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: \( \text{Force} = \text{Pressure} \times \text{Area} \) 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

\[ \text{Force} = \text{Pressure} \times \text{Area} \]

<table>
<thead>
<tr>
<th>FORCE</th>
<th>PRESSURE</th>
<th>AREA</th>
</tr>
</thead>
<tbody>
<tr>
<td>OBJECT WEIGHT SAFETY FACTOR ( \times ) Lbs (Kg)</td>
<td>CONVERT ( ^\circ \text{Hg} ) TO PSI, DIVIDE BY 2 ( \text{psi} = \frac{1}{2} \text{Hg} )</td>
<td>AREA = ( \pi (d/4)^2 ) or AREA = ( \pi r^2 )</td>
</tr>
</tbody>
</table>

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.

3 Vacuum Level Ranges:
- “L” or “F” Series \( 0-10''\text{Hg}, [0 to 339mbar] \) for low vacuum / high flow applications
- “M” or “D” Series \( 0-20''\text{Hg}, [0 to 677mbar] \) for medium vacuum / high flow applications
- “H” or “S” Series \( 0-28''\text{Hg}, [0 to 948mbar] \) 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

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### Application #1

**Evacuate Vacuum Cup 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
   \[ \frac{\pi d^2}{4} \times L = \frac{\pi (0.375)^2}{4} \times 36" = 3.976 \text{ cu. in.} \]

2. Convert cu. in. to cu. ft – divide by 1728
   3.976 / 1728 = 0.0023 cu. ft. (volume of tubing)
3. Go to Evacuation Time chart – find desired vacuum level.
   28"Hg = 790.80 seconds per cu. ft.
4. Multiply cu. ft. (0.0023 x 790.80) = 1.82 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])
3. To find required time, start with smallest pump first.
   (Assumption: Evacuation Time - 5 minutes or less.)
   Model # 60H = (2.0023 x 790.80) / 60 = 26.39 min. - over 5 minutes
   Model # 150H = (2.0023 x 125) / 60 = 4.17 min - 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.

---

### Performance Data

<table>
<thead>
<tr>
<th>Model#</th>
<th>Evacuation Time in Seconds Based on 1 Cu. Ft. Volume /&quot;Hg&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0&quot;Hg</td>
</tr>
<tr>
<td>60H</td>
<td>0.00</td>
</tr>
<tr>
<td>150H</td>
<td>0.00</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Model#</th>
<th>Evacuation Time in Seconds Based on 1 Liter Volume/mbar</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0 mbar</td>
</tr>
<tr>
<td>60H</td>
<td>0.0</td>
</tr>
<tr>
<td>150H</td>
<td>0.0</td>
</tr>
</tbody>
</table>

For additional Performance Data see pages 1.20-25
**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)

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**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/Elevation:**
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, Eductors:**
All of these are different names for air powered vacuum pumps.

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**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

<table>
<thead>
<tr>
<th>% Vacuum</th>
<th>“Hg</th>
<th>mmHg</th>
<th>bar</th>
<th>PSI</th>
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</thead>
<tbody>
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<tr>
<td>100</td>
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<td>769.23</td>
<td>-1.0</td>
<td>-14.70</td>
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</tbody>
</table>

**Conversion Chart – Vacuum vs. Pressure**

**Vacuum vs. Elevation:** Vacuum Level = The magnitude of suction created by the vacuum pump. Vacuum level is affected by elevation and barometric pressure. For each 1,000 feet of elevation, the vacuum level that the pump can achieve decreases by approximately 1”Hg (33.9mbar).

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**Product Warranty**

Vaccon Company warrants that its products are free from defects in workmanship and material under normal conditions and usage for a period of three (3) years. Your exclusive remedy in the event of such a defect is to return the product to our factory for repair, replacement or refund, and be clearly identified by the Vaccon Return Material Authorization Number.

This Warranty does not cover products which have been subject to misuse, negligence, accidents, misapplications or tampering in a way so as to affect their normal performance. Vaccon shall not be liable for special, indirect or consequential damages, labor or delays incidental hereto. Vaccon gives no other warranty, express or implied, as to merchantability, fitness for particular purpose as sold, description, quality or any other matter beyond that specified above. Vaccon does not assume, nor authorize anyone else to assume for it, any other obligation or liability in connection with the sale or use of its products.

Product enhancements resulting from our continuing quality improvement effort may necessitate changes in specifications without notice.

**Electronic Products (Switches, Sensors, Solenoid Valves)**

Vaccon Company warrants that its electronic products are free from defects in workmanship and materials for a period of 90 days after invoice. The company makes no other warranty, expressed or implied, and will not assume any liability for damages, labor or delays incidental hereto.

**NOTE:** Vaccon electronic products are not intended for life support systems.

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