

# COMPRESSED AIR BEST PRACTICES

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December 2016

## Central Compressor Controls



- 10 Compressed Air Central Controller Delivers 5 KPI's
- 18 Permanent Compressed Air System Metering and Monitoring
- 30 Control Improvements at Forge Plant Make Big Impact

24 2016 WEEC:  
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# SUSTAINABLE MANUFACTURING FEATURES

**10 Compressed Air Central Controller Delivers 5 KPI's**

By Don van Ormer, Air Power USA

**18 Permanent Compressed Air System Metering and Monitoring**

By Jan Hoetzel, Airleader Compressor Management USA

**24 Show Report  
2016 WEEC: Chiller & Compressed Air Control Technology**

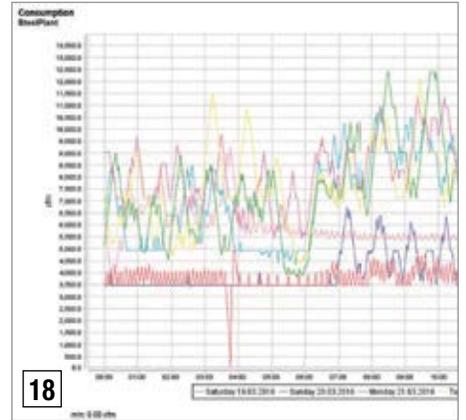
By Rod Smith, Compressed Air Best Practices® Magazine

**30 Control Improvements at Forge Plant Make Big Impact**

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# FROM THE EDITOR

## Central Compressor Controls



Six rotary screw air compressors are working at partial loads independently of one another. They are located in two air compressor rooms, send the compressed air to the same storage tanks, and one system has a dryer while the other doesn't. Sound familiar? Don van Ormer, from Air Power USA, kicks off this issue providing an example of how central compressor controllers, properly informed by instrumentation, can improve air compressor reliability, air quality and energy efficiency.

Our second article, provided by Airleader's Jan Hoetzel, examines the benefits of permanent compressed air system metering and monitoring. He provides an example of a two-stage audit, at a factory with more than 10,000 cfm, where stage one included a master controller, energy-efficient dryer and VFD air compressor. After two months of accumulating data, the master controller then helped uncover a massive volume of leaks whose repair quickly became the focus of phase two.

Metaldyne Performance Group runs a forge plant in Columbus, Ohio. With the help of their service provider, IAC Air Compression, MPG has implemented some innovative control on their existing air compressors, added new air compressors with variable capacity control, and tied everything together with a modern central controller. IAC's Steve Briscoe and Ron Marshall tell the story.

The 2016 World Energy Engineering Conference gave me my annual dose of "tackling fuel" and fill of stories of the amazing progress and projects performed by Industrial Energy Managers. I hope you enjoy my Show Report on this and also on the 2016 International Woodworking Show where vacuum systems run the show (in my mind). At IWF we report on the real progress being made, in rough vacuum optimization, as this industry begins using VSD technology and centralized system designs.

Thank you for investing your time and efforts into **Compressed Air Best Practices**®.

**ROD SMITH, Editor**  
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## Edgetech Introduces Certification Services, Replacement Sensors, and Rapid Response Customer Service

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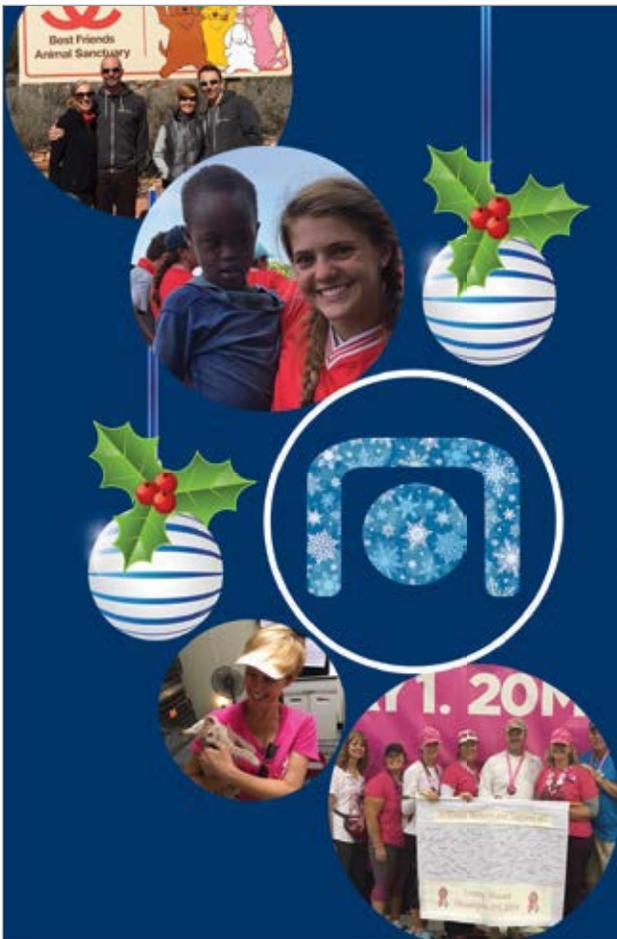
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## INDUSTRY NEWS

### VPInstruments in Top 10 of Small Business Innovation Top 100

VPInstruments gained 9th place of the “MKB Innovatie” (small business innovation) top 100 awards on September 29, 2016 with their latest product, the VPFlowScope M. VPInstruments offers innovative and user friendly measuring and monitoring equipment for compressed air and technical gases.

The new design comes as two interconnecting modular elements: the transmitter (the “head”) and the VP Sensorcartridge® (the “probe”). The old-fashioned way of submitting an entire instrument for recalibration has been abandoned; instead the sensor cartridge is simply replaced by a new one when the time comes, this is in fact cheaper and far less time consuming than



*Delft, VPInstruments gained 9th place of the “MKB Innovatie” top 100 awards with their latest product, the VPFlowScope M.*

going through the whole calibration process. Not only does this mean the lowest possible Total Cost of Ownership, but users also benefit from zero down time in the field, ergo no loss of data.

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# COMPRESSED AIR CENTRAL CONTROLLER DELIVERS 5 KPI'S

By Don van Ormer, Air Power USA

► Quite often the typical variability in compressed air flow demand does not proportionately translate into power reductions at the air compressors. This can be a result of numerous problems with the compressed air supply system. It is important to understand the supply-side's ability to respond to the demand-side of the compressed air system. If the air compressors, on the supply-side, are not able to translate flow reductions into

energy savings, implementation of demand reduction projects should be re-evaluated.

How often are products pitched to plant personnel and touted as energy-saving because they can reduce the use of compressed air in terms of flow (scfm) and/or pressure (psig)? There are many very valid products and techniques (which we deploy during our audits) able to reduce compressed air demand requirements.

Reducing compressed air use, however, will not turn into energy-savings at the air compressors in a large percentage of installations we visit. Why? There are many potential reasons. The air compressors may not have the local controls permitting them to use less energy at partial loads. Or, the air compressors may be working simultaneously – all at less than optimal points in their efficiency curves.



**“Compressed air demand is always changing in plants. This is why the use of a central controller for the system can deliver high ROI's with benefits extending to reliability and compressed air quality enhancements.”**

— Don van Ormer, Air Power USA



Compressed air demand is always changing in plants. This is why the use of a central controller for the system can deliver high ROI's with benefits extending to reliability and compressed air quality enhancements. A central control system is able to automatically respond to changes in compressed air system dynamics and provide the plant with Key Performance Indicators.

**The “Norm” is Multiple Air Compressors Working Individually**

Here are our notes from what is a typical discovery process at an audit. We start with finding two air compressor rooms and begin figuring out what's going on. Compressor Room #1 has several air compressors available for use to meet production demand. There are three 150-hp class single-stage lubricated rotary screw air compressors from two different manufacturers. One unit is air-cooled and two are water-cooled. The most efficient unit, Compressor #6, is used primarily as a back-up in case Compressors #1 or #2 goes down for repair. Compressor #6 is approximately 15% more efficient at full load than either Compressor #1 or #2. This unit, however, is quite old and its' reliability is questionable.

Air Compressor Room #1 has two refrigerated dryers. One is an older refrigerated dryer from Brand “D”, rated for 1600 scfm. This unit was turned off and valved out. The second unit is a Brand A refrigerated dryer, sized for 870 scfm, and left to handle the total air flow from the air compressors. This dryer works for the current demand profile, but is vastly undersized should the full capacity of this compressor room be utilized.

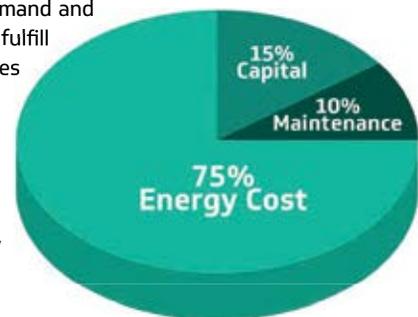


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## COMPRESSED AIR CENTRAL CONTROLLER DELIVERS 5 KPI'S

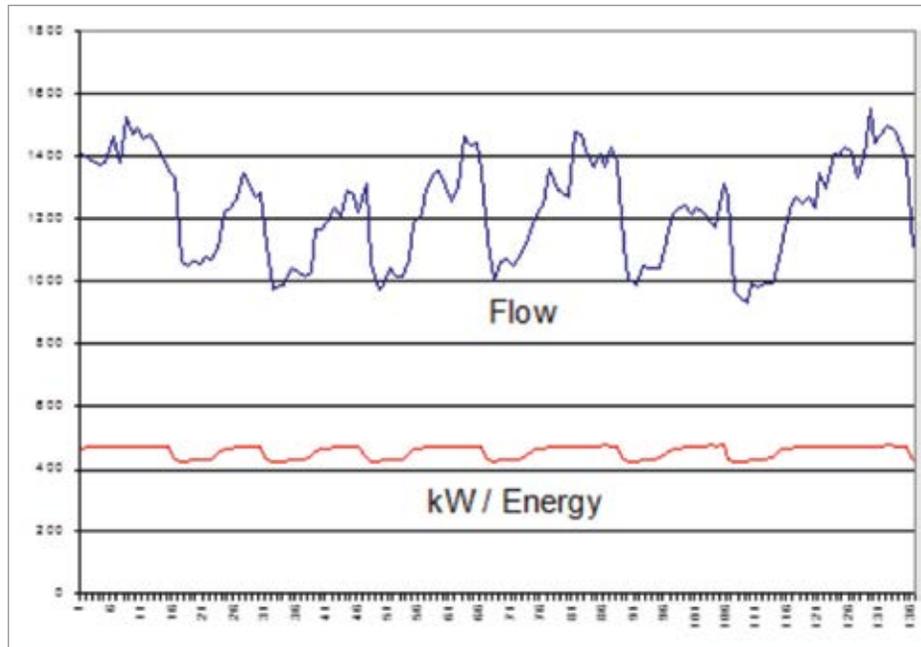


Figure 1: A common problem-this graph shows air compressors using roughly the same amount of energy, no matter what amount of compressed air flow is required.

Air Compressor Room #1 has a single 900-gallon receiver installed next to the dryers and a single point entry 1,060-gallon receiver located outside the compressor room, mounted horizontally on the wall. The single point entry setup does not work effectively to supply the system with storage.

Air Compressor Room #2 has three single-stage rotary screw air compressors; a 75-hp class and a 50-hp class from Brand A and a 75-hp class from another brand. During our site visit, all of the compressors were running at some time with the 50 and 75 horsepower units from Brand A cycling on and off as needed. A Brand A sequencer was installed but had been deactivated – so the air compressors were all operating on local controls. All of the air compressors are operating in online / offline control.

There are no compressed air dryers in Air Compressor Room #2. All the compressed air leaving this area is saturated with moisture and mixes with the dried air leaving Room #1. There are no filters installed to remove oil or solid particulates. Saturated compressed air is sent from Room #2 to the receiver tanks located in Room #1.

All of these single-stage rotary screw air compressors use two-step controls. Two-step unloading is where the air compressor is fully loaded or unloaded (idling) - without actually stopping and starting the compressor, so there is no motor heat buildup problem. To work well, this type of control requires 3 to 5 gallons/scfm of effective storage. This control strategy is also known as load/unload or online/offline. The most important variable here is the blow-down cycle – how long does it take to reach idle (in seconds) after switching to unloaded?

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**The “Norm” is System Dynamics are Always Changing**

The one thing you can count on, from a compressed air system, is that tomorrow will be different from today. The system requirements will likely be dramatically different 1 year from now. This means compressed air flow (cfm) requirements may be higher. Perhaps a new production line was added. Perhaps three 1/2" leaks blew open, tucked away under some production equipment, and no-one has detected them. Perhaps flow requirements are lower due to a loss of business or an excellent compressed air leak survey (and repair). Perhaps the plant energy engineer has successfully reduced plant pressure from 110 to 90 psig by isolating one

ROOM	SINGLE-STAGE ROTARY SCREW AIR COMPRESSORS ALL USE TWO-STEP CONTROLS- EXCEPT FOR #6 WHICH IS VARIABLE DISPLACEMENT	FULL LOAD		ELECTRIC DEMAND		BASELINE AIR FLOW	
		DEMAND (KW)	AIR FLOW (SCFM)	% OF FULL KW	ACTUAL KW	% OF FULL FLOW	ESTIMATED FLOW
#1	Brand A Air Compressor #1	129.3	598	48%	62.6	33%	200
#1	Brand A Air Compressor #2	125.3	598	83%	103.5	63%	376
#2	Brand A Air Compressor #3	61.0	294	64%	38.8	28%	82
#2	Brand A Air Compressor #4	43.6	188	23%	10.0	15%	28
#2	Brand B Air Compressor #5	65.7	306	16%	10.4	10%	30
#1	Brand C Air Compressor #6 – older variable displacement unit reserved for back-up	123.8	684	0%	0.0	0%	0
<b>Total</b>					<b>225.4 kW</b>		<b>716 cfm</b>

Table 1: A typical scenario-five air compressors working on their own do not optimize energy efficiency opportunities and can lead to reliability issues.

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## COMPRESSED AIR CENTRAL CONTROLLER DELIVERS 5 KPI'S

COMPRESSED AIR SYSTEM KEY PERFORMANCE INDICATOR	PRODUCTION DAYS	WEEKEND DAYS
Average system flow (scfm)	716	178
Sustained peak flow (scfm)	1,202	309
Average system pressure (psig)	110	110
Input electric power (kW)	225.4	53.2
Operating hours of air system	7,252	1,508
Annual electric use (kWh)	1,634,377	80,166
Average specific power (scfm/kW)	3.18	3.35
Pressure Dew Point	55°F	38°F
Annual electric cost (\$)	\$130,750	\$6,413

Table 2: These are the Key Performance Indicators we measured manually when we visited this plant. An instrumented master controller will provide this information year-round.

guilty high-pressure user and servicing it with a booster. Whatever the future might hold, one must plan for change.

The system described was running multiple air compressors in part load conditions. This was partially due to piping restrictions. Once the piping is reconfigured, the set points can be cascaded in a manner that will operate fewer units unless otherwise required by the compressed air system. A central control system will help ensure proper set points are maintained.

Pressure dewpoint was not monitored. During production days, we measured an elevated dewpoint due to the mixing of treated and un-treated compressed air from the two air compressor rooms. During the weekend, the pressure dewpoint dropped to 38°F as the compressed air came only from Air Compressor Room #1. A central compressed air controller will monitor and report any variations from the compressed air quality specification – triggering corrective actions.

### Air Compressor Data Required to Evaluate the Supply-Side Project

Supply-side projects will increase the overall efficiency at which compressed air is delivered to the plant. The decision of whether or not to add a Central Control System will be reached after evaluating the pre-project power consumption, as shown in this article, prior to implementing any of the supply side projects. Second, the most likely post-project compressor operation pattern is established by considering:

- Which compressors are regularly available for operation and which are getting old
- Their individual full load capacities and specific powers



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- The likely idle time at an unloaded power level before being fully turned off
- The pre-project load demand profile.

### Benefits of a Central Compressed Air Management and Monitoring System

A central compressed air management system offers several advantages, the primary being to improve air compressor specific power (kW per cfm) by ensuring the constant optimum air compressor selection and the elimination of excessive pressure loss. A central compressed air management system can also:

- Establish and monitor proper compressed air quality throughout the system
- Reduce average compressed air demand by implementing the myriad of air conservation programs and monitor the actual demand levels on a continuing basis

A central control system will allow fewer air compressors to operate at a given time as well as smoothing out the air produced by the compressed air system.

In the example given in this article of the two air compressor rooms with six air compressors, the projected improvement in specific power (at the same demand with the same compressors on-line) is from the current 3.17scfm/kw (716 scfm/225.4 input kw) to a projected 3.76 scfm/kw (716 scfm/190.3 input kw). An improvement in compressed air efficiency of about 16%. This would yield a projected electric operating cost savings of \$21,000 to \$22,000 per year.

Without considering other savings such as lower maintenance costs and repair costs - this is a 24 – 27 month simple payback. These type monitoring and control systems can be added in steps over time to lessen the annual capital investment over time. This project will also allow any reduction in compressed air demand to generate a commensurate reduction in input energy.



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## COMPRESSED AIR CENTRAL CONTROLLER DELIVERS 5 KPI'S

### Instruments Deliver 5 Key Performance Indicators

A compressed air monitoring system will enable the plant to track air system performance and energy efficiency levels on an ongoing basis so energy savings achieved in the proposed projects can be maintained over time. The primary elements of such a monitoring system such as the location of recommended flow, kW, and pressure meters are listed below. At installations such as the one we've profiled in this article, we also review where to install monitoring points in the air compressor room(s) and in the factory to optimally control the air compressors with a central control system. The Key Performance Indicators to monitor are pressure, flow, dew point, and individual compressor power.

The recommended elements instruments, for this project, to support a comprehensive monitoring system included:

- (6) kW demand meters on each individual compressor — \$1,500 each for a total of \$9,000
- (12) PSI transducers (7 in the compressor room and 5 out in the plant)— \$200 each for a total of \$2,400
- (1) Compressed air flow meter — \$3,000 each
- (1) Dew Point Demand Meter — \$2,500 each
- (2) Data Integrators — \$5,000 each for a total of \$10K

The total price tag for the monitoring system equipment was \$26,000. Installation cost were projected at \$20,000 for a total cost of \$46,000. This instrumentation would then provide the Central Compressor Control System with the information required to deliver these Key Performance indicators:

1. Flow levels over time (e.g., upward trends could indicate increased leak levels)
2. Individual compressor kW readings (e.g., upward trends could indicate compressor malfunction)
3. Basic System Efficiency over time — Specific Power defined as Flow / Total kW demand (e.g., upward trends indicate loss in efficiency)
4. Dew Point Levels (e.g., upward trends indicate increased moisture levels and possible air treatment equipment malfunction)
5. System Pressure (e.g., erratic pressure levels could indicate insufficient air supply capacity; excessively low levels could be harbingers of production equipment failure)

### Conclusion

Compressed air systems are dynamic – they are always changing! Central control systems, supported by instrumentation and an understanding of the individual air compressors, can automatically respond to these dynamic conditions and ensure optimal performance. Key Performance Indicators can be selected and then the performance can be managed with once-a-year “check-up” reviews ensuring the system is maintained optimally. **BP**

For more information, contact Don van Ormer at don@airpowerusainc.com or visit [www.airpowerusainc.com](http://www.airpowerusainc.com)

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## Measure | Manage | Improve

# Permanent Compressed Air System METERING AND MONITORING

By Jan Hoetzel, Airleader Compressor Management USA

► Optimal compressed air system performance, defined by efficiency, reliability and air quality, has now become the main goal when operating, installing, purchasing or designing compressed air products. Whether you are the air compressor manufacturer, distributor or end user - everyone in the compressed air industry needs to be aware and work towards these goals.

## Baselines Developed by Permanent Monitoring vs. Temporary Compressed Air Audits

Rapidly rising energy costs, tough economic times and the need to reduce costs are factors impacting all businesses operations. This is driving a wave of demand for energy reduction measures and technologies. Compressed air systems, a very expensive utility, have become

the first target for energy reduction measures in most industrial facilities today.

“Free” sales-based audits have become readily available, in the compressed air industry, from many organizations pushing product sales. How reliable are the results and recommendations from these free audits lasting a maximum of ten days? What is the



“Compressed air systems, a very expensive utility, have become the first target for energy reduction measures in most industrial facilities today.”

— Jan Hoetzel, Airleader Compressor Management USA

actual value to the bottom line for an end user? These are the questions typically raised surrounding free audits. Since free doesn't exist, what's the catch? Do factories have another option? Yes, they do.

Airleader is heavily involved in compressed air audits, working with several utilities in the United States and in other countries around the world. For larger compressed air systems, we recommend the utility providers spend the extra incentive money to invest in a permanent monitoring system - rather than ten days of temporary metering for an audit. A permanent monitoring system can provide a very solid baseline, developed over several weeks or months. It also allows one to examine and quantify various metrics such as weekend leak rates, and different loads based on many more production day profiles. Creating a more robust baseline profile allows an audit to better identify several corrective measures such as storage, piping changes, control systems or leak repair - and precisely quantifying the ROI for each measure and prioritizing them with budgets or timelines.

### An Audit Process Using Two Months of Data

We recently performed a compressed air audit at a large manufacturing facility running several large air compressors at two separate locations in the plant. Metering equipment was installed including kW meters, flow meters and pressure sensors throughout the facility. A thorough leak audit for the whole facility was also performed. The audit process took just under two months to collect the data, find the system inefficiencies and make the proper recommendations.

The compressed air audit report was presented to the client identifying substantial

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Gerald "Gerry" Bauer  
President, EccoFab - Rockford, IL

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## PERMANENT COMPRESSED AIR SYSTEM METERING AND MONITORING

inefficiencies due to poor piping, improper control of the air compressors, excessive unloaded compressor times, huge amounts of air leaks, and to everyone's surprise, the discovery that the system runs on two different pressures as the systems are separated via underground piping networks. As one can imagine, getting to the bottom of a system like this was going to be a massive undertaking. It would need to be done in stages, using a tremendous amount of instrumentation.

The first measure had to be a master controller. With the master controller, we would then be able to control the compressors and correlate the data collected to production demands and leak loads. Stage one included the master controller, large air receivers, a large energy efficient compressed air dryer and

a large VFD air compressor to trim the base loaded units. Once the system was installed the savings were immediate, unloaded air compressor power went from 70% to 15% while decreasing the motor cycles - saving the motor and bearing life of the air compressors.

### Five Months After the Audit

With proper control of the compressed air system now in hand, we began the task of identifying further measures through the data collection system and permanent metering installed. This quickly identified a leak rate >50%, which on a system consuming more than 10,000 cfm at times, is a massive volume of leaks. We identified the leak rate by correlating flow rates during down-time on Sundays and Saturday off shifts. This data

was compared to the data from the kW meters (on the air compressors) which allowed us to build a proper ROI for the client. Without the permanent metering, we would have had no way of accomplishing this task. The plant, however, needed to understand the data to believe in the project.

I remember coming back to the site, five months after the audit, to do some customer training on the master controller. Just as I getting ready to leave, I was told I had to wait for their system analyst to come down. I asked the maintenance manager, "What analyst?" He responded saying the analyst was from the accounting department but he didn't know what the analyst wanted. Soon the gentleman arrived, carrying some printed graphs from the monitoring system, similar to graph 1. He asked me, "Can I trust the data provided from your system?" I looked at the data and said, "Yes you can, why do you ask?"

The analyst was shocked that on Sundays, when the plant was closed, the flow rate was 3500 CFM and even more shocked when he realized that the plant leaks the same amount 365 days a year. The next question from the Analyst was, "How can you confirm this is the correct flow rate?" I then used the kW data, to show that yes, three air compressors were running loaded - again confirming the leak rates were correct.

We printed the weekly performance table (table 1) and a weekend day performance table (table 2), allowing us to perform the following calculations.

Leakage = 16,789 kWh (Saturday to Friday) = 117,523 kWh / week

Total Air Demand (Saturday to Friday) = 206,666 kWh/ week

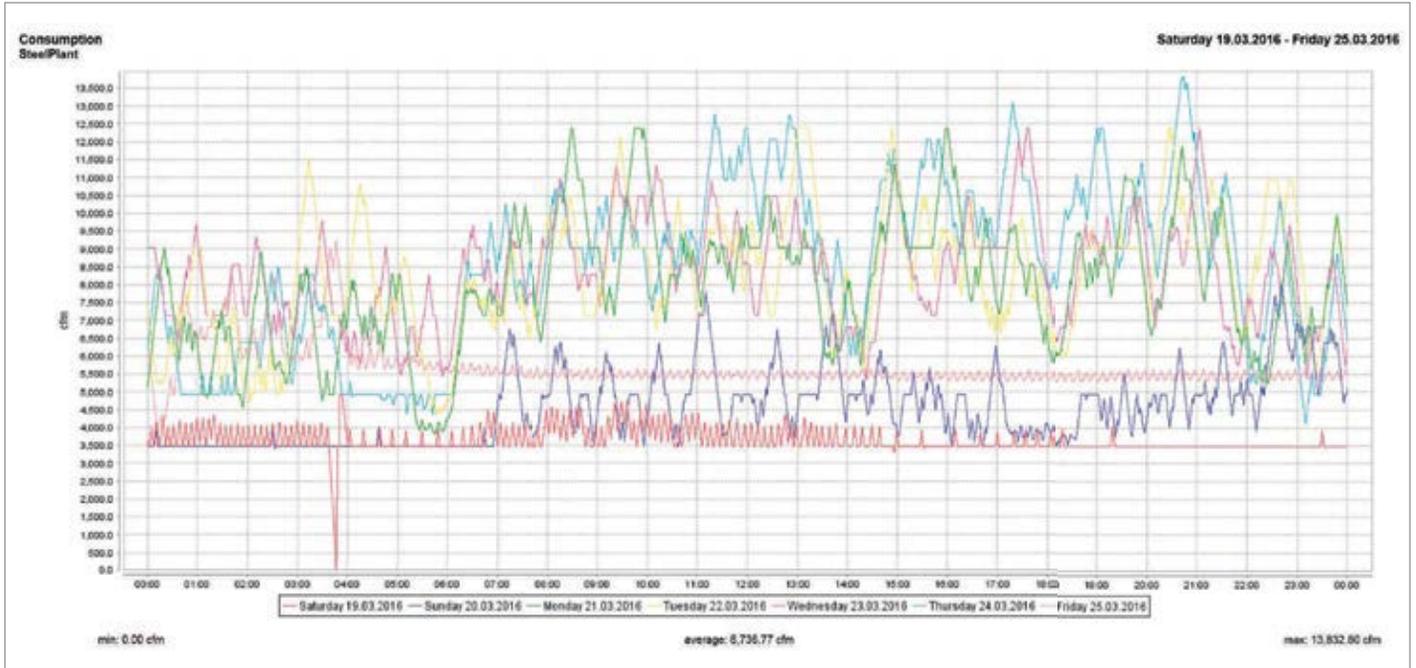
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Metering and Monitoring of Compressed Air Flow

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- At 10 cents/kWh = leaks represent US \$611,120 annually

Within a few weeks of our conversation, a plan was in place to install multiple flow meters and pressure sensors throughout the facility to find the losses in the vast piping network. Identifying the leak losses of 6.1 million kWh triggered the immediate installation of the sensors, which through the webserver software on the master controller, allowed the client to identify the areas of the plant that should be targeted for leak repair first. Using the tools now available to the Client, a long-term leak prevention strategy is in place by setting limits to the flow across the flow meters triggering an email or alarm if the flow (CFM) should start to climb beyond the existing “best practice” values.

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# PERMANENT COMPRESSED AIR SYSTEM METERING AND MONITORING

COMPRESSOR DATA AND ENERGY CALCULATION															Saturday 19.03.2016 - Friday 25.03.2016										
system rated capacity:		17.98908 kW/(100cfm)					S&Wh: 0.10 S&Wh					load costs:		90.80 %											
efficiency:		0.29948 kWh/100cf					P-min: 101.0 psi					unload cost:		9.29 %											
costs:		0.02995 \$/100cf					P-max: 106.0 psi					total costs:		20,666.63 \$											
channel	compressor	cfm		load kW		kW		load		unload		average %		cycles		compressed air			total kWh			system rated capacity	total costs \$		
		min	max	min	max	unload	h	min	h	min	h	min	load	motor	load	cf	load	unload	total	load	unload		total		
01	LP #1		1,899.0		312.10	87.40	71	12	14	6	83.5	24	46			8,112,528	22,276.8	1,294.6	23,571.4	17.43331	2,227.68	129.46	2,357.14		
02	LP #2		1,899.0		318.00	88.90	44	17	30	38	59.1	50	102			5,045,643	13,980.6	2,954.8	16,935.4	20.13866	1,388.06	295.48	1,683.54		
03	LP #3		1,899.0		316.10	86.00	52	5	11	44	81.6	43	57			5,934,375	4,129.9	1,067.9	5,197.5	5.25527	412.99	106.79	519.78		
04	LPE #4		1,899.0		314.60	86.40	58	41	29	53	86.3	47	114			6,686,379	17,658.2	2,789.2	20,444.4	18.34574	1,785.62	278.62	2,064.44		
05	LP #5		0.0		316.20	86.10	0	0	0	0	0.0	0	0			0	0.0	0.0	0.0		0.00	0.00	0.00		
06	LP #6 VSD	432.0	2,032.0	66.40	325.00	95.00	167	58	0	0	100.0	0	2			12,505,244	32,421.1	0.0	32,421.1	15.56561	3,242.11	0.00	3,242.11		
07	LP #7		1,449.0		266.80	57.10	143	35	15	5	90.5	8	122			12,483,135	39,014.3	1,152.5	40,166.8	19.30909	3,921.43	115.25	4,036.68		
08	LP #8		1,449.0		277.50	66.70	165	45	2	14	98.7	1	32			14,410,305	46,517.4	163.8	46,681.1	19.02020	4,561.74	16.38	4,668.11		
09	LP #9		1,449.0		262.10	91.10	44	3	58	39	42.9	53	280			3,829,707	12,657.5	9,590.8	22,248.3	34.85633	1,285.75	959.06	2,224.83		
SteelPlant												sum total		226	755	69,007,316	187,855.8	19,010.5	206,666.3	17.96908	18,785.68	1,801.05	20,666.63		

Table 1: Air Compressor Performance during a full week

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## Conclusion

Being involved in hundreds of audits of facilities, like the one described, we see the same thing repeatedly. Typically a free audit is performed and a large VFD air compressor is installed. The client carries on with production never realizing what's going on with the system. Installing a VFD air compressor is a supply side addition, which may or may not generate savings, depending on how it is sized and applied.

A new VFD air compressor doesn't change the demand side of the compressed air system - where the air is being used and/or wasted. The new VFD air compressor may help supply the compressed air leaks and inefficiencies at a better specific power - but it will not rectify the issues still present within the system. Opting for a more expensive, but much more detailed audit of the entire compressed air system is the only way to find these kinds of

COMPRESSOR DATA AND ENERGY CALCULATION															Saturday 19.03.2016							
system rated capacity:		18.49080 kW/(100cfm)					\$/kWh: 0.10 \$/kWh					load costs: 93.52 %										
efficiency:		0.30818 kWh/100cf					P-min: 101.0psi					unload cost: 6.48 %										
costs:		0.03082 \$/100cf					P-max: 106.0psi					total costs: 1,678.90 \$										
channel	compressor	cfm		load kW		kW	load		unload	average %	cycles		compressed air			total kWh			system rated capacity	total costs \$		
		min	max	min	max	unload	h	min	h	min	lead	motor	load	cf	load	unload	total	load		unload	total	
01	LP #1		1,899.0		312.10	87.40	0	0	0	0	0.0	0	0	0	0.0	0.0	0.0	0.0		0.00	0.00	0.00
02	LP #2		1,899.0		318.00	88.90	0	0	0	0	0.0	0	0	0	0.0	0.0	0.0	0.0		0.00	0.00	0.00
03	LP #3		1,899.0		316.10	88.60	0	0	0	30	0.0	2	0	0	0.0	48.5	48.5		0.00	4.85	4.85	
04	LPE #4		1,899.0		314.60	86.40	0	0	0	0	0.0	0	0	0	0.0	0.0	0.0	0.0		0.00	0.00	0.00
05	LP #5		0.0		316.20	86.10	0	0	0	0	0.0	0	0	0	0.0	0.0	0.0	0.0		0.00	0.00	0.00
06	LP #6 VSD	432.0	2,032.0	66.40	325.00	65.00	23	59	0	0	100.0	0	2	2,855,518	7,654.1	0.0	7,654.1	16,98286	765.41	0.00	765.41	
07	LP #7		1,449.0		266.80	57.10	8	3	11	42	40.8	4	85	699,887	2,096.1	876.5	2,972.6	25,48417	209.61	87.65	297.26	
08	LP #8		1,449.0		277.50	66.70	21	46	2	14	90.7	1	32	1,892,394	5,949.9	163.8	6,113.7	19,38396	594.99	16.38	611.37	
09	LP #9		1,449.0		292.10	91.10	0	0	0	0	0.0	0	0	0	0.0	0.0	0.0	0.0		0.00	0.00	0.00
SteelPlant											sum total		7	118	5,447,779	15,700.2	1,068.8	16,789.0	18,49080	1570.62	108.88	1,678.90

Table 2: Air Compressor Performance during the weekend

savings. Combining this type of audit with permanent metering and monitoring is a long-term sustainable solution and not just a way to purchase a new air compressor.

Permanent metering and monitoring will also provide a continuous 24/7 audit helping to sustain the savings - after compressed air system improvements are made. This provides the plant the tools to adhere to ISO 50001 energy guidelines, provide the data for utility incentives without the costs of a post-audit, as well as justify the ROI to carry out any future efficiency upgrades. 

For more information contact Jan Hoetzel, Airleader Compressor Management USA and a Compressed Air Challenge Board Member, at email: [info@airleader.us](mailto:info@airleader.us), tel: 616-828-0716, [www.airleader.us](http://www.airleader.us)

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# SHOW REPORT: 2016 WEEC Chiller & Compressed Air Control Technology

By Rod Smith, Compressed Air  
Best Practices® Magazine



► The 2016 World Energy Engineering Congress (WEEC) was held September 21-23 at the Walter E. Washington Convention Center in Washington D.C. According to the producer, the Association of Energy Engineers (AEE), the WEEC is the largest energy conference and technology expo held in the U.S. specifically for business, industrial and institutional energy users. Widely known for its recognized energy certification programs, including the Certified Energy Manager CEM® program, the AEE has led the development of the fields of energy engineering and energy management since its' founding in 1977.

The Association of Energy Engineers (AEE) has a membership base of over 17,500 professionals in 98 countries and has 96 locally-run chapters. Both Chiller & Cooling Best Practices and Compressed Air Best Practices® Magazines were pleased to be in the literature bins and to have a booth at the 2016 WEEC!

## SMARTLINK Energy Management and Data Monitoring

When Atlas Copco announced, a few years ago, they would begin shipping a data logger (they call it SMARTLINK) standard with every air compressor – I was quite impressed. This meant every air compressor would have the capability to self-provide the power consumption data one

normally only receives from a compressed air audit. What's more the data would be better as it would represent power data from as long as the air compressor had been installed – not just from an audit period.

Fast forward to the WEEC where I had the chance to speak with Segment & Global Account Manager, Tony Beeckmans, from Atlas Copco, about the SMARTLINK. “We have close to 70,000 SMARTLINK



Tony Beeckmans, Ryan Wilburn, Chris Dominick and Brian Blum (left to right) reviewed the SMARTLINK Data Monitoring at the Atlas Copco booth

units installed,” Beeckmans said. “We are providing monitoring services for 8,000 units installed with our clients.” Beeckmans manages many multinational pharmaceutical and food industry global key accounts for Atlas Copco. “SMARTLINK has become a useful tool for the Energy Managers at our key accounts. We are able to provide them energy consumption data and analysis across their plants. This allows them to identify and benchmark “best practice” plants and deploy their ideas to the other facilities when appropriate.”

The SMARTLINK Data Monitoring Program is offered in three levels on the air compressors. The first is a Service level providing a service log book and the ability to easily schedule service visits and request spare parts. The second is the Uptime level where clients receive relevant warning or shutdown alarms via email or text – allowing them to respond more quickly and avoid costly downtime. The third is the Energy level reviewed earlier. This provides, in a dashboard format, key performance indicators in graphs. Energy managers can define data points to data trend including energy consumption, flow, pressure and dewpoint. Reports can be created at any time with data up to one year old. This data actually provides a better supply-side baseline report to analyze than some compressed air

audits – as it covers a one-year period. In closing, I was very pleased to hear this data monitoring program has gone well as it represented an investment for Atlas Copco to help factories manage their compressed air systems better.

### ENERGY STAR® Industrial Sector Partnerships

The ENERGY STAR for Industry program, run by Elizabeth Dutrow, is an amazing program within the U.S. Environmental Protection Agency (EPA). They are a very active participant at the WEEC as they work extensively with the same AEE member industrial Energy Managers who are also our subscribers. Readers of our publications know we are always profiling ENERGY STAR Industrial Energy Management Partner of the Year award winners. For companies simply wanting to certify their own plant, they have an interesting energy management tool they call the ENERGY STAR Challenge for Industry. There are over 800 sites using it in North America. In order to participate, a site expresses its goal to achieve an energy intensity reduction of 10 percent in five years or less. A plant baseline is developed and registered with ENERGY STAR. They then have to track their progress and report when they achieve the goal.

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## 2016 WEEC: CHILLER & COMPRESSED AIR CONTROL TECHNOLOGY



Jeff Kahn (CAM Technologies), Paul Edwards (Compressed Air Consultants), Gerard Zolkowski (Consumers Energy) and Elizabeth Dutrow (EPA ENERGY STAR).

At the WEEC, many Energy Managers meet with the industry-specific user groups organized by ENERGY STAR. Here they are able to share “best practices”. I know our Editorial Board Member Bill Jerald, from CalPortland Cement is active here as well as fellow Board Member Paul Edwards, from Compressed Air Consultants, who was invited to speak at the cement users group. Ms. Dutrow also chaired a Session at the Conference titled, “Overcoming Barriers for Savings in Industrial Energy Management”. The four speakers were Lawrence Fabina (Manager of Continuous Improvement, Arcelor Mittal), Brett Rasmussen (Senior Energy Engineer, Nissan North America), Bill Jerald (Chief Energy Engineer, CalPortland) and Sharon Nolen (Manager Worldwide Energy Program, Eastman Chemical).

### Compressed Air System Optimization

CAM Technologies had a booth where they presented their CAMLink™ compressed air automation systems. There is a Mini system designed for up to four air compressors and an Advanced system designed for up to six air compressors (including centrifugals). The systems monitor changes in the supply pressure to 0.01 psi and respond to the “rate of pressure change.” The company specializes in combining air compressor automation with high-accuracy system pressure control with their CAM Demand Expander™. President Chris Wagner explained, “As the original developers of the Demand Expander, our engineers understand the importance of isolating the plant from the trim compressor supply.” Wagner continued, “When combined with event storage, this valve station provides stable plant pressure, regardless of the conditions of supply. It also provides for the expansion of compressed air from storage to the system with a minimum loss of energy.”



Chris Wagner and Chris Wells (left to right) at the CAM Technologies booth.

The Hitachi Air Technologies group continues to focus on oil-free air compressors, offering both oil-less scroll compressors and oil-free rotary screw compressors. The SRL stand-alone scroll air compressor range is from 2 to 7.5 hp. The SRL oil-free multiplex line offers fully packaged and enclosed units from 10-40 hp. By the way, did you know Hitachi built it’s first air compressor in 1911? I always find it interesting to think a conglomerate, as large as Hitachi, has air compressors in its’ DNA. Hitachi’s Amy Offord and Shawn Moon told me their move into a larger distribution center, in the Charlotte area, had been completed and it was providing many benefits such as increased testing and packaging capabilities. This is helping them gain approvals for Canadian certifications and work with engineering firm specifications.



Eddie Rogers at the tekWorx booth.

John Henry Foster, based in St. Louis, is a company whose name keeps popping up when I speak to the Energy Managers at some very large factories in the Midwest. The reason is they are providing compressed

air auditing and air compressor service to them. They had a booth, at the WEEC, where they presented their new AIRx and AIRx Pro air compressor controllers. Their literature states these controllers offer universal integration with any type and brand of air compressor. They also provide detailed monitoring and reports.

VP Instruments had a booth displaying their compressed air flow measurement technology. Menno Verbeek said demand for their VP FlowScope® in-line flow meter continues to grow. It's interesting to me to see how end user demand, for compressed air flow measurement, is forcing air compressor companies to begin more work with instrumentation. Verbeek commented, "We spend a lot of time educating on how and where to best measure compressed air flow to assure the attainment of reliable and accurate information." Verbeek was also demonstrating the tool they have to manage the information, VPVision Basic which consists of energy monitoring software and data acquisition hardware. Up to 12 channels can be monitored simultaneously.

Speaking of instrumentation, Vaisala's booth presented their DRYCAP® and HUMICAP® sensor technologies used for dewpoint instruments needed to assure compressed air quality. One excellent "Energy Kaizen" idea is to challenge the notion of a -40°F (-40°C) dewpoint specification for the whole facility. Vaisala offers a hand-held DM70 Meter able to help do a "dewpoint audit" at different points in the factory. They also offer a full range of DMT dewpoint transmitters designed for OEMs building refrigerated and desiccant compressed air dryers.

Compressed Air Best Practices® Magazine hosted a WEEC Conference Session on September 22<sup>nd</sup> titled "Best Practices in Compressed Air." An original title, I know. The Session was very well attended. Our focus this year was on the compressed air distribution system. The proper use of compressed air piping, storage, flow control and knowing how/where to measure flow was the focus. I'd like to thank our speakers for making the time and for presenting:

- Wayne Perry, Senior Technical Director, Kaeser Compressors: "The Proper Application of Pressure/Flow Controls."
- Frank Moskowitz, AirScan Specialist, Atlas Copco Compressors: "Compressed Air System Storage."
- Menno Verbeek, Sales Manager, VP Instruments: "The Importance of Bi-directional Flow Measurement in Compressed Air Systems."
- Kenneth Flannery, Energy Engineer, Bender Energy Group: "Compressed Air Piping Optimization for Low Pressure Drop."



Shawn Moon, Amy Offord, Daniel Tisak (Bala Consulting), and Sayaka Eiki at the Hitachi Air Technologies booth.



Menno Verbeek at the VP Instruments booth.



Bryan Crane, Ashley Conrad and Ernie Pither (left to right) at the John Henry Foster booth.

## 2016 WEEC: CHILLER & COMPRESSED AIR CONTROL TECHNOLOGY

### Chiller Plant System Optimization

tekWorx is a company closely aligned with AEE member Energy Managers and whose principal, Mike Flaherty, is often asked to speak at the ENERGY STAR user group meetings. They conduct comprehensive chiller plant system assessments for many industrial companies. They then can offer optimization solutions for both small chillers and large complex chiller plant stations. Their COACH™ system is a scaled-down solution able to provide standalone and integrated control for smaller chiller plants of even two chillers. For larger plants, tekWorx conduct a full system assessment, laying out hydronic and control modifications to maximize efficiency and configure their CEO® algorithms into a customized central controller for the entire chiller plant. I can tell you, tekWorx has the attention of our Energy Manager subscribers. The two Chiller Control Webinars they have done for us have been extremely informative and well attended.

Smardt claims to be the #1 manufacturer in oil-free centrifugal chillers. They have long seen energy and water optimization, of industrial and commercial chiller systems as the next frontier. CEO and Founder Roger Richmond-Smith was well ahead of his time when he launched Smardt in 1992 and developed the Turbocor Compressor (the first oil-free magnetic bearing refrigeration compressor). Now a division of Danfoss, Richmond-Smith remains directly involved. The Smardt booth featured Smardt S-Class Solar Integrated Chillers rated for 100 to 450 tons. A patent pending design, their product literature claims ROIs of less than 2 years, lower noise levels and a durable 20 year PV warranty. Mounted on rooftops, the idea of integrating solar into large chillers is very interesting to improve chiller efficiencies.



Joseph Bissi and Caleb Jones (Kiltech) at the Smardt booth (right to left).

Kiltech offers a Central Plant Energy Control System (CPECS) to control and optimize the performance of multiple chillers. Closely aligned with Smardt and with many team members involved with the development of the Turbocore compressor, the basis of CPECS is an optimization logic created to sequence anywhere from 2 to 8 variable speed refrigeration compressors installed on a single chiller. According to their literature, CPECS utilizes Continual Feedback Loops and Advanced control algorithms to provide real time and predictive data processing that analyzes the historical data, load profiles of the building, climate data and the manufacture's equipment performance models to provide automatic modulation of control levels to all VFD's. CPECS logic provides the maximum level of system performance while respecting chiller, tower, building flow and temperature limits.

Chiller & Cooling Best Practices Magazine hosted a WEEC Conference Session on September 23<sup>rd</sup> titled "Best Practices in Chiller and Cooling Systems." Also an original title, I know. Even though it was held the last morning of the show, it was very well attended! I'd like to thank our speakers for making the time and for presenting:

- Roger Richmond-Smith, Chairman and CEO, Smardt: "New Levels of Chiller Plant Energy Efficiency attained by Remote Monitoring, Chiller Plant Optimization and Continuous Commissioning."
- Adam Medaugh, Director Centrifugal Chiller Products, Daikin Applied: "Refrigerants: Where are we Headed in North America?"
- Howard Kielar, Engineering and Technical Services Manager, MTA-USA: "Designing Free-Cooling Chillers to Maximize Efficiency."
- Davide Peter Ross, Director Audits and Research, Pangolin Associates: "Chiller Savings Using Automatic Tube-Cleaning Systems."

The 2017 WEEC will be held at the Georgia World Congress Center in Atlanta, Georgia and will feature President George W. Bush as the Keynote Speaker. [BP](#)

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# Control Improvements at Forge Plant Make Big Impact

By Ron Marshall

*Figure 1: MPG Columbus Plant 1 forges parts for the automobile industry. Due to the environment and lack of available floor space, the newest air compressors are installed outdoors with cold weather packaging as can be seen in the background.*

► Metaldyne Performance Group (called MPG in this article) Plant 1 in Columbus, Indiana (formerly known as Impact Forge) has made significant efficiency improvements to their compressed air system. With the help of their service provider, IAC Air Compression, MPG has implemented some innovative control on

their existing air compressors, added new air compressors with variable capacity control, and tied everything together with a modern central controller. This installation has been recognized for its wise use of power by their power utility Duke Energy.

## Background

MPG produces parts for the automobile industry. Plant 1 has five large drop forge presses and nine hammers along with various compressed air operated production machines with which they produce their parts. The plant in 2011 had three large 400



“With the help of IAC Compression, MPG has tied everything together with a modern central controller.”

— Ron Marshall

hp air-cooled lubricated air compressors, a water-cooled 500 hp unit, and a 300 HP unit. The facility's Engineering Manager attended a Compressed Air Challenge training in 2011, and as a result, MPG became aware their system had a high potential for energy savings. They invited IAC Air Compression into their plant to perform a compressed air audit and produce a report of recommendations. "When we moved into the central Indiana area, MPG attended our very first Compressed Air Challenge Fundamentals of Compressed Air Systems Workshop, and left with a lot of things to look into. It is difficult to find companies that truly embrace the desire to improve their compressed air system. We were happy to help them through this process," said IAC's Steve Briscoe.

**Baseline Findings**

IAC developed an energy and flow baseline by data logging the energy input to the air compressors and calculating the flow output. The data showed that even though an older model central controller was installed on the compressors, the production of compressed air was inefficient because problems with the control strategy allowed more than one compressor to load and unload at a time. Some units spent many hours running unloaded, producing no air, but consuming significant power. At the same time the compressed air pressure fluctuated from a high of 121 psi to as low as 68 psi during transient plant peaks.

Through the years the plant had expanded production and new air compressors were added that were not connected with the existing compressor controller. As a result less efficient compressors were running at times where newer more efficient compressors could supply the load.

**Improvements**

Over the years some of the older air compressors reached the end of their useful life. Since 2012, MPG has renewed three of their compressors to more efficient two-stage variable

capacity units for a gain in efficiency. Two new 400 hp units and a new 350 hp are located outdoors where cooling is controlled using variable speed fans. A 300 hp compressor with poppet valve control plus an old 400 hp unit in standby only capacity remain inside the plant.

**Compressor Performance Summary**

Compressor Name	Manufacturer Model	Nominal HP	% Run Time	Average HP	% Loaded Power	% Loaded CFM	Average Pressure	Average Flow
AC #3	Quincy QSI-1500	300.0	4.8	271.3	79	32	99.1	449.9
AC #1	Ingersoll Rand XF 400	400.0	25.7	295.8	65	24	98.2	427.4
AC #2	Ingersoll Rand EP 400	400.0	62.9	247.1	61	34	99.3	548.5
AC #4	Ingersoll Rand XFE 400-2S	400.0	60.6	370.4	79	85	99.8	1,753.6
AC #10	Ingersoll Rand XFE 500-2S	500.0	69.8	442.0	79	75	101.1	1,831.8

Figure 2: Compressor average load percentages were very low on average. Today, MPG's system runs at an average of 92.5% loaded, shown later in the article.

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## CONTROL IMPROVEMENTS AT FORGE PLANT MAKE BIG IMPACT

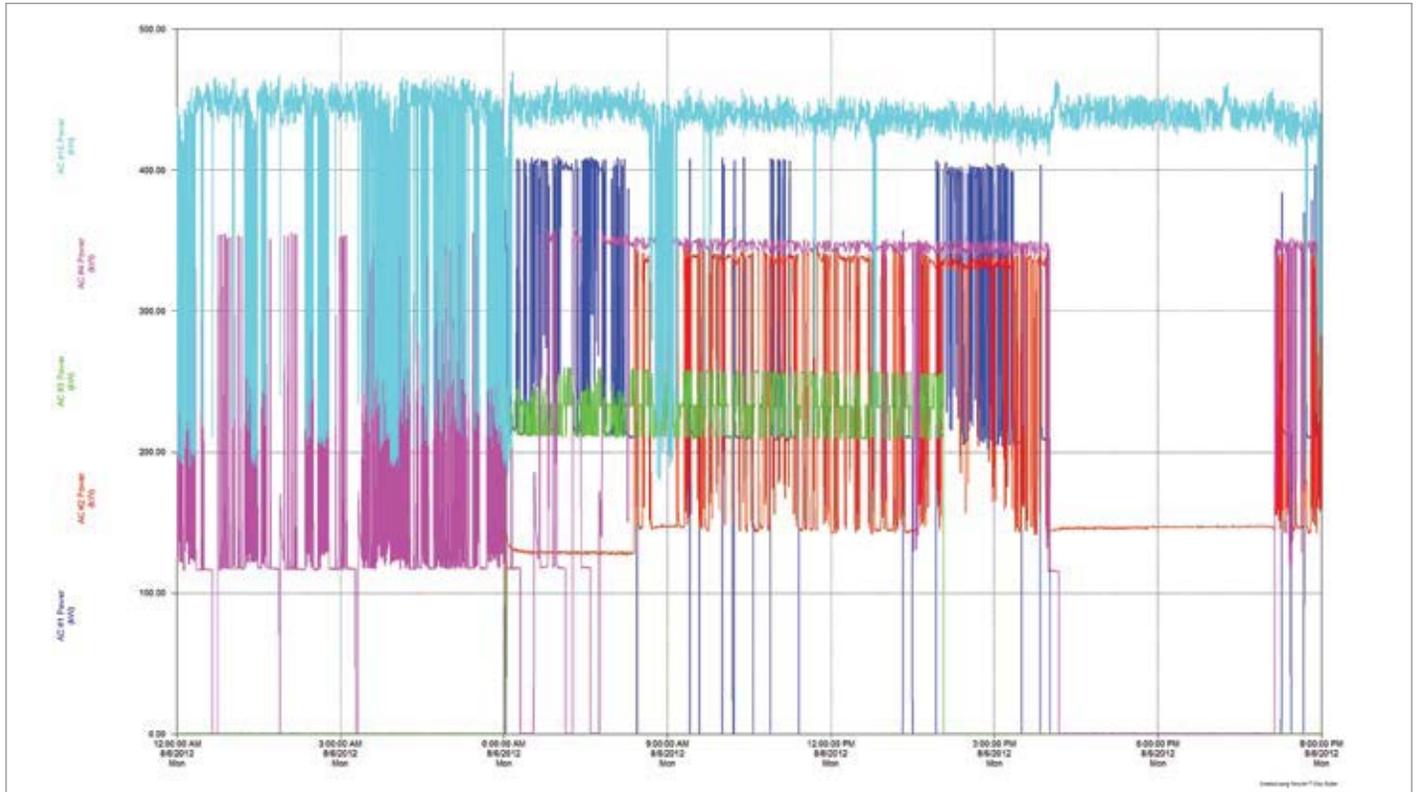


Figure 3: Power of each compressor and evidence of inefficient compressor system control was found in the 2012 audit.

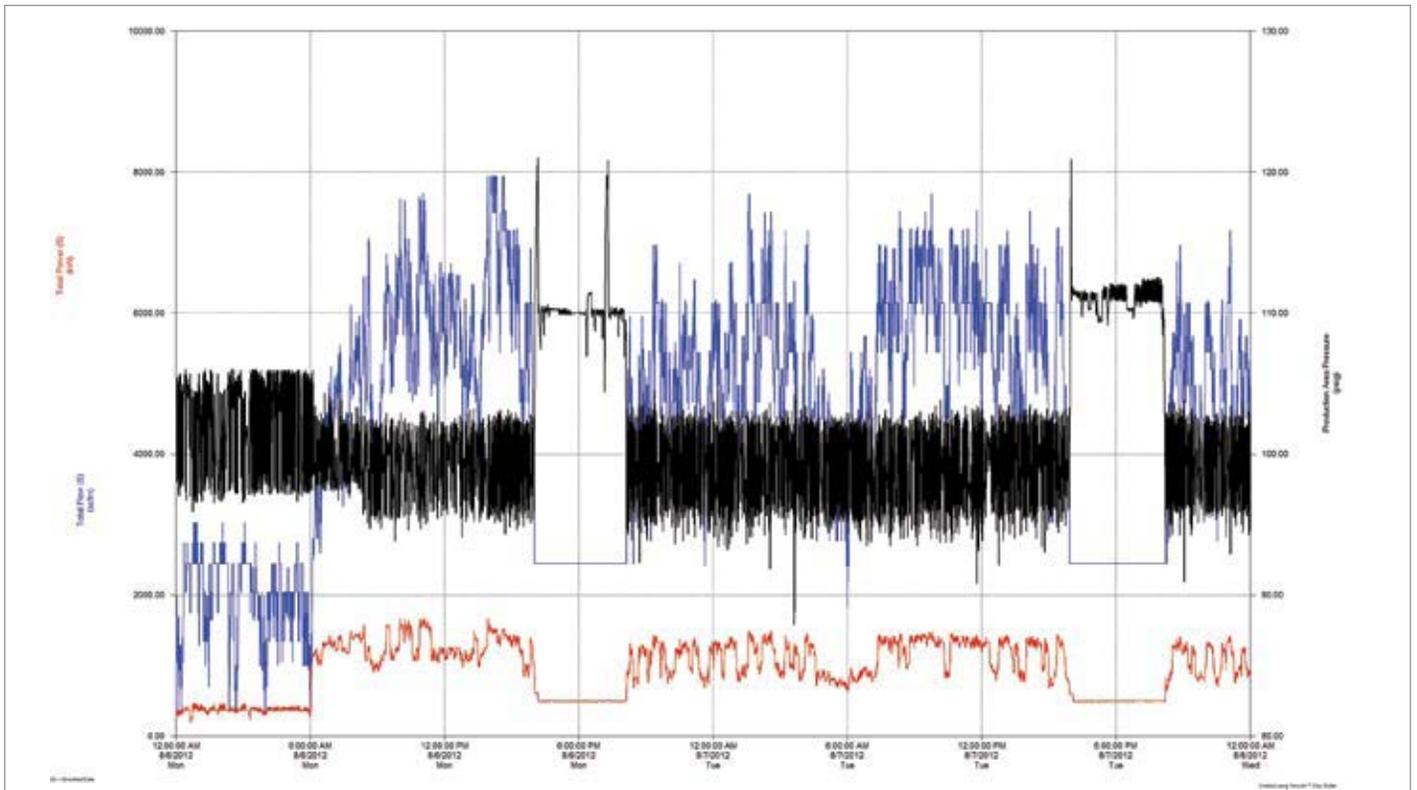


Figure 4: Rapid demand changes made it difficult to control and maintain stable pressure and an efficient air system (Blue=Flow, Black=Pressure, Red=Power)

The new air compressors that had variable capacity control could not be tied into the existing compressor controller without losing the part-load efficiency benefit. Facilities engineering called in two teams of compressed air auditors to do another baseline of the system key parameters and recommend improvement solutions.

One team represented a large national compressor manufacturer that had a controller they offered, but it was not compatible with their compressor with variable capacity controls. The other team, IAC Air Compression, was working with Airleader, a supplier of innovative air compressor controls, and had modules that could be used to very efficiently control any type of compressor.

Often compressor companies will recommend a centrally controlled system with one or more VSD compressors installed to run as efficient trim units to optimize compressed air system energy consumption. In normal environments this would do the job, however, hot forging plant conditions are typically not clean and cool places where the electronics associated with variable frequency drives will last, so this option was not considered good solution. Also a problem was a very wide variation in plant load, from as low as 1,100 cfm to as high as 8,000 cfm, often taking place in a matter of minutes. This type of characteristic needs special fast-acting and intelligent controls to be able to maintain regulated pressure, yet keep the compressors running efficiently.

### Modifying Control

The solution implemented uses a special interface to all the variable capacity compressors that will allow remote control of the poppet and spiral valve compressors. This is not a standard option offered by either of the manufacturers who supplied the air compressors, so some design and innovation had to take place. IAC, with Airleader, implemented a variable displacement controller interface that was installed within each compressor and tied to the central controller. This mode of operation now operates similar to a system with a variable speed compressor, with good turn down of power as the flow reduces, but is a much more robust system suitable for this challenging environment.



Figure 5: This controller runs the air compressors with best efficiency at full load and varies the flow of the compressors with variable capacity control.



Figure 6: To better control this compressor of another brand, IAC integrated a Sullair microprocessor and Airleader took direct control of the poppet valves to control part loading of this unit.

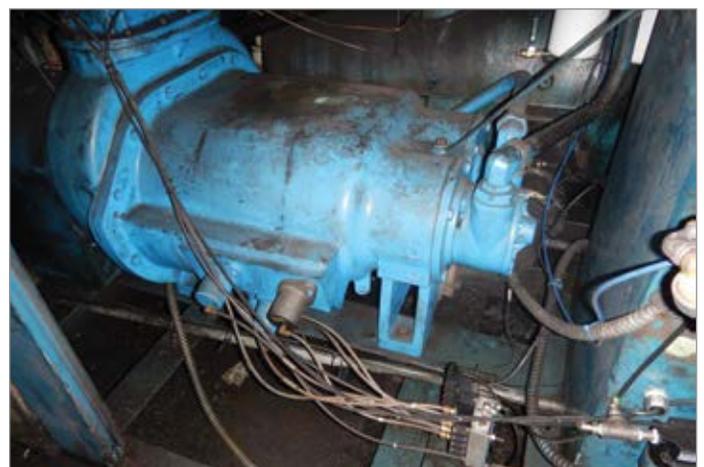


Figure 7: Custom controls allow the central controller to efficiently operate the poppet valves on this compressor.

# CONTROL IMPROVEMENTS AT FORGE PLANT MAKE BIG IMPACT

## Results of Implementation

Implementation of this control, and the elimination of some drainage and leakage, has reduced the energy consumption of the system from a high of 7,690,229 kWh in 2012 to the current consumption of 4,759,000 kWh, a reduction of 38% saving MPG about \$290,000 per year in reduced energy costs. What makes this even more amazing is

the production throughput of the plant has increased by 45 percent since 2012 because of increased product sales and demand. The average demand in 2012 for this facility was 4,277 cfm. Today, after spending time addressing inappropriate uses of compressed air, lowering the facility pressure and taking care of some high profile leaks, the facility average demand during production is closer to

COMPRESSOR DATA AND ENERGY CALCULATION														Monday 21.03.2016 - Sunday 27.03.2016												
system rated capacity:		16.80969 kW/(100cfm)				\$/kWh: 0.10 \$/kWh				load costs:		92.51 %														
efficiency:		0.28016 kWh/100cf				P-min: 91.0 psi				unload cost:		7.49 %														
costs:		0.02802 \$/100cf				P-max: 101.0 psi				total costs:		9,347.64 \$														
channel	compressor	cfm		load kW		kW		load		unload		average %	cycles		compressed air			total kWh			system rated capacity	total costs \$				
		min	max	min	max	unload	h	min	h	min	h	min	load	motor	load	cf	load	unload	total	load		unload	total			
01	SULLAIR 350 HP	940.0	1,875.0	190.00	320.00	94.37	64	49	14	31	81.7	40	86	5,888,323	18,032.4	1,374.6	10,407.0	19,775.12	1,803.24	137.46	1,940.70					
02	Modul 2		0.0		0.00	0.00	0	0	0	0	0.0	0	0	0	0.0	0.0	0.0	0.0		0.00	0.00	0.00				
03	QUINCY QSI1500	750.0	1,500.0	166.75	255.00	112.56	69	42	25	13	73.4	57	138	3,366,314	12,122.1	2,256.3	14,380.4	25,389.70	1,212.21	225.83	1,438.04					
04	IR XFE 400 HP		2,200.0		332.43	178.42	4	21	9	42	31.0	21	52	574,200	1,439.4	1,676.8	3,116.2	32,561.88	143.94	167.68	311.62					
05	SULLAIR 400 #5	1,110.0	2,220.0	104.03	327.00	150.00	93	18	8	55	91.3	13	29	12,107,063	26,657.0	1,243.2	27,900.2	13,829.69	2,665.70	124.32	2,790.02					
06	SULLAIR 400 #6	1,110.0	2,220.0	161.76	320.00	178.00	107	49	3	2	87.3	7	20	11,367,247	28,225.5	447.2	28,672.7	15,094.51	2,822.55	44.72	2,867.27					
ImpactPlant												sum total		138	325	33,366,177	86,476.3	7,000.0	93,476.4	16.80969	8,647.64	700.00	9,347.64			

Figure 8: The controller maintains a database of system readings with which daily, weekly, monthly or annual efficiency reports like this can be generated.

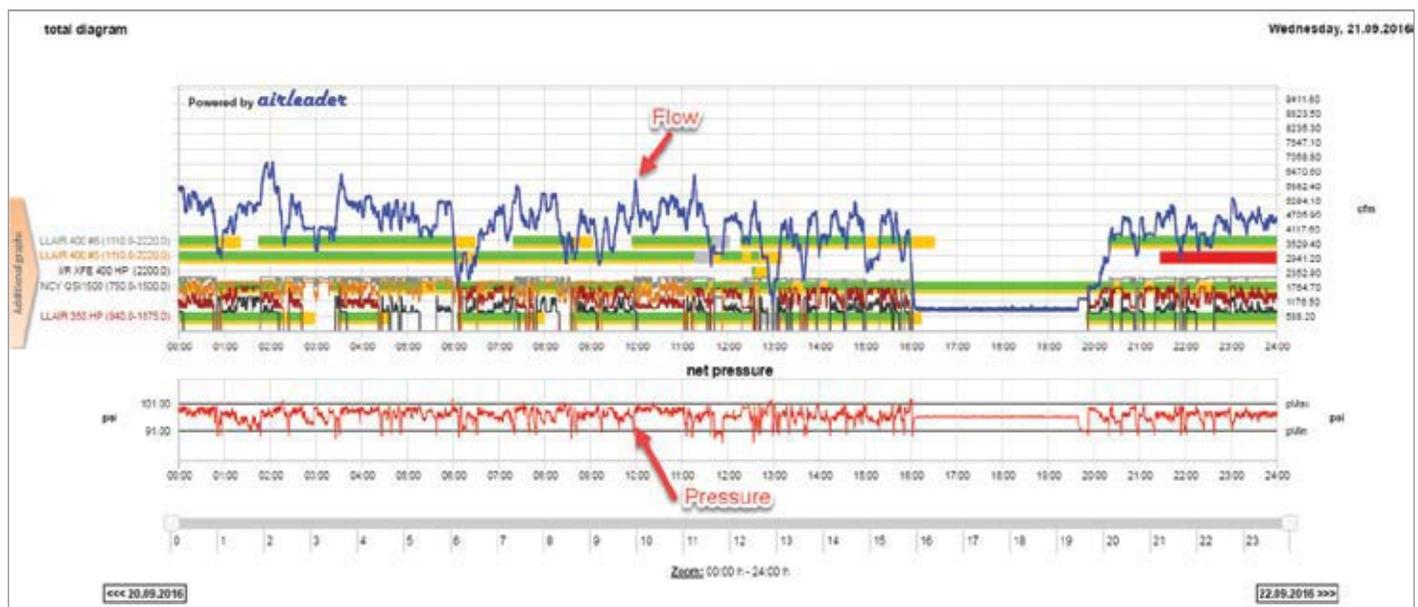


Figure 9: The system pressure is now maintained between 91 and 101 psi even in the face of large swings in flow using variable capacity control as trim and is a great way to review the entire system performance at a glance.

3,500 cfm. This means they are producing more parts, with less air, less power, and an improvement of the generation efficiency. As an example of this, the implementation of the new compressors and the Airleader controller in 2014 has improved the system specific power (power input in kW per 100 cfm) from a high of 22.3 kW per 100 cfm to the current 16.5 kW per 100 cfm, an improvement of 26 percent. It should be noted that this improvement has taken place without the addition of large storage receivers, mainly due to the lack of space, but even with this limitation the quick response of the control maintains adequate pressure at impressive efficiency levels.

### Additional Benefits

One of the side benefits of the Airleader control is its web interface and reporting functions. This is used as a tool by plant personnel to track the efficiency of the system and even troubleshoot problems. “We don’t have to call in an audit team anymore when we want to check the efficiency of our system.”, the Facilities Engineer stated. “Having the web interface and reporting function is like doing a continuous audit, and when we want to do something like experiment with a lower system pressure we can immediately see the results. Previously we didn’t know much about our compressed air system until something broke, but now we have the tools to continuously check on the health of our system and do some preemptive repair work”.

Airleader is also a tool to provide easily understood trending data to enable facilities engineering to become the plant leak reduction champions. One of the engineers keeps a constant monitor on air leaks. He checks his system flows daily and when he spots a problem he will go out onto the plant floor to find it. “One time I was away on medical leave for a few weeks. When I came back I checked on the leakage level for the days I was away, there was an obvious increase because nobody was watching the levels. Every system needs the attention of a process engineer to ensure it is running efficiently, and we now have the capability of continuously monitoring our compressed air production system”.

“Airleader has been a great product for us to offer our customers. Every system we have installed has resulted in significant savings for

our customers. MPG has the most unique system with four variable displacement compressors out of the five compressors in operation being controlled by Airleader, and it has worked out great. Their system is continuously used as a showpiece for us,” said Steve Briscoe with IAC Air Compression.

### Custom Compressed Air Dryer

One other improvement implemented was the installation of whole plant compressed air filtration and a chiller system to dry the air. Because the plant has huge presses operating during production shifts the vibration of each press operation translates to high shock vibration in auxiliary equipment such as standard refrigerated dryers. These units can quickly break down under the extreme conditions so were not seen as an adequate solution to the poor compressed air quality in the plant.

A custom chiller system was designed for MPG and located outside of the main building. This cools and pumps coolant to shell and tube heat exchangers with water separators located after the compressor discharge. After the water separator, the cold dry air passes through a pre-cooler re-heater exchanger to increase the temperature of the air to the system. This drying of the air helps prevent water from forming in the plant piping, which in the past had caused the plant to shut down due to the constant condensate drainage.

### Conclusion

This project is an example of how awareness of compressed air costs can act as a catalyst for change. The plant personnel acted on this knowledge by seeking help from compressed air service providers who could provide innovative solutions to their challenges. Their control system not only increases the efficiency, but allows them to constantly check and correct their system to maintain optimum efficiency. **BP**

To learn more about IAC Compression visit [www.iacserv.com](http://www.iacserv.com)

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# Show Report: IWF 2016 Vacuum & Compressed Air Technology

By Rod Smith, Blower & Vacuum Best Practices Magazine



► The IWF 2016 International Woodworking Fair was held August 24-27 at the Georgia World Congress Center in Atlanta, Georgia. The Show announced the attendance of 16,000 verified buyers of woodworking equipment – a healthy increase over the 14,400 attending in 2014. “We had double digit growth in attendance, exhibit space, and the number of exhibitors. The show floor was very active

and exhibitors were seeing high demand for their products,” commented Tom Onsrud, IWF 2016 chairman and president C.R. Onsrud Inc.

Over 90 foreign countries and 49 states sent their key decision makers to IWF 2016. The educational conference was the largest ever held at IWF with over 50 educational programs.

Both Blower & Vacuum Best Practices and Compressed Air Best Practices® Magazines were pleased to be in the literature bins!

IWF is largest woodworking technology trade show in North America and is held every other year at the Georgia World Congress Center in Atlanta, Ga. It is ranked among the largest trade shows in the world.

Vacuum pumps are everywhere at this show, flanking all the CNC panel-cutting and routing machines.

### Fender CNC Panel-Cutting Centers and KOMO CNC Machining Centers

There were at least 20 routing machine companies with their equipment on display. Roaming the aisles, I had the chance to speak with Wyeth Schifflbein, a Service Technician for the Felder Group. The Felder Group is an Austrian company, which has been making a broad range of woodworking machinery for 60 years. To name a few products they manufacture, their line-up includes table saws, panel saws, jointers, planers, jointers-planers, tilting shapers, and 5 axes CNC machining centers. They operate three locations in the U.S. with a headquarters in New Castle, Delaware.

The booth featured a Fender Profit H10 CNC panel-cutting center. Mr. Schifflbein explained some fundamentals about the vacuum hold-down requirements of this machine. "We use a 45 lb. MDF (medium density fiberboard) for our spoilerboard and typically run 20-22" HgV vacuum levels." The unit also features a vacuum manifold underneath the MDF directing the vacuum to different zones. "Our units feature an intelligent vacuum system able to minimize leakage rates by only sending vacuum flow to where it's needed." I found this very interesting. He continued, "This vacuum manifold helps you run smaller pieces and also helps with onion-skinning processes." OK, I admit I have no idea what onion-skinning wood is. I'm not sure if this "intelligent vacuum system" is now the standard "state of the art", but I do know in the recent past, vacuum was sent to the entire table - even after large sections of the board were long gone. When cutting small pieces of wood, high leak rates caused pumps to work at higher vacuum levels.

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## IWF 2016: VACUUM & COMPRESSED AIR TECHNOLOGY

The Profit H10 is shipped with two vacuum pumps included. “We ship two Becker 10 hp oil-less rotary vane pumps with each 5 x 12 table,” Schiffelbein continued, “While I understand the merits of the idea, I have rarely seen a centralized vacuum system at one of our clients.” My feeling is commercial/industrial woodworking is just at the beginning of a new chapter of optimization as it relates to their vacuum and compressed air systems.

The Komo booth featured a pretty impressive 1205 Fusion Twin Table CNC Machining Center supported by an in-booth Atlas Copco GHS 900VSD+ rotary screw vacuum pump. The Fusion Twin Table provides customer the flexibility of two tables and one or two spindles. The machines feature a moving table configuration and spindle-mounted tool changers. The booth was very busy so I really didn’t get a chance to learn more about their technology.

### Air Compressors and Vacuum Pumps

Kaeser Compressors has a long history providing their positive displacement blowers to the CNC routing machine industry for vacuum hold-down applications. “We are very effective with spoiler-board systems in routers running at 11-13 HgV,” said Marketing Manager Michael Camber. “We often find energy-saving opportunities of 50-60% by reducing the vacuum specification while increasing flow.” The booth featured the Kaeser BB 89C tri-lobe, fully-enclosed, quiet blower which they recommend for routing machines.

Kaeser personnel also said the compressed air systems, in the woodworking industry, are modernizing to rotary screw air compressors with integrated refrigerated dryers (AirTowers and AirCenters), to aluminum piping (SmartPipe) and to smart controls such as their Sigma Air Manager 4.0. They also had a SFC30 in the booth - a 40 hp VFD rotary screw air compressor.

Atlas Copco is also working vigorously at teaching the woodworking industry the benefits of going to centralized vacuum systems and integrating variable speed technology into the system design. “The GHS VSD+ rotary screw vacuum pump is becoming very popular with the CNC guys in both the woodworking and thermoforming (plastics) industries,” said Atlas Copco’s Steve Nash. “When you combine the efficiency and durability benefits of centralizing with the trim capabilities of our VSD+ technology, plants can now have their energy consumption mirror their vacuum demand.” Nash went on to say a good system design efficiently accounts for the intermittently changing leak rates inherently present in vacuum hold-down applications.



Wyeth Schiffelbein, a Service Technician for the Felder Group, stands next to the Profit H10 Panel-Cutting Center.



The KOMO booth featured a KOMO 1205 Fusion Twin Table CNC Machining Center supported by an Atlas Copco GHS 900 VSD+ rotary screw vacuum pump.



Mike Matijevich, Mick Wentzel and Jim Duggan at the Becker Vacuum booth (left to right).

## IWF 2016: VACUUM & COMPRESSED AIR TECHNOLOGY



Thomas Grommersch reviews the Mink MV oil-less rotary claw vacuum pump at the Busch booth.

The air-cooled GHS+ rotary screw vacuum pumps are also targeting applications traditionally using liquid ring vacuum pumps. “There are many liquid rings used in applications which aren’t ingesting water,” said Nash. “There are efficiency benefits to switching to rotary screws but one of the biggest benefits can be eliminating the chilled water requirements placed on the chillers needed to support the liquid ring pumps.” Last but not least, the booth featured a GA30 VSD+FF variable speed drive rotary screw air compressor with an integrated R410A refrigerated dryer. The unit features IE3 or NEMA premium efficiency motors and the in-house designed NEOS drive featuring IP5X protection and a robust, aluminum enclosure designed to operate in harsh conditions.

### Vacuum Pump Technology

Becker products are widely used in the woodworking industry. The CNC routers in particular, seemed to have two 15 hp Becker’s in every booth next to their machines. I always enjoy speaking with Becker’s Mick Wentzel. “Our dry (oil-less) rotary vane vacuum pumps have been the technology of choice by U.S. and European OEM’s for many years,” Wentzel said. “The combination of extremely low maintenance requirements along with the benefits of oil-less technology are the decision drivers.” I liked his line saying, “sawdust and oil aren’t friends!” Wentzel explained they’ve been designed to be very easy to work on for standard filter and bearing maintenance.



Becker is also engaged with variable speed drive (VariAir) technology. VariAir is available on rotary vane vacuum pumps, regenerative blowers, dry rotary screw vacuum pumps and compressors. Becker also offers pre-packaged Central Vacuum Systems on tank-mounted skids with modular packages for redundancy (laboratories) and flexibility. There’s a VariAir Central System (VACS) combining the two concepts as well.



Cat Jennings, Juan Rodriguez, Duncan Buie, Bill Mehall, Michael Camber and Michelle Teekasingh at the Kaeser Compressors booth (left to right). Michael Camber stands next to the BB 89C tri-lobe blower.

Busch Vacuum Pumps and Systems presented the Mink MV 100% oil-less rotary claw for woodworking applications. They stated the unit has been optimized for quiet, energy-efficient performance and the compact design works well with tight spaces. Busch makes the case for the durability of the two non-contacting ‘S’ profile rotary claw rotors, resulting in no internal friction and thus no wearing parts to

replace. They believe this is a very durable design compared to other oil-less vacuum pump designs.

Centralization of vacuum supply is a big topic. A vast majority of woodworking plants have decentralized vacuum with two pumps (one for backup) parked next to each CNC routing machine. Busch provided an interesting case study of a furniture manufacturer who had two CNC portal machining centers with grid-based clamping tables. Each center was supported by two dry-running rotary vane vacuum pumps. When the company decided to purchase an additional CNC router, they chose to decentralize the system using oil-less Mink rotary claw pumps. The new central vacuum system reduced the energy requirements from what would have 68 kW in a decentralized layout to 44 kW.

Dekker Vacuum Technologies had a nice booth displaying their rotary vane and liquid ring vacuum pump systems. Applications Engineer Rae Isbell was busy taking care of customers but found time to share some excellent product literature with me focused on the woodworking industry. She said Dekker makes an effort to help customers understand the relationship between vacuum level and hold-down force. She explained that in general, the smaller the work piece, the more leakage through the MDF board, requiring a larger vacuum pump capacity to achieve the required vacuum level. Dekker is performing “Vacuum Performance Assessments” to help CNC router users understand their needs.

Part of a Dekker Vacuum Performance Assessment includes an analysis of whether VFD variable frequency drive technology would provide benefits. They explained many plants have vacuum pumps operating only 50 percent of the time. Using an example of a 40 hp vacuum pump system with a VFD operating in a system working 4,992 hours per year (two shifts per day), a utility rate of \$0.10 kWh, and a 93% motor efficiency – they calculated a reduction in energy consumption from \$16,000 to \$12,000 per year on this one 40 hp unit. **BP**

For more information on IWF 2018 visit [www.iwfatlanta.com](http://www.iwfatlanta.com)

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Rae Isbell provides information at the Dekker Vacuum Technologies booth.



Greg Currie and Steve Nash in front of the Atlas Copco GHS 730 VSD+ rotary screw vacuum pump (left to right) and Nash and Andrew Smith assisting customers in the booth.

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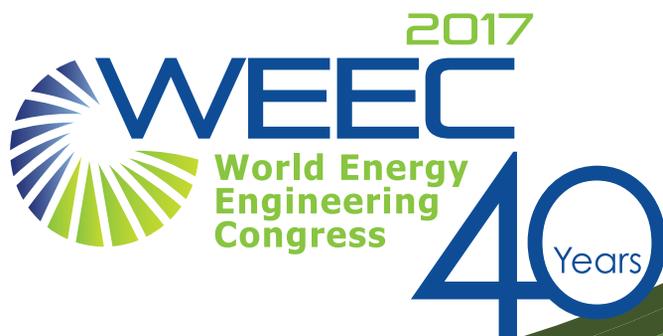
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# RESOURCES FOR ENERGY ENGINEERS

## TECHNOLOGY PICKS

### Michell Instruments Introduces Portable Hygrometer for Convenient Spot Checks

The MDM50 portable hygrometer from Michell Instruments makes taking spot checks of dew point or moisture content down to  $-50^{\circ}\text{C}$  dew point quick, easy and simple.

Because it has its own self-contained sampling system, setting up the MDM50 involves simply connecting the hose to the sample point: there is no extra sample conditioning add-ons to purchase or to carry around. The integral sampling system allows for measurements of dew point to be made at pressure, up to 20 barg, with an option available to measure up to 300 barg. The integrated filter removes particulates down to  $0.3\mu\text{m}$ , which provides 99.5% protection to the sensor.

A long battery life is essential for making measurements in the field, especially in locations where there is limited access to charging points, so the MDM50 portable hygrometer has an operation time of 16 hours on one full charge. This means users have the confidence that they can work all day without having to stop taking measurements for charging. The universal charger fits neatly into the case when not in use to make sure it's always handy.

The fast-responding polymer moisture sensor of the MDM50 gives rapid dew-point measurements in compressed air – T95 to  $-35^{\circ}\text{C}$  from ambient typically in less than 5 minutes. The sensing element is highly stable, resistant to contamination and, along with the robust and sturdy case; this means the hygrometer is well suited for the often-tough conditions in industrial applications.

As well as dew point in compressed/instrument-air dryers, typical applications for the MDM50 include moisture measurements in

medical gases, polymer chip and the output from refrigerated dryers.

### About Michell Instruments

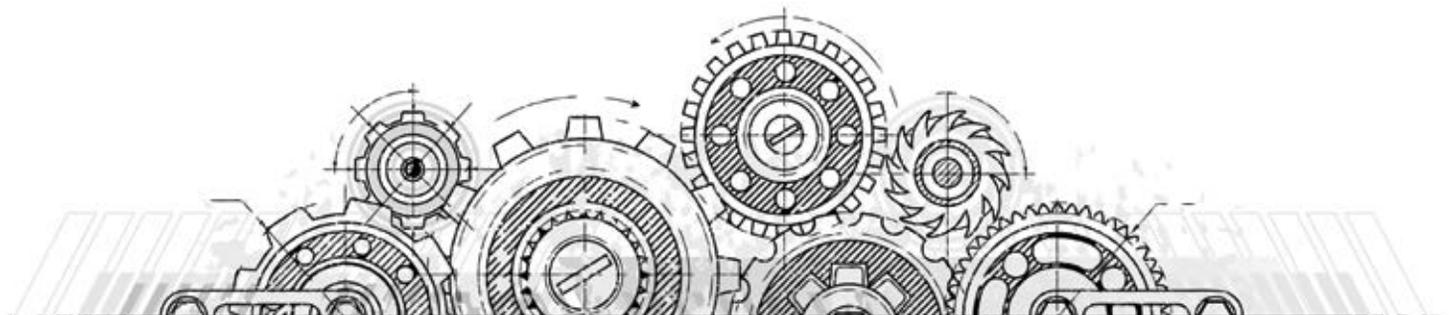
Michell Instruments Group is a worldwide leader in the field of moisture and humidity measurement solutions. With four decades experience, Michell designs and manufactures a wide range of sensors, instruments and customized systems capable of measuring dew-point, humidity and oxygen in applications and industries as diverse as compressed air, power generation, petrochemical, oil and gas, food processing and pharmaceutical. Michell's innovative products make processes cheaper, cleaner, more energy efficient and safe.

The Group has multiple manufacturing locations across Europe with their international headquarters located in Ely, UK and a North America sales and service headquarters located in Rowley (MA). It has its own facilities in 10 countries with an extensive network of factory trained application and service engineers, subsidiaries and distributors stretching across 56 countries.

**For more information, visit <http://www.michell.com/us>**



*The MDM50 portable hygrometer has an operation time of 16 hours on one full charge.*



## RESOURCES FOR ENERGY ENGINEERS

### TECHNOLOGY PICKS

#### SONOTEC Presents New SONAPHONE

The new SONAPHONE extends the product range of the ultrasonic specialist SONOTEC with a digital ultrasonic testing device including touchscreen technology. This device for preventive maintenance is a hit with users thanks to apps that are intuitive to operate and opens up new domains of application in connection with innovative sensors.

"Our SONAPHONE is a trendsetter in preventive maintenance. The goal was to develop the first user-friendly ultrasonic testing device that combines novel measuring technology, innovative sensors and intelligent software for preventive maintenance," explains Hans-Joachim Münch, CEO of SONOTEC. Besides apps that are intuitive to operate, the robust tablet shape with touchscreen technology and large 5-inch display also houses a new sensor concept with a large frequency range.

#### Broadband sensors open up new fields of application

Using the new device, maintenance personnel can see and hear everything that happens in the ultrasonic frequency range from 20 to 100 kHz. Prof. Peter Holstein, Director of Strategic Development at SONOTEC, explains what is special about broadband sensors:

"Whereas with the usual ultrasonic testing devices on the market you

can only hear a tone, with the new SONAPHONE you can now here music." Thus the innovative testing device paves the way for new domains of use. Whereas with comparable ultrasonic testing devices it is possible only to find leaks in compressed air and gas systems, the SONAPHONE also makes it possible to assess their size.



*With the new SONAPHONE maintenance personnel can see and hear everything that happens in the ultrasonic frequency range of 20 to 100 kHz. Thus this innovative testing device paves the way for new domains of use and leak analysis*

Thus the multi-function ultrasonic testing device not only is appropriate for leak detection and classification, but is also useful for tightness testing of unpressurized systems and condition monitoring through checking bearings. The new SONAPHONE is also used for electrical inspection by detecting partial discharges and for checking valves and steam traps.

#### Apps that are intuitive to operate

The device's apps, which are intuitive to operate, offer many new options and support maintenance personnel throughout the entire testing process – from planning, to measurement, to analysis. The apps combine simple operation with the complex analysis software behind it. Besides measured values and spectrograms, it is also possible to add images, voice memos and comments to the respective test object. A clearer presentation of the data gathered makes subsequent analysis easier. Test reports can be prepared quickly and easily and processed further with PC software. Users benefit from more precise data, which they can access more easily, and convenient handling.

The mobile ultrasonic testing device contributes significantly to greater plant safety and availability by efficiency determining the condition of machines and systems. It minimizes downtimes, helps reduce energy costs and thus improves the efficiency of the



*The multi-function ultrasonic testing device is used in preventive maintenance for, among other things: leak detection and classification, tightness testing of unpressurized systems, condition monitoring of machinery, checking valves and steam traps and detection of partial discharges*

## TECHNOLOGY PICKS

entire production. All in all using the testing device leads to an optimized process.

With the new SONAPHONE, SONOTEC extends the domains of application of ultrasonic testing devices and meets the desire of many maintenance personnel for reliable assessment of leaks and estimation of the savings potential.

### Technical Data: SONAPHONE

- Frequency range: 20 to 100 kHz
- 5-point multi-touch screen
- Dimensions (WxHxD): 90 x 174 x 325 mm
- Weight: 370 g
- Auto-focus camera with 5 megapixels

### SONOTEC

Founded in 1991, nowadays SONOTEC GmbH is a leading specialist in ultrasonic measurement technology solutions. With more than 120 employees, the technology company based in Halle (Saale) in the heart of Germany develops and manufactures customer-specific ultrasonic transducers and sensors as well as testing equipment and measuring technology solutions for a wide variety of industries. These range from medical technology and the chemical and pharmaceutical industries to engineering and plant construction and non-destructive testing.

*For more information, visit <http://www.sonotec.eu/products/preventive-maintenance/ultrasonic-testing-devices/sonaphone>*

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## RESOURCES FOR ENERGY ENGINEERS

### TECHNOLOGY PICKS

#### Edgetech Instruments' COM.AIR Hygrometer Offers Reliability and Accuracy

Edgetech Instruments' COM.AIR employs a highly developed chilled mirror sensor, the most accurate commercial dew point sensor type available, to deliver drift-free dew point measurement in compressed air systems without the need for regular calibration or sensor replacement. It utilizes the company's programmable Automatic Balance Control to correct for the effects of mirror contaminants and provide continuous monitoring with little to no maintenance.



COM.AIR is a complete dew point monitoring system

Accuracy certification of the chilled mirror sensor technology used in the COM.AIR is fully traceable to NIST.

COM.AIR is a complete dew point monitoring system contained in a ruggedized NEMA-12 enclosure. The wall mountable package contains the sensor, control circuitry and flow control assembly. After mounting, a single sample line and power connection are all that is

needed to put the COM.AIR into operation. An alarm relay, horn and warning light as well as an analog output is included.

Edgetech Instruments designs and manufactures accurate and reliable absolute humidity hygrometers, relative humidity transmitters, humidity probes, moisture and dew point analyzers, relative humidity calibrators, dew point generators and oxygen measurement instrumentation. Edgetech Instruments products are manufactured, calibrated and serviced to the highest industry standards in a modern, ISO 9001 certified facility located in Hudson, Massachusetts. All certifications and calibrations are traceable to NIST.

**For more information contact Edgetech Instruments Inc., Email: [b2o@edgetechinstruments.com](mailto:b2o@edgetechinstruments.com) or visit [www.edgetechinstruments.com](http://www.edgetechinstruments.com)**

#### New Festo DRVS Pneumatic Semi-Rotary Drive

Festo recently introduced a new pneumatic semi-rotary vane drive and matched contactless position sensor that transforms a relatively simple and low cost drive into a solution that lowers engineering and inventory overhead, is fast and easy to install, and delivers long service life due to its sealed housing.

Standard swivel angles for the DRVS semi-rotary drive are 90, 180, and 270 degrees. Custom swivel angles are possible with a stop

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TECHNOLOGY PICKS



*Festo's new DRVS Pneumatic semi-rotary drive*

bracket accessory. At six bar pressure, the seven different sizes in the DRVS line deliver a torque range of .15 Nm to 20 Nm. Festo sizing software makes ordering the optimum unit for the application fast and accurate. The company

guarantees overnight shipping for standard DRVS drives, which lowers inventory requirements for OEMs and assures end use customers fast delivery of replacement parts.

**The SRBS – a unique position sensor for a semi-rotary drive**

The SRBS, a compact, contactless magnetic position sensor, attaches to the DRVS via a single cable and three screws. During installation, personnel simply move the vane to the drive's two positions and with a few clicks of the SRBS push button both positions are located for the position-sensing unit. Repetition accuracy is < .0039 inches (.1 mm). Through its push button, the SRBS position sensor can be designated PNP or NPN and NO or NC, which means that one part number covers all the different combinations.

"Festo is fundamentally reshaping its product lines to engineer end-to-end productivity for customers," said Mike Guelker, Festo Product Manager. "Customers are going to like the fast, accurate ordering, delivery, and installation of the DRVS and the flexibility, ease of use, and accuracy of the SRBS."

**About Festo**

Festo is a leading manufacturer of pneumatic and electromechanical systems, components, and controls for process and industrial automation. For more than 40 years, Festo Corporation has continuously elevated the state of manufacturing with innovations and optimized motion control solutions that deliver higher performing, more profitable automated manufacturing and processing equipment.

*For more information on the new DRVS semi-rotary drive and matched SRBS contactless position sensor, call 800-993-3786 and/or visit <https://www.festo.us>.*

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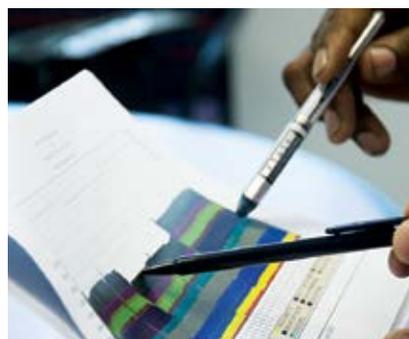
A music studio equipment manufacturer had problems maintaining steady pressure with their compressed air system. Additionally, there never seemed to be enough air to meet production demand despite having both a 50 hp and a 75 hp rotary screw compressor. Month after month, energy costs soared with the compressors being the highest consumers. And during the summer months, increased condensate in the lines caused severe air quality issues.

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