*Triton® White Paper*

# Using Triton Vacuums for Evacuating Air from a Pipeline or Vacuum-Tight Box

It is sometimes desired to know how long it takes to empty the air out of a vacuum-tight container, such as a pipeline, a vacuum box, etc. The length of time depends on a few factors: how large (the cubic volume) of the pipe, vessel, or container; how low of a vacuum you want to achieve; and how big the pump that is evacuating the vessel. In general, though, the amount of time is very short, vs if the container was filled with a liquid.

In this whitepaper, we'll use our mid-sized Triton 1500 as an example, evacuating a fairly large line – 24" diameter and 1500 feet long, and that we want to pull it down to 15" Hg. We can use a "vacuum evacuation time calculator" available online at: http://www.engineeringtoolbox.com/vacuum-evacuation-time-d_844.html. In our example, the answer comes out to 131 seconds, or a little over two minutes. Pulling down to 24" Hg would theoretically take 303 seconds, or 5 minutes.

Here's how this calculation was done. It's fairly straightforward, as long as you make sure you get the units correct, such as cubic feet per second. Using our example, we would first calculate the volume of the pipe, using the formula $\pi r^2 h$, where $\pi$ is a constant (3.1416), $r^2$ = the square of the radius (half of the diameter, or 12", time itself, so 144 inches), and $h$ is the length of the pipe in inches (1,500 feet x 12 inches per foot = 18,000 inches). The result is in cubic inches, and comes out to 8,143,027 cubic inches. We need the units to be cubic feet. There are 1728 cubic inches in a cubic foot. So, doing the math: 3.1416 x 144 x 18,000 ÷ 1,728 = 4712 cubic feet. That number goes in the first box, Enclosed Volume (V).

The second box is Volume Flow Rate Capacity (Q). The flow rate depends on which Triton vacuum is used. Our Triton 1500 system achieves approximately 1500 cfm (cubic feet per minute) at 15" Hg. The box asks for cubic feet per second, so we divide by 60 seconds in a minute to get the answer 25 cubic feet per second.

The third box is Initial Pressure ($P_0$). Since we are starting with atmospheric pressure, that number will always be 1000 mbar (assumes we're at sea level).

The fourth and final box is Final Pressure ($P_1$). If we want to achieve 15” Hg for our test, that’s equivalent to ~500 mbar.

Plugging those 4 numbers in results in 131 seconds.

What if you are using a vacuum box? To determine the volume of a rectangle, multiply length x width x height (l x w x h, in inches) and divide by 1,728 cubic inches in a cubic foot. Or just take the cubic yardage of the box (in this case, it may be a standard 25 yard box) and multiply by 27 (the number of cubic feet in a cubic yard). In that case, the number we should plug into calculation box #1 is 675 cubic feet.

Let’s assume you are using a 24” Hg. For purposes of calculation box #4, that’s 200 mbar. The amount of time to remove the air to that level of vacuum comes out to 44 seconds. Remember, that’s just the box, and doesn’t count any lines attached to it.

It’s hard to be exact in the “real world”, but this math should give you some idea of what evacuation times you can expect. It has also been pointed out that this calculator isn’t completely correct, that you should follow the natural log equation to get a more accurate answer (the equation sometimes comes up with twice as long as the answer the calculator gives*). But even if you quadruple the time, you’re talking 4 minutes or so, not a terribly long time. (and using the calculator means no fooling with natural logs and complicated equations).

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*02/15/13*

** using the pipeline examples, the equation yields 271 seconds vs the 131 seconds the online calculator gives.*

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