



Measuring Flow: A Critical Component of any Compressed Air Management System

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Measuring Flow: A Critical Component of any Compressed Air Management System

Introduction by Rod Smith, Publisher,
Compressed Air Best Practices® Magazine

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All materials presented are educational. Each compressed air system is unique and must be evaluated on its own merits.

About the Speaker



Hank van Ormer, Air Power USA

- Founded Air Power USA in 1986
- Over 50 years of experience in the compressed air and gas industry

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Measure Flow – A Critical Component of an Effective Compressed Air Monitoring / Management System

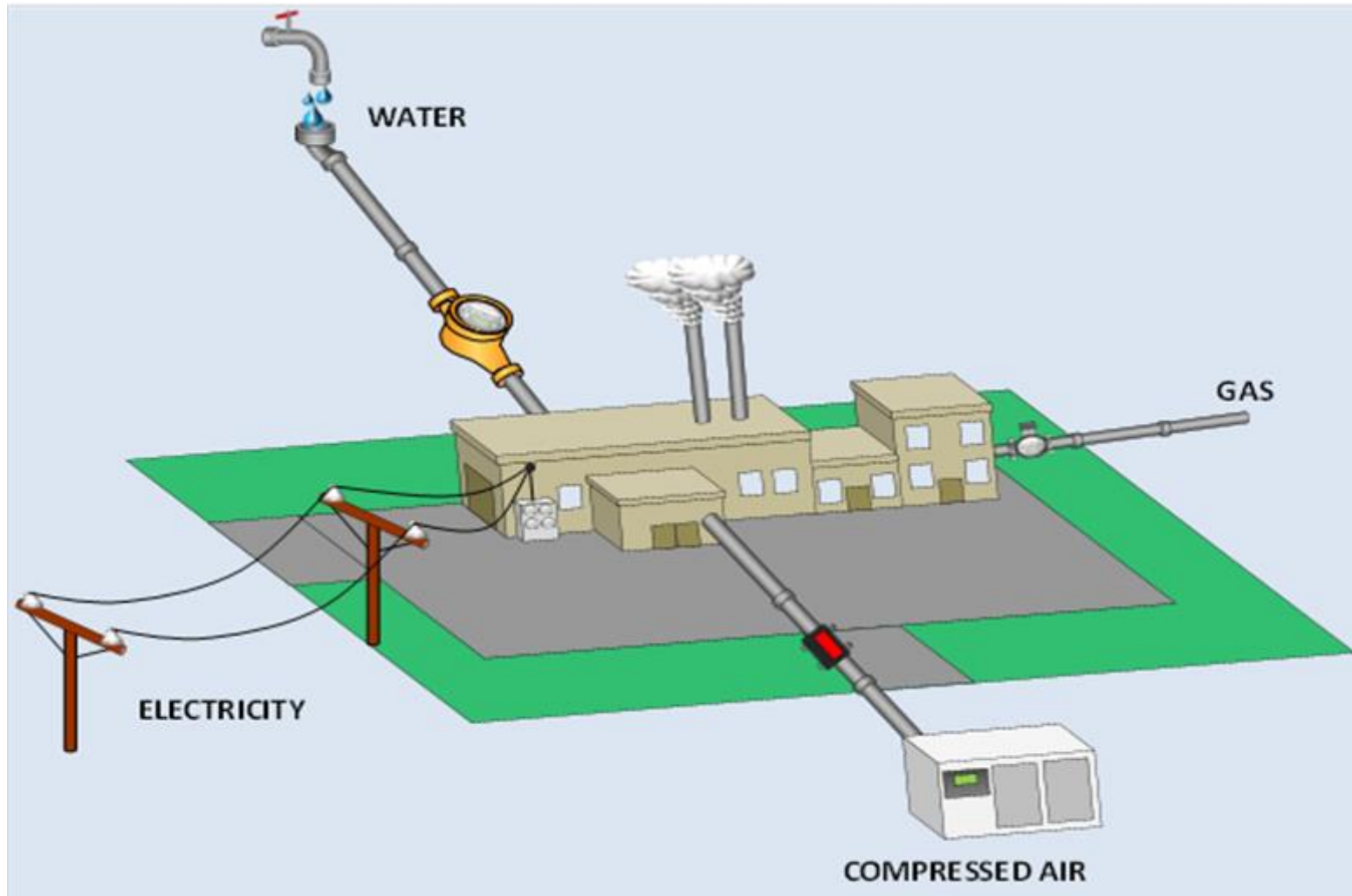
If you don't measure it, you cannot manage it!

Air Power USA

June 30, 2016



Electricity, Natural Gas and Water Always Measure Flow



Why Not Compressed Air?

Measure and Monitor the Total System

A compressed air system is not just an air compressor. **It is a “SYSTEM.”**

Where do you measure flow?

- Often the first choice is each compressor and/or the compressor room
- **IMPORTANT** particularly when the program is combined with other data to generate specific power (scfm / input kW) as a **BASIC EFFICIENCY OF COMPRESSED AIR PRODUCTION.**



Measure and Monitor the Total System

To evaluate the true system dynamics we need to know not just how much air is being produced and delivered, but where it is going.

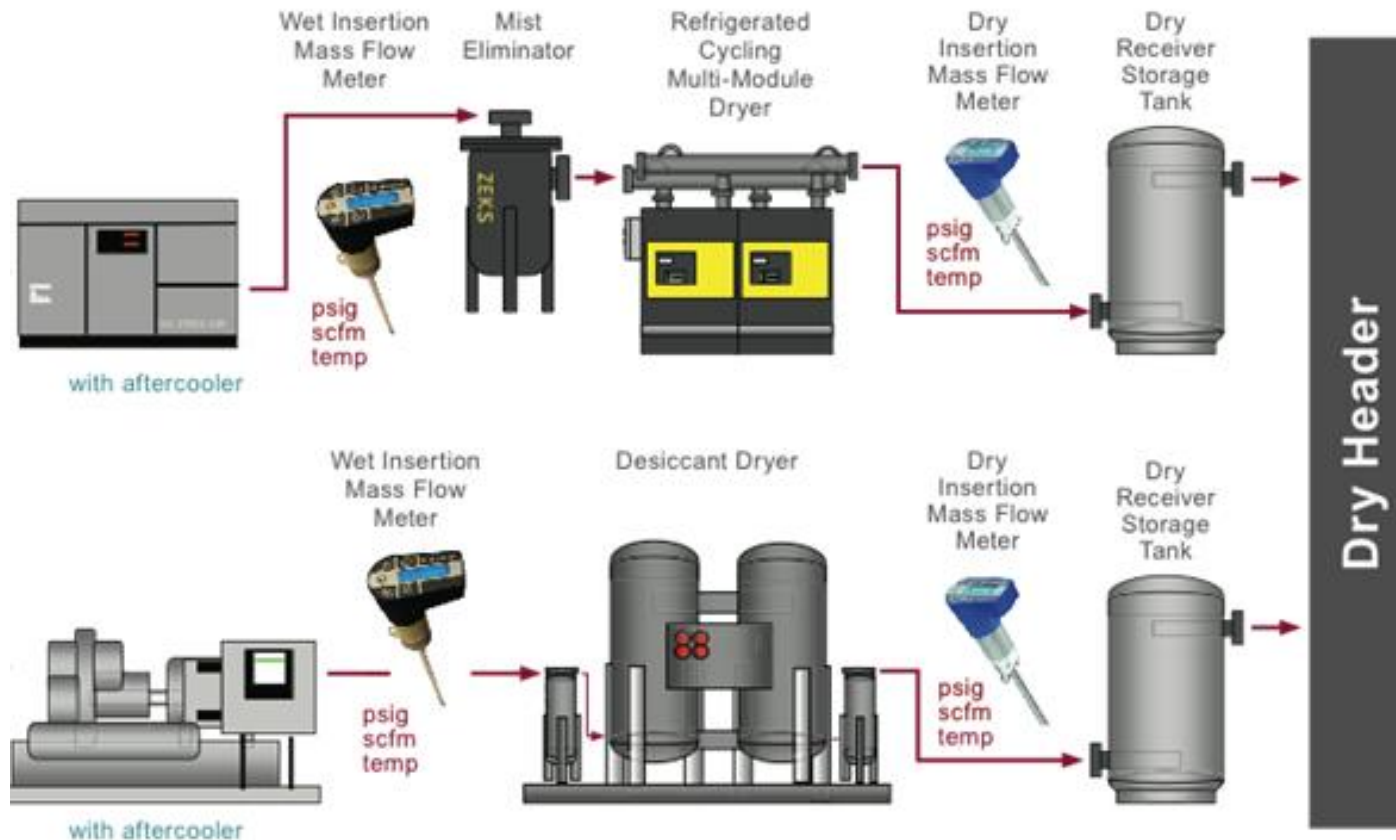
Important questions to ask:

- Who is using it?
- How does this actually compare to the estimate or calculated estimate?
- How does the current flow volume compare to past measurements?
- Where are the peak / surge demands?



A Good Start

- Now we are monitoring how efficiently we produce, the proper quality of compressed air.

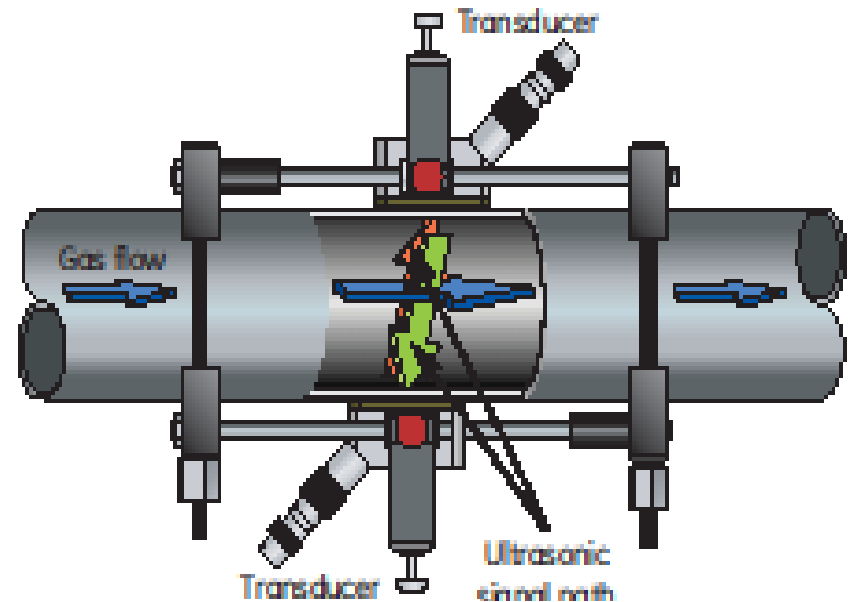


Types of Flow Meters

- There are many types of flow meters on the market today. Before you can discuss flow measurement; you first have to decide what type of flow meter to use.
- The two basic type of flow meters available are **invasive** or **non-invasive** to the pipe.

Non-Invasive Flow

- Non-invasive or ultrasonic air meter – clamp on type.
- Measures velocity – can read mass flow when temperature and pressure are measured simultaneously and accurately.
- Less effective at lower pressures, particularly in larger pipe.

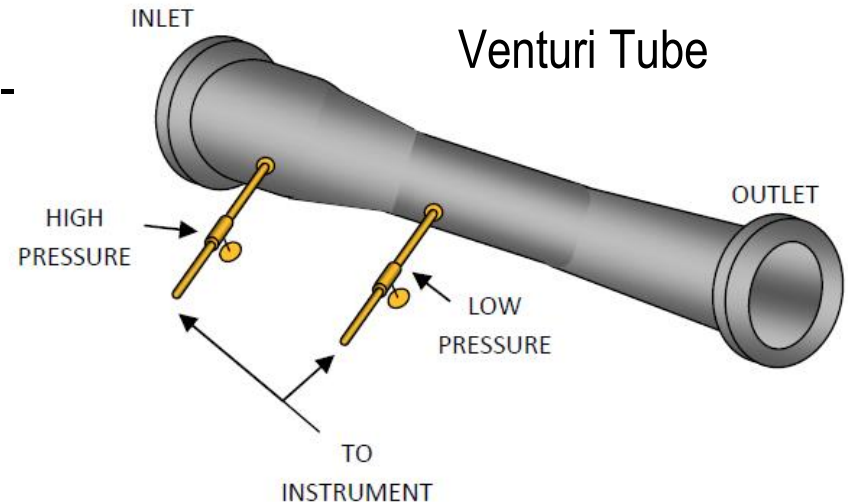


Picture courtesy of GE Parametric Digital/Flow

Invasive Type Flow Meters

Venturi Tube

- Basic designed for liquids and slurries - but are also used for air.
- Pressure differential design
- Does require pressure and temperature corrections
- Relatively accurate measuring wet air.



Orifice Plate

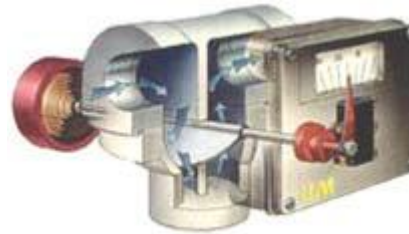
- Similar performance to the Venturi Tube
- Pressure differential design
- Requires pressure and temperature correction
- Finer measurement



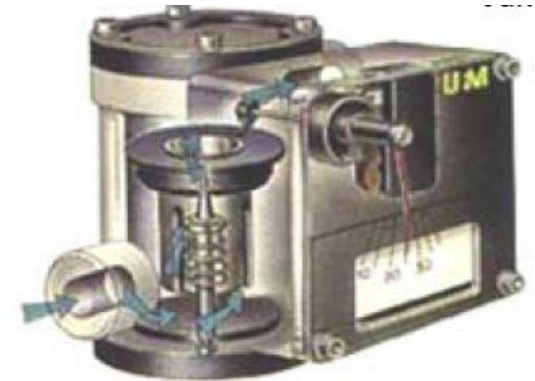
Orifice Plate

Inline Invasive Flow Meters

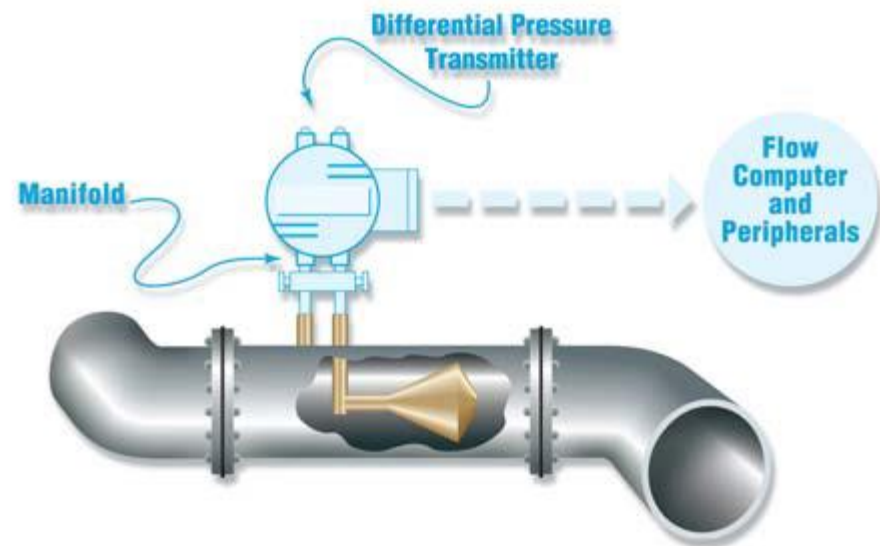
Air flows through the meter at a given resistance – most accurate in the middle of range – accurate pressure and temperature is CRITICAL!



Vane and piston
(variable-area meters)

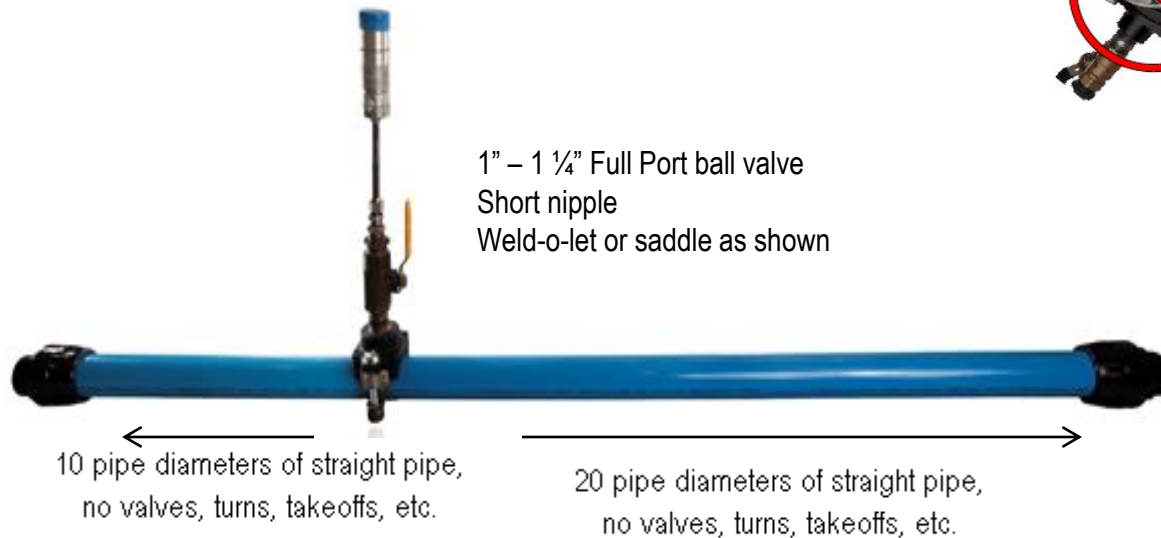


V-Cone



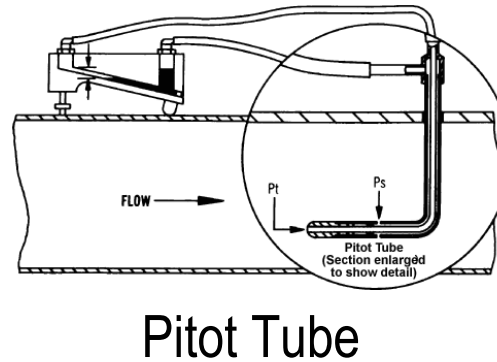
Insertion Flow Meters

Insertion flow meters are **invasive** but can often be inserted through a proper compression fitting and valve arrangement while the pipe is still pressurized.

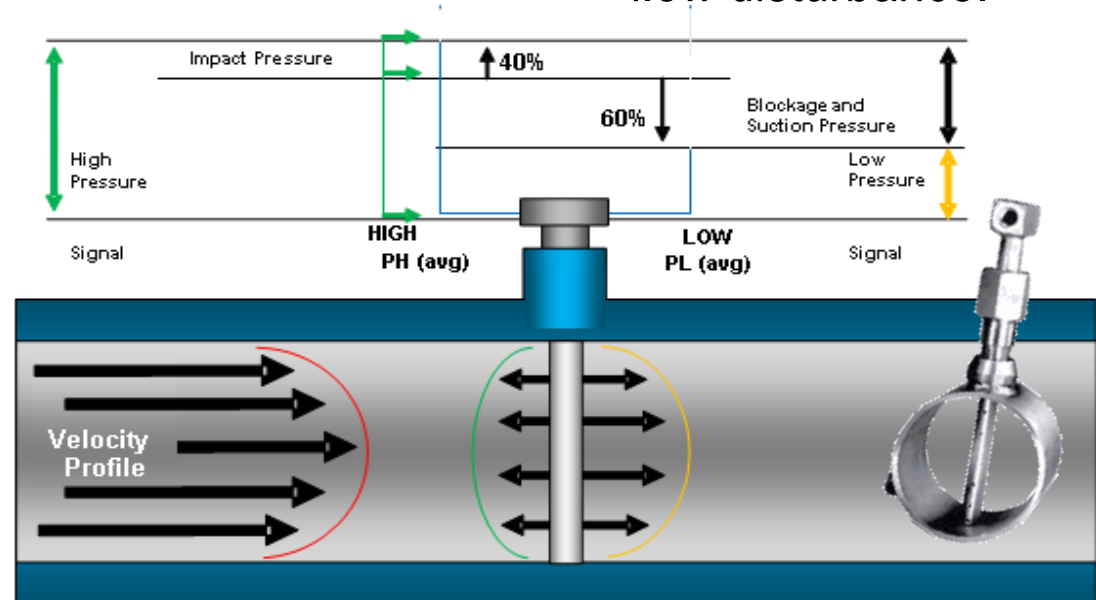


The entry point through the pipe should be hot tapped through this same valve arrangement mounted to a pre-welded fitting or saddle.

Some Basic Insertion Type Flow Meters



- None of these are mass flow
- These meters are based on pressure differential and/or flow disturbance.



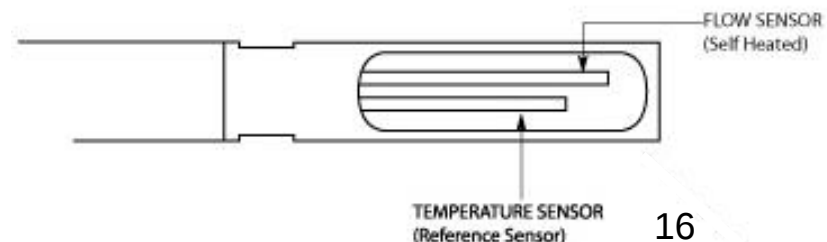
Annubar

$$DP_{(rwr)} = P_H (avg) - P_L (avg)$$

Insertion/Heated Wire Flow Meter

Plus Side:

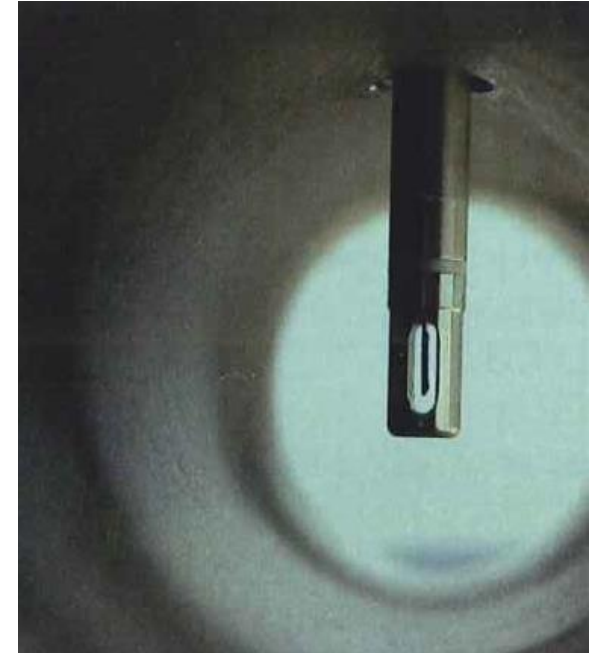
- Unlike pressure differential and flow disturbance meters with very limited accuracy range, the heated wire measures with the same accuracy throughout its total range.
- Probes support sensor for direct contact with air
- Data is fed to a microprocessor designed to hold fixed temperatures – to calculate mass flow
- No additional pressure or temperature compensation required.
- Relatively insensitive to dirt
- Easy installation and removal



Insertion/Heated Wire Flow Meter

Limitations:

- Must have dry air
 - No liquid water or condensate
 - No liquid or aerosol oil mist



Inline version for smaller pipe sizes < 2 inches

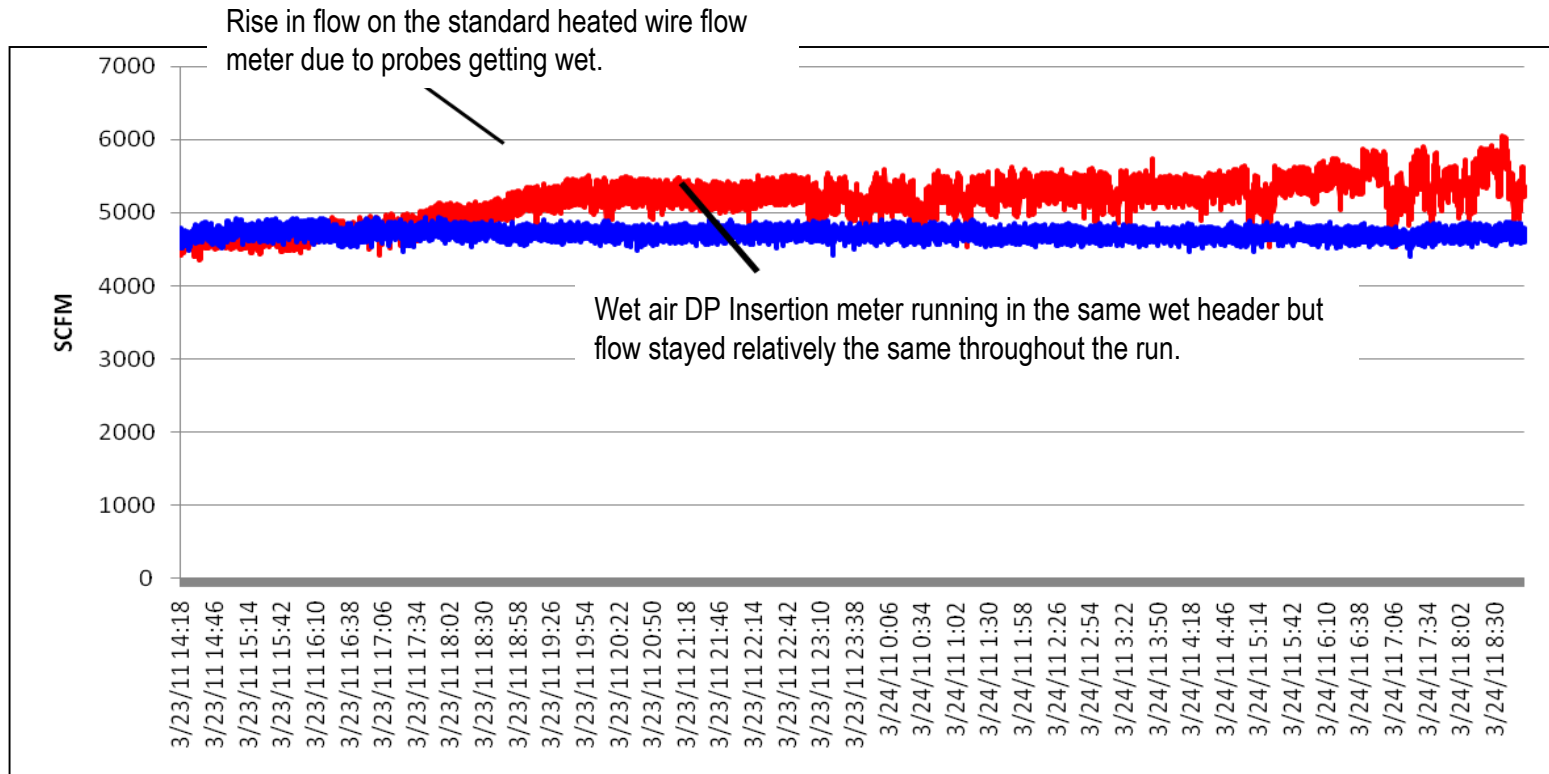
Other Insertion Flow Meters

- “New” Special DP insertion meters for **wet** or dry air.
- Measures **controlled flow**, pressure differential, temperatures and pressure in a filtered encased head.
- Feeds directly to a microprocessor for the MASS flow calculations; no temperature or pressure corrections are required.

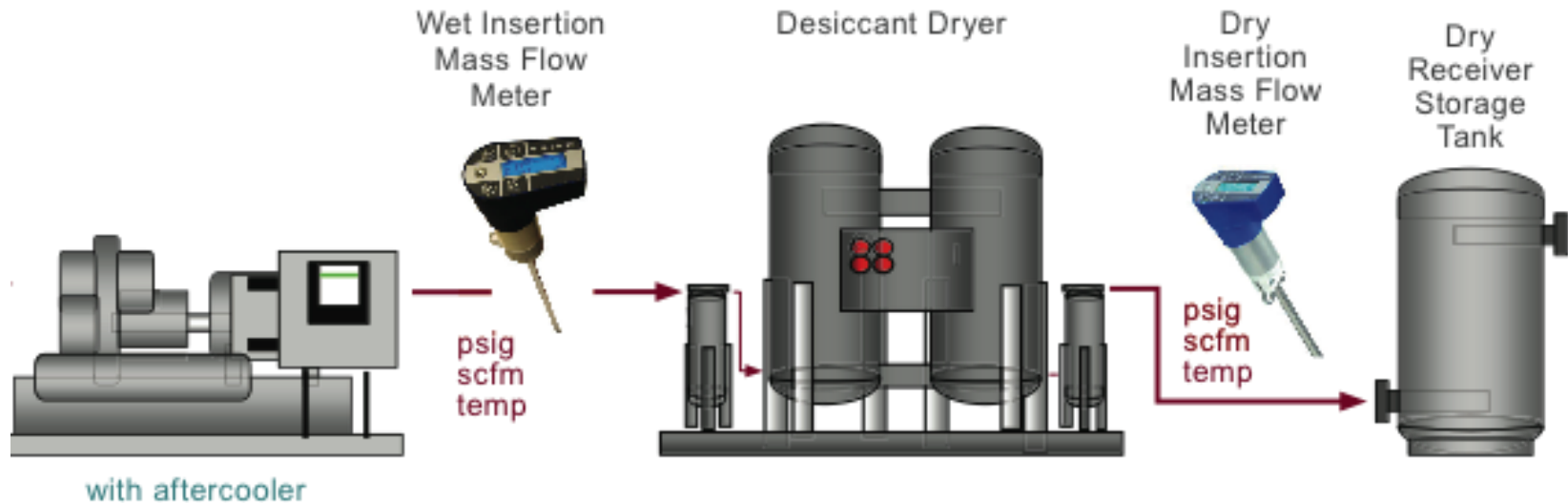


Standard Heated Wire vs. Wet Air DP Insertion Meter

Standard heated wire flow meter vs. Wet air DP insertion flow meter in the same wet header.

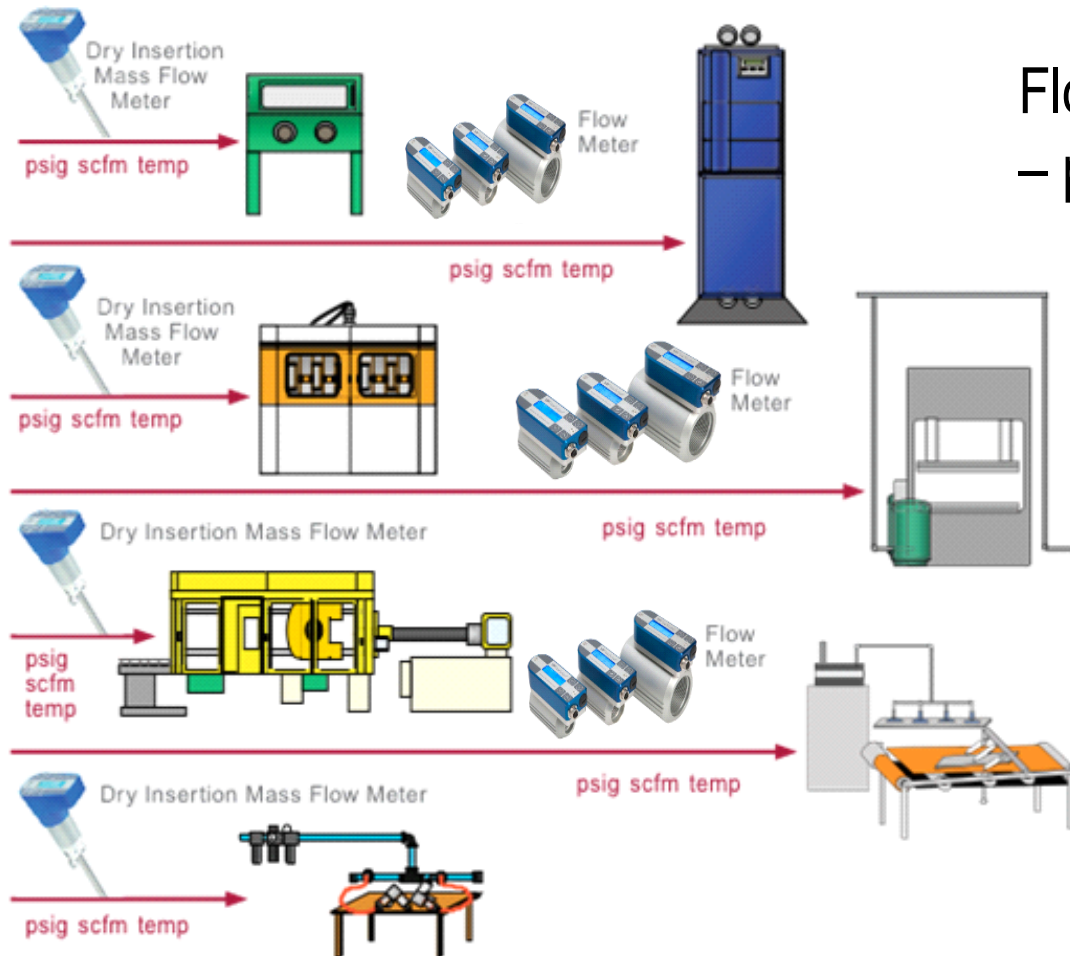


Compressor Room Measuring



- Combined with other key operating monitoring data we now have a very good supply efficiency operating profile.
- But...are we using the air efficiently?

Measuring Flow to each Independent Sector



Flow to each independent sector
– pressure and temperature.

- Add pressure dewpoint if critical
- Assign optimum compressed air use of sector and monitor compared to budget
- Implement a program to operate at the lowest effective pressure

Measuring Flow to each Independent Sector

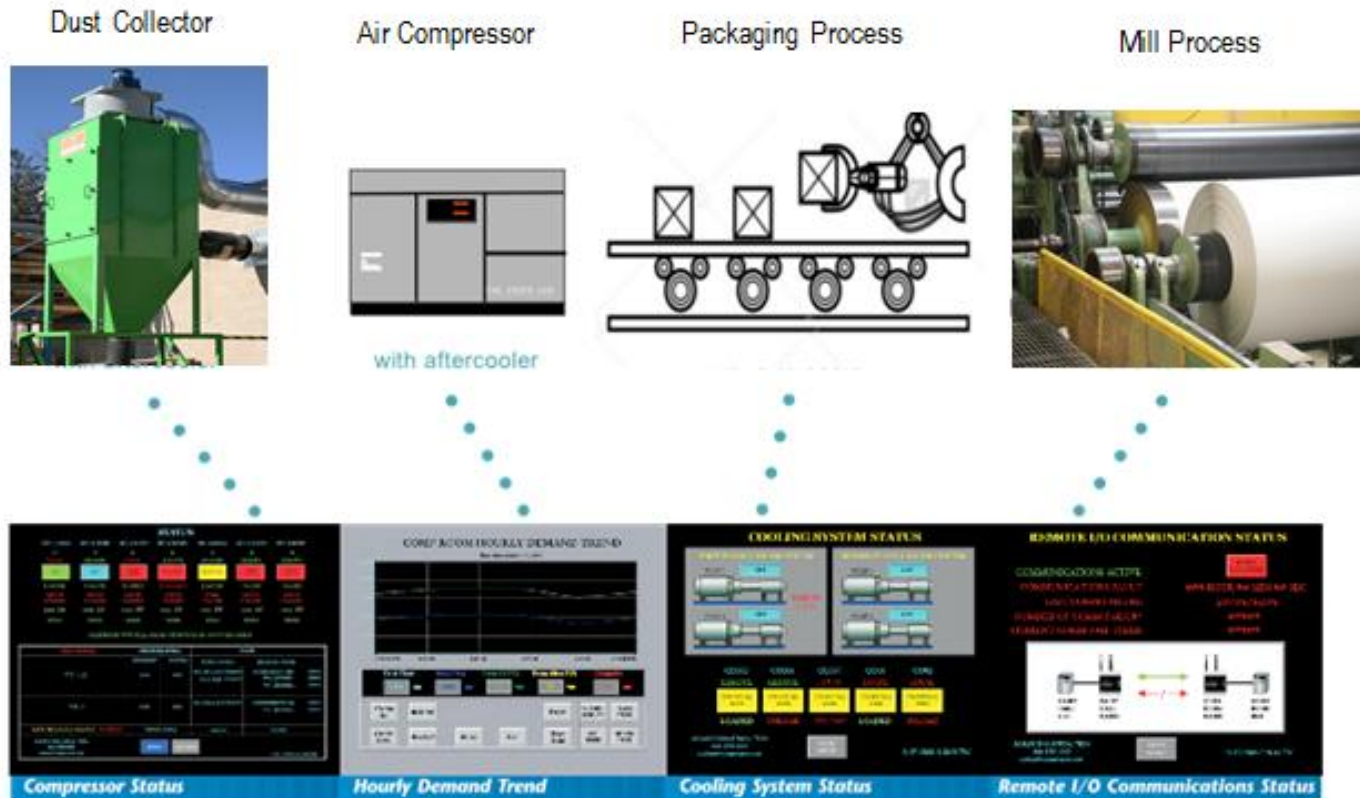
Measure Feed Lines to Production Processes with Dry Insertion or
Inline Mass Flow Meter

Measure and monitor air use

- Pressure – lowest effective
- Dewpoint – if critical
- Identify total leaks – when operating and at rest
- Establish optimum air use per process
- Use separate pressure transducers as required

Utilizing the Data

The path to compressed air optimization is finalized with proper sustainability, measurement and monitoring.



Central Compressor Management Control

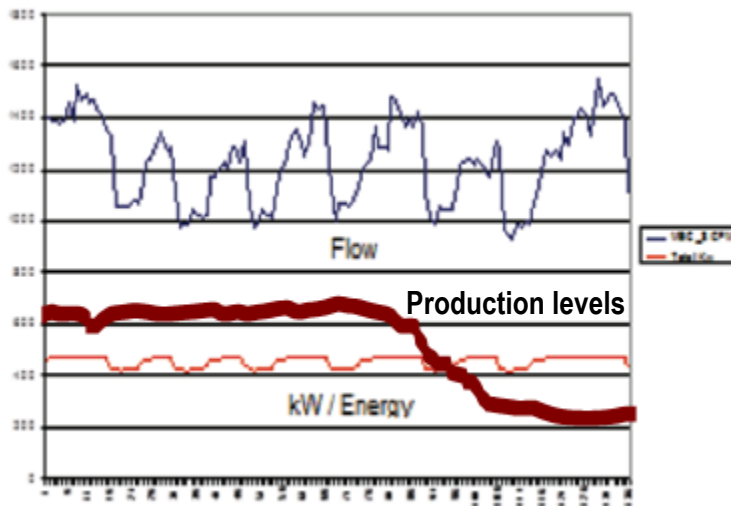
Final Evaluation

Central Compressor Management Control

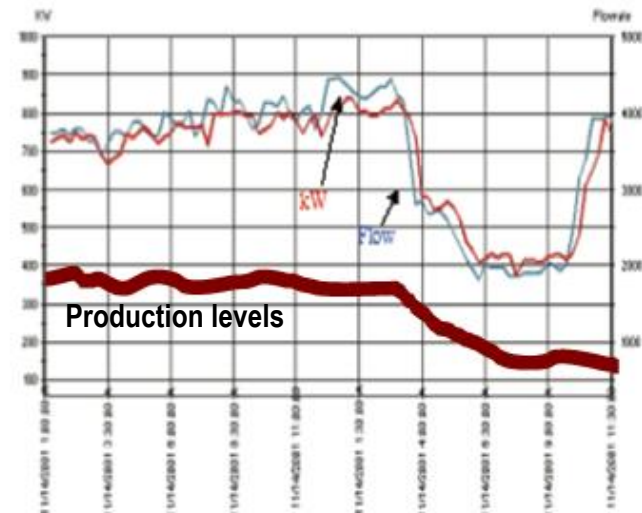


Final Evaluation

- Uncontrolled system – flow changes but kW does not change proportionally.
- Energy and flow don't follow production.



- Control management systems can significantly improve efficiency to minimize energy costs.
- KW, Flow and production are proportional.



**If you do not manage, You cannot save.
If you do not monitor, you cannot manage.**

**Thank you for the
opportunity to present.**

Hank van Ormer – Technical Director

Air Power USA

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www.airpowerusainc.com

About the Speaker



- Founder and CEO of VPIstruments

Pascal van Putten, VPIstruments

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A hand is holding a tablet that displays a software interface for managing a compressed air system. The interface includes a schematic diagram of the air system with various components like tanks and pipes. On the left side of the screen, there is a vertical menu with icons for different functions: a three-dot icon, a waveform icon, a warning triangle icon, and a downward arrow icon. The main area of the screen shows several data points. Two large numerical values are prominent: '650.13' and '23093.22', each with a small bar chart below it. Other smaller numbers and labels are visible, including '1200.0 m³/h', '6.1 bar', '1.8 bar', and '1.77'. The background of the image is a blurred outdoor setting with a wooden surface.

Managing Bi-directional flow & Implementing (flow) monitoring

Compressed Air Best Practices
Webinar

- Introduction
- Bi directional flow + example
 - Why
 - How it works
 - Other technologies
 - Application
- Energy monitoring
 - Why permanent monitoring
 - How it works, benefits
 - Application

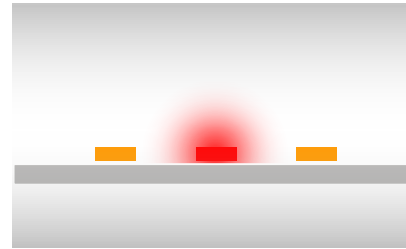
Why bi-directional flow meters?

Reverse flow situations: More often than you think!

- Leaking drains, non return valves, leaking seals
 - Compressors “fighting” each other: oscillation
 - Interconnected ring networks
 - Distributed Receiver tanks
- Non bi-directional meters: potentially large errors!

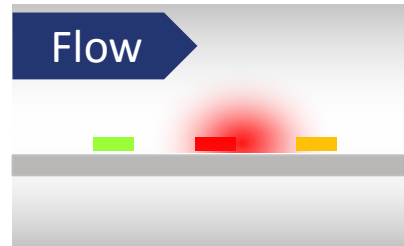
No flow

Everything in balance.



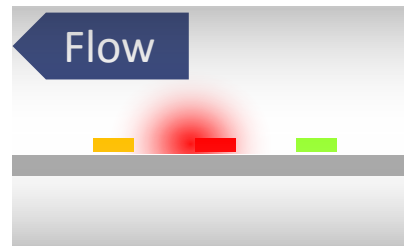
Flow from left

The left part is cooled down; the right part of the bridge is heated up.



Flow from right

Vice versa! Now the left part is heated up and the right part is cooled down.



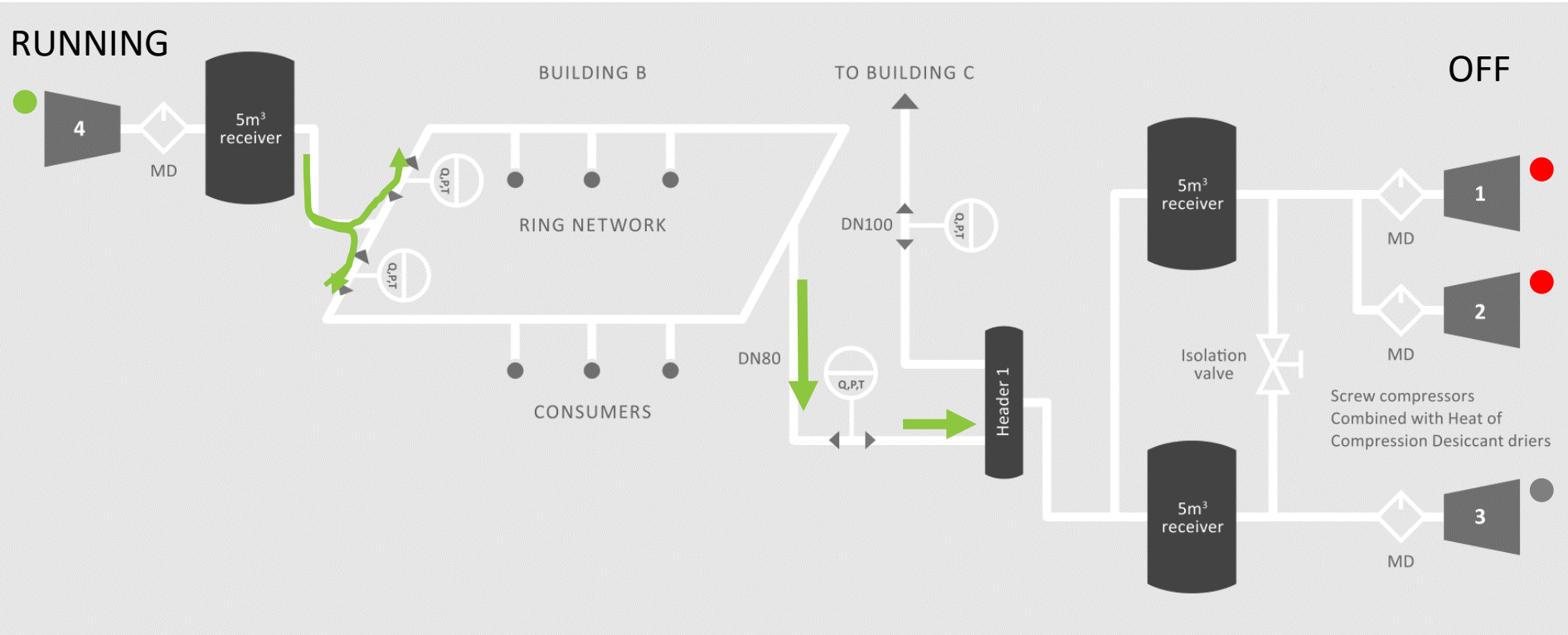
Technology comparison bi-directional

Technology	Bi-directional?	Range	Pressure Loss	Price	Pressure sensor	Mass flow
Thermabridge 3 in one	Yes*	1:300	Low	Low	Yes	Yes
Thermal dispersion	No**	1:300	Low	Low	No	Yes
Orifice + transmitter	Option	1:10	High	Medium	Option	Option
Vortex + transmitter	No	1:10	Medium	Medium	Option	Option
Ultrasonic	Yes	1:50	Low	High	Option	Option

* Sold as optional feature, fully integrated in the unit

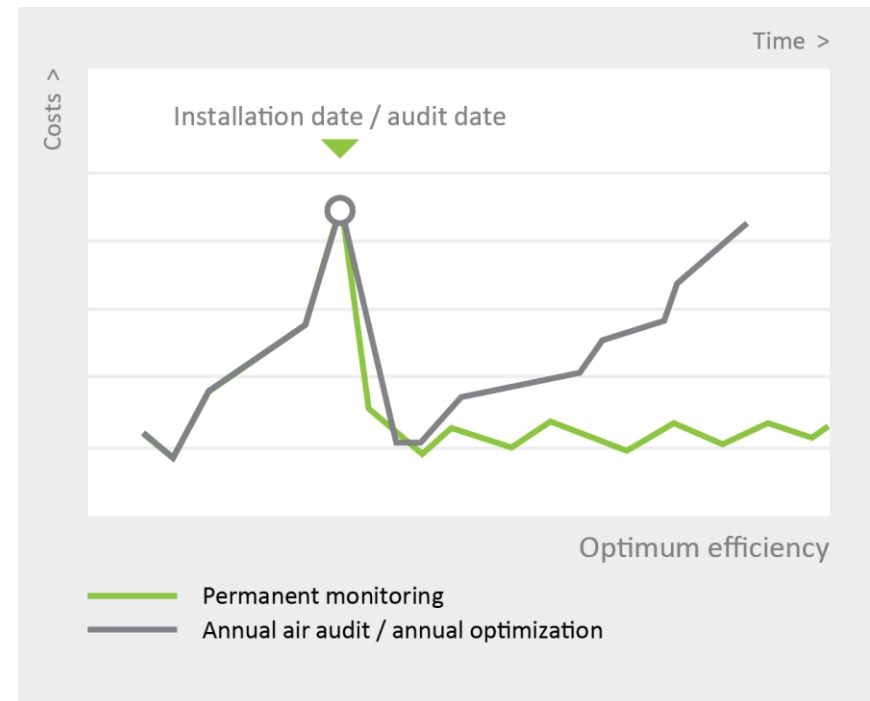
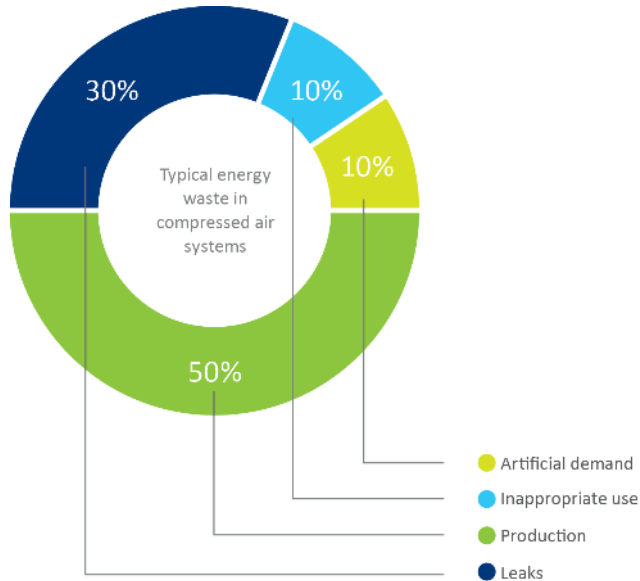
** sold in some cases as external mechanical paddle switch, prone to failure due to humidity and mechanical wear. Sold also as thermal direction switch, PLC needed to combine

Application example: multiple compressor rooms



Why monitor compressed air?

✓ Sustainable results



What can monitoring systems offer you?

- ✓ Overview in real time of all important KPI's
- ✓ Supports ISO 50001, ISO 11011 based energy management
- ✓ All data centrally stored in data base
- ✓ Advanced analysis of combined signals



Your plant



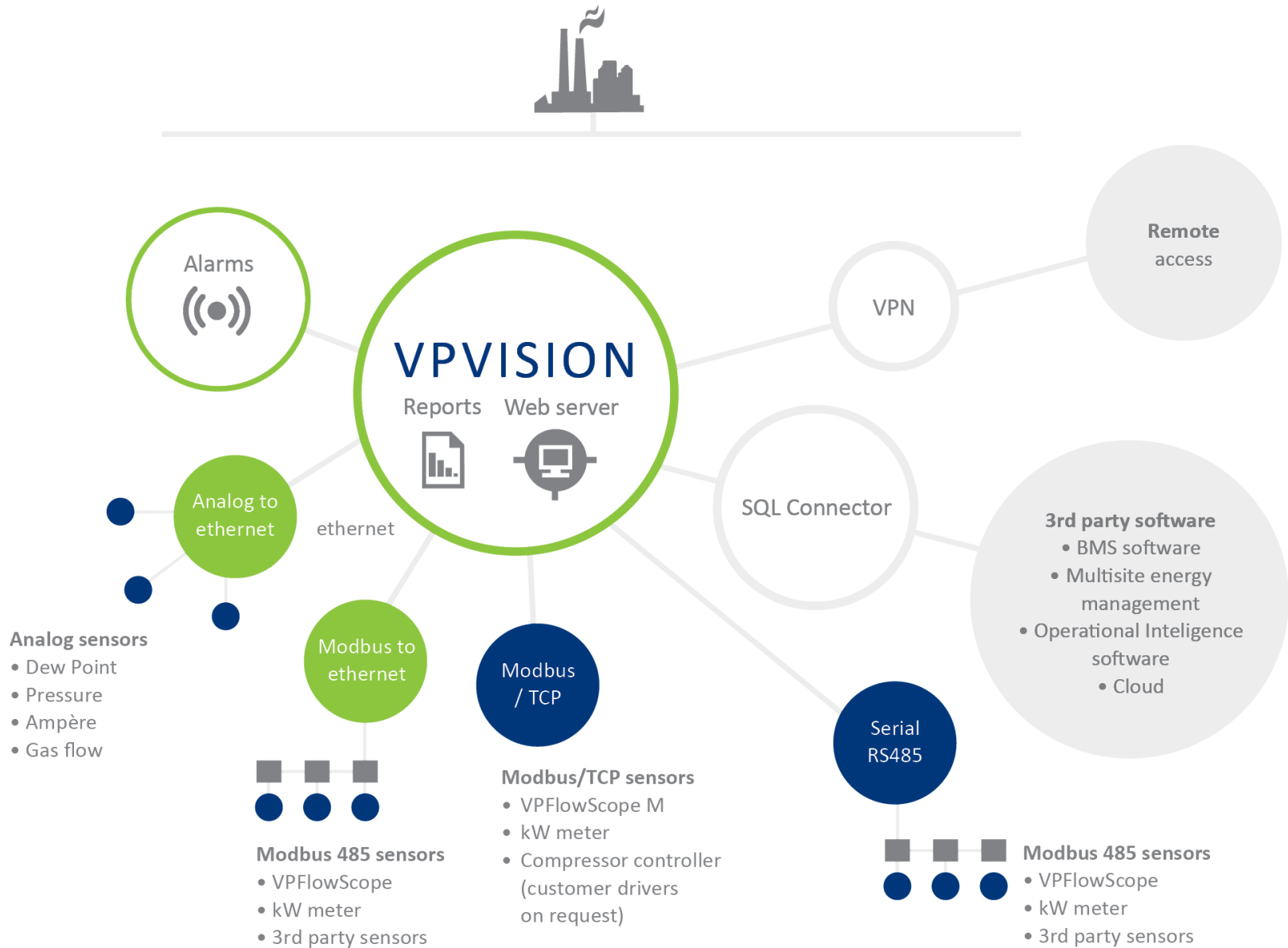
Data



VPVision

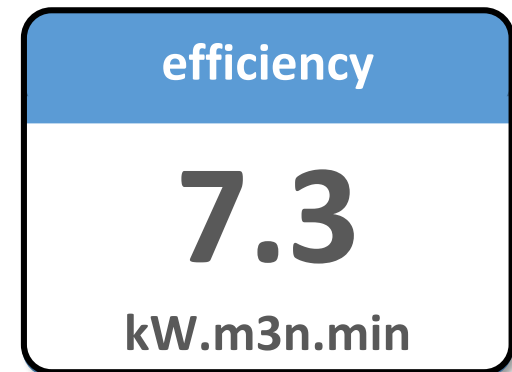


Fact based improvement



Application: Efficiency trending

- Monitoring practical efficiency vs specs:
- Leaking internal drains?
- Pressure loss over the inlet filter?
- Multi-compressor controller ok?
- Performance as promised by the supplier?



Thank you!

VPInstruments

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The Netherlands

USA, Menno Verbeek: 312 2393052

INTL: +31 (0)15 213 1580

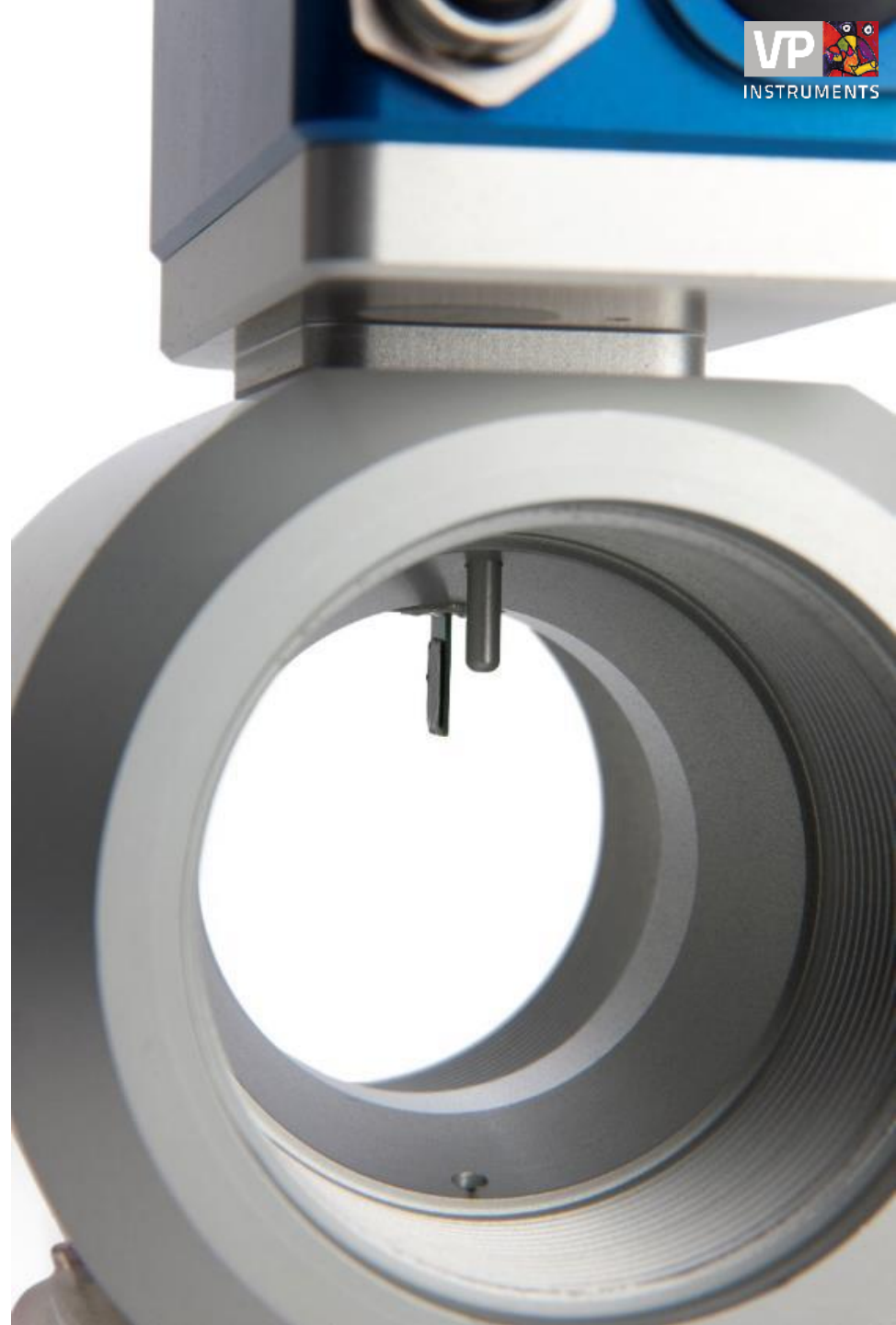
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About the Speaker



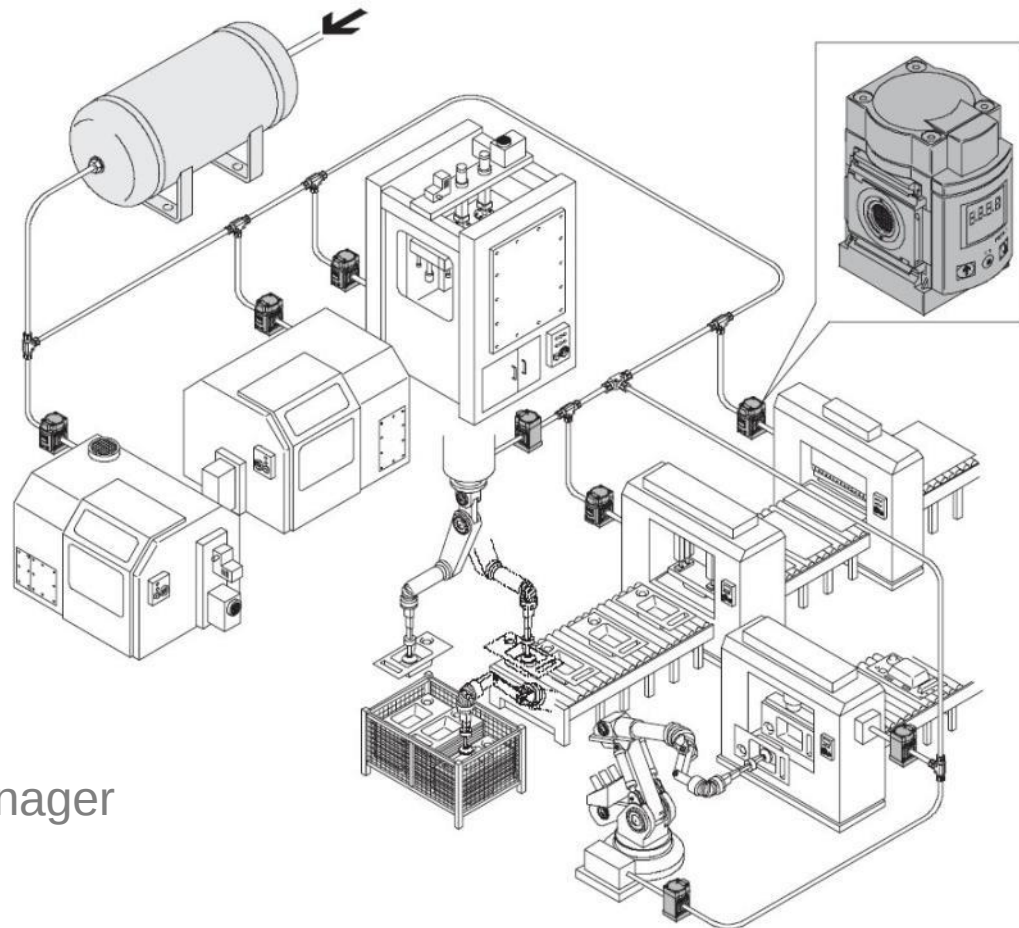
- Product Manager for Festo

Michael Guelker, Festo

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FESTO

Measuring Flow on Production equipment



presented by
Michael Guelker, Product Manager
Festo Corp.

Types of Flow Sensors

Compact

- Application Point-of-use
- Lower flow rates
 - less than 1,000 L/min (35 scfm)
- In-line connection
- May have a display



Modular

- Stand-alone or Integrated into Air Prep unit
- Higher flow rates
 - up to 15,000 L/min (530 scfm)
- Integrated Display
- Additional capabilities



Integrating Flow Measurement into Air Prep units



Integrating Flow Measurement into Air Prep units

Main Applications

Condition Monitoring

- Flow rate
- Cumulative air consumption
- Measure system consumption to allocate costs to production/products

Energy Efficiency

- Leakage monitoring
- Calculation of energy costs
- Production cost controlling

Diagnostics

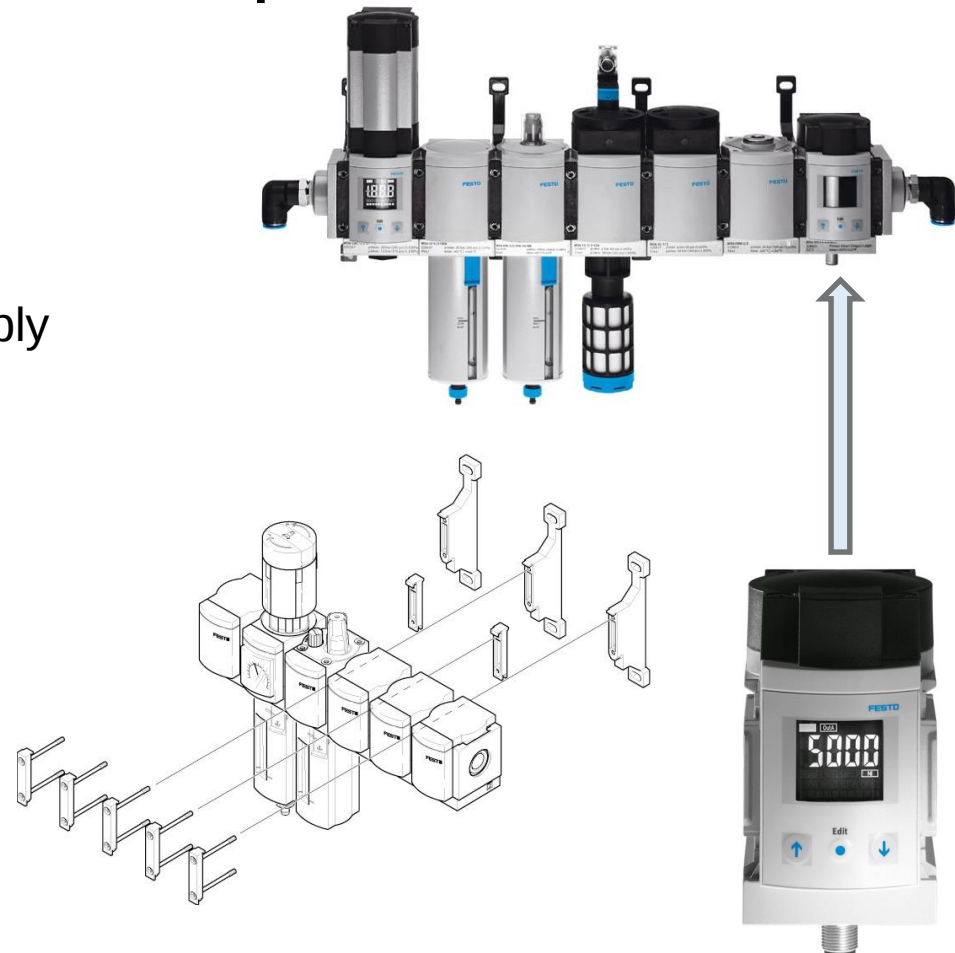
- Process monitoring of system
- Reduce downtime with preventive maintenance
- Manual consumption measurement



Integrating Flow Measurement into Air Prep units

Benefits

- Modular assembly
 - single order code for entire assembly
- Simple to order
 - arrives fully assembled
 - no need to install piping
- Flexibility
 - thread sizes & mounting brackets
- Easy to view/access





Measuring Flow: A Critical Component of any Compressed Air Management System

Q&A

Please submit any questions through the Question Window on your GoToWebinar interface, directing them to Compressed Air Best Practices. Our panelists will do their best to address your questions, and will follow up with you on anything that goes unanswered during this session.

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July 2016 Webinar:
**Common Desiccant Compressed Air Dryer
Sizing Errors**



Hank van Ormer, Air Power USA
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