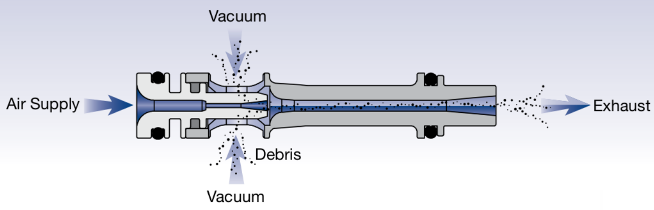
"Designed for Dirt" – Vaccon pumps don't lose suction or require maintenance.

Vacuum pumps, by their nature, use available atmospheric air. Whatever debris, dirt and/or dust are in the air will be drawn into the pump. Whether your application is carton erecting, pet food bagging or feeding die-slick coated sheet metal into a press, Vaccon pumps operate continuously without maintenance or vacuum filters that can clog, degrade performance, cause downtime and increase costs.

Vaccon Venturi Cartridges – The Indestructible Vacuum Engine



- **Non-clogging - no maintenance - no downtime due to cleaning - increased production - increased savings (time & money)**
  Vaccon's advanced venturi design generates high internal velocities that carry dirt through and out of the pump. With no obstacles to impede flow or trap dirt, Vaccon pumps never lose suction or require maintenance. *It's that simple.*
- **High flow - high reliability - high performance - secure holding power**
  Knowing that the majority of work is done above 9"Hg [305mbar], Vaccon specifically designed its single stage venturi's to provide higher flows at the upper levels of vacuum. In most cases, our vacuum flow rates at the upper levels exceed multi-stage pumps by a factor of 2 to 7 times.
- **Compact - close**
  For 40 years, Vaccon's design philosophy has been KISS - "Keep it simple and small." Our compact, single stage venturi's require little installation space and can be positioned close to the vacuum point for faster response and increased productivity.
- **Streamlined design and quick assembly**
  Now, Vaccon pumps can be mounted to T-slot extrusions making design and assembly quick and easy.

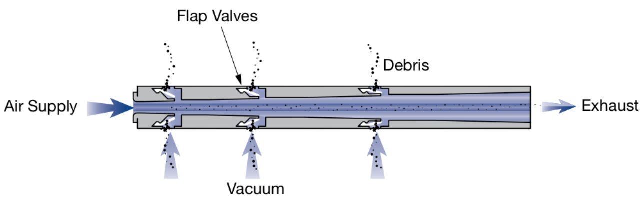
Vaccon's Mid Series Venturi Vacuum Cartridges – Nylon – lightweight – non-clogging - debris passes through the venturi and out the exhaust.

Multi-stage Design Flaw - Flap Valves!

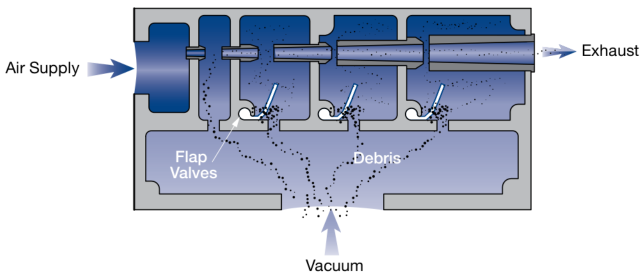
- Flap valves get stuck open from ingested debris
- To protect these flap valves, an intake filter is required
- Intake filters get clogged and cause loss of suction
- Loss of suction causes production to stop until maintenance is performed and/or replacement of the intake filter and/or the flap valves occurs

Result: Multi-stage pump flap valves cause downtime, increase operating expenses - maintenance and replacement costs.

Typical in-line multi-stage pump



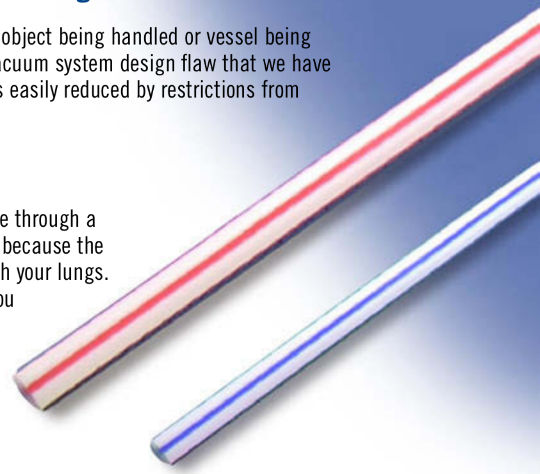
Typical multi-stage pump



When performance, production and reliability matter… it's Vaccon Single-Stage Venturi's – *Simply Better!*

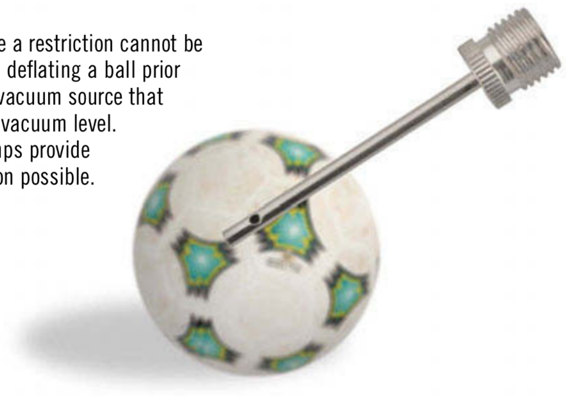
Design Your Vacuum System to Breathe… Avoid the #1 System Design Flaw.

To ensure an efficient vacuum system, emphasis should be placed on the vacuum flow path beginning with the object being handled or vessel being evacuated and ending at the vacuum source. Improper sizing of the system components is the most common vacuum system design flaw that we have seen in the field. Vacuum is a low pressure power source (max value of 14.7 PSI, [1 bar]) whose effectiveness is easily reduced by restrictions from tubing, valves, fittings, etc.



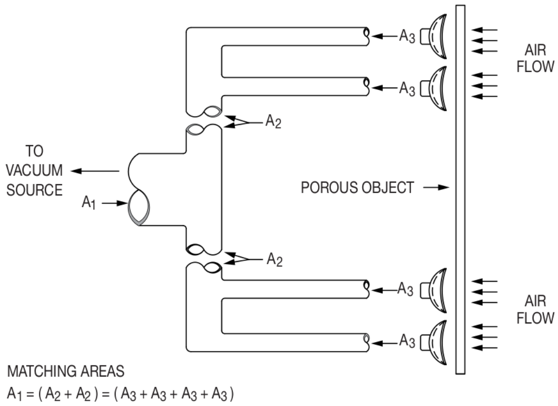
An excellent analogy is a person trying to breathe through a cocktail straw. It's almost impossible to survive because the small flow path will not allow enough air to reach your lungs. A drinking straw with its larger flow path let's you breathe much easier by allowing more air flow.

In applications where a restriction cannot be eliminated, i.e. when deflating a ball prior to shipping – use a vacuum source that can generate a high vacuum level. Vaccon H Series pumps provide the fastest evacuation possible.

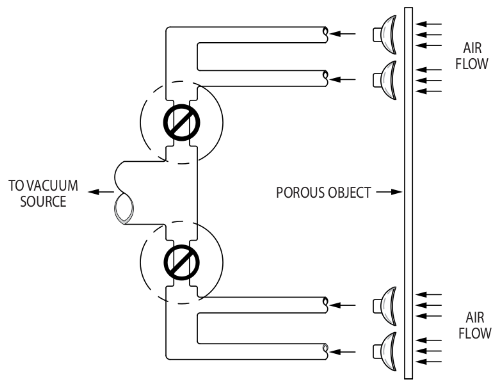


To determine if your system is restricting vacuum flow, place a vacuum gauge at the pump. If the gauge reads vacuum when nothing is connected to the Suction Cup or a vessel is not attached, the system is restricting flow. If the system is not working, i.e. not picking up a porous object or not evacuating a vessel fast enough, a larger vacuum pump will not fix the system until the flow path size is increased.

Proper Design



Improper Design



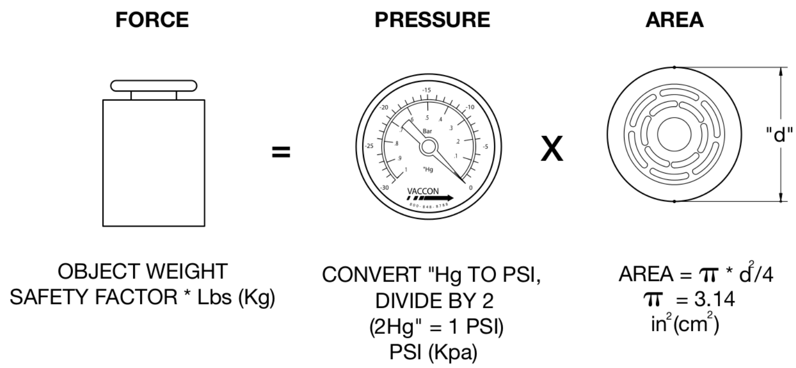
Plumbing a vacuum system is very similar to a municipal water distribution system where the lines closest to the pump are the largest and get smaller as they get to your house (Vacuum Cup/vessel). The area of each branch of tubing should match that of the next branch and the main trunk line should be sized to handle the maximum flow. **Remember that just a small change in diameter causes a large change in area** - a 2x change in diameter increases the area 4x.

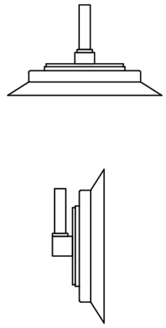
1. Pick and Place/Material Handling:

Pick & Place/Material Handling refers to lifting, gripping, rotating and positioning of an object through the use of a vacuum pump with a Vacuum Cup.

Use the Equation: Force = Pressure X Area to determine:

- Lifting capacity of the pump and cup
- Required vacuum area, i.e. diameter of the cup – see cup section for a more detailed explanation
- Required vacuum level of vacuum pump





Safety Factors

Horizontal lift = 2
Safety factor of 2 is recommended when cup face is in horizontal position.

Vertical lift = 4
Safety factor of 4 is recommended when cup face is in vertical position.

Force = Pressure x Area where:

F = the weight of the objects in lbs [kg] multiplied by the safety factor above
P = the expected vacuum level in PSI [Kpa], remember to convert "Hg to PSI by dividing by 2
A = the area of the Vacuum Cup measured in square inches. Use the equation **A** = $\frac{\pi d^2}{4}$

3 Vacuum Level Ranges:

- **"L" or "F" Series** 0-10"Hg, [0 to 339mbar] for low vacuum / high flow applications
- **"M" or "D" Series** 0-20"Hg, [0 to 677mbar] for medium vacuum / high flow applications
- **"H" or "S" Series** 0-28"Hg, [0 to 948mbar] for high vacuum / standard flow applications

3 Types of Material:

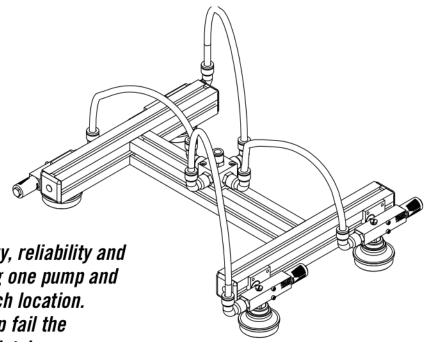
- Non-porous materials: steel, glass laminated chipboard, rigid plastic, semiconductors, etc.
- Porous materials: corrugated, wood, foam, felt, woven materials, objects with extremely rough or uneven surfaces
- Flexible materials: plastic films, baked good, IV bags, paper bags – things that wrinkle

Inexact Science:

When handling porous materials such as corrugated or heavy fabric, it may be hard to choose the exact pump required because the leakage rate is not normally known. It is best to run a trial to test the ability of the pump to overcome the leakage. For existing systems, consult Vaccon for the equivalent pump size. For new applications, take advantage of ***Vaccon's 30 day Test & Evaluation program to ensure proper pump selection.***

System Speed:

Cycle rate of the pump/cup system is determined by the evacuation speed of the venturi. **See Vessel Evacuation.**



Increase safety, reliability and speed by using one pump and one cup at each location. Should one cup fail the others will maintain their grip.

2. Vessel Evacuation:

In many process applications it is necessary to evacuate a vessel for the purpose of purging gases, leak testing and degassing viscous fluids. It may also be simply the length of tubing between the pump and cup that needs to be evacuated.

Knowing the pump's evacuation speed will help determine process completion time or the production rate of a pick & place system. To find the speed, use the evacuation charts listed in the performance data for each venturi pump. Note that the charts are based on a volume of one cubic foot or one liter of volume to a given vacuum level in "Hg or mbar.

1. Determine the total volume to be evacuated – vessel and/or vacuum lines (cu. ft.), 1728 cu. in = 1 cu. ft.

2. Desired vacuum level Hg [mbar] is determined by customer

3. Time to reach vacuum level (seconds) – determined by customer

Application #1

Evacuate Vacuum Lines Between Vacuum Cup and Pump

Application #1 Assumptions:

Desired Vacuum level: 28"Hg [948 mbar]
Evacuation time: 10 seconds or less
Vacuum line: 3/8" ID, 3 ft length [10mm ID, 100cm length]

1. Volume = Area of Tubing ID x Length

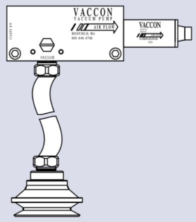
$$\frac{\pi d^2}{4} \times L = \frac{\pi\,(.375)^2}{4} \times 36'' = 3.976 \text{ cu. in.}$$

$$\left[\frac{\pi d^2}{4} \times L = \frac{\pi\,(1\text{cm})^2}{4} \times 100\text{cm} = 78 \text{ cm}^3\right]$$

2. Convert cu. in. to cu. ft – divide by 1728
3.976 / 1728 = 0.0023cu. ft. (volume of tubing)
[Convert cu. cm to liters - divide by 1000
78 / 1000 = 0.078 liters (volume of tubing)]

3. Go to Evacuation Time chart – find desired vacuum level.
28"Hg = 790.80 seconds per cu. ft.
[948 mbar = 27.9 seconds per liter]

4. Multiply cu. ft **(0.0023 x 790.80) = 1.82 seconds**
[Multiply liters **(0.078 x 27.9) = 2.17 seconds**]



Answer:
Depending on the style of pump and options needed, choose from either the VP Series or J Series pumps – both series have the ability to meet your application requirements.

Application #2

Evacuate Vessel and Vacuum Lines

Find Total System Volume

Application #2 Assumptions:

Desired Vacuum level: 28"Hg [948 mbar]
Evacuation time: 5 minutes or less
Vessel volume: 2 cu ft [50 liters]
Vacuum line: 3/8" ID, 3 ft length [10mm ID, 100cm length]

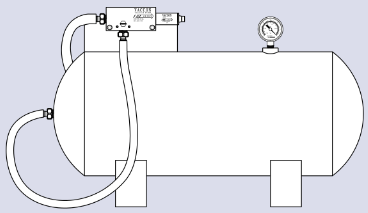
1. Add vessel volume + tubing volume (See Application 1.1 & 1.2)
2 cu. ft + 0.0023 cu. ft. = 2.0023 cu ft.
[50 liters + 0.078 liters = 50.078 liters]

2. Go to Evacuation Time chart – find desired vacuum level.
(Assumption: 28"Hg [948 mbar]) (Note: Chart is based on Evacuation in seconds.)

3. To find required time, start with smallest pump first.
(Assumption: Evacuation Time - 5 minutes or less.)

Multiply cu. ft. [liters] x Evacuation Time in Seconds / divide by 60 for minutes

Model # 60H = (2.0023 x 790.8) / 60 = 26.39 min. - over 5 minutes
(Metric) = (50.078 x 27.9) / 60 = 23.29 min. - over 5 minutes
Model # 150H = (2.0023 x 125) / 60 = 4.17 min - under 5 minutes
(Metric) = (50.078 x 4.4) / 60 = 3.67 minutes - under 5 minutes



Answer:
Depending on the style of pump and options needed, choose from either the VP Series or J Series pumps – both series have the ability to meet your application requirements.

Model#	Evacuation Time in Seconds Based on 1 Cu. Ft. Volume /"Hg										
	0"Hg	3"Hg	6"Hg	9"Hg	12"Hg	15"Hg	18"Hg	21"Hg	24"Hg	27"Hg	28"Hg
60H	0.00	15.00	29.80	50.60	74.20	102.80	135.90	183.20	245.90	410.20	**790.80**
150H	0.00	2.30	3.80	6.50	10.20	14.10	21.30	44.90	55.00	81.00	**125.00**
Model#	Evacuation Time in Seconds Based on 1 Liter Volume/mbar										
	0 mbar	102 mbar	203 mbar	305 mbar	406 mbar	508 mbar	609 mbar	711 mbar	813 mbar	914 mbar	948 mbar
60H	0.0	0.5	1.1	1.8	2.6	3.6	4.8	6.5	8.7	14.5	**27.9**
150H	0.0	0.1	0.1	0.2	0.4	0.5	0.8	1.6	1.9	2.9	**4.4**

For additional Performance Data see page 94.

When comparing Vaccon venturi vacuum pumps to our competitors…

Compare vacuum flows in the working range (9”Hg - 27”Hg) where work is actually accomplished. Comparing vacuum flow at 0”Hg is like comparing the output of a compressor at 0 PSI. High flow at 0”Hg is meaningless…no work is done at 0”Hg.

Consider the analogy of an air compressor to a vacuum pump…

Suppose a compressor dealer claims a compressor generates 100,000 CFM at 0 PSI (exaggeration) but only 1 CFM at 80 PSI… Is the 0 PSI flow rate meaningful? The same holds true for a vacuum pump flow rating at 0 ”Hg.

1st - Compare Max. Vacuum Level, 2nd - Compare Air Consumption (Operating Pressure is not important), 3rd - Compare Vacuum Flow in the working range

Model #	Air Consumption SCFM	Imperial – Vacuum Flow (SCFM) vs. Vacuum Level (“Hg)										
		0”Hg	3”Hg	6”Hg	9”Hg	12”Hg	15”Hg	18”Hg	21”Hg	24”Hg	27”Hg	28”Hg
VP80-200H	**7.80**	5.40	4.70	3.85	3.30	3.00	2.60	2.10	1.60	1.20	0.60	0.00

Working Range

Vacuum Terms and Definitions

Air Consumption:
The volume of compressed air required to power the pump.

Atmospheric Pressure:
The atmosphere that surrounds the Earth can be considered a reservoir of low pressure air. Its weight exerts a pressure that varies with temperature, humidity and altitude.

Barometer:
A device usually filled with mercury that measures atmospheric pressure.

Compressed Air Considerations:
1HP @ 80 PSI generates approximately 4 SCFM of flow.

Standard or Average Atmospheric Pressure at Sea Level:
29.92”Hg or [760 mmHg]

Vacuum Flow:
The volume of free air induced by the vacuum pump per unit of time, expressed as standard cubic feet per minute – SCFM or [liters per minute - LPM]

Vacuum Force:
Equal to the vacuum level X the area of the vacuum surface, i.e. holding area of a Vacuum Cup.

Vacuum Level:
The magnitude of the suction created by the vacuum pump. The unit of measure is inches of Hg (“Hg) or (mbar). Vacuum level is affected by elevation and barometric pressure. For each 1,000 feet of elevation, vacuum level decreases by 1” of Hg.

Venturi’s, Ejectors, Transducers, Generators:
All of these are different names for air powered vacuum pumps.

Facts to Remember:

50 mmHg = 1 PSI
1mmHg = 1 torr (vacuum)
1”Hg = 25.4 mmHg
2”Hg = 1 PSI
29.92”Hg = 100 Kpa
14.7 PSI = 100 Kpa
14.7 PSI = 29.92”Hg
14.7 PSI = 760 mmHg

Conversion Chart – Vacuum vs. Pressure				
% Vacuum	“Hg	mmHg	bar	PSI
10	3	76.92	-0.1	-1.47
20	6	153.85	-0.2	-2.94
30	9	230.77	-0.3	-4.41
40	12	307.69	-0.4	-5.88
50	15	384.62	-0.5	-7.35
60	18	461.54	-0.6	-8.82
70	21	538.46	-0.7	-10.29
80	24	615.38	-0.8	-11.76
90	27	692.31	-0.9	-13.23
100	30	769.23	-1.0	-14.70