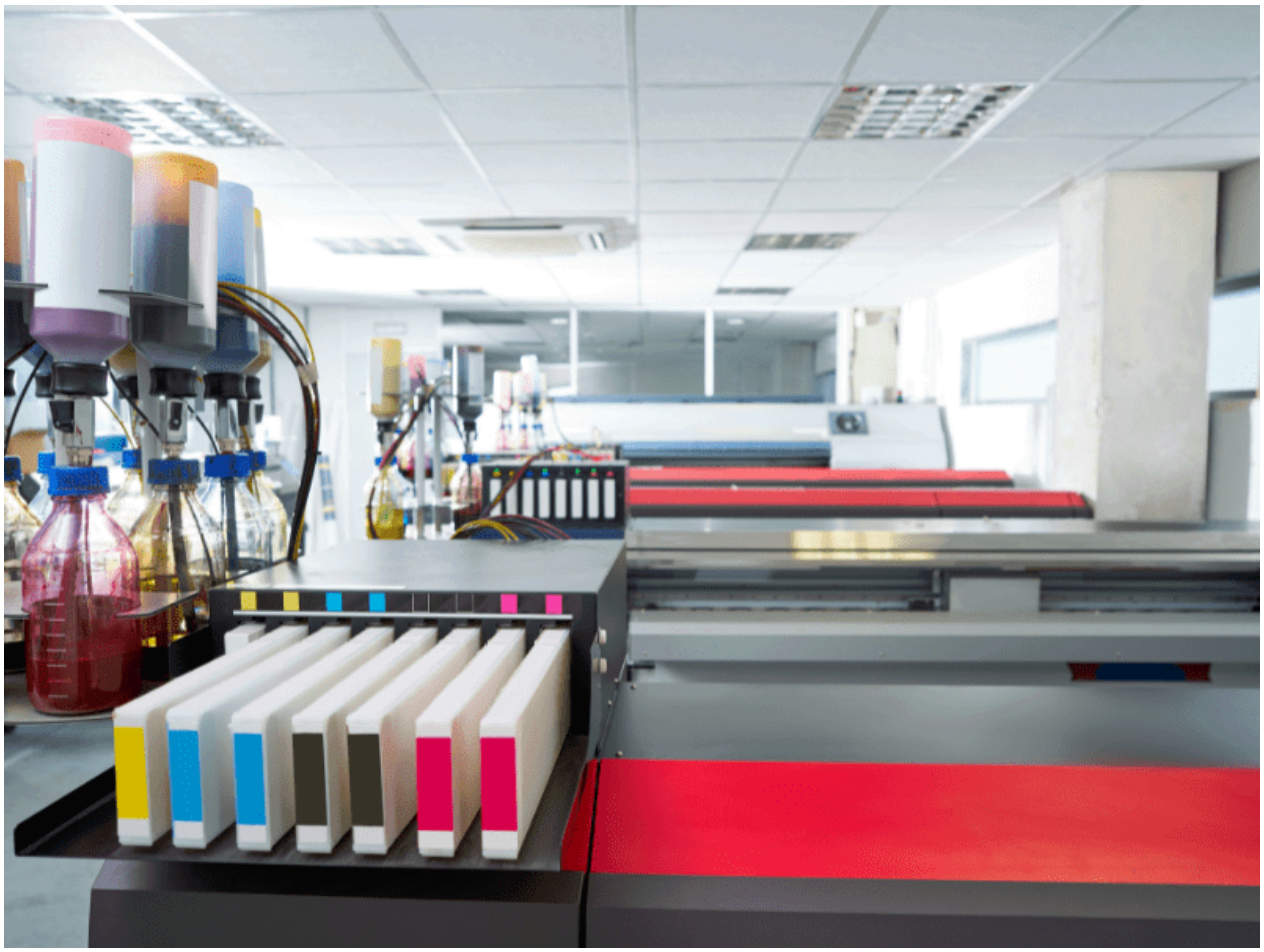
# Application Case Study: Vacuum Limit Controls in Digital Screen Printing



Not long ago, we had only a vague idea of what the phrase ‘screen printing’ meant.  We had a rough mental image of t-shirts and golf umbrellas printed with artistic company logos, but it was not until a recent project that we found out what industrial screen printing was all about first-hand.  For this project, a new client introduced themselves as a manufacturer of advanced textile screen printing equipment and asked for help solving a print quality concern they kept running into.  As the client explained, the issue involved vacuum control and required a sensing

solution to save them from the unexpected downtime and wasted prints their end-users were experiencing. At that, we knew we could help figure out a plan of attack and jumped into action.

**About Us**

As a veteran-owned small business, Whitman Controls is dedicated to supplying premium quality, reliable, technologically advanced instrumentation for use in nearly any application. Our Bristol, CT manufacturing facility embodies over 40 years of engineering, fabrication, and customer service expertise, serving both end-user and manufacturing customers nationwide through direct and distribution channels.

**Application Summary**

Traditional screen printing is an artistic textile printing technique that uses mesh stencils to pass a pattern of ink onto a solid substrate. Most commonly, screen printing is used to print colorful designs and logos on clothing, posters, signage, packaging materials, and promotional products. Many materials, such as fabric, wood, metal, plastic, glass, and ceramic are all viable choices for screen printing, which is one of the key reasons that it remains such a popular industrial imaging solution. As with so many artisan crafts, this centuries-old process holds onto its relevancy by incorporating digital technologies into its fold, today offering a wide range of automated functionality that perfectly blends craftsmanship and technical precision.

**Challenge**

To kick off the project, our client introduced us to their lineup of advanced printing equipment, including computer-to-screen (CTS) printers, direct-to-mesh printers, exposure enclosures, and imagesetters, all of which featured highly automated positioning, motion, and printing controls. Each package was clearly industrial scale, capable of producing hundreds of screens per day, around the clock. In fact, our client's goal for their entire catalog was to provide higher print quality in shorter print durations over longer continuous run cycles than their competitors – an inspiring goal, and one that resonates well with our own mission. It was in discussing this shared vision that our client brought us to their core objective: they needed a solution to control vacuum levels in their CTS printers' ink delivery systems. Knowing that Whitman produces vacuum sensors specifically engineered for Original Equipment Manufacturers (OEMs) like themselves, our client was keen to see what we'd recommend.

To better understand the application, we penciled out our client's specific concerns around vacuum controls:

- Each CTS printing system includes a vacuum pump that generates vacuum needed to execute printing functions.
- Stable vacuum levels are very important to accurate screen printing, serving the purposes of physically holding screens in place during printing, as well as combating wax ink head weeping.
- Wax ink head control is mission-critical in these systems. Liquid ink is primed up to the printhead nozzles and held flush with the nozzle ends between print passes by an extremely precise level of vacuum pulled on the ink circuit.
- If this level of vacuum is too high, the surface tension at the upper nozzles' outlets will break and lead to entrained air in the printhead, causing gaps and stutters in the print.
- If this level of vacuum is too low, the lower nozzles will freely weep out ink under the force of gravity, leading to bleed-over and smudging in the print.
- While we could see that vacuum controls needed to be applied within a tight bandwidth, vacuum settings could not be set identically across all machines – that is to say, users still needed adjustability for both upper and lower vacuum limits to accommodate different wax properties, geographical elevations, temperatures, and other variables.

***"Ink head issues can be one of the most inconvenient problems a print shop runs into with our digital printers. They take a while to figure out, and sometimes don't get spotted until screens are already being pressed. This is why we have to avoid ink head issues entirely, and the only way we can do that is with a vacuum sensor that cuts off printing if vacuum gets out of range".***
**-** Lead Service Technician, Confidential Digital Screen Printing System Manufacturer

**Solution**

After chewing on the above application concerns, we arrived at a few immediate conclusions. First, analog vacuum measurement would allow one transmitter and PID loop to control the entire vacuum range, but this would be costly to implement over the top of the system's existing PCB and relay control platform. Second, the print shops in which these systems are installed are not typically supported by internal automation engineers or technicians, so any unnecessary complexity added to the system would fall to the client's remote customer service staff to

support. Between these two conclusions, we knew that we needed to proceed in the direction of simple point vacuum control, as follows:

- Provide (2) discrete vacuum switches, one each set to monitor high and low vacuum setpoints.
- These setpoints would be determined during each machine's installation and physically set using each sensor's field-adjustable setpoint collar.
- The span between these setpoints would be set wide enough to allow for slight drift and deadband in the vacuum pump's performance.
- Each sensor would be wired in series using its normally closed contacts and run back to an alarm input contact on the PCB.
- If either the high or low vacuum setpoint were to trip, the respective sensor would open its contacts, breaking the alarm circuit and causing the system to enter an alarm-idle state.

The control scheme decided, all we had left to do was to pick a capable sensor. We recommended the Whitman's P117V Stainless Steel Vacuum Switch, based on the following features:

- Compact, Ultra-Dependable Instrument
- Highly Versatile Design Specifically Engineered for OEM Applications
- Always In-Stock Model, Intended for Same-Day Shipping
- Setpoint Range 1.6 to 28.2 InHg
- Max System Pressure up to 150% of Sensor Capacity
- Wide Temperature Range -65°F to 225°F
- SPDT / SPST, 5 Amp Max Switch
- Low Weight of 3.0 oz (varies slightly with electrical interface selection)
- 17-7 PH Stainless Steel Capsule
- 303 Stainless Steel Body and Fitting
- Loctite #271 Seal
- Standard Fitting 1/8-27 MNPT

**Results**

After installing and testing Whitman's P117V vacuum switches in a demo screen printing rig, our client concluded that this solution was the way to go. During extensive rounds of testing, these vacuum switches halted the system any time the vacuum fell out of range with 100% success, which is a testament to the P117V's high repeatability. Once all technical requirements were validated, our client proceeded to standardize their systems using our vacuum switch solution for all new system builds. We thoroughly appreciated our client's creative spirit and uncompromising commitment to finished product quality during this project, and we welcome more opportunities to dabble in projects where art and process automation combine!

**Data Bullets**

- **100%** decrease in print head issues caused by undetected vacuum problems
- **7%** increase in screen room productivity was achieved by avoiding undetected vacuum faults
- **1** day's lead time on in-stock OEM sensor models
- **3** test t-shirts printed with Whitman's "Have It Your Way" slogan

Here at Whitman Controls, our values drive us to provide the highest level of servant partnership that you can find.
To discuss your applications or to learn more about our capabilities, please contact us at (800) 233-4401 via email at info@whitmancontrols.com, or online at www.whitmancontrols.com.