HOW TO SELECT & SIZE YOUR PUMP

Air-Vac designs and manufactures a broad range of both Single Stage and Multistage air operated vacuum pumps because one style of pump is not always suited for every application.

With a wide variety of choices...

- **TD or AV Configurations**
- **Single Stage or Multistage**
- **High, Medium or Low Vacuum Levels**
- **Sometimes more than one style of pump can do the job.**

...selecting the *right* pump for your application can be confusing.

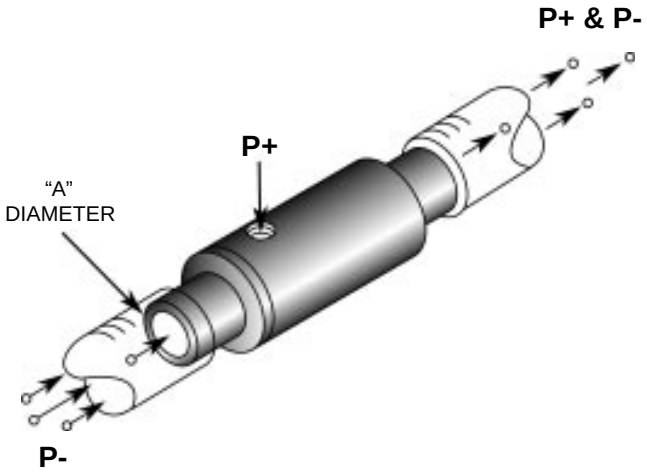
Vacuum applications generally fall into three broad categories:

Vacuum Transfer

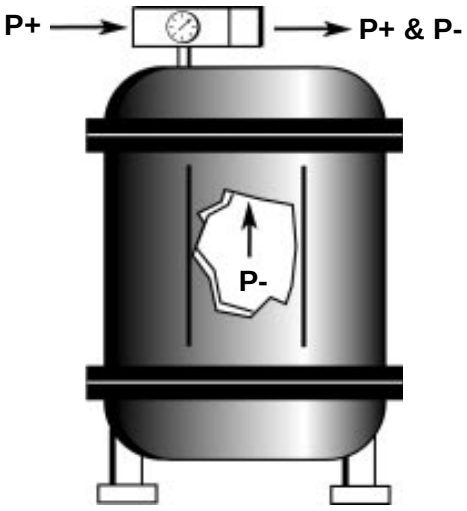
Vacuum is used to transfer solid materials by entraining them in the vacuum flow stream and conveying them through tubing or piping from one location to another. For these applications, a Single Stage TD or TDRH Series pump is required, pages 12 thru 15. Since the solid material passes directly through the pump, select one with a large enough throat diameter, "A" diameter.

Next consider the weight of the material to be conveyed. A light material may require an "L" version of the pump producing a low vacuum level while heavier materials may require an "M" or "H" version producing a medium or high vacuum level.

Finally consider the transfer rate and select a pump with the appropriate vacuum flow characteristics.



Evacuation



Selecting a pump to remove air (or other gases) from a process vessel, chamber, tank, or some other closed system requires information about the volume of the system, the desired level of vacuum, and time allowed to reach the desired level of vacuum.

Select a pump which produces the required vacuum level:

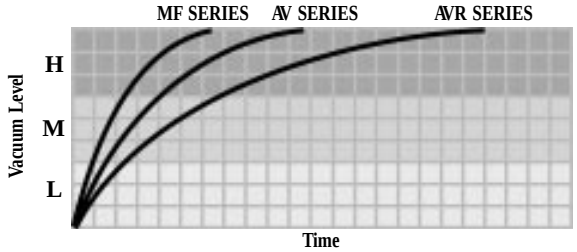
- "H" Version.....21-28"Hg
- "M" Version.....12-20"Hg
- "L" Version.....5-11"Hg

} *See listing of pumps by Vacuum Level, pages 6 and 7.*

To generate a vacuum level greater than 29"Hg, see UV143H on page 21.

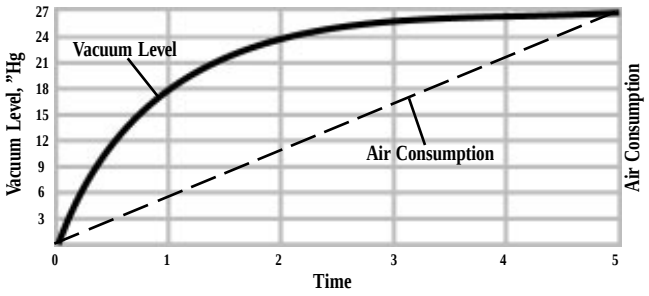
Select a pump which can evacuate the system within the time allowed. Evacuation times for each pump are given on the data sheets. Generally, MF Series pumps evacuate a volume the fastest, followed by the AV Series and AVR Series.
For small volumes, consider the AVR Series, page 8. For medium sized volumes where evacuation times are not critical, consider AV Series, pages 9-11 or MFP Series, page 16. For larger volumes requiring rapid evacuation to high vacuum levels, see the MF Series, page 17.

Characteristic evacuation curves for each series.



Material Handling Applications

A vacuum pump can be used with a suction cup to lift a part or hold down a part as a vacuum chuck. The size and weight of the part, the condition of its surface, the total volume of tubing to evacuate, and the cycle rate of the process are important considerations. Generally, material handling applications operate at a Vacuum Level of between 12 to 18"Hg because this range produces ample Holding Force, requires less energy (Air Consumption), and can be generated much faster than higher Vacuum Levels.



Note the slope of the curve as the pump quickly generates usable vacuum (12-18"Hg). The curve then flattens out requiring more time and more compressed air to reach 27"Hg.

HOLDING FORCE

Since *Force is the product of Pressure times Area*, maximizing the Holding Force can be achieved by increasing Vacuum Level or by selecting a cup with a Larger Area.

EXAMPLE 1 - Maximize Holding Force by increasing Vacuum Level. At a Vacuum Level of 18"Hg, a suction cup with a 1" diameter ideally produces a Holding Force of 6.9 lb. The same cup at a Vacuum Level of 27"Hg produces 10.4 lb. of Holding Force. Increasing the Vacuum Level increases the Holding Force but with a substantial increase in Air Consumption, resulting in higher operating costs.

EXAMPLE 2 - Maximize Holding Force by increasing Cup Diameter. At 18"Hg, a 1" diameter cup produces a Holding Force of 6.9 lb. A 2-1/2" diameter cup operating at the same Vacuum Level produces a Holding Force of 43 lb. The larger cup increases the Holding Force over 6 times without any increase in Air Consumption.

LET'S DO THE MATH:

$A = \pi r^2$

Area of 1" diameter cup: $A_1 = (3.14)(.5)^2 = 0.785$ in^2

Area of 2-1/2" diameter cup: $A_2 = (3.14)(1.25)^2 = 4.91$ in^2

p = Equivalent Pressure = Vac. Level x Conversion Factor

$p_1 = 18$"Hg (14.7 lb/in^2 /29.92"Hg) = 8.84 lb/in^2

$p_2 = 27$"Hg (14.7 lb/in^2 /29.92"Hg) = 13.27 lb/in^2

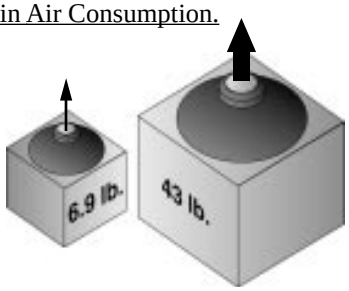
$F = p \times A$

$F_1 = p_1 \times A_1 = (8.84 \text{ lb/in}^2)(0.785 \text{ in}^2) = 6.9$ lb

$F_2 = p_2 \times A_1 = (13.27 \text{ lb/in}^2)(0.785 \text{ in}^2) = 10.4$ lb

$F_3 = p_1 \times A_2 = (8.84 \text{ lb/in}^2)(4.91 \text{ in}^2) = 43.4$ lb

A vacuum pump operating at 18"Hg can lift a 6.9 lb. weight using a 1" diameter cup or a 43 lb. weight using a 2-1/2" diameter cup.



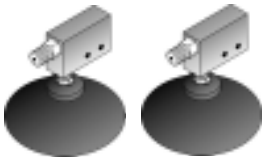
CONCLUSION - For speed of response and economy of operation, increased Holding Force should be achieved by increasing the size of the cup rather than by increasing the Vacuum Level.

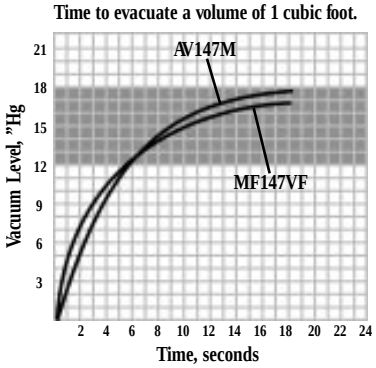
CYCLE TIME

In systems where multiple cups are connected to a single large vacuum pump, the volume of the cups and interconnecting tubing must be considered in order to select a pump that will be able to respond to the time requirements of the system.

The chart to the right shows that an economical **Single Stage** pump can perform as well as a more expensive **Multistage** pump in quickly generating usable levels of vacuum (12-18"Hg). Both pumps use the same amount of compressed air.

To provide instantaneous response, many times cups are mounted directly to individual small pumps.





AIR LEAKAGE

Textured, rough, or uneven surfaces allow leakage of ambient air around the cup and into the system and porosity allows leakage through the product itself. In both cases, *vacuum flow* must be considered. Vacuum flow is a measure of a pump's ability to overcome the effects of leakage while maintaining acceptable vacuum levels. Vacuum flow rates for each pump are given on data sheets. For applications where leakage is a concern, see MFP Series, page 16 or MF Series, page 17. Listings of all vacuum flow rates are on pages 6 and 7. Detailed specifications for each pump are shown on data sheets, pages 8 thru 23.

To insure you get the right pump for your application, Air-Vac offers a 30 day evaluation of any pump in this catalog.