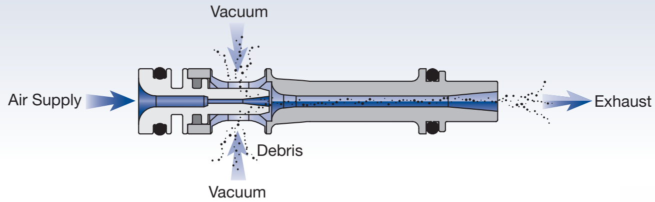
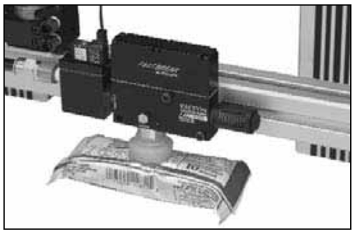
"Designed for Dirt" – Vaccon pumps don't lose suction or require maintenance.

Vacuum pumps by nature, suck in the atmosphere they operate in. 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 sheet feeding die-slick coated 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**
  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 performance**
  Knowing that the majority of work is done above 9"Hg [305mbar], Vaccon specifically designed it single stage venturi's to provide higher flows at the upper vacuum levels. In most cases, our flow rates at the upper levels exceed multi-stage pumps by a factor of 2 to 7 times.
- **Compact - close**
  For over 35 years, Vaccon's design philosophy has been "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, increased safety and greater productivity.
- **Streamlined design and quick assembly**
  Now, Vaccon pumps can be mounted to T-slot extrusions making design and assembly quick and easy.



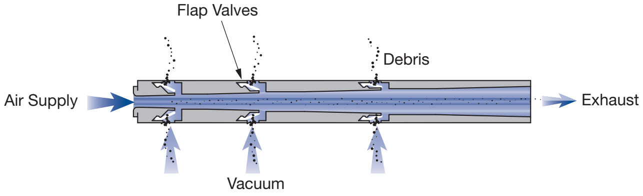
Vaccon's Mid Series Venturi Vacuum Cartridges – Nylon – lightweight – non-clogging - debris passes through the venturi and out the exhaust.

Multi-stage Design Flaw - Flap Valves!

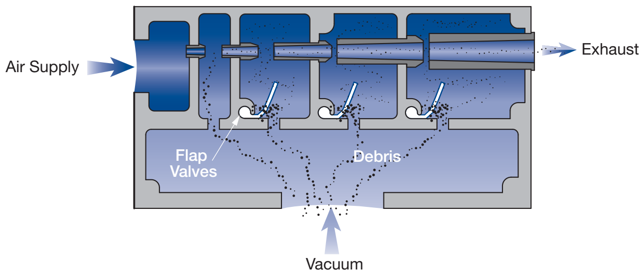
- Flap valves get stuck open from ingested debris.
- To protect these flap valves, an intake filter is required.
- Intake filters get clogged and cause loss of suction.
- Loss of suction causes production to stop until maintenance is performed and/or replacement of the intake filter and/or the flap valves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

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

Typical in-line multi-stage pump



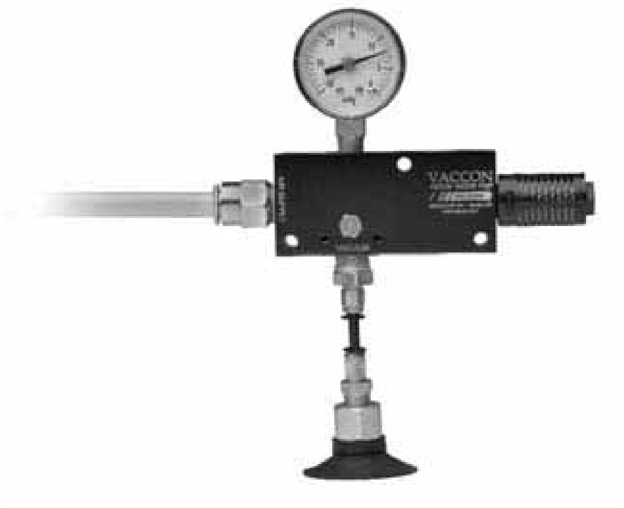
Typical multi-stage pump



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

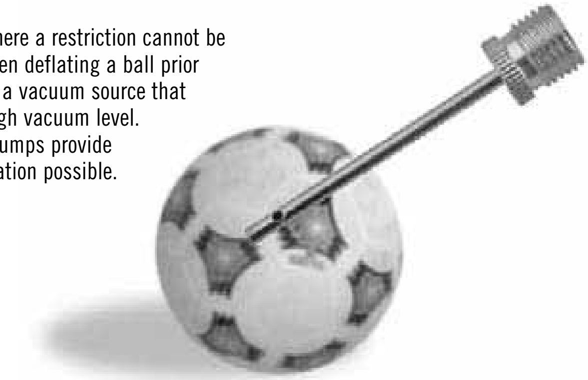
Design Your Vacuum System to Breathe… Avoid the #1 System Design Flaw.

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. 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.



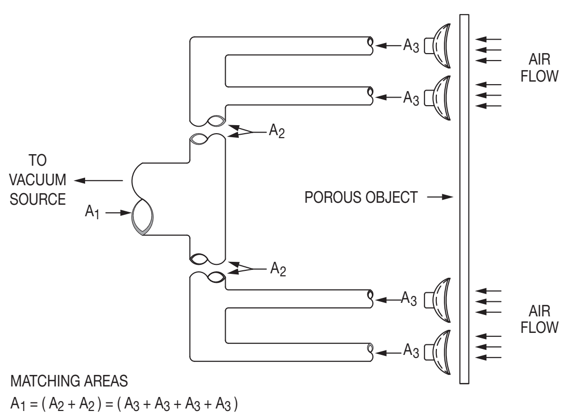
An excellent analogy is trying to breathe through a cocktail straw. It's almost impossible to survive because the small flow path will not allow enough air to reach your lungs. A drinking straw with its larger flow path let's you breathe much easier by allowing more flow.

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.

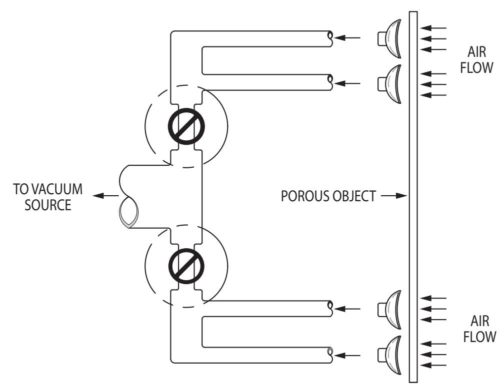


To determine if your system is restricting vacuum flow, place a vacuum gauge at the pump. If the gauge reads vacuum when nothing is connected to the vacuum cup or a vessel is not attached, the system is restricting flow. If the system is not working, i.e. not picking up a porous object or not evacuating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

Proper Design



Improper Design



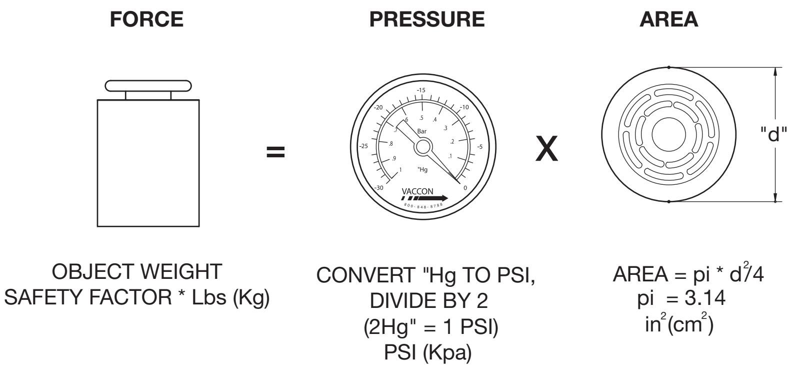
Plumbing a vacuum system can be thought of like a municipal water distribution system where the lines closest to the pump are the largest and get smaller as they get to your house (vacuum cup/ vessel). The area of each branch of tubing should match that of the next branch and the main trunk line should 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:

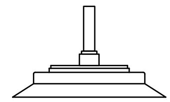
Pick and Place/Material Handling refers to lifting, gripping, rotating and positioning of an object through the use of a vacuum pump and vacuum cup.

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

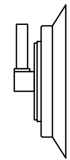


Safety Factors



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:

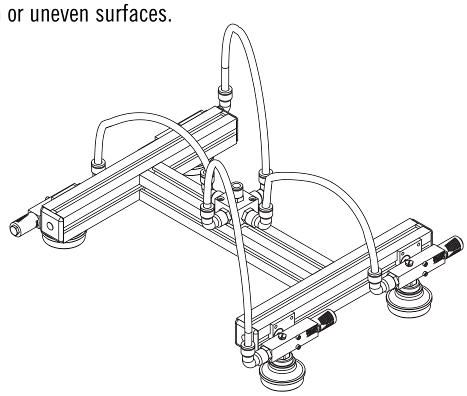
- Non-porous materials: steel, glass laminated chipboard, rigid plastic, semiconductors, etc.
- Porous materials: corrugated, wood, foam, felt, woven materials, objects with extremely rough or uneven surfaces.
- Flexible materials: plastic films, baked good, IV bags, paper bags – things that wrinkle.

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.

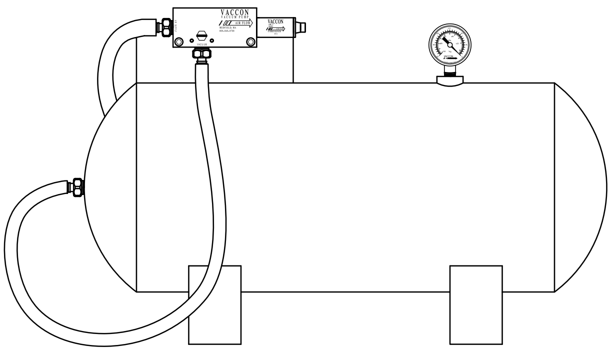
2. Vessel Evacuation:

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.

Knowing the evacuation speed will help determine process completion time or the production rate of a pick and place system.

To find the speed, use the evacuation charts listed in the performance data for each venturi. Note that the charts are based on a one cubic foot volume.

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 Assumptions:

Vessel volume: 2 cu ft
Vacuum line: 3/8" ID, 3 ft length

Application #1

Evacuate Vacuum Lines Between Vacuum Cup and Pump

Desired Vacuum level: 28"Hg
Evacuation time: 10 seconds or less

1. Volume = Area of Tubing ID x Length

$$\frac{\pi d^2}{4} \times L = \frac{\pi (.375)^2}{4} \times 3' = 0.11045$$

2. Multiply 0.11045 x length of tubing in inches
   0.11045 x 36 = 3.976 cu. in.
3. Convert cu. in. to cu. ft – divide by 1728
   3.976 / 1728 = 0.0023cu. ft. (volume of tubing)
4. In evacuation chart – go to vacuum level required
   28"Hg = 790.80 seconds per cu. ft.
5. Multiply cu. ft **(0.0023 x 790.80) = 1.82 seconds**

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

Application #2

Evacuate Vessel and Vacuum Lines

Find Total System Volume

Desired Vacuum level: 28"Hg
Evacuation time: 5 minutes or less

1. Add vessel volume + tubing volume (Application 1)
   2 cu. ft + 0.0023 cu. ft. = 2.0023 cu ft.
2. In evacuation chart – go to vacuum level required
   28"Hg – start with smallest pump first until you find the time that meets your requirements. Note, you may have to go to larger pumps
3. Multiply cu. ft **(2.0023 x 125) / 60 = 4.17 minutes**

Answer:
Depending on the style of pump and options needed, choose from VP Series, J Series, VDF Series or FDF Series pumps – they all 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**
90H	0.00	6.50	12.30	18.90	32.50	47.00	65.40	92.20	130.00	222.20	281.30
100H	0.00	2.70	6.50	11.20	17.50	25.80	38.40	55.40	79.20	166.70	251.80
150H	0.00	2.30	3.80	6.50	10.20	14.10	21.30	44.90	55.00	81.00	**125.00**

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 4 SCFM of flow.

Standard or Average Atmospheric Pressure at Sea Level: 29.92"Hg or [760mm Hg]

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 are air powered vacuum pumps, just different names.

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

Phone: **1-800-848-8788** or **508-359-7200** E-Mail: **engineering@vaccon.com**