

Instrumentation and Monitoring for Vacuum Systems

Emma Larrabee and Todd Dunn
Zorn Compressor & Equipment
Keynote Speakers

The recording and slides of this webinar will be made available to attendees via email later today.

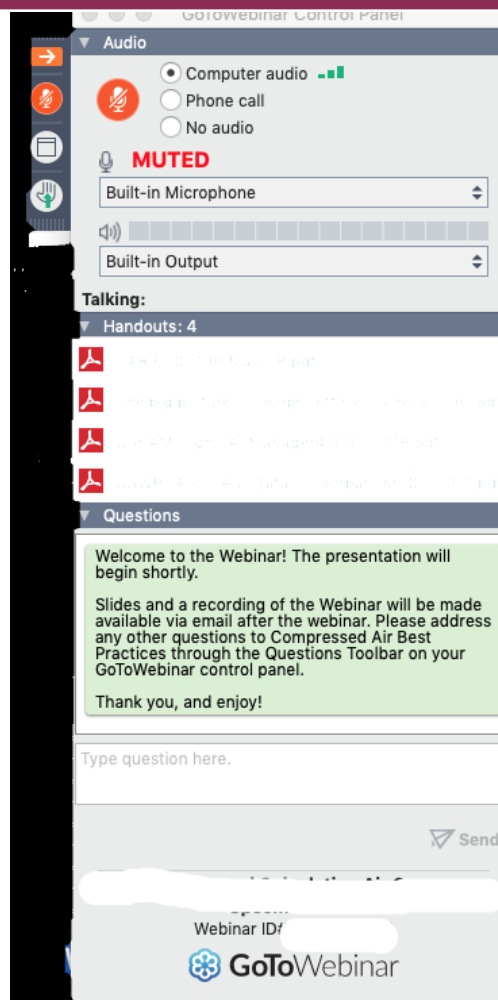
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Q&A Format



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Vacuum Pumps Series

Quincy Compressor is your headquarters for high-quality, reliable vacuum pumps that are the product of over 100 years of unrivaled industry expertise. Quincy vacuum pumps are used by companies across the United States and around the world due to their unsurpassed reliability and unbeatable performance. They're also backed by superior 24-hour service and support from our extensive worldwide distributor network.

There are various Quincy vacuum pump models to choose from, ensuring you'll be able to find the right one for your applications. Quincy has a vacuum pump portfolio that covers the needs of most industrial vacuum applications: Whether low or high flowrate, low tech or sophisticated controls, standard "off the shelf" or specially configured Quincy has the right product for you.

QSV – Oil Sealed Rotary Screw

Oil sealed rotary screw pumps offer a wide range of pumping speed and excellent turn-down efficiencies. The on-board VSD makes the QSV pump a "plug and play" solution for vacuum level control.

SPECIFICATIONS
281 - 3023 ACFM, 7.5 - 125 HP, 59 - 76 dB(A)

- ✓ Inlet Filter
- ✓ Multiple cooling options
- ✓ Many Fieldbus protocols supported

ECOnrol 3.0 – Multi-Pump Control Panel

This control panel makes creating a central vacuum system from existing variable speed pumps easy, while also balancing run hours and optimizing energy savings.

- ✓ 10" HMI
- ✓ Easy connection to network
- ✓ Many Fieldbus protocols supported

QV – Oil Sealed Rotary Vane

Rotary vane pumps are perhaps the most well-known vacuum pump technology. Low noise, compact size and easy maintenance make rotary vane pumps a versatile vacuum solution for many different applications.

SPECIFICATIONS
17 - 200 ACFM, 1.2 - 8.8 HP, 59 - 76 dB(A)

- ✓ Integral non-return valve
- ✓ Exhaust Filter removes 99% of entrained oil
- ✓ Direct Driven (no belts)
- ✓ Air-Cooled (no water)


QCV – Dry Running Rotary Claw

Rotary claw pumps offer oil-free pumping, making them a great choice for point of use applications involving humidity.

SPECIFICATIONS
46 - 170 ACFM, 3 - 30 HP, 75 - 85 dB(A)


- ✓ Integral non-return valve
- ✓ Direct Driven (no belts)
- ✓ Air-Cooled (no water)

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ECOnrol 3.0

ECOnrol 3.0 Multi-Pump Vacuum Controller



ECOnrol 3.0 is Quincy's multi-vacuum pump system controller. As the central brain for your entire vacuum system, the ECOnrol 3.0 comes equipped with all the functionalities and connectivity needed for optimal operation. It leverages the powerful capabilities of Air Logic 3, Quincy's vacuum pump controller, to deliver precise set-point control and continuous efficiency monitoring. By connecting two or more Quincy vacuum pumps via ECOnrol, you will optimize your operations while saving on energy and maintenance costs, and gain control of your vacuum system from anywhere in your facility.

Product Description

- ✓ Wall mounted panel with 10" HMI
- ✓ Integrate and control the Quincy VFD driven vacuum pumps in your system
- ✓ Connect up to 7 pumps standard, or up to 20 pumps with additional software
- ✓ Can connect to your facility's network via LAN cables or Wi-Fi
- ✓ Sequencing software options to save energy and extend maintenance intervals

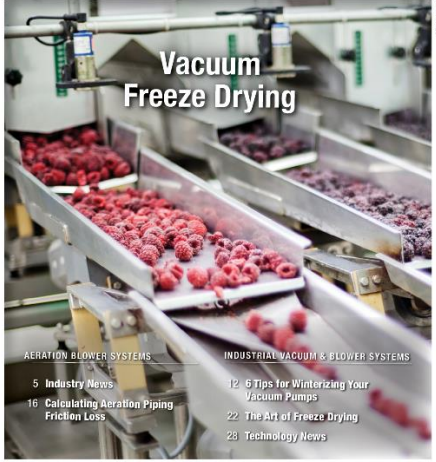
Key Features and Benefits

- ✓ Two sequencing software options with different control focuses
 - **Standard:** Focus on both balancing maintenance hours and energy efficiency: shuttles a single pump on and off often as it flows, saving 10% more energy than other sequencers.
 - **Optimizer:** Focus on energy efficiency: Consider all combinations of pump speeds and the total energy consumed to deliver up to 20% more energy savings when compared to the standard sequencing software.
- ✓ Visualize the user interface of all your pumps on the HMI or on your work devices (laptops, tablets, etc.)
- ✓ Plug and play installation - able to network pumps with AirLogic 3 controllers, AirLogic 2 controllers, or a combination.
- ✓ Many Ethernet based protocols supported, and older protocols can be supported with an additional gateway.

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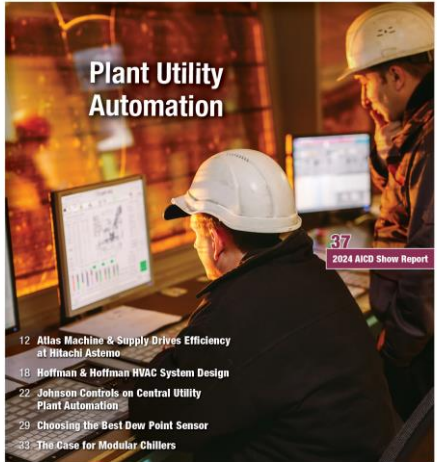
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Jacobs



Neil Mehlretter
Technical Director,
Kaeser Compressors



Tim Dugan, PE
President, Compression
Engineering Corporation

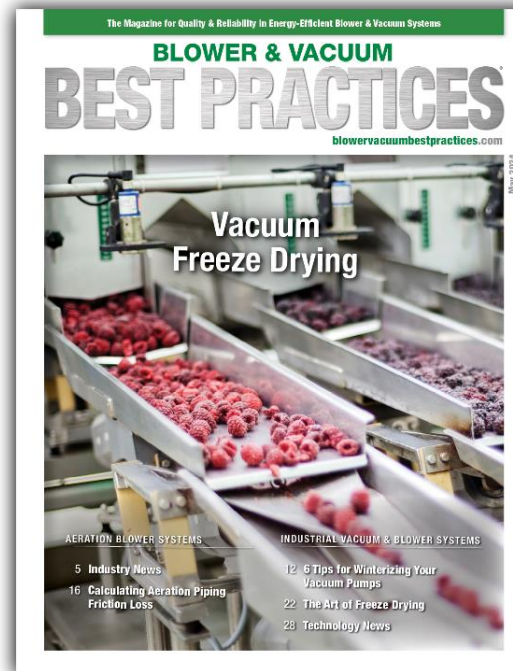


Martin Zeller
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Instruments USA, Inc.

Instrumentation and Monitoring for Vacuum Systems

Introduction

Blower & Vacuum Best Practices Magazine



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About the Speakers



Emma Larrabee
Marketing Manager
Zorn Compressor & Equipment



Todd Dunn
Vice President Sales & Marketing
Zorn Compressor & Equipment

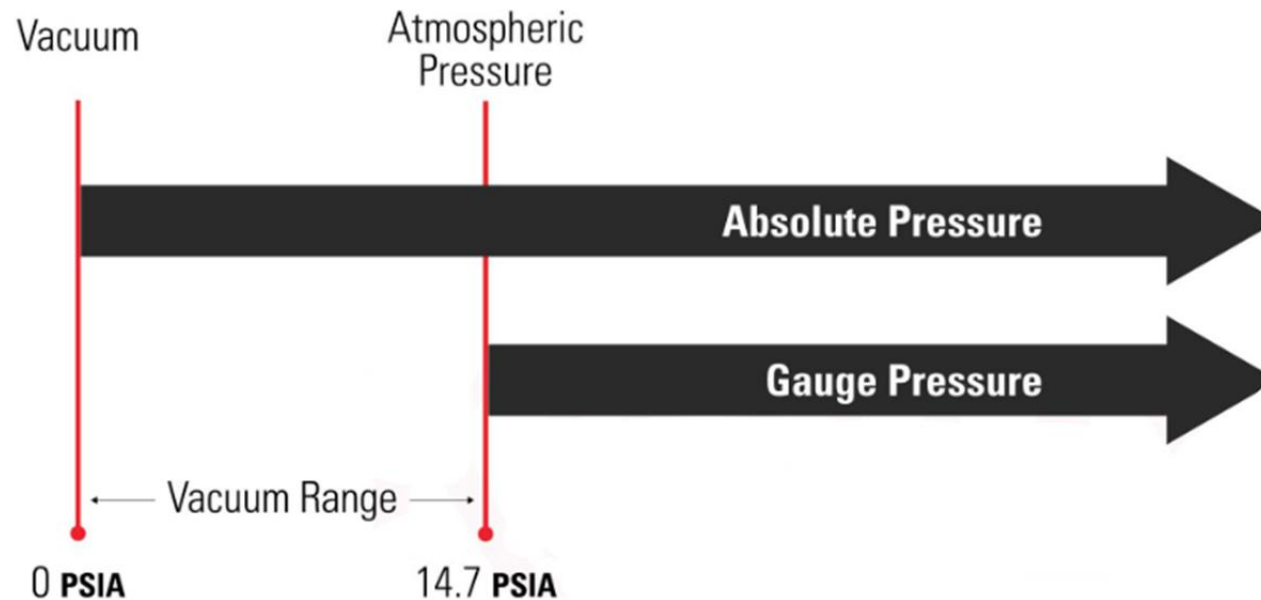
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What Is Vacuum?

- **Vacuum:** air drawn down to below atmospheric pressure
 - In contrast to compressed air: air raised to a pressure above atmospheric pressure
- **Vacuum Pumps:** pull large volumes of air into the vacuum chamber.
 - When the air is pulled in, the area left where the air once existed creates a vacuum effect.



Vacuum Applications

- Packaging & Bottling
- Drying
- Wood Fabrication
- Assembly Line Picking & Placing
- Degassing
- Glass & Stone Cutting
- Various Medical Uses
- Thermoforming
- Battery Manufacturing
- CNC Processes

And many more!

Why Is Vacuum Important?

- Vacuum plays an incredibly large role in the creation of many manufactured products
- Many of these manufacturing processes rely heavily on vacuum and cannot complete the job without it
- Vacuum systems come in a variety of technologies, sizes, and operating pressures to maximize your facility's efficiencies
 - Consulting a professional and properly sizing a vacuum system with coordinating instrumentation to your unique applications is extremely important

Overview of Vacuum Instrumentation & Monitoring

- Gauges, valves, interlocks, and app-specific instrumentation are all examples of important pieces to Vacuum Instrumentation & Monitoring
- These pieces ensure that...
 1. Proper vacuum level is produced for each unique application
 2. Multiple vacuum pumps are effectively controlled at the same time
 3. The units are exhausted properly

Let's look at an example of the importance of vacuum instrumentation & monitoring...

Vacuum Monitoring Mistake

OVERVIEW

- Industrial woodworking customer had vacuum pump installed by an independent contractor for use on router table to hold wood in place
- The unit was installed without any monitoring equipment like a temperature sensor or pressure transducer on the exhaust piping

PROBLEM

- There were too many elbows in the exhaust piping causing a restriction
- This ultimately caused the system to run hot which caused the oil to breakdown and overheat the unit

Vacuum Monitoring Solution

SOLUTION

- Clean up the discharge piping with proper sized pipe and proper turning radiuses
- Install proper vacuum monitoring equipment

CONCLUSION

- Had the customer purchased and installed equipment to monitor the vacuum temperature and discharge pipe pressure, they could have caught the issue earlier before it became a major catastrophe in need of emergency repair and/or replacement

What An Efficient System Looks Like- In Real Life!

THE BEFORE



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What An Efficient System Looks Like- In Real Life!



THE AFTER

About the Speaker



Benjamin Cameron
Quincy Compressor

- Vacuum Business Line Manager, Quincy Compressor
- 17 years of experience in Vacuum Technology: Roles include Applications Engineer, Systems Manager, and Product Marketing Manager
- Worked with Mitsubishi Chemical and Nova Chemicals
- B.S. in Chemical Engineering from Virginia Tech and an MBA from Old Dominion University
- Aspiring carpenter, tiler, electrician, and plumber

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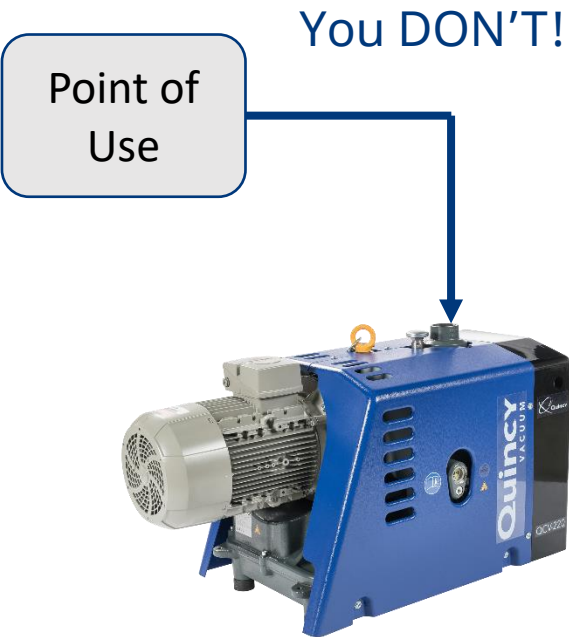




Instrumentation & Monitoring for Vacuum Systems

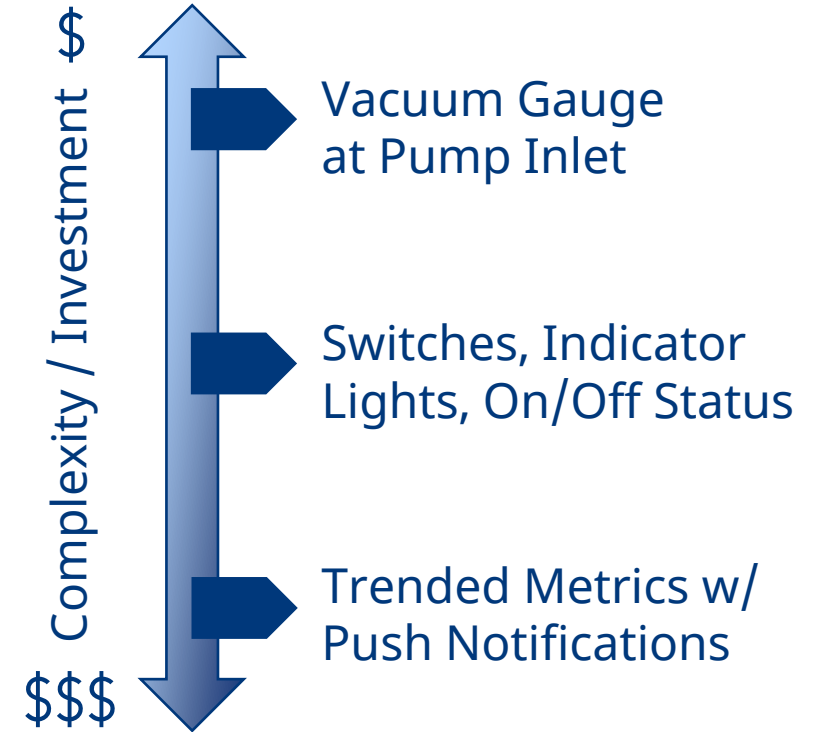
Instrumentation & Monitoring Vacuum Systems – WHY?

WHY do I **need** instruments & monitoring devices on a vacuum pump/system?



WHY is it a good idea to include instruments & monitoring devices?

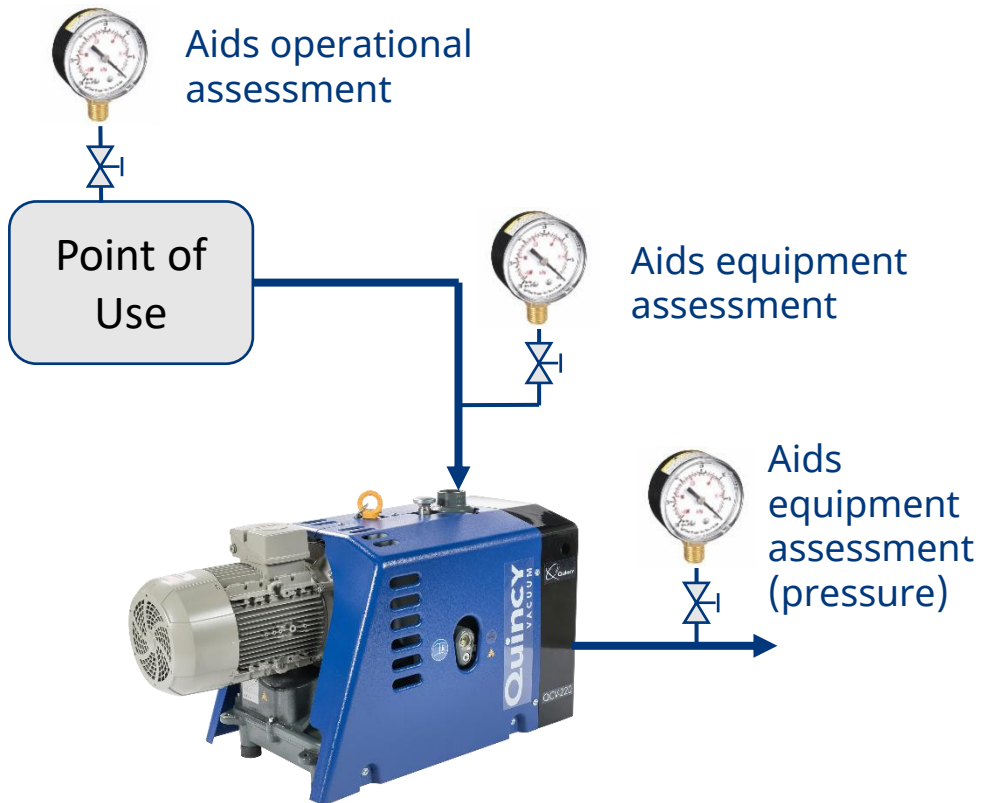
1. Vacuum level is important!
 - Impact product quality and throughput
 - Too shallow / Too deep can be problematic
2. Uptime depends on equipment health...so it's good to have some understanding of how the equipment is behaving



Will have to find the balance that suites your organization / objectives



Where should I put vacuum gauge?



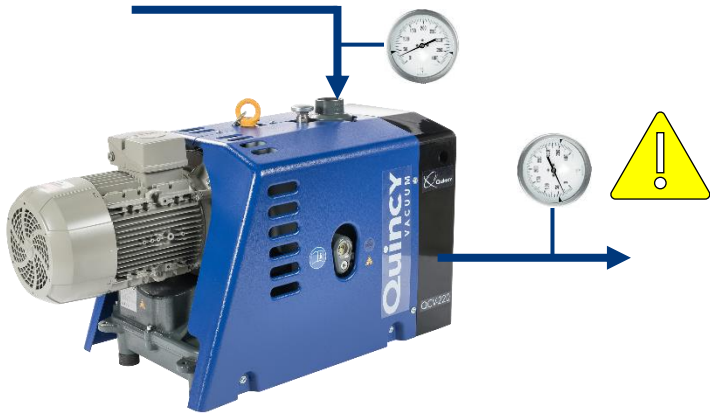
What type of vacuum device?

1. Bourdon Tube – Good for industrial applications
 - Consider Dial Size (4 or 4.5" dial)
 - Liquid Filled
2. Vacuum / Pressure Switch
 - Discrete signal(s) based on vacuum
3. Transmitter – For use within control systems
 - Monitor inlet for use with vacuum level control (ON/OFF or modulating)
 - Alarm for low vacuum and shutdown for high discharge pressure
 - Consider redundancy
 - Check requirements of PLC input card



Temperature

Where should I put a thermometer?



Wet Vacuum Technologies (Oil Sealed Vane, Oil Sealed Screw, Liquid Ring)

In seal fluid – Oil Sump, Seal Fluid Inlet

Dry Vacuum Technologies (Screw)

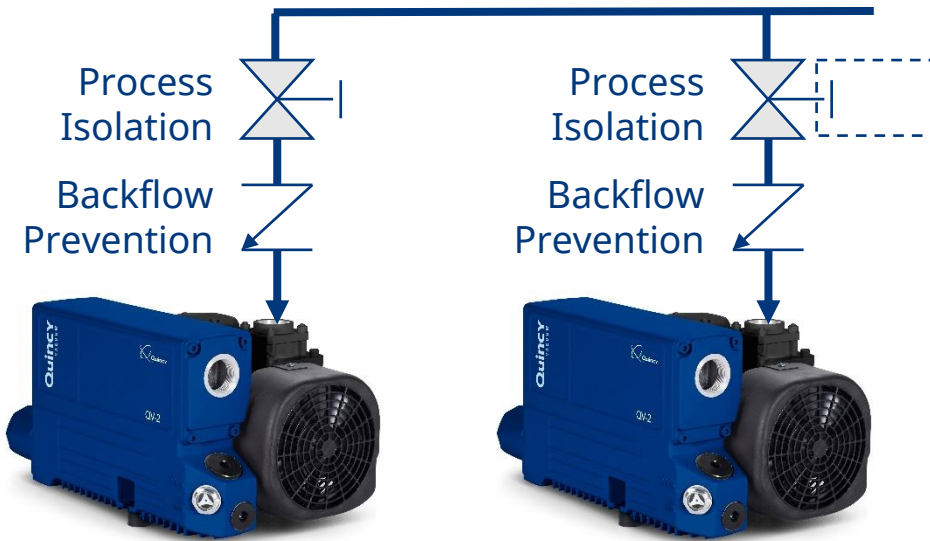
In cooling jacket



What type of temperature device?

1. Bi-Metal – Good for industrial applications.
 - Pay attention to insertion length!
 - Thermowell for use with corrosive gasses
2. Capillary Style – For remote dial installation
3. Temperature Switch
 - Discrete signal(s) based on temperature
4. Transmitter – For use within control systems
 - Monitor pump temperature
 - Alarms for high temp
 - Consider redundancy
 - Check requirements of PLC input card

Where should I put valving?



What type of valve?

1. Isolation Valve

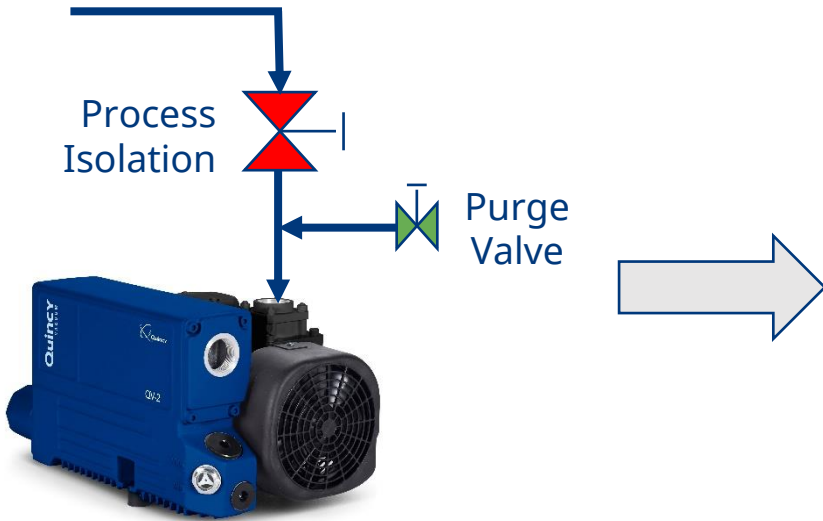
- Ball (up to 3"), Butterfly (4"+)
- Manual, or Actuated (Pneumatically or Electrically)
- Limit switches for positive OPEN/CLOSED indication
- For high vacuum applications use full port ball valves or high-performance butterfly valves

2. Check Valves – Prevent backflow into process

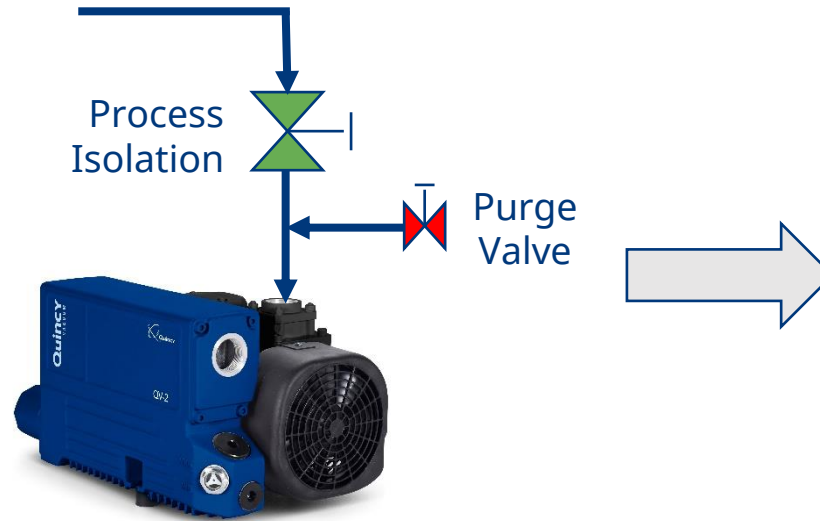
- Swing checks in horizontal orientation
- Butterfly style – Spring/No Spring, Clearance

Control Scheme – Start / Stop Purge

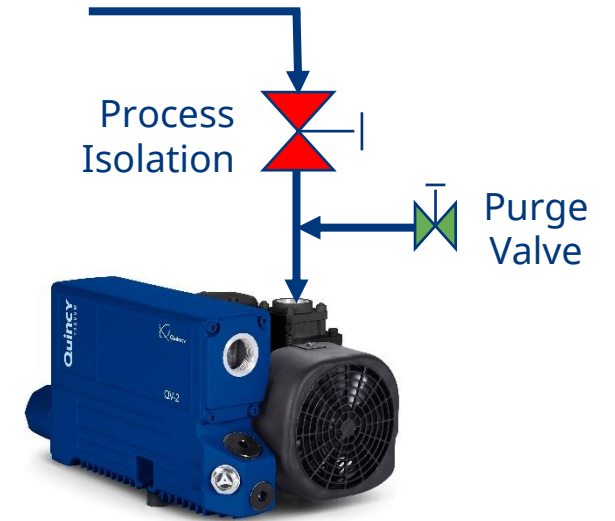
Start Purge: Warm up pump prior to going “on process”



On Process:



Stop Purge: Sweep potentially condensable gasses from pump before shutdown

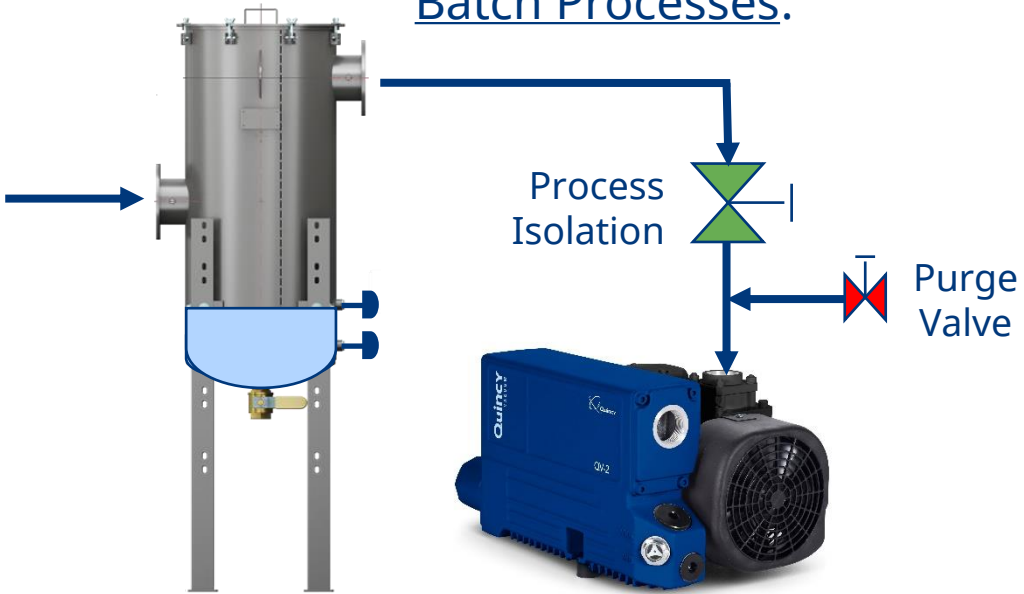


When to Consider Start/Stop Purge?

1. Operation close to pump’s end-vacuum is critical
2. Pumping vapors which exist as liquids at room temperature and atmospheric pressure

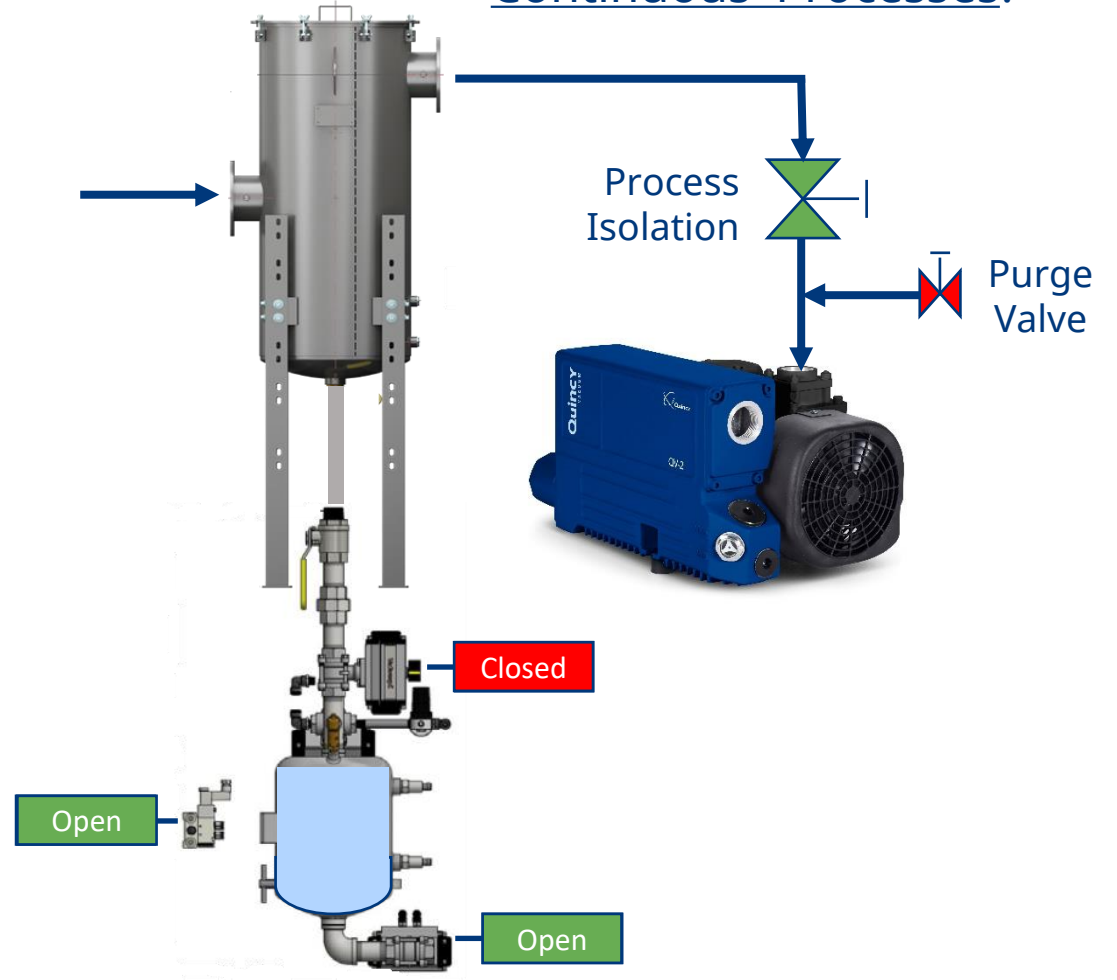
Control Scheme – Liquid Capture / Drain

Batch Processes:



- Manually drain at some regular interval
- Low level switch = Alarm
- High level switch = Shutdown
- Level switches: Float & Capacitance

Continuous Processes:

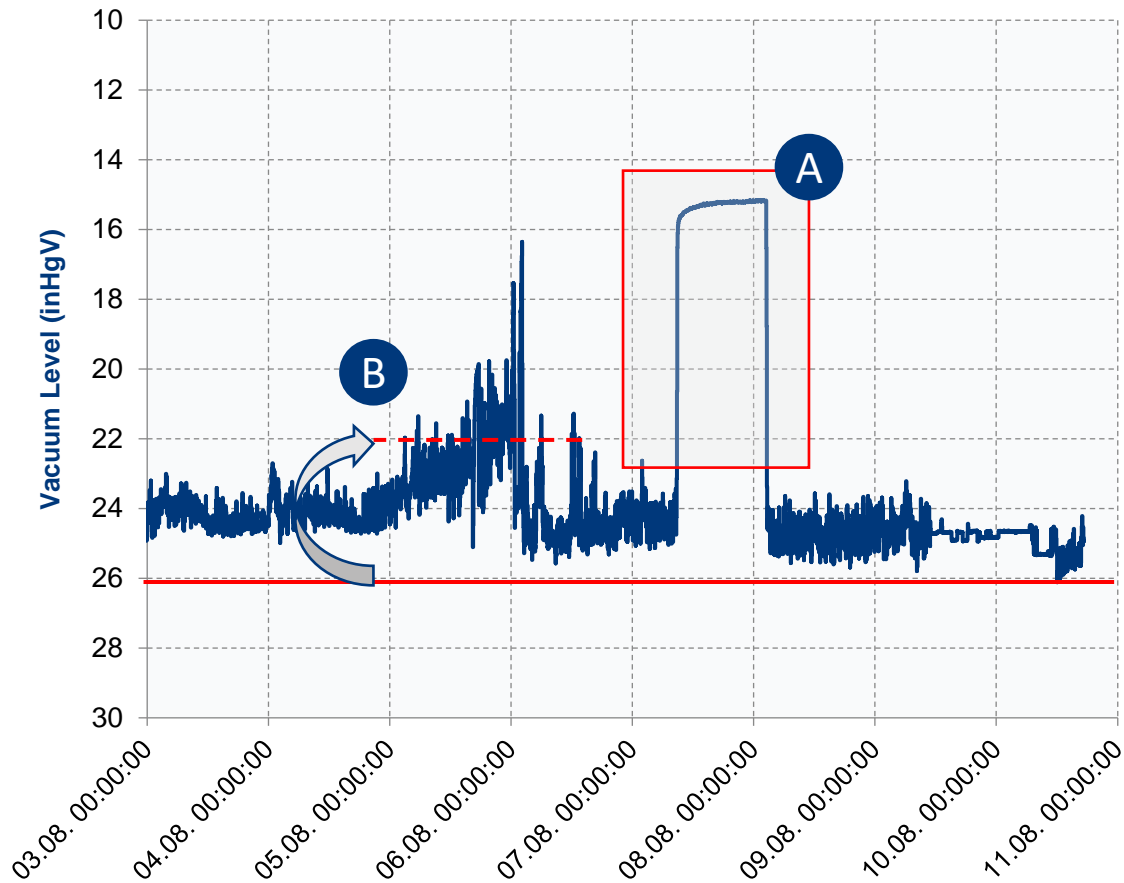


Monitoring



Monitoring – Vacuum Level

Vacuum Level vs. Time



A. Operational Diagnostics:

- Why did throughput / quality suffer? Was the vacuum system a potential cause?

B. Vacuum System Optimization (Efficiency):

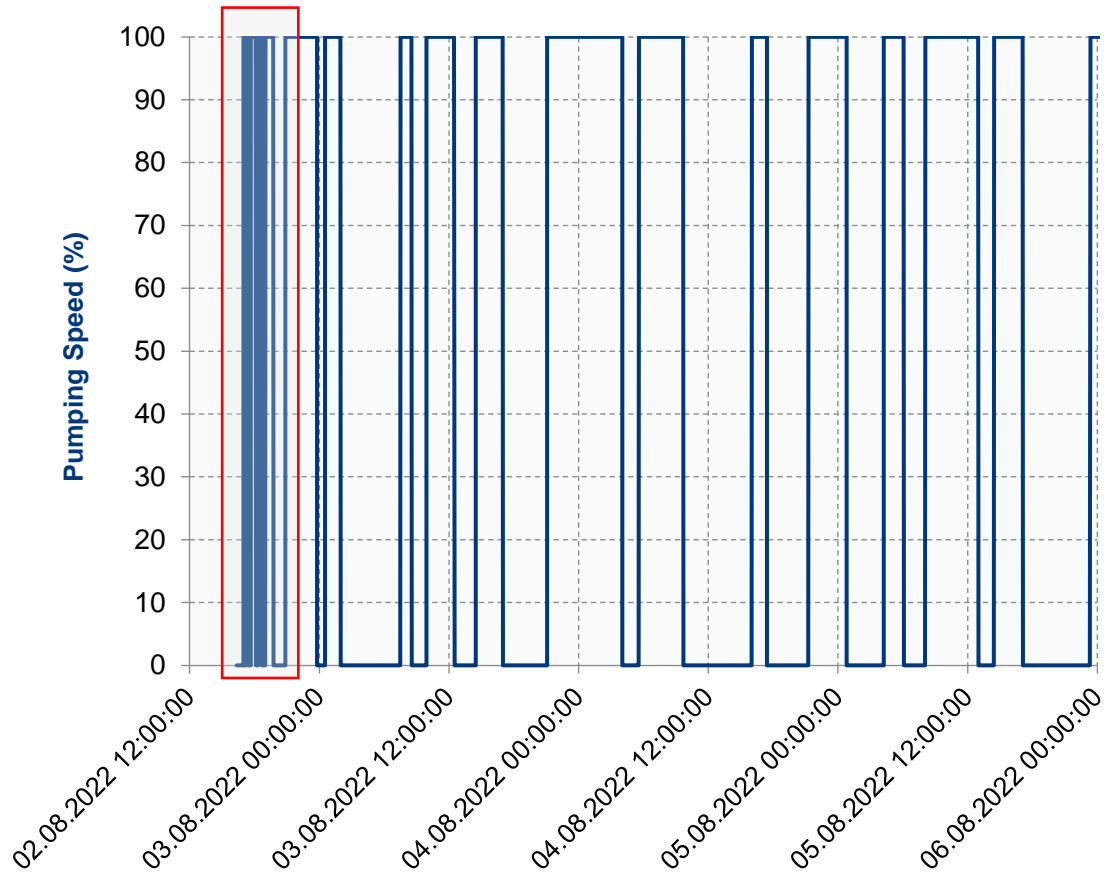
- How quickly does vacuum system respond to changes in demand?
- Operate at the least possible vacuum level, which accomplishes operational objectives

What Vacuum Level Do You REALLY Need?

- Monitoring data removes subjectivity

Monitoring – How is the Pump Behaving?

Pump Speed (Run Command) vs. Time

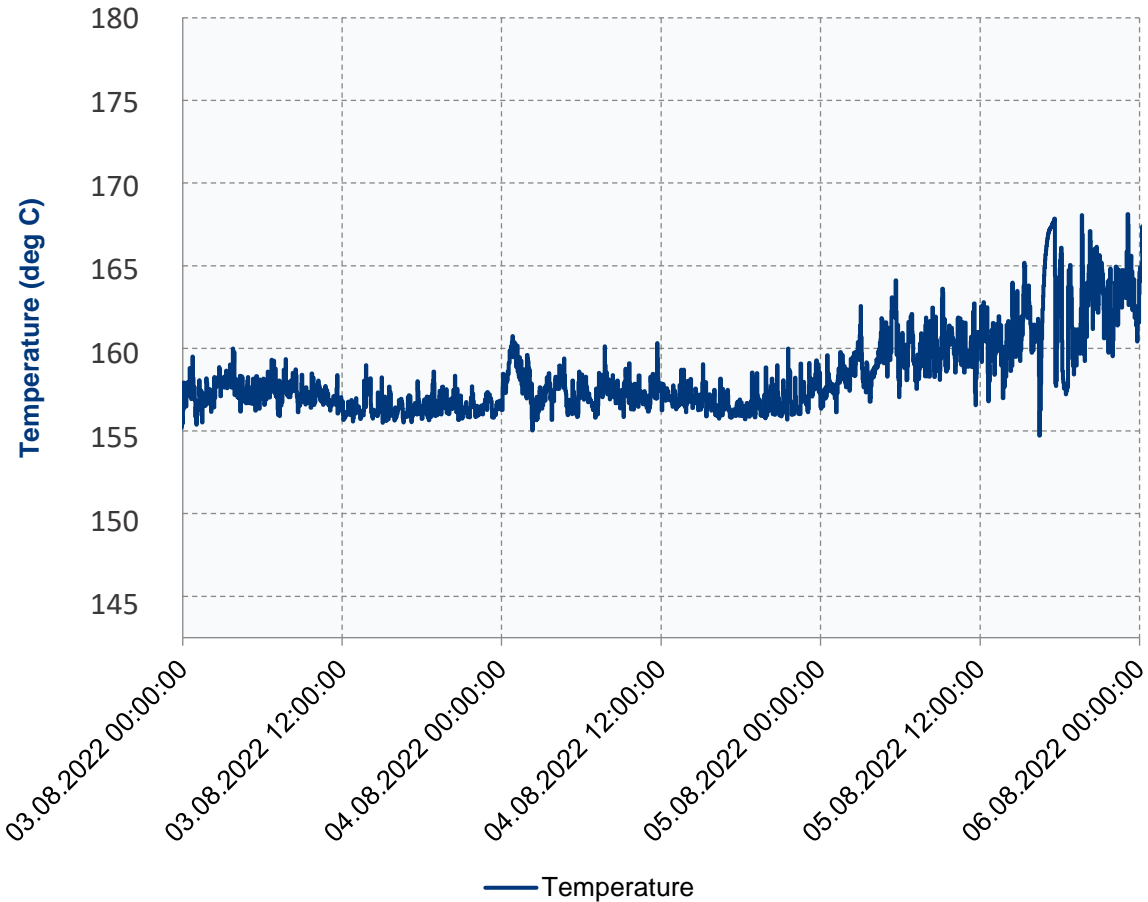


Operational Diagnostics:

- How consistent is the demand from application?
- Are there detectable patterns between shifts, operators, or product types
- Frequent start/stops could be indication that pump is oversized

Monitoring – Predictive Maintenance

Temperature, Vibration, HP vs. Time



Predictive Indications:

- Many variables/instruments which can be leveraged for indication of machine “health”
- Mitigate the severity of issues by acting sooner
- Understanding thresholds is important
- Plenty of IoT solutions offering data collection and “push” notifications

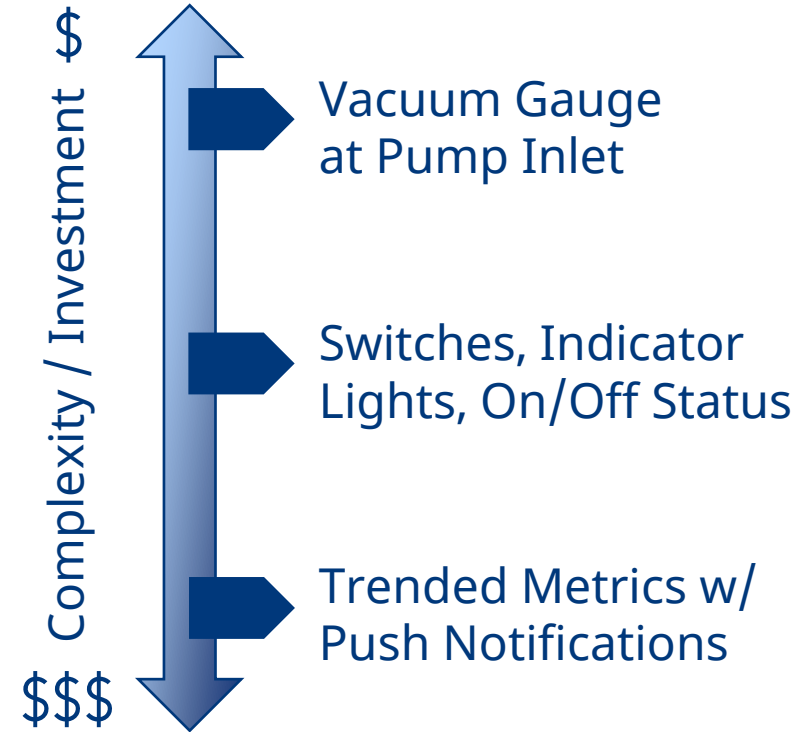
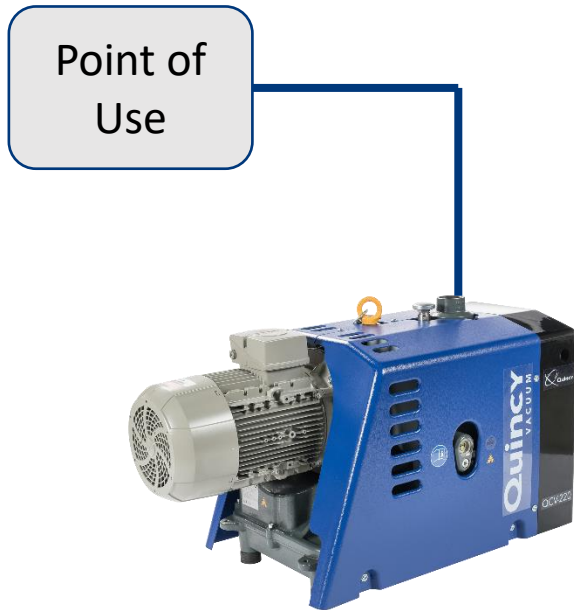
Look for “off the shelf” trending capabilities



Instrumentation & Monitoring Vacuum Systems – Conclusion

WHY do I **need** instrumentation & monitoring devices on my vacuum system?

You DON'T!



Will have to find the balance that suites your organization / objectives





Ben Cameron

Business Line Manager – Vacuum

251-395-7164

benjamin.cameron@quincycompressor.com



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Please submit your answer in the upcoming poll

What is the primary purpose of instrumentation in industrial vacuum systems?

A

- To monitor and control the pressure within the system

B

- To provide lighting inside vacuum chambers

C

- To clean the interior surfaces of vacuum chambers

*By entering you are giving permission to announce your name if you are a winner

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Q&A

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