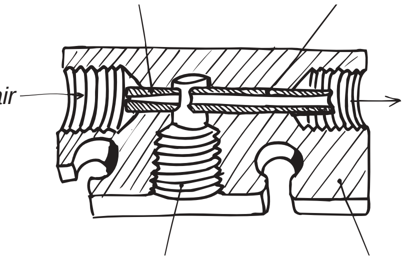
Diameter in mm	Area in cm²	Lifting force Horizontal in N	Vertikal in N	Volume in cm³
5,0	0,20	0,7	0,4	0,005
10,0	0,79	2,9	1,4	0,07
15,0	1,77	6,5	3,3	0,2
20,0	3,14	11,6	5,8	0,5
25,0	4,91	18,1	9,0	1,1
30,0	7,07	26,0	13,0	1,1
35,0	7,07	35,4	17,7	2,3
40,0	12,56	46,2	23,1	3,0
50,0	19,63	72,2	36,1	7,3
60,0	28,26	104,0	52,0	12,7
80,0	50,24	184,8	92,4	27,3
95,0	70,85	260,6	130,3	39,3
120,0	113,04	415,6	207,9	77,3
150,0	176,63	649,8	324,9	197,0
200,0	314,00	1155,1	577,6	387,0

Capacity table for lifting horizontal and vertical surface with flat suction cups, and 75 % vacuum and safety factor of 2. Values shown in the table are calculated values, determined from the following formula:
Lifting force = (pressure x area x coefficient of friction)/safety factor at 75 % vacuum on a dry surface layer. Safety factor = 2 and coefficient of friction = 0.5.

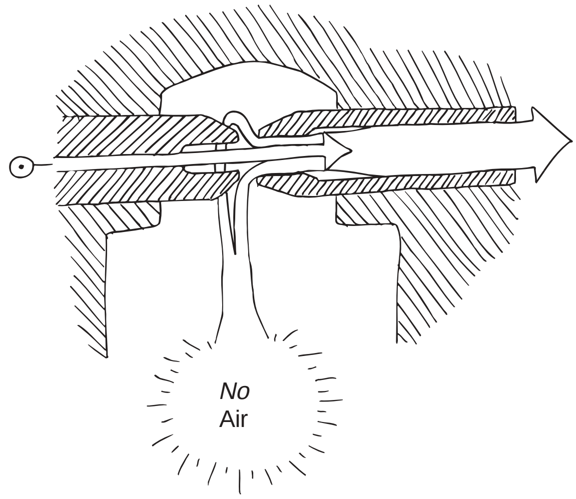
Vacuum generators

There are several ways of producing a vacuum: comparison of three different types are shown in the table below. However, in this brochure, we shall restrict ourselves to consideration only of generators.

Generator pumps operate on the venturi principle, and are powered by compressed gas, usually compressed air.



Generator pump, 0 - 90 % vacuum.



The venturi principle.

The venturi principle involves connecting a compressed air supply to the generator, in which it expands through one or more nozzles. Expansion converts the stored energy in the air, in the form of air pressure, to kinetic energy, in the form of movement of the air. The velocity of the jet increases, and pressure and temperature drop, creating a negative pressure on the suction side.

The advantages of generator pumps include compact dimensions, no moving parts, low maintenance costs and rapid response.

Drawbacks generally include their low flow capacity (e.g. in comparison with that of fans), relatively high compressed air consumption and high noise level of the discharged air.

Generator pumps can be designed either as high-vacuum or as low-vacuum generators.

- High-vacuum generators can produce a high vacuum, but at low suction flow rates.
- Low-vacuum generators produce a low vacuum, but at high suction flow rates.

Glass, metal sheets etc. do not allow air to pass through them, and so high-vacuum generators are recommended for such handling applications.

Low-vacuum generators are recommended for applications dealing with materials such as paper etc., having high air permeabilities.

Generator	Fan	Positive displacement pump
+ Very low purchase price. Rapid response to high vacuum level. Low weight and modest dimensions make it easy to install wherever required. Mounting an generator on, or close to suction cups reduces the air volume to be evacuated, resulting in relatively low energy consumption.	+ Low purchase price Can evacuate large quantities of air (important when working with materials with high air permeability).	+ Low running costs. Low noise level.
– High exhaust noise. Relatively high running costs if used for continuous operation.	– High noise level. Low vacuum level.	– High purchase price. High service costs. Central installations mean that high system volumes must be evacuated, with the result that hoses, suction cups and valves etc. all affect performance of the system.

Comparisons of generators, fans and positive displacement pumps

Selection of Generators

Theoretically, even the smallest generator could evacuate the air from an entirely airtight container down to 90 % vacuum. The reason for using larger generators is the time taken, because although the small generator can eventually raise the same vacuum as a large one, it will take longer.

When selecting an generator, add the total volume of the suction cup(s) to obtain the volume to be evacuated by the generator. The generator can then be selected on the basis of the time taken to raise the necessary vacuum and on safety aspects resulting from leakage.

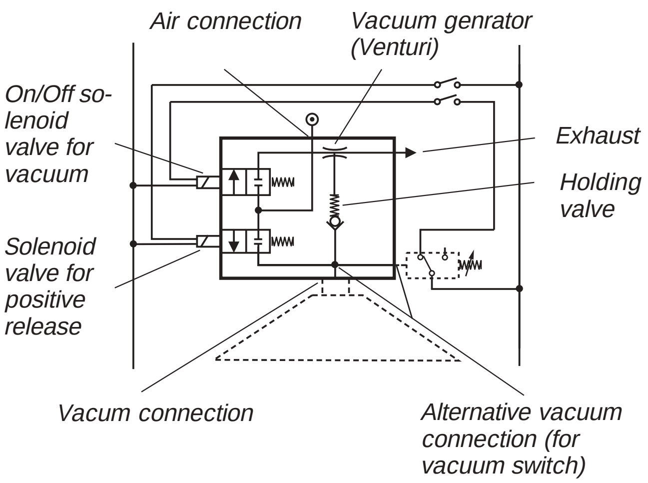
Generators	Air consumption at 4 bar pressure in Nl/min	Time to evacate 1 litres volume to 75% vacuum in s	Vacuum flow in Nl/min
P5V-GSN02A1	18	9	14
P5V-GPN0312	30	6	32
P5V-GPN0412	42	4,5	37
P5V-GMB06142CP	60	3	88
P5V-GAR1214	120	1,5	121
P5V-GMB18142CP	180	1	161
P5V-GAR2414	240	0,7	284
P5V-GMB36142CP	360	0,5	285
P5V-GPN4214	420	0,4	286
P5V-GAN7214	720	0,25	483

Generator evacuation times vacuum flows.

There is also a certain air volume in the hoses and valves etc. Generally, this volume is negligible, as the generator capacity should be chosen to provide a certain margin of safety, as leakage can never entirely be avoided.

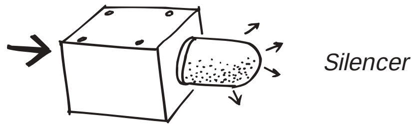
Note also that the smaller the safety margin, the greater the care that must be taken to avoid leakage, and the more frequently the system should be inspected in order to detect possible leaks in connections and in the suction cups. The suction cups are subject to wear and tear, and must be replaced at regular intervals.

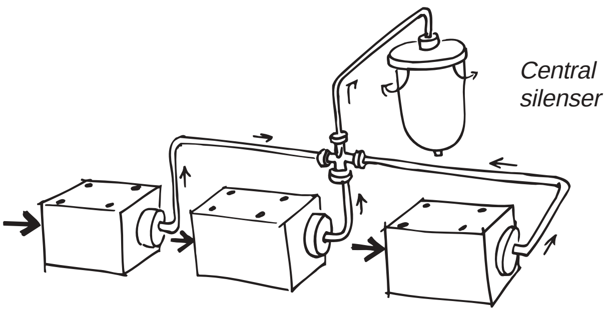
Generators consume relatively large quantities of air if operated continuously, which can become expensive if employed for such applications as long-duration holding of items.



Schematic diagram of an Autovac system for compressed air conservation.

In order to save compressed air, components have therefore been developed in recent years that consume compressed air only when building up the vacuum or when it drops below a preset level. This allows air consumption to be reduced to about 1% of what an ordinary generator would consume in continuous operation. Compressed air consumption is affected by general airtightness of the system and the permeability of the material to be lifted.

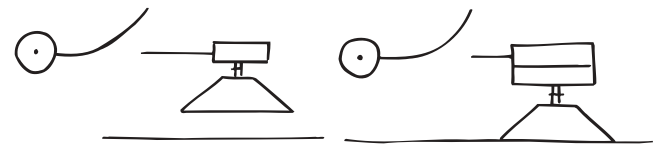




Silencing generator exhausts.

The venturi principle of establishing a vacuum requires a high air velocity through the generator. Traditionally, the high noise level of generator exhausts is usually dealt with by fitting silencers, which involves a back pressure for the generator which reduces the air velocity and therefore also reduces the power of the generator. This applies particularly if any dirt is carried over in the air, either from the vacuum cup or in the compressed air, which will gradually block the silencer.

In order to counter this, a hole is drilled in the end of sintered plastic silencers, which means that such silencers are effectively merely a pipe with porous walls, in which no significant back pressure can be built up and which cannot be blocked by dirt.



Operating principle of the VSA holding valve.

The vacuum in a suction cup is maintained by a continuous air flow through the generator. If this flow should be interrupted, e.g. by rupture of the compressed air hose, the generator immediately ceases to be able to maintain the vacuum. Air enters the system and the load is released.

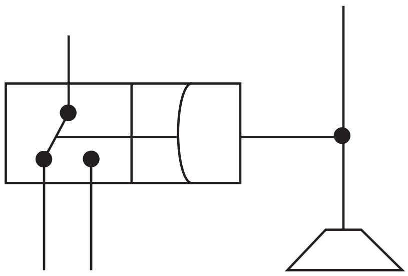
In order to prevent the suction cup from being filled with air in the event of loss of the compressed air supply to the generator, a holding valve is fitted between the generator and the suction cup. This valve operates in the same way as a check valve, i.e. when the generator is not evacuating air, the surrounding atmospheric pressure presses the ball against its seat and prevents atmospheric air from entering the vacuum system.

Although the holding valve may be closed, this does not mean that the vacuum will be maintained indefinitely in the system. Air will find its way in through worn parts of the vacuum cup, leakage through valves and fittings, surface unevenness of the load or permeability of the material. The rubber seal around the edge of the vacuum cup becomes damaged and worn with time. For sensitive applications, it is therefore important to replace the suction cups at regular intervals in order to prevent the load from being dropped in the event of failure of the compressed air supply.

As mentioned above, the quality of the valves and fittings is important, particularly in applications where holding valves are used. When using a holding valve in situations in which there is a risk of damage in the event of loss of the compressed air supply, care should be taken in selecting the suction cup, as cups are available for use on uneven materials.

Holding valves are generally used in applications in which the air permeability through the material is negligible: glass, sheet metal, plastics etc. Holding valves are also fitted with positive release valves, to which a compressed air supply is connected for providing pressure to drop the part.

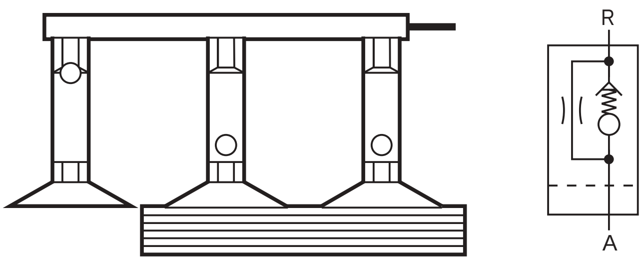
Vacuum switch



Principle of operation of a vacuum switch.

If an attempt is made to lift the load before the generator has established the necessary vacuum, it may be dropped. A vacuum switch is therefore used to check that the correct vacuum has been achieved. It is connected to the suction cup, so that it senses the pressure in the suction cup. The surrounding atmospheric air pressure presses against a membrane in the switch, opening or closing an electric contact when the necessary vacuum is reached, thus providing an appropriate signal to the control system.

Vacuum switches may either have a fixed vacuum setting - usually 75 % vacuum - or a variable setting.

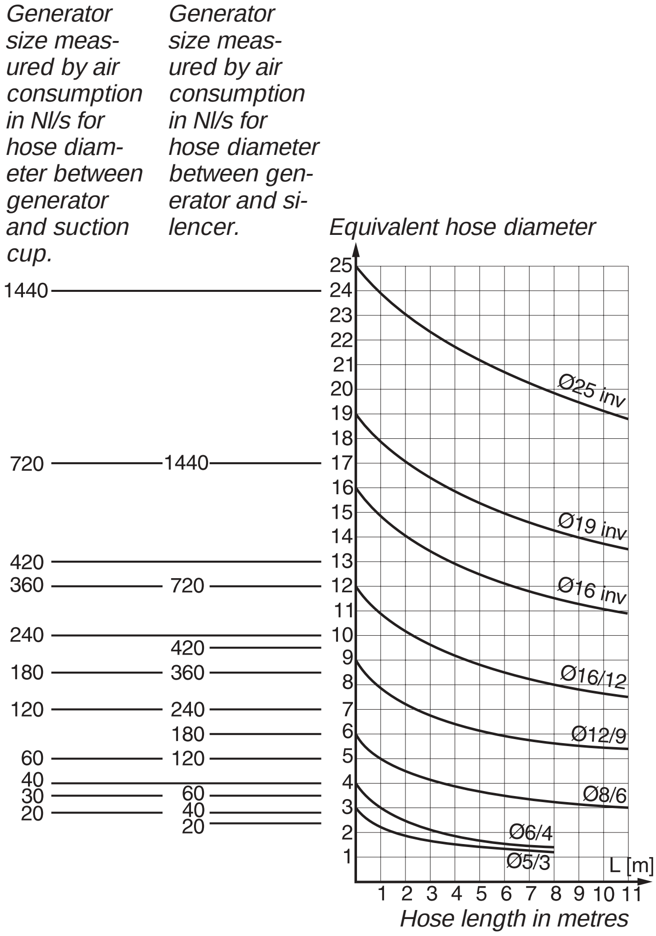


Principle of operation of a flow valve.

A flow valve operates by permitting a slight air flow through it when attaching the suction cups to the load. If the load should drop, so that a high air flow passes through the valve, the ball lifts off its seat and closes the valve.

An example of use of a flow valve is in applications in which a central vacuum pump is connected to several suction cups, and where there is a risk of one or more of the cups dropping the load. If this occurred, and the system did not incorporate flow valves, all the cups would then lose their grip, as the vacuum power unit would be incapable of maintaining the necessary vacuum with such a high inward air leakage.

Choice of hoses



Hose dimensioning between generator and suction cup, and between generator and silencer.

The capacity of the entire vacuum installation depends on ensuring that all the hoses used are correctly dimensioned. If the hose which connects the power valve to the generator is underdimensioned, the generator will not receive enough compressed air, and will have difficulty breathing. The consequence will be that the capacity of the installation will fall, even if all the other components are correctly dimensioned. The table shows that the length of the hoses is decisive for the amount of air which reaches the components. The longer the hose is, the greater is the diameter required.

It should be noted that all bends and angles reduce air flow and should therefore be avoided as far as possible. If possible, select hoses which are a further dimension larger.

The hose which connects the generator to the suction cup should be dimensioned in accordance with the table above. If this hose is underdimensioned, the flow of air evacuated from the suction cup is restricted and it takes longer time to achieve the vacuum in the suction cup than calculated, even if the generator is correctly dimensioned. In some cases, the generator is mounted directly on the suction cup, and this does not then have to be considered.

The hose which connects the generator with the silencer, if a centrally located silencer is fitted, should be dimensioned in accordance with the table on the previous page. The venturi generator operates on the principle of high air speed through the generator, and everything which brakes this air flow also adversely affects the capacity of the generator. For this reason, the hoses from the generator to the silencer are of large diameter. On this hose as well, every elbow and bend has a braking effect on the air flow and should be avoided as far as possible. The silencer is frequently located directly adjacent to the generator, and dimensioning does not have to be considered in such cases.

The table below shows some of the most common hose dimensions and their volume capacity at various lengths.

Diameter in mm		**Area in mm²**	**Air volume in cm³** Hose length			
External	Internal	Internal	1 m	5 m	10 m	100 m
4	2,70	5,7	5,7	28,5	57	570
5	3,15	7,8	7,8	39	78	780
6	4	12,6	12,6	63	126	1260
8	6	28,3	28,3	142	283	2830
12	9	63,6	63,6	318	636	6360
16	12	113	113	565	1130	11300
22	16	201	201	1005	2010	20100

Volume of air in various hose dimensions.

The volume of air in the suction cup and the volume of air in any hoses should be added to find the total volume of air which has to be evacuated by the generator.

It is important to note, when selecting hoses, that hoses maintain the tolerances and quality requirements relevant to the environment in which the hoses will be used.

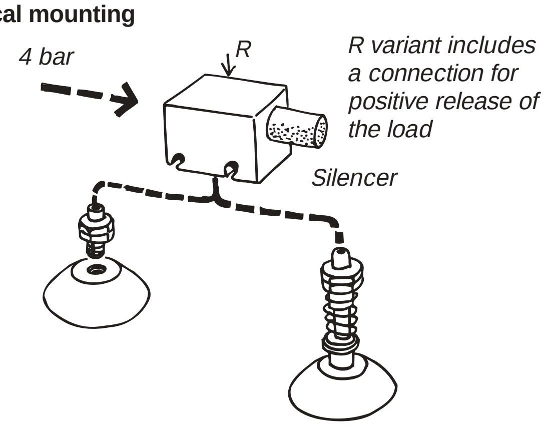
Choice of fittings

When fittings are selected, the most important single criterion is minimising leakage. Cap nuts used to be specified for fittings. Recent product development has permitted quick-release couplings to also be used for vacuum installations, however. When quick-release couplings are used, the tolerances of the hoses used become even more important, so we recommend that users should contact their suppliers for advice on optimising component selection when quick-release couplings are used.

Method of mounting

Each vacuum application requires its particular combination of vacuum components. We describe below those most commonly employed.

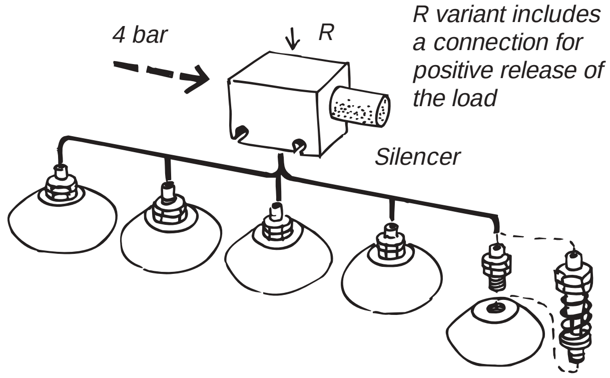
Local mounting



Local mounting: Type P5V-GSN, -GCN, -GP, -GA standard generators.

This combination of vacuum components is the basic combination for applications in which an generator is the vacuum source.

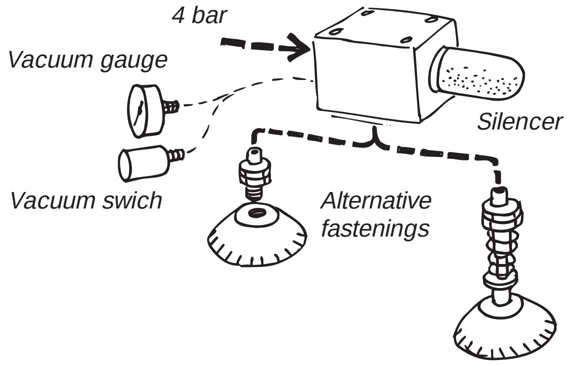
Central installation



Central installation: Type P5V-GSN, -GCN, -GP, -GA standard generators.

This combination is suitable where the shape of the load is such that several suction cups are required, and where there is little or no risk of any of the vacuum cups losing its grip or where there is no risk of damage.

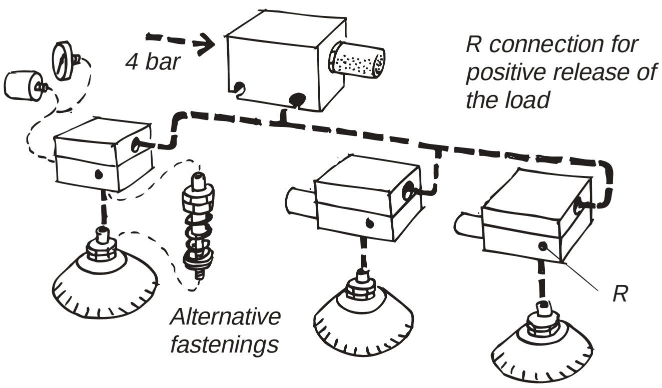
Direct mounting, one generator type P5V-GW AirSaver on each suction cup



Direct mounting, one generator type P5V-GW AirSaver with integral holding valve for enhanced safety.

Use this combination where there is a risk of dropping the load or risk of injury.

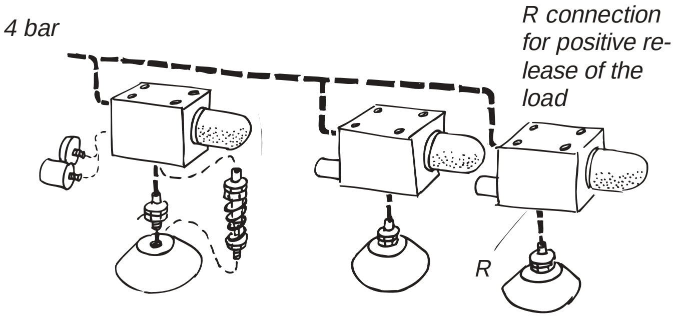
Central installation with a holding valve for each suction cup



Central installation with a holding valve VSA60 for each suction cup.

Use this combination of vacuum components when several suction cups are powered from one generator, and where there is a risk of injury or damage if the load should be dropped.

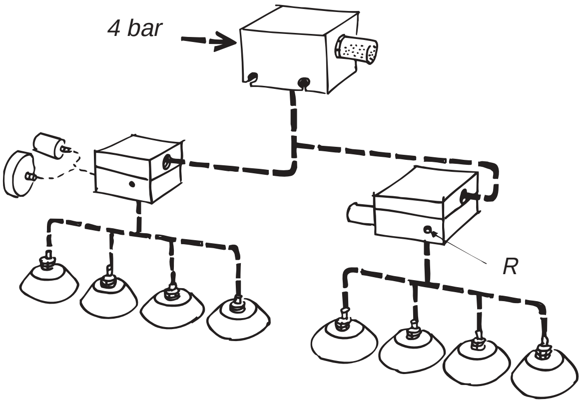
Generators type P5V-GW AirSaver with integral holding valve



Alternative arrangement to central installation, employing local generators type P5V-GW AirSaver with integral holding valves.

Use this combination in the same way as the previous example, i.e. where there is a risk of injury or damage if the load is dropped. However, this arrangement further increases safety by providing an generator for each suction cup.

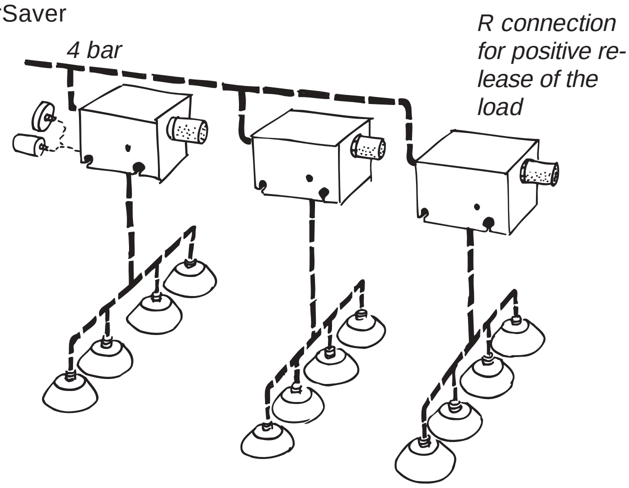
Simplified safety with holding valves



Simplified safety with holding valves VSA60.

Use this combination when there is only a limited risk of damage.

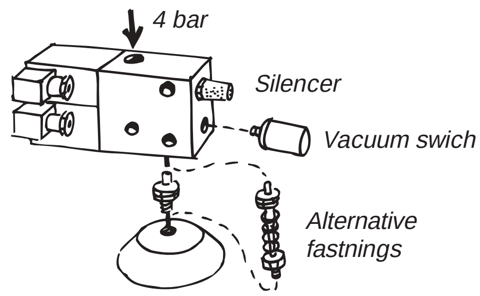
Simplified safety with multiple generators type P5V-GW AirSaver



Simplified safety with multiple generators type P5V-GW AirSaver.

In the same way as described in the previous example, this arrangement is intended for use where there is only a limited risk of damage in the event of loss of the compressed air supply or if one or more suction cup(s) loses its/their grip. However, safety is improved with this arrangement, as vacuum is maintained in the other groups of suction cups.

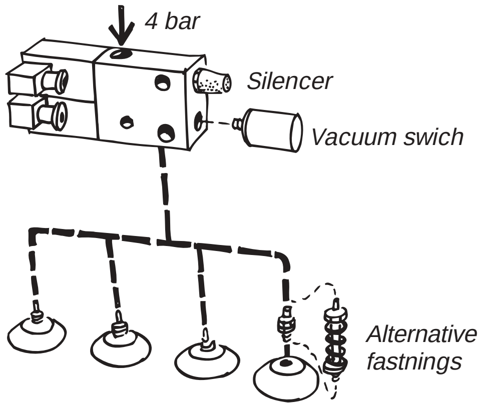
Conservation of compressed air



Multi Function system for compressed air conservation.

Use this combination of components where the load is to be supported for long periods of time, which would result in high compressed air consumption if a conventional generator arrangement was used.

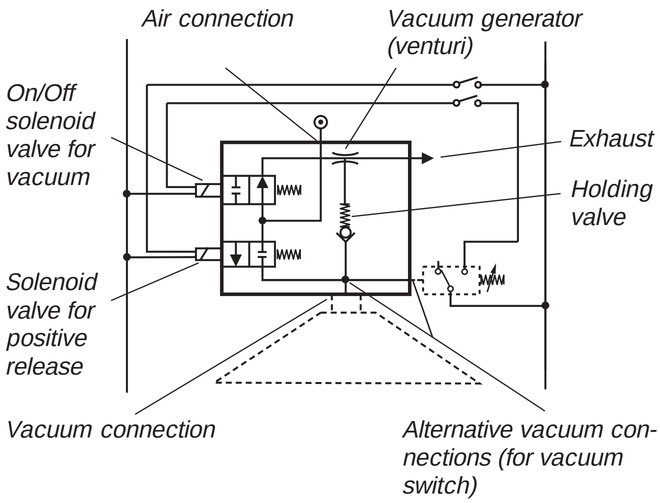
Conservation of compressed air with a central vacuum system



Multi Function system for compressed air conservation with a central generator.

Use this combination of components where several suction cups are required in order to hold the part, and where there is only slight risk of damage in the event of failure of the air supply or if one or more of the suction cups loses its grip.

Safety in the event of loss of power supply and conservation of compressed air

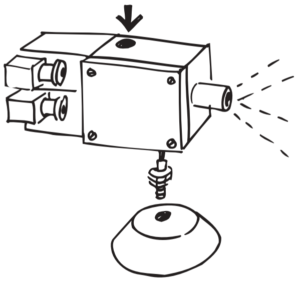


Schematic diagram of Multi Function unit, incorporating safety features against loss of power supply.

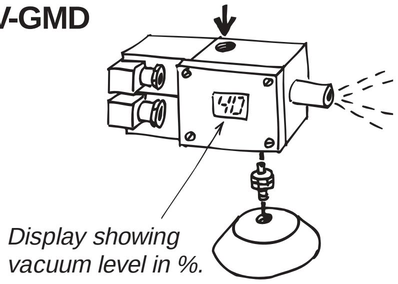
Use this arrangement where the requirements are the same as in the two previous examples, but where there is also a risk of loss of power supply.

Alarm if vacuum falls below safe level

P5V-GMC
P5V-GMG



P5V-GMD



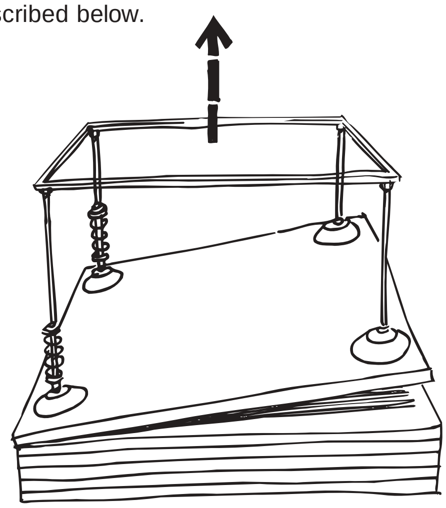
Multi Function advaced.

Use this combination of components when an alarm signal to the control system is required, to indicate that the vacuum level has fallen below some predetermined safety level; often about 40 % vacuum.

This system interrupts the compressed air supply when a vacuum of 75 % has been attained, turning it on again when the vacuum has fallen to 60 %. Both these settings can be adjusted. In addition, a further (adjustable) setting is provided, e.g. 40 % vacuum, at which an alarm will be generated, indicating that there is a risk of the part being dropped.

Separating horizontal materials with sprung suction cup mounts

Theoretically, a force of 10 tonnes would be required to separate two 1 m2 sheets of material if there was no air between them. The various ways of solving this problem differ, depending on the particular applications, but the commonest means are described below.

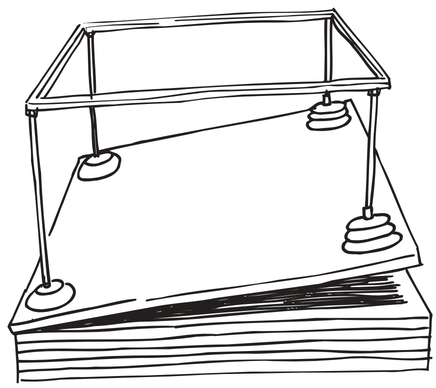


Separating horizontal sheet materials, e.g. glass or other smooth materials, using sprung suction cups.

When sheet metal, glass or other impermeable materials are to be lifted, e.g. from a palett, the suction cups are often lowered on to the upper surface by a powered mechanism. This means that the cups are pressed down onto the material, thus also pressing out any air between the sheets.

Use this arrangement when the sheets to be lifted can flex slightly.

Separating horizontal sheet materials using bellows suction cups



Separating horizontal sheet materials, e.g. glass or other smooth materials, using bellows suction cups.

In the same way as for the previous example, this arrangement is used when there is a risk of lifting several sheets at a time.

The difference between them is that this arrangement is more reliable, but has the disadvantage that the bellows suction cups have a tendency to greater wear in this application, thus increasing their service requirements.