

### Establishing Best Practice Compressed Air Flows

Sponsored by cdimeters

Featured Speaker: Hank van Ormer, Air Power USA

For your free subscription, please visit <u>http://www.airbestpractices.com/magazine/subscription</u>.



### Handouts







Wednesday March 22 <sup>rd</sup> 2017		— Silver Sponsor —	
10AM-4PM	FREE EXPO ADMISSION TICK		
Thursday March 23 <sup>et</sup> 2017		- Presented by -	
10AM-2PM		- kroner Sponer - 104 + - Featuring	
PENNSYLVANIA			
CONVENTION CENTER Hall E   Philadelphia, PA	Energy/Power, & Facility Mandgement Strategies & Technologies		
	GLOBALCON Conference - Seminars - Workshop	s - Expo www.globalconevent.com	
Discover new products, techniques, solutions,	VIP GUEST OF:	COPIES CAN RE MA IF NEEDED.	
and services Network with industry	5700.0		
professionals To register online (19-49.3)	e, print out additional expo tickets, or for more show informat	ion, including workshops, visit: <u>www.globalconevent.com</u>	
poofessionais To register anim the second	e, print out additional expo tickets, or for more show informat COMPLIMENTARY RAPID EXPO anythefelse is 774 UFM as also COMPLIED WITH Payses, ALL THE Revi an adjust at allotted on Sec.	In the control of the	
professionals. To register online to register online to register sources of the COMENT day while price 2. Provident to Ref. (	e, print out additional expo tickets, or for more show informat complexities to 78 407 497 and and collations 2017 hyping. MC 1988 and complexities to 78 407 497 and and collations 2017 hyping. MC 1988 and the optimal and and the optimal of any data for the complexities and and the optimal model to 2017.	ELEVITE     Construction of the second	
To register online	e, pinto out additional expo tickets, or for more show informat COMPLIMENTARY RAPID EXTERNATION and the state of the state of the state of the state of the state of the state of the state and state of the state of the state of the state and state of the state	Experience of the second	
professionals. To register online WWW 5. delice. Truster of WWW 5. del	e print out additional exporticient, or for more show informat COMPLIATENTARY RAPID EXPO angina faith out allow of the start of the start of the start angina faith out allow of the start of the start of the start of the start angina faith out allow of the start of the start of the start of the start angina faith out allow of the start of the start of the start of the start angina faith out allow of the start of the start of the start of the start angina faith out allow of the start of the start of the start of the start and the start of the start and the start of the start o	Control Contro Control Control Control Control Control Control Control Control Co	
To register online To register online Sector (1998) to the sector of the sector of the sector of the sector of the sector of the sector of the sector of the lad and sector of the secto	e potet out additional expo trickets, or for more show informat COMPLIANCE AND ADDITED ADDITE	Comparing the date of any of the date	
To register online To register online UNITY to a UNITY to a UN	control and additional apport takes, or for more shown information of the second state	Comparing workshop, with envergebioteconstant     Comparing the second sec	
Devicesionals. To register online the device of the devi	a point out additional says taking, or for more above informat COMPLIMENTARY RAPID EXPO To a strange of the last set as a strange of the last set of the last set as a strange of the last set as a strange of the set as a strange of the last set as a strange of the last set as the last set as a strange of the last set as a strange of the set of the last set as a strange of the last set as a strange of the set of the last set as a strange of the last set as a strange of the set of the last set as a strange of the last set as a strange of the set of the last set as a strange of the last set as a strange of the set of the last set of the last set of the last set as a strange of the set of the last set of the last set of the last set of the last set of the set of the last set of the last set of the last set of the last set of the set of the last set of the last set of the last set of the last set of the set of the last set of the last set of the last set of the last set of the set of the last set of the last set of the last set of the last set of the set of the last set of the set of the last set of the set of the last set of the last s	top including workshops with <u>manufally</u> however, the provide the second of the s	
professionals.     To register conline     To register conline     With the Addate Negative for the Addate     With the Addate Negative for the Addat	c port out additional apport location, or for more above information of the second sec		
Dordesionals.     To register collect     the collection of the collectio	a port out additional apport (starts, or for more above information of the start out additional apport (starts, or for more above information of the start out additional apport (starts, or for more above information of the starts, or formation of the starts, or form	top including workshops, with <u>meansibility too one</u> The and the set of the one of the set	
Professional:	control additional apporticity, or for more above information of the control of t	Constraints of the second	
protestandi. To registre califie To the spectre califier To the spectre califi	spetra and additional rape tables, or for more above information of the second	Boy Including workshops, with annualization of the second se	





All rights are reserved. The contents of this publication may not be reproduced in whole or in part without consent of Smith Onandia Communications LLC. Smith Onandia Communications LLC does not assume and hereby disclaims any liability to any person for any loss or damage caused by errors or omissions in the material contained herein, regardless of whether such errors result from negligence, accident, or any other cause whatsoever.

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



### Establishing Best Practice Compressed Air Flows

### Introduction by Rod Smith, Publisher Compressed Air Best Practices<sup>®</sup> Magazine

For your free subscription, please visit <u>http://www.airbestpractices.com/magazine/subscription</u>.



### About the Speaker



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

Sponsored by cdimeters

Hank van Ormer, Air Power USA

For your free subscription, please visit <u>http://www.airbestpractices.com/magazine/subscription</u>.

## Establishing Best Practice Compressed Air Flows – Measuring and Monitoring to the Manufacturing Processes

Air Power USA – Hank van Ormer February 22, 2017



## Introduction

- Every production process has an optimum set of operating conditions
  - Specifically flow, pressure and in some cases relative humidity
- Pressure and flow are related and supplying "extra pressure" to any process will create immediate excess flow – which increases the energy cost to produce the air at a higher pressure. The process uses more volume (scfm) with no increase in productivity – This is often called **ARTIFICAL DEMAND**

## **Energy Cost of Compressed Air**

Example: 100 psig / \$.06 kWh / 8,000 hours per year

Compressed air with a typical single-stage lubricant-cooled rotary screw air compressors is calculated as follows:

- 1 scfm = ± @ \$100 / scfm year
- $1 \text{ psig} / 100 \text{-hp} = \pm \$160 \text{ year}$

A change in air compressor input energy only occurs when there is an actual compressor discharge pressure change at the compressor – **not the system pressure**.

## **Artificial Demand at the Process**

## Excess pressure in the system and / or to the process will create extra flow wherever it occurs.

- This excess is often termed "artificial demand"
- Increase in flow (100 psig class) about 1% per psig change up or down
- For a process that takes about 500 scfm -

Extra air volume at +10 psig = 50 scfm or \$5,000 year

Extra input energy at +10 psig discharge pressure = \$1,600 year

## The extra flow generated by the extra pressure is much **MORE** expensive than the extra energy to produce the pressure!

Measure, monitor, and control the pressure and flow to each air using sector and air using process.

The net result:

- Operate in the most energy efficient manner
- Improve productivity and product quality reduce scrap
- Establish solid baselines for effective benchmarking
- Establish critical "red flags" for each process to assure "Best Practice Flow"

### 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?
- What is the operating pressure at rest and at cycle?
- Who monitors and how?

### **Measure and Monitor the Total System**

## Measure and monitor flow to separate production sectors and buildings



### **Measure Flow to Each Independent Process**

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 and flow.



## **Typical Process Applications**

### **Dust Collectors –**

Installed without adequate storage ran for years with continuing problems

- Pressure differential control when used created:
  - Short bag life
  - Poor filtration
  - Interrupted process

#### Uncontrolled use - 146 scfm / \$14,600 yr.



## **Dust Collector – Solution and Result**

### Installed flow meter identified the problem

Storage to control pressure drop with flow meter installed permanently ahead of new storage receiver.

Pressure differential control now works

- Bag life 3 to 4 times longer @ \$10K annual savings
- Filtration always within regulation level
- Nearby process No ISSUES
- Controlled air use 49 scfm / \$4,900 yr.

Total annual energy savings: \$9,700 Red flag when valves stick!



#### Independent and Brand Neutral

Lowpressure entry auto

shutofuale

#### airpowerusainc.com

## **Identify System Dynamics**

### **Example: PET Blow Molding**

Due diligence is required along with measurement. Identify (calculate) the blow mold operating demand.

Blow Mold Line / Model	#1 SBO30 (24 oz) 48,000 bph	#3 SBO20 (2 Liter) 22,000 bph	#2A SBO20 (20 oz) 30,000 bph	#2B SBO20 (20 oz) 30,000 bph
Blow Air (scfm) 32 Bar	1007	1042	524	524
Pre-blow (scfm) 7 Bar	406	184	208	208
Stretch (scfm) 7 Bar	270	474	180	180
Service(scfm) each 7 Bar	125	100	100	100
Air Required at 464 psig / 32 Bar (scfm)	1007	1042	524	524
Air Required at 100 psig / 7 Bar (scfm)	801	836	488	488
Total Delivered at 464 psig / 32 Bar (scfm)	1808	1878	1012	1012
Projected Blow Air Recovered (scfm)	(403)	(416)	(210)	(210)
Projected Maximum High Pressure of Air Use (scfm) with Recovered Blow Air	1405	1461	802	802

### **Identify System Dynamics**



Blow Mold Line	Calculated SCFM	Measured / Actual SCFM			
#5	1,405	1,380			
#4	1,461	1,390			
<b>#2A</b> *	802 1,100				
#2B*	802 1,100				
*Net flow includes 40% blow air savings per blow					
mold OEM (manufacturer) specifications.					

Flow measurement graph indicates blow mold lines 2A and 2B are consistently using more than the calculated demand

## **Identify System Dynamics**

## A more refined look using 5-second data points for flow and pressure.



Average demand from blow mold lines 2A and 2B is about 2500-2700 scfm. Minimum pressure to blow mold lines – 470 psig With both units running the entry pressure to the blow mold falls to **LESS** than 400 psig.

### **Identify the Cause – Additional Refinement**

## Trended pressure data – 1 second intervals – before and after the dryer/ filter



### **Observation:**

This occurred with 3 blow molds on and when one stopped. The blow mold restarts up to full demand in about 1-minute – the compressor took about 3-minutes to go from full idle to full load – during that time the pressure falls – often causing poor quality product and potentially unplanned shutdowns.

### **Calculate & Identify Proper System Storage**

# Calculated proper storage was added to the total system and at the entry to each blow mold and the problem was resolved.

Operating KPI's for pressure and flow were created and monitoring instruments installed – data trended, collected and analyzed with vast improvements.

- Monitor pressure and flow to each blow mold
- Compare to calculated and established values



#### Independent and Brand Neutral

#### airpowerusainc.com

### **Industrial Sandblasting**

- Perceived to be "inexpensive to operate" and only uses "compressed air" and reusable media
- Air use depends on pressure, nozzle type and size and **BLAST** time
- All of this adds up to what is the total average flow per minute - scfm



### **Opportunity – Automatic Blasting Cabinets**



A nozzle has the most effective removal with the proper media.

As the nozzle wears larger – it uses more compressed air with less effective removal -- therefore is in BLAST mode longer.

- All nozzles blasting air when not all are used.
- Nozzles left on with no parts to blast. Operator off site waiting for next job – working on something else.
- Automatic blasting cabinets exacerbate this situation.
- Old nozzles well-worn continue in use..."they still work".
- What is the magnitude of these opportunities?

### **Cost Analysis and Solution**

#### Example:

Blasting with two, #5 (5/16") "new" ceramic nozzles at 80 psig Air use is 137 scfm at 35% utilization Annual operating cost =  $$13,700 \times .35 = $1,795 \text{ year}$ 

As the nozzle wears to 3/8" at 80 psig – the air use climbs to 196 scfm and the blast time increases from 35% to 48% due to pattern deterioration. New annual operating costs =  $$19,600 \times .48 = $9,408 \text{ year}$ 

#### Solution:

A flow meter installed on the airline tied into an alarm switch is set to alert operators at 150 scfm (10% increase). This system worked to inform operators of nozzle wear and potential pattern deterioration before it occurred. Also alarms when air is on and no product is present.

### Summary

### **MEASURE FEED LINES TO PRODUCTION PROCESSES**

Measure and monitor air use

- Flow in scfm
- Pressure lowest effective psig /Bar
- Identify total leaks when operating and at rest
- Establish optimum air use per process set as "red flag"
- Monitor and/or "red flag" significant only pressure during cycles
- Dewpoint if critical

### **Trend and Collect Data**



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

### **Connect Back to Supply-Side Controller**

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

Flow

kW/Energy

Production levels

- 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.

- 100,3.0%

Independent and Brand Neutral

10.0

#### airpowerusainc.com

# Thank you for the opportunity to present.

Air Power USA Hank van Ormer – Technical Director (740) 862-4112 / airpowerusainc.com





### About the Speaker



•Spent 20 years in energy consulting before founding CDI Meters, Inc.

•His first flow meter, the CDI 5200, was introduced in 2002.

Roger Dennison, CDI Meters

### cdimeters

For your free subscription, please visit <u>http://www.airbestpractices.com/magazine/subscription</u>.

## Application of Clamp-On Insertion Flowmeters

Roger Dennison-CDI Meters, Inc. February 22, 2017



## **Thermal Mass Flowmeters**

- Meter mass flow of air
- Sense heat dissipation
- Little sensitivity to pressure
- Temperature compensated



## Limitations

- Not for use where water droplets present
- Do not indicate direction of flow



## **Clamp-On Insertion Design**

- Separate probes
- Small holes in pipe
- Gasket to seal
- Easy installation





## Range of Application and Required Adjustments

- Temperature: 20 to 120 degrees F
- Pressure: 0 to 650 psig; consult CDI above 200 psig
- Adjustments for pressure or pipe area may be required
- Most installations require no adjustment



## Locating the Meters

- Ample upstream pipe
- Think visibility
- Avoid fittings that distort or concentrate the flow



## Challenges



## Challenge: System Can't Be Shut Down

- Seasonal shutdowns only
- Scheduling constraints of auditors

## The 5450 Hot Tap Meter

- Installs without system shutdown
- Same electronic and sensing technology as our standard meters
- Quick and easy to install



































## Challenge: Costly Wiring

- Wiring can be as costly as meter installation
- Requires an additional trade



## **Wireless Data Collection**

- Radio boards mounted inside meters
- Ethernet-connected gateways
- ZigBee® mesh networking extends range
- Host either
  - Factory automation system or
  - PC running MeterGrapher software provided by CDI



## Challenge: Metering Compressor Output

- Verify compressor output
- Compare dryer input and output
- Thermal meters not suitable because of water droplets



## **Coming: CDI Target Meter**

- Senses force of moving air
- Suitable for moisture-laden air leaving a compressor
- Flow, pressure and temperature available through digital output
- Field trials under way



## CDI Meters, Inc.





## **Thank You**





### Thank you for attending!

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

PDH Certificates will be e-mailed to Attendees within two days.

Sponsored by



For your free subscription, please visit <a href="http://www.airbestpractices.com/magazine/subscription">http://www.airbestpractices.com/magazine/subscription</a>.



#### March 2017 Webinar: Blower Demands with DO Control



**Tom Jenkins, JenTech Inc.** *Keynote Speaker* 

Wednesday March 15, 2017 – 2:00 PM EST

Register for free at: <u>www.blowervacuumbestpractices.com/magazine/webinars</u>