SMC Expert Article – Vacuum

Don’t get sucked into poor vacuum system configuration

By Tom Litster, Engineer, Air Equipment, SMC European Technical Centre

The performance of your vacuum handling system is typically only as good as its configuration for the specific application in hand. This of course makes direct reference to the workpiece you are looking to lift or transfer in terms of its weight and shape, for example, while further considerations include target cycle time and stroke travel. Upon establishing these factors it becomes possible to experiment with vacuum level, pad diameter and number of pads to deliver the optimal-performing vacuum handling system, one that is fast, reliable and energy-efficient.

Get smart with parts

Becoming fully acquainted with the workpiece should always be your starting point for any project involving a vacuum handling system. For example, how much does your component weigh, and what is the shape, texture and temperature of its surface?

SMC´s ZP3P-JT Series - For the adsorption transfer of workpieces with flexible soft film packaging

SMC´s ZNC Series - For the adsorption transfer of thin cloths, films, printed circuit boards, etc.

SMC´s ZP3C Series - For the adsorption transfer of corrugated cardboard, etc., requiring high abrasion resistance, in applications such as pick & place and packaging

Process factors are also influential. For instance, what speed per unit of time is required for the completion of your cycle? And what stroke travel and conveying distances are involved for workpiece handling?

All systems go

System design can commence at this point, although determining the optimal operating parameters will take some trial and error as part of process development.

First of all, pay close attention to your vacuum level, as when this increases, so does energy consumption. It’s worth explaining that vacuum level is the difference between atmospheric pressure and pressure in the evacuated system. Typical atmospheric pressure is 101.4 kPa (0% vacuum), so 50% vacuum is 50.7 kPa (or 5.07 N/cm^2). The perfect vacuum will offer a force of 10.14 N/cm2, but vacuum levels in handling systems are always lower.

Extra padding?

Some engineers make the mistake of increasing supply pressure to achieve a higher holding force, but this leads to more energy consumption and more cost. Instead, it may be possible to increase the diameter of the vacuum pads in certain applications. When doubling the diameter of your pads, the lifting force quadruples, while energy costs remain the same as there is no increase in supply pressure. The price difference between a 20 mm and 40 mm diameter vacuum pad is typically less than €5.

Adjusting the number of pads might also be an option to reduce total cost of ownership (TCO). However, in all cases, the best solution for those looking to maximise energy efficiency and drive down costs is to use simulation software, calculation tables and SMC's extensive experience in vacuum handling applications.

Safety in numbers

Most players in the market will apply a safety factor of 2 for horizontal vacuum handling systems and 4 for vertical ones. Other times they will consider applying a force twice that of the one required, to try and compensate for leakage risks, among other things. However, there is no substitute for experience. Here at SMC, our know-how and expertise built up over many decades informs us that higher safety factors are required to ensure your vacuum system remains reliable under any circumstances. For this reason we apply a safety factor of 4 in horizontal applications and 8 in vertical ones.

Ultimately, only through calculation of the right system configuration will the optimal outcome result: a safe, reliable, high-performing, energy-efficient vacuum handling system that delivers low TCO.

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