



DESIGNING INNOVATIVE VACUUM
GAUGES AND CONTROLLERS FOR
OVER 30 YEARS

CUSTOMIZATION OVERVIEW / FOOD & BEVERAGE PROCESS CONTROL—PIEZOTORR MANOMETER

PROBLEM STATEMENT: Our customer needed to automate their food and beverage process to remove oxygen (O_2) by evacuating then bleeding in Nitrogen over several cycles. Oxygen is an oxidizer, which can affect the taste of some foods or beverages. They were currently manually completing this process, which was time consuming and led to measurements being inconsistent. The customer wanted to speed up the process by automating it.

Current: Manually removing O_2 from food & beverage process

Need: Food & Beverage Process Automation

Goal: Remove O_2 to avoid oxidation by evacuating then bleeding in nitrogen over several cycles

ENGINEERING APPROACH: To assist this customer with automating their process, the DigiVac Engineering team modified the current PiezoTorr Manometer with 2 control set-point relay controls, modified the code to make adjustable hysteresis, and implemented an adjustable time function with a start button. These allowed for choosing a custom set-point to start the oxygen removal process by evacuating, then bleeding in nitrogen; the 2nd relay could be set to a time duration that each cycle would last.



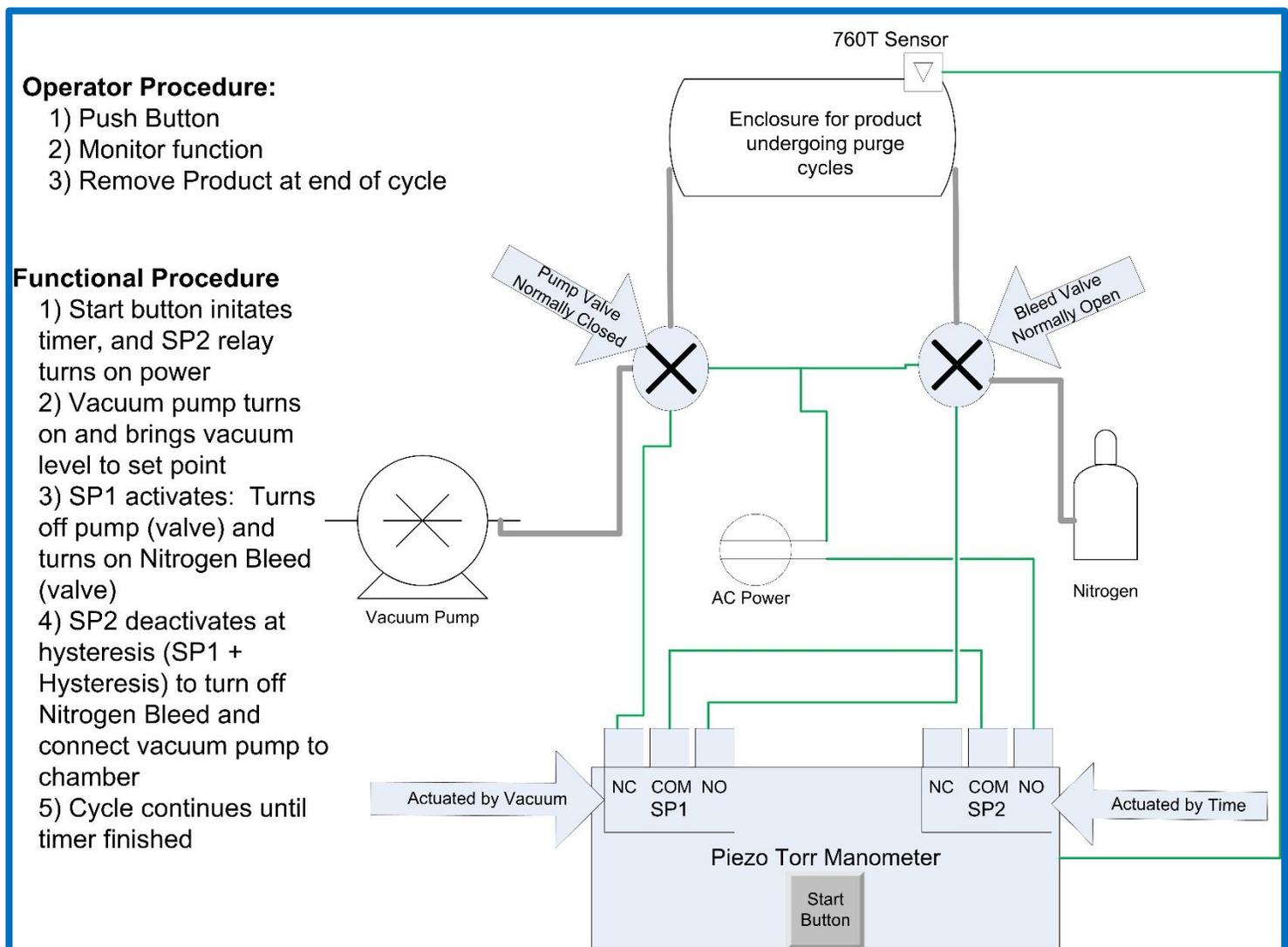
PiezoTorr Manometer | Measures from 1 Torr up to 760 Torr, similar to a 1000 Torr capacitance manometer and controller assembly. It is available in Torr or mbar.

Automation Process with Customized PiezoTorr Manometer

- 1st Relay Set-Point: Determined how deep to evacuate the chamber
- The hysteresis determined up to what vacuum pressure to back-fill nitrogen into the system
- 2nd Relay Set-Point: The time determined how many Evacuate-Back-Fill Cycles were required to achieve the desired O₂ level
- The amount of cycle time required was determined empirically by the customer

**New Automated
Process Solution**

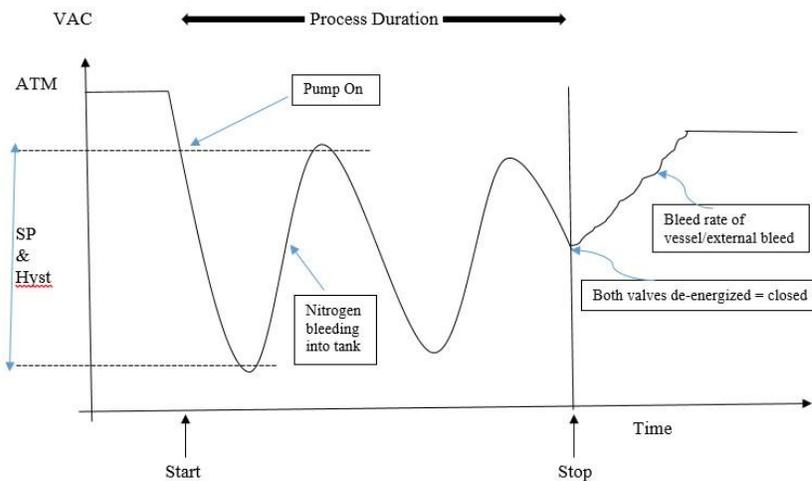
Customized RAMP Vacuum Instrument Solution: Vacuum – Purge Cycle Example



RESULTS: The customized PiezoTorr Manometer [an extremely accurate Torr manometer (+/- 2 Torr) that leverages a gas-independent fast-response transducer], was successful in automating our customer's food and beverage process.

The addition of 2 relays, hysteresis code, and adjustable time function reliably executed their need to have an automated process that removed O₂ and avoided oxidation which could have changed the taste of their product.

- Set-Point 1 is a one set-point relay that is adjustable with a potentiometer
- The software enhancement allows the user to set the hysteresis of Set-Point 1 on boot-up
- Set-Point 2 (the other potentiometer) sets the time and duration of the process. When the button is pressed, the process starts (Set-Point 2 is active). Once the Set Point has been reached, then Set-Point 2 will be deactivated



WHAT IS HYSTERESIS?

The scientific definition of hysteresis (hī's-tə-rē'sīs) is the dependence of the state of a system on the history of its state.

One example could be: A system has a relay with a 24VDC coil with a variable power supply hooked to the coil. A process slowly starts raising the voltage from zero. At some point there will be enough voltage to activate the relay, for this example we will say around 21 volts. Continue raising the voltage to 24 volts.

If you slowly start decreasing the voltage, the relay will not drop out at 21 volts, but will stay actuated until some lower voltage is reached, for example 18 volts.

The relay has hysteresis. If there are 20 volts on the coil the relay could be on or it could be off, the state is going to depend on its history.

Often we build in hysteresis. For example, say you want an alarm to sound when vacuum pressure reaches 80%. It could be distracting for the alarm to sound repeatedly if the level were bouncing between 79.9 and 80.1. Instead, we would activate the alarm at 80% and program the alarm to recover at some lower level, say 78%.

<http://www.merriam-webster.com/dictionary/hysteresis>



SUMMARY

- The food/beverage process was **successfully automated** by modifying our readily available PiezoTorr Manometer. The resulting product was less expensive for the customer and allowed for a quick turn-around
- The **PiezoTorr Manometer** is an extremely accurate Torr manometer (+/- 2 Torr) that leverages a gas-independent fast-response transducer
 - Piezo-Resistive technology yields milli-second response and accuracy for clean dry air
 - Often used as an alternative to capacitance manometers
 - Highly accurate pressure sensor replacement for strain gauge
 - Every PiezoTorr Manometer is calibrated under actual vacuum against a NIST standard
- The **DigiVac Design Advantage** delivers a wealth of vacuum engineering knowledge at your disposal to develop innovative products that meet your specific needs in a cost effective manner. Contact us to see how we can meet your vacuum needs at <http://www.digivac.com/contact-us/>.