What Rate Can I Move Liquid With a Triton Vacuum?

Triton® White Paper

A common question we face is what rates a user might expect from our systems. This whitepaper addresses that issue for liquids – water, slurries, sludges – that rely on the vacuum level to pull a "solid column" through the hose. Solid *products* – sand, abrasive media, grain – do not rely on vacuum, per se, but rather on creating a high airflow that carries the solid along with it. Those products will be addressed in a separate whitepaper. Here we are talking about liquids.

A vacuum machine is typically defined by its suction (as expressed most commonly as inches of mercury, or "Hg) and its airflow (as expressed in the US as cubic feet per minute, or cfm). When a "solid column" of liquid is pulled through the hose, the airflow is not important….the system is under vacuum….while the "Hg becomes the dominant factor in determining flow rates for a given system.

The size of the hose used, the smoothness of its bore, the straightness of its runs all affect rate. Triton can recommend the appropriate hose and setup for your application. See our whitepaper "Effective Use of Triton Vacuum Systems" for more information. Today's whitepaper addresses what can be expected from a defined setup, using water.

The flow properties of water are well understood. Firefighters have made a science of its flow to help them determine the best layout of hose. To make things simple, we are going to look at a table that shows, for a given suction in "Hg, what rate water will flow through 100' feet of a straight 4" diameter hose, or alternatively, how high that water can be lifted under vacuum. (Because of the laws of physics, a solid column of water cannot be lifted much more than about 30 feet….the atmospheric pressure which is "pushing" the water through the line is balanced by the weight of the water column, leaving no driving force upward. However, it is possible to make lifts up to ~100 feet through the introduction of air – meaning you no longer have a "solid column" of water. Triton can provide more information on how to accomplish that.)

"Hg	Flow per 100' of Straight 4" Hose	Vertical Lift in Feet
5"	324 gpm	5'
9"	445 gpm	10'
15"	587 gpm	17'
18"	648 gpm	20'
26"	790 gpm	29.4'

5514 Airline Highway | P O Box 144 | Lottie LA 70756 | T 225.637.3700 | F 225.637.3412 | info@triton-industries.com | www.triton-industries.com

Let's look at a vacuum that puts up 26" Hg. The T1500 and our other liquid ring vacuum systems put up 26" Hg or more. At 26", the machine can pull 790 gallons per minute of water through a straight 4" hose, or alternatively it can lift a solid column of water 29.4 feet….or some combination therein.

Now let's assume that you have to lift that solid column of water 10 feet. Looking at the table, you can see that it requires 9" of vacuum to make that lift. Subtracting that 9" from the 26" that you have available leaves 17" of vacuum to use for flow. We don't show 17" on the table, but you can estimate that its going to be in the range of 625 gpm. So, if you have 5000 gallons of water that you need to lift 10' and flow through 100' of a 4" hose, it will flow at ~625 gallons per minute, and thus require ~8 minutes to do it.

This table assumes a 100' hose. If it is a shorter hose, there will be less friction, and the rates will be higher. If it is a longer hose, there will be more friction, and the rates will be lower. Another 100' section might reduce rates on the order of 30%.

Also, this table assumes a 4" hose. A smaller diameter hose has more friction than a larger hose.

Finally, this table assumes water. The product you are trying to use may be heavier than water, which means it takes more force to lift the column, and there will be higher friction losses. To give an idea, here are the lifts that can be expected at 26" Hg for products of various densities. Note that the value for water is the same as given in the previous table.

	Vertical Lift in Feet of Solid Column Lift at 26" Hg			
Product	Water	Slurry	Sludge	Sludge
Density	8.3 lbs/gal	9 lbs/gal	11 lbs/gal	14 lbs/gal
Vertical Lift	29.4	27.4	22.4	15.6

You can see that a heavier product can make quite a bit of difference in terms of lift. The vertical lift is the most challenging part of the job, and can be helped by introducing air into the inlet.
Please contact Triton for more information.