The Magazine for ENERGY EFFICIENCY in Compressed Air Systems

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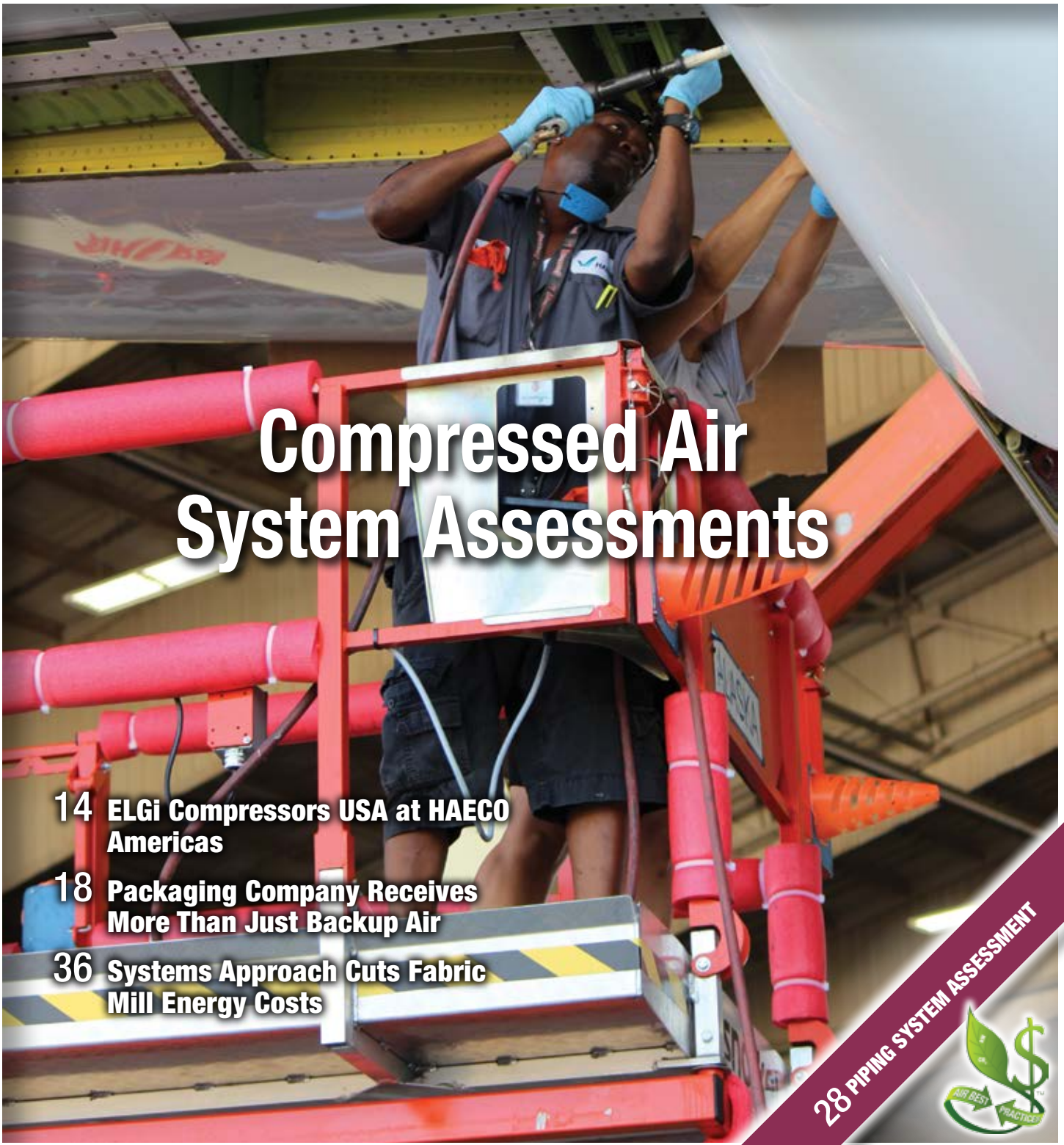

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FROM THE EDITOR | Compressed Air System Assessments

HAECO Americas Airframe Services provides aircraft maintenance and MRO services to major commercial and military clients. Compressed air is important to them. "Compressed air is our lifeline. Everything here runs on air," explained Curtis Wood, HAECO facilities team supervisor. We hope you enjoy our article describing the system assessments they've conducted, with ELGi Compressors USA, to optimize their energy consumption while remaining able to handle their highly fluctuating air demands in each hangar.

Diversified Air Systems provides us with an excellent system assessment story about a packaging company requiring backup air system. They had multiple 50 horsepower single stage lubricated rotary screw air compressors performing well but barely keeping up with demand. After a thorough system assessment, the packaging company installed a new compressed air system cutting energy consumption in half, qualified for a $46,000 energy rebate and allowed the older equipment to provide the desired redundancy.

I often hear from Energy Managers how hard it is to "sustain the gain" after system assessments optimize their systems. This is often due to new production equipment requiring higher pressures. I'm very pleased to publish an article titled, "Lantech Case Erectors Engineered for Compressed Air Efficiency." This Company has truly re-designed their equipment to function equally well at significantly lower compressed air pressure.

The compressed air industry is doing a great job transitioning to a systems approach. Opportunities for improvements abound in the end use equipment, the piping and storage networks, and the compressed air treatment equipment. System assessment professionals are helping factories assess their true compressed air needs and design optimized systems.

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

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Cover photo provided courtesy HAECO Americas Airframe Services.

▶ Join Hank van Ormer and Compressed Air Best Practices® Magazine to take an in-depth walk on the demand-side of a system – by signing up for our free June 30th Webinar titled, "Demand-Side: Compressed Air Flow and Pressure Measurement", at **www.airbestpractices.com/magazine/webinars.**

INDUSTRY NEWS

Quincy Compressor Acquires Five Scales Industrial Technologies Northeastern Branches

Quincy Compressor has acquired Scales Industrial Technologies based in Carle Place, NY and operating from five locations in New York, New Jersey, Pennsylvania, Connecticut, and Massachusetts. The acquired company has been a Quincy distributor for more than 50 years.

"The Scales organization has successfully developed a robust and broad customer base, which is supported by a seasoned team of knowledgeable and dedicated employees," said John Thompson, President Quincy Compressor. "This acquisition allows us to focus on growing the business with the intention of strengthening our market presence in the Northeastern region."

Quincy Compressor President John Thompson and Scales President William Scales (right to left) complete the Scales Industrial Technologies acquisition.

Scales Industrial Technologies has about 180 employees and is focused on distribution, service and rental of compressors and air treatment systems for use in applications such as medical, general manufacturing and industrial. Scales also offers medical gas solutions for hospitals and laboratories.

The parties have agreed not to disclose the purchase price. The business will operate as a division of Quincy Compressor LLC.

Headquartered in Bay Minette, Alabama, Quincy Compressor is a leading designer and manufacturer of reciprocating and rotary screw air compressors, from one-third to 350 horsepower; vacuum pumps and a full line of air treatment components. Quincy has more than 450 employees worldwide, and its products are sold through multiple channels, including a network of distributors, commercial retailers, online and company-owned stores.

About Quincy Compressor

Quincy Compressor is a leading designer and manufacturer of reciprocating and rotary screw air compressors, vacuum pumps and a full line of air treatment components. In business since 1920, Quincy has built its reputation on quality and rugged reliability, building tough air compressors for the most demanding applications. The Quincy brand is synonymous with quality, delivering *"Performance You Demand. Reliability You Trust."*

To learn more, visit www.quincycompressor.com.

INDUSTRY NEWS

CTA to Open North American Operation

CTA of Chaponost, France is proud to announce arrival into the North American compressed air treatment and process cooling market.

CTA was founded as a sales and service business in the process cooling and compressed air treatment markets in France in 1987. Throughout the 90's, CTA experienced rapid growth both organically and through strategic acquisition. Engineering and production of refrigeration dryers led to a solid European market presence and eventually to the acquisition of Euroklimat, an industrial process chiller manufacturer based in Milan, Italy.

Development has always been at the core of the CTA philosophy. CTA brought the first propane chiller to the European cooling market. Recently, CTA has redesigned their process chillers and refrigeration dryers to bring significant improvements for both products to market…the unique and patented 'No Frost' process chiller utilizing the OPTIFLUX evaporator and an improved two-stage DryMass cycling dryer. By separating the air-to-air exchanger from the air-to-refrigerant exchanger, the CTA cycling dryers react more quickly to changing compressed air conditions while consuming less energy. These improvements mean more consistent

Don Joyce is the Director of Sales and Marketing for CTA North America

dew points, increased energy savings and utility rebate qualification for end-users.

With products now ready for the North American market, the key task remaining was to hire the correct person to manage sales for North America. With compressed air and process cooling experience spanning 20+ years and having succeeded on every level from distributor to manufacturer, Don Joyce was the natural choice to lead CTA into the North American market. Don has the application experience ranging from thermal spray to MRIs and welders to linear accelerators while CTA has the expertise and reliable portfolio of products to serve a wide variety of applications.

CTA North America will be based in the Charlotte, NC area and plans are in place to open an office and warehouse in Q3 2016. Process chillers along with both thermal mass and direct expansion dryers will be stocked in the North Carolina facility. In 2017, CTA will introduce other key products including filtration, condensate treatment and market-specific process cooling products.

For further information please contact Don Joyce, Director Sales and Marketing, CTA North America, tel: 980-241-3970, email: djoyce@cta-na.com or visit www.cta.fr/GB/home.php

JHF Co. Partners Up with Ameren Missouri BizSavers® Program

John Henry Foster Company (JHF Co. – St. Louis, MO; www.jhf.com), a leading supplier of compressed air and hydraulic systems for industrial customers, is once again working closely with Ameren Missouri, as it relaunches its energy efficiency incentive program. "The Ameren Missouri BizSavers® program offers a variety of ways for customers to reduce energy consumption and better manage their energy costs," said Dan Laurent, director,

INDUSTRY NEWS

Over the past six years, the John Henry Foster Company has helped Ameren Missouri customers save over 17 million kWh; resulting in over $1 million in incentives.

Energy Services for Ameren Missouri. "We're investing approximately $158 million over three years to offer a comprehensive portfolio of programs for our residential and business customers".

Specializing in compressed air energy reduction and compressed air system optimization, John Henry Foster Company assist eligible participants to receive cash incentives through low-cost or no-cost efficiency measures.

For the past six years, JHF Co. has been an Ameren Missouri Trade Ally. As a Trade Ally and Registered Service Provider (RSP) of Ameren Missouri, John Henry Foster Company is trained to conduct surveys and assist in implementations of energy saving projects. By assisting Ameren Missouri customers, JHF Co. has helped save over 17 million kWh; resulting in over $1 million in incentives.

For more information please contact JHF Co. at tel: 1-800-444-0522 or visit www.jhf.com

Airleader Compressor Management wins 2016 Energy Efficiency Award Challenge

Airleader was honored with the coveted Energy Efficiency Award at the 2016 Energy Efficiency Award Challenge for the installation of their compressor management system at the Herman Miller facility in Spring Lake, MI. The judges chose Airleader from the four finalists, highlighting that the company made a return on investment within one year. Airleader's compressor management system has already paid for itself and continues to improve operating efficiency within Herman Miller's furniture plant.

Jan Hoetzel from Airleader Receives the Winners Plaque

Award Winner Jan Hoetzel said: "We believe that informed people make the difference. Airleader enables compressor operators to understand their system and harvest energy savings. Energy efficiency is the cheapest energy source."

The Award Challenge was organized and hosted by GACC Midwest to showcase and promote American and German partnerships for innovative and energy efficient building technologies. The Award Challenge is part of the "energy solutions – made in Germany" initiative sponsored by the German Ministry for Economic Affairs and Energy to recognize the positive impact German businesses and technologies have in the US.

INDUSTRY NEWS

About Airleader

Airleader is a compressor management system from WF Steuerungstechnik GmbH, represented in the US by SIGA Development LLC DBA Airleader. Airleader has sold more than 10,000 controllers and is a household name in Germany. Their monitoring system performs as a continuous Air Energy Audit as required by ISO 50001 and allows the monitoring of air quality as defined in ISO 8573-2010, and provides other system reliability data and assures long-term effectiveness.

About GACC Midwest

The German American Chamber of Commerce® of the Midwest (GACC Midwest), headquartered in Chicago with a branch office in Detroit, was founded in 1963. GACC Midwest is an integral part of the network of German Chambers of Commerce Abroad (AHKs) with 130 offices in 90 countries around the globe. Our continuing mission is to further, promote, and assist in the expansion of bilateral trade and investment between Germany and the United States, especially the Midwest.

For more information on the 2016 Energy Efficiency Award Challenge, please contact Svenja Schroeder at (312) 561- 9791 or schroeder@gaccmidwest.org.

Walker Filtration Wins Fifth Queen's Award

Compressed air filtration and drying specialists, Walker Filtration, have been honoured with a 2016 Queen's Award for Enterprise in Innovation, their fifth Queen's Award to date. Proving that, with determination, innovation and hard work, the UK manufacturing industry can continue to prosper.

The Headquarters of Walker Filtration in the U.K.

The award celebrates Walker Filtration's commitment to providing innovative, market leading products, and the development of a unique range of air/oil separators for use in oil flooded rotary vane pumps. The need for innovation was identified internationally and Walker Filtration took a bold step to enter a new sector. With significant investment in R&D, new product development and rigorous testing programmes progressed standard filtration to a new market levels. New superior performing technology was developed and extensive field testing convinced customers of product reliability.

The Queen's Award for Enterprise recognises outstanding achievements made by UK companies and is the UK's most prestigious acknowledgement of business enterprise. Walker Filtration, have a history of success, having previously received the Queen's Award for Enterprise in International Trade four times in recognition of the growth of their export business. This is Walker Filtration's first time receiving the Queen's Award for Enterprise in Innovation.

The company, established in 1983 and headquartered in the North East of England, continues to go from strength to strength – despite UK market reports showing an economic slowdown in the UK manufacturing sector and a tough export market. With

THE QUEEN'S AWARDS FOR ENTERPRISE: INNOVATION 2016

offices in Australia, America and Japan they supply compressed air filtration and drying solutions on a global scale, exporting to over 100 countries worldwide. The company's success is evidence that manufacturing companies in the United Kingdom can compete with the best in the world.

Commenting on the award, Lianne Walker MBE, Group Managing Director of Walker Filtration, said:

"We are overjoyed and honoured to have been presented with another prestigious Queen's Award, this time for innovation. Innovation is essential to sustaining business performance and maintaining competitive advantage in the marketplace."

"Our company-wide commitment to exceptional and innovative design, along with a proven track record of engineering excellence, enables us to remain at the forefront of the compressed air filtration and drying industry. This award is recognition of this – it acknowledges the efforts of all of our employees, both here at our UK headquarters and in our divisions overseas."

Walker Filtration designs, manufactures and exports a wide range of high efficiency filtration and drying solutions for compressed air, gas and vacuum – suitable for a wide range of industrial applications.

To find out more visit www.walkerfiltration.com

ELGi Compressors USA at HAECO Americas

By Compressed Air Best Practices® Magazine

In aerospace manufacturing, tiny details matter most. For instance, if proper torque is not applied to the screws and bolts fastening an aircraft fuselage, catastrophic failures can result. Compressed air is used to power the tools needed to apply that torque, making the compressed air system a critical part of the facility, though it largely stays behind the scene.

"Compressed air is our lifeline. Everything here runs on air," explained Curtis Wood, facilities team supervisor at HAECO Americas (HAECO). "The pneumatic tools, the rivet guns — all of those things are run by compressed air. We need high-volume, quick, very clean air, and we need it to be very stable."

HAECO Americas Airframe Services provides aircraft maintenance, repair and overhaul (MRO) services to major commercial and military clients. On any given day, one of the multiple hangars at the Greensboro, North Carolina, facility might harbour an aircraft from large commercial airlines, private operators, or the U.S. government. The Greensboro complex is nearly 1,000,000 square feet, with each hangar sprawling over 2 acres under roof.

The rigors and demands of the applications, in conjunction with the sheer scale of the facility, make the compressed air system at HAECO's Greensboro facility a challenge just to maintain — let alone improve upon. However, Curtis Wood and his team at HAECO managed to do just that, with the help of Patton's, Inc., a compressed air equipment supplier, and ELGi USA. In an on-going modernization project, the team of engineers has gradually improved reliability of the system and its energy efficiency — all the while adding sophisticated control and data-logging capabilities.

Compressed air is used to power nearly every application. "When you walk around in this place, you hear [compressed] air everywhere," Wood explained. "It's all around you." And, since the mechanics work in confined spaces, the compressed air needs to be treated for contaminants, such as water vapor and oil, making the supply of clean and reliable compressed air paramount for HAECO.

Each of HAECO's hangars has its own compressed air system, which are under the process of modernization. Ultimately, the final systems will include two ELGi air compressors, an air dryer, a mist eliminator, a storage tank, and a flow controller. While each hangar is unique and demands fluctuate consistently, target pressures remain around 90 psi (8.27 bar), and compressed air flow requirements do not exceed 350 cfm for any hangar.

Impact of Aerospace Applications on System Dynamics

Compressed air demand fluctuates dramatically at HAECO's Greensboro plant, largely due to the nature of applications that are unique to aerospace maintenance. For instance, what Wood describes as "blowing down the fuel tank" is a venting procedure that requires about 125 cfm for extended periods of time. When aircraft first arrive at HAECO, their fuel tanks need to be inspected, requiring

Compressed Air…Everywhere

HAECO's Greensboro plant performs maintenance on commercial, cargo and military aircraft. Inspections can last from days to a couple of months in duration, depending on the scope of the work. HAECO also runs a metal fabrication shop with a license to make FAA-approved parts. They have the capability to take a part off a plane and reproduce one exactly like it enabling them to do any type of composite repair with the exception of engine work. Visit www.haeco.aero

mechanics to go inside the tank. However, fumes from the tank are toxic and filled with volatile organic compounds (VOCs). To vent the jet fuel fumes out of the tank, compressed air is used to create a Venturi effect that evacuates the tank. Operators use a one-inch air hose to draw off the fumes. The process causes large spikes in compressed air demand for days at a time, and it may occur in multiple hangars simultaneously.

Unique workflows also impact the system dynamics of the compressed air system at HAECO. Air travel increases tremendously around the holidays, making for a temporary lull in work at HAECO. Demand comes surging back immediately afterwards as airplane manufacturers look to get routine maintenance completed during less busy times of the year.

"During the holidays, if you have a plane — it better be in the air," Wood said. "So we're really slow the week before Christmas. We run a real low cfm. But the day after Christmas, our cfm will skyrocket when those planes start cycling back in here. We'll peak out at around January 5, and we'll be near maximum capacity going forward."

Workflow also differs hangar to hangar. Although seemingly contradictory, some large aircraft require less compressed air, as the work can move more slowly. Hangars handling other aircraft, such as narrow-body jets, will have much higher compressed air demands over prolonged periods of time.

Configuration of the Original Compressed Air System

Under consultation with ELGi, the engineers at HAECO have wisely implemented adequate storage and 50-hp variable frequency drive (VFD) air compressors from ELGi to handle the highly fluctuating demand in each hangar. Prior to that, however, the system was quite different.

"Everything here was 75-hp air compressors, and they were set up as load/unload. Then you ran through a dryer, and you had very little storage," Wood said of the original compressed air system. "Basically, it was a run-all-the-time system. After we studied it with ELGi, we learned a lot about compressed air. We determined that 75 hp was way too much."

In total, the Greensboro facility had eleven 75-hp air compressors running in load/unload mode. Whenever compressed air demand spiked — due to the fuel venting application or increased workflow — compressors would kick in, and continue running inefficiently for prolonged periods of time.

"One compressor would take the load, and when there was a small spike in demand, another one would kick in but carry very little load, nearly running unloaded," Wood explained. "And these things would run unloaded for days. They didn't have VFDs on them, so they weren't running at brake horsepower proportional to the load. That meant that

ELGI COMPRESSORS USA AT HAECO AMERICAS

it's the same whether it's running at full load or idling."

Leveraging Compressed Air Storage to Handle Demand Spikes

With ELGi's help, HAECO redesigned the system to make better use of compressed air storage, helping each hangar respond to compressed air demand spikes better. Each hangar is a little different in system configuration, but the premise, or the mode of operation, remains the same.

"We've basically doubled the number of receivers to handle that [fluctuation] in the system, and then we put flow controllers in there," Wood explained. "We let the air compressors work to 125 psi (8.6 bar), and then we use a flow controller to modulate the pressure. Each hangar is a little different, but at our most remote point we deliver 90 psi (6.2 bar). Some hangars need 102 psi (8.27 bar) to get 90 psi at the remote end — it just depends on the setup. Then we monitor the cfm that is used, not what is created."

As Wood explained, each hangar's compressed air system is a little different: Hangar 1 has about 1900 gallons (254 cubic feet) of storage; Hangar 2 has 1300 gallons (173.7 cubic feet); and Hangar 3 will ultimately have 2000 gallons (267.3 cubic feet) of storage. The goal, according to Wood, is to have 1800 to 2000 gallons of storage in each hangar.

The major difference between each hangar was ceiling height. Hangar 4, for instance, only had enough headroom to install 400-gallon (53.4 cubic feet) receivers. Where Hangars 1, 2 and 3 used dry tanks, Hangar 4 required a wet tank with zero-loss drains. The team at ELGi was helpful in designing that system in particular.

"ELGi actually helped design the system in Hangar 4 because it was very tight," Wood said. "They were able to help us out with totally different setups and systems. Even though it's the same concept and design, there are differences in the way we're delivering compressed air in each building."

In conjunction with installing appropriate storage capacity, HAECO is also in the process of replacing each pair of 75-hp air compressors with two 50-hp ELGi air compressors.

Enhanced Energy Efficiency with ELGi Air Compressors

In conjunction with installing appropriate storage capacity, HAECO is also in the process of replacing each pair of 75-hp air compressors with two 50-hp ELGi air compressors.

"We didn't need these bigger air compressors, so we were able to downsize to a 50-hp machine," Wood said. "We found it best to install a 50-hp fixed-speed air compressor, and then put a 50-hp VFD with it. We let the VFD handle the low load, and let the fixed-speed machine do the high load. And probably 25 percent of the time we are running both."

With these changes the electrical load of the plant has dropped substantially. To date, HAECO has retrofitted the compressed air system of two hangars, effectively eliminating 100 hp. Additionally, with proper storage and VFDs, the compressed air system runs much more efficiently: Inclusively, the new VFD machines cost a maximum of $29.39 per hour at full load, and can throttle down to run at $5.87 per hour. In contrast, the original system's 75-hp air compressors required about $48.00 per hour.

"Basically, by trading two [Brand Xs] for two 50-hp ELGi air compressors, it saved us about $128,000 per year — on the low end," Wood explained. "That's easy for our corporate controllers to understand. I can pay for two of these air compressors in the first year."

Handling Compressor Data

Every hangar has its own Building Management System (BMS), and the new compressed air systems are each tied to their respective BMS. Integrating the new installations into the BMS had its own suite of challenges, but the capabilities to monitor and dictate air compressor performance is quite valuable. One particular challenge was writing the code

to convert the air compressor standard values to the metric system used by the BMS.

"That was one of the biggest challenges — converting the data," Wood said of the air compressor integration. "What that compressor actually shoots out is this huge fraction. We wanted it to read in a standard format. Our programmers went in there, took the data coming out of the ELGi compressor, and learned how to convert it by working with the programmers at ELGi. They helped convert it to data we could use."

Once the BMS receives and converts the air compressor data, it stores the information at several locations. The metrics are stored on the controller for a week before being sent to the server, where they are stored indefinitely. The record keeping is yielding major operational benefits for HAECO.

"We're storing that data indefinitely so we can see how things change," Wood explained. "As we change aircraft, layouts or configurations, we put notes in there. From a business pricing aspect, this is helping us understand what the demand is. Larger aircraft actually require less [compressed air]. The smaller, older airplanes require the most."

Education from ELGi

Designing an efficient and reliable compressed air system suited for a specific facility is a long and challenging process. Compound that effort with multiple hangars supporting different work requirements, and the process becomes even more difficult. Despite the daunting task, ELGi USA has successfully collaborated with HAECO Americas to dramatically improve the compressed air system at the Greensboro plant.

"The ELGi team helped us overcome some setup issues," Wood commented. "They were actually able to educate us. We went down to Charlotte, and they broke one of these machines down for us. We learned how to take one of these apart. We knew we were going to do our own service, so we needed to know the same thing the service guys would know — very specific details about how to take these things apart."

The HAECO plant was one of ELGi's first customers. The partnership has proved valuable to HAECO from an educational standpoint, and the facilities team is quite pleased with the equipment.

"We're slowly but surely switching them all to ELGi air compressors," Wood said. "We like ELGi air compressors because they're easy to work on. Inside, they're made in a way that it is easy to maintain. It's all stainless steel or aluminium. The thing's going to last a long time, and it can take a lot of abuse."

HAECO Americas has allotted budgetary resources for more air compressor upgrades in the coming year. Through a partnership with ELGi USA, the compressed air system at the Greensboro plant will continue its modernization process, improving the energy efficiency and putting insightful performance trends on record. BP

For more information on HAECO Americas please visit www.haeco.aero. For more information on ELGi Compressors USA please visit www.ELGI.us

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Packaging Company Receives MORE THAN JUST BACKUP AIR

By Jeremy Theis, sales engineer, Diversified Air Systems, Inc.

When a successful Midwestern United States-based packaging company reached out to Cleveland, Ohio-based Diversified Air Systems, Inc. (Diversified), it was simply looking to fulfill its need for backup air. Compressed air is a vital component of the packaging company's business, used for a variety of purposes, such as in its corrugating machines, conveyors, actuators, and more. In the end, the company received much more than just air redundancy, including a new variable speed drive, two-stage air compressor, a completely reconfigured and upgraded piping system, improved system

A $46,000 energy rebate helped finance the installation of a new Sullair V320-TS-250H two-stage tandem air compressor using two sets of rotors for full-load and part-load efficiency.

> "The annual energy cost of the current system totaled $149,000. Both the customer and the distributor recognized the importance of incorporating an efficient backup air system."
>
> — Jeremy Theis, sales engineer, Diversified Air Systems, Inc.

efficiencies, energy savings, and a significant energy rebate.

Data-logging the Installation

Diversified, along with its Sullair sales manager, met with the new customer to conduct an initial air study. The plant communicated they have 8,728 annual operating hours and a utility rate of $0.08 per kWh. The Demand rate was $10.00 per kw per month. The air compressors were data logged for a period of seven days during which the average ambient temperature was 49°F and the relative humidity was 72%. Plant personnel confirmed the running hours and plant loads, recorded during this period, was a good representative sample of annual production. The data-logging tools recorded data every 15 seconds.

The next step involved gathering information on the six installed air compressors. The plant was running five 50 HP and one 20 HP air compressors, all with on load/unload controls. They were all single-stage, lubricated rotary screw air compressors. The reliability of the machines had been "solid". The data gathered for each air compressor was nominal horsepower, motor efficiency rated psig, rated acfm, full load brake horsepower and fan horsepower.

The "Before" Situation

The audit showed that each air compressor was running at partial loads, with a total average flow of 623.8 scfm during the weeklong testing period. The total of six air compressors were necessary to run the plant, and as a consequence, there was no

PACKAGING COMPANY RECEIVES MORE THAN JUST BACKUP AIR

TABLE 1: "THE BEFORE SITUATION" — INSTALLED AIR COMPRESSOR PERFORMANCE SUMMARY

AIR COMPRESSOR	NOMINAL HP	% RUN TIME	AVERAGE HP	% LOADED POWER	% LOADED CFM	AVERAGE PRESSURE	AVERAGE FLOW	EFFICIENCY CFM/BHP	ANNUAL COST $
Backup	20	3.4	16.3	87	92	80	71	4.36	5,091
#3 Machine	50	41.5	34.4	69	48	86	94.6	2.75	16,555
#1 Machine	50	91	47.6	94	100	90	198.9	4.18	30,896
#2 Machine	50	90.2	46.3	93	87	88.4	171.5	3.70	31,426
#1	50	74.8	42.1	78	55	106.1	108.1	2.57	27,561
#2	50	98.5	49.4	91	85	106.7	168.1	3.40	37,478

About Diversified Air Systems, Inc.

Since 1979, Diversified Air Systems, Inc. has been a full service and stocking distributor of industrial equipment specializing in energy saving engineered solutions for both oil flooded and oil-free compressed air and vacuum systems, piping installations, air treatment equipment, "Airtility" leasing of compressed air, as well as closed loop water recovery systems, cooling towers and chillers. The company offers top manufacturers such as, Sullair, along with FS Curtis, Champion, Hitachi, SPX/Deltech, Generon Nitrogen Generators, Energair Compressor Sequencers and many more.

Servicing Northern Ohio, Western Pennsylvania, Southern Michigan and the Pan Handle of West Virginia, Diversified Air Systems is committed to providing engineered solutions through its system based engineering approach. With service and sales locations in Cleveland, Akron, Toledo, Pittsburgh and Erie, Pennsylvania, the company specializes in improving production efficiency and reducing operating costs for its customers. Visit www.diversifiedair.com

Diversified is proud to have been named the "Sullair 2015 Distributor of the year for all of North America." Pictured are Jeremy Theis, Bob Lisi, Laura Lisi, Eric Dickey and Angie Dickey (left to right).

Diversified Air Systems, Inc. provides engineered compressed air solutions to Northern Ohio, Western Pennsylvania, Southern Michigan and the Pan Handle of West Virginia.

redundancy whatsoever. Thus, if any of the compressors were to go down for maintenance the company would not be able to sustain its production. The annual energy cost of the current system totaled $149,000. Both the customer and the distributor recognized the importance of incorporating an efficient backup air system. It also became clear that running so many load/unload machines at partial loads was inefficient.

Ensuring Efficient Redundancy

After analyzing the audit information, Diversified suggested the plant install one Sullair V320-TS-250H with a new Sullair RC2000 refrigerated air dryer, pre- and after-filters, and a new 1550 gallon receiver tank. Not only would the new system fulfill the need for 100 percent redundancy, but the two-stage VSD compressor would also be more durable and efficient. Sullair's two-stage tandem compressors use two sets of rotors arranged in an end-to-end design for full-load and part-load efficiency, with a two-year payback on energy savings compared to a single-stage compressor. Capacity is matched to system need for reduced cycle time and longer life. The packaging company would use the new system as its primary air source and its previous compressors as a back up.

Pressure, Distribution Concerns

From the start, Diversified recognized this would not be a standard installation. First off, this was not a one-for-one replacement, but more along the lines of a complete overhaul of the air system. Thus, there was not enough space in either existing compressor rooms for the new Sullair equipment and receiver tank.

The existing installation had five 50 HP and one 20 HP single-stage, lubricated rotary screw compressors running partially loaded.

PACKAGING COMPANY RECEIVES MORE THAN JUST BACKUP AIR

TABLE 2: SYSTEM SUMMARY

	ANNUAL ENERGY COST	AVG FLOW (SCFM)	MAX FLOW (SCFM)	AVG PRESSURE (PSIG)	MAX PRESSURE (PSIG)	AVG HP	MAX HP
Before	$149,007	624	1,092	96	116	193	292
Post-Project Air Study	$74,828	389	1,072	101	103	101	221

The new compressor room location included the installation of new cooling air exhaust ducting from the air compressor for heat recovery, expanded headers, aluminum distribution piping, refrigerated air dryer, pre- and after-filters, and a new 1550 gallon receiver tank.

Plus, with more than 50 years in business, the packaging company had expanded its facility multiple times, making distribution a concern. Additionally, due to different size piping throughout the plant, the customer was experiencing pressure loss at various points of use locations of the building. After analyzing the facility and studying the customer-provided piping schematic for the entire plant, Diversified suggested a new location for the air compressor.

Unfortunately, the new location only had two-inch pipe surrounding the room, which would fall well below the recommended pipe size for a 200 HP compressor, and would also fail to maximize the efficiency of the new compressor. Diversified proposed expanding the main header at the new installation site to four-inches and running that out of the tank in two directions, connecting into the existing header in two separate connection locations.

Ducting the updraft exhaust cooling air from the compressor, then recouping that heat into two portions of the plant using a diverter for both "summer" and "winter" modes was also part of the installation. Diversified also brought in an outside contractor to grout the machine, which ensures it will have complete and uniform contact with the mounting surface. While those services were outsourced, Diversified's own technicians handled the

"Not only did the packaging company receive a complete air system upgrade and back up air plan, but it also received an unanticipated bonus—significant annual energy savings and a rebate of thousands of dollars."

— Jeremy Theis, sales engineer, Diversified Air Systems, Inc.

piping installation with roughly 600 feet of Infinity brand aluminum piping. The end result was an impressive-looking system with a drastic improvement in pressure consistency throughout the plant.

Energy Savings Plus a Rebate Check

Not only did the packaging company receive a complete air system upgrade and back up air plan, but it also received an unanticipated bonus—significant annual energy savings and a rebate of thousands of dollars. In a post-air study conducted by Diversified, the new load profile showed the VSD machine varying between 30 – 80 percent capacity, with an average of 388.9 scfm.

The weeklong study showed a projected annual energy cost of under $75,000 with an annual kWh reduction of 550,536.13 kWh. This equated to an impressive 50 percent reduction from the previous system. In addition to annual energy savings, the post-project compressed air verification study resulted in an energy rebate of more than $46,000 from the local utility company—nearly doubling the amount anticipated. Further, by ducting the cooling exhaust air into the plant during the winter operation, they achieved an additional estimated cost savings of nearly $15,000 compared to the cost of natural gas supply the same amount of heat (761,700 BTUs / hour). BP

For more information please visit Diversified Air Systems at www.diversifiedair.com

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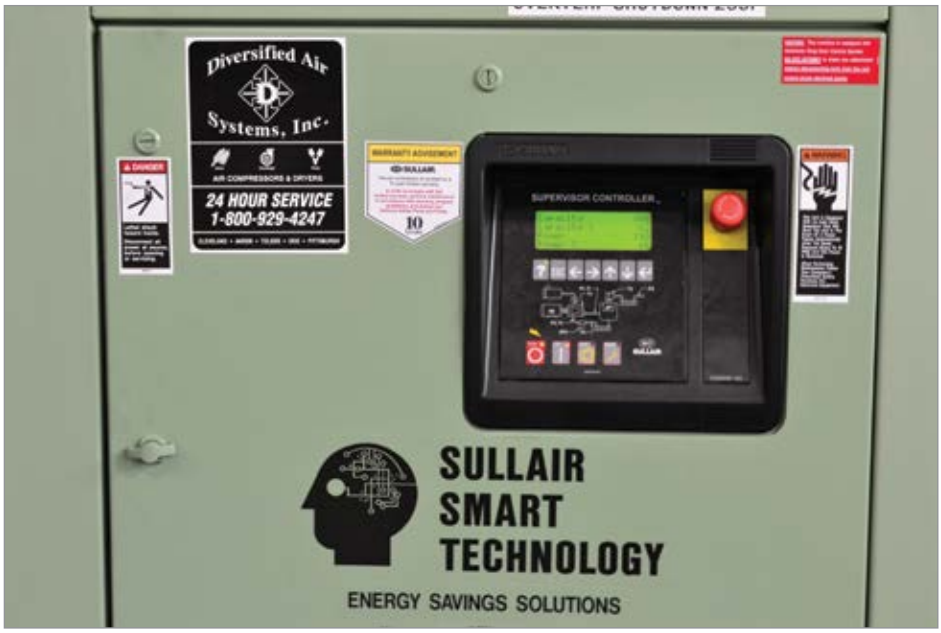

The post-project compressed air study triggered the release of an energy rebate check of more than $46,000 from the local utility company—nearly doubling the amount anticipated.

Lantech Case Erectors Engineered for COMPRESSED AIR EFFICIENCY

By Mike Castelli, Director Global Business Development, Case Handling Products, Lantech

Focus on Energy Reduction

Founded in 1972 at the peak of an energy crisis, Lantech made an impact on the world as the inventors of stretch wrapping and started a packaging revolution.

Energy, in all forms, has always been a key Lantech focus. It was, in fact, a key element of the core packaging problem the company's founders set out to address. They saw an opportunity to capitalize on an inexpensive and under-used resource – stretch film – to displace a high materials cost and energy intensive way of unitizing pallet loads of products – shrink bagging.

Today, the huge, energy intensive, gas-fired shrink ovens and expensive two-pound polyethylene bags of the 1970s have disappeared from the packaging landscape – replaced by armies of stretch wrapping machines unitizing the very same loads at a fraction of the energy, materials and labor costs.

Increasing Customer Value

So it was only natural that the engineering team at the company's corrugated case (cardboard box in layman's terms) handling equipment plant in Cuijk, The Netherlands applied the core principle of energy reduction to improve the pneumatic efficiency of its machines.

Compressed air is expensive and case handling machines are notoriously air-hungry. Vacuum pulls corrugated cases or "blanks" from magazines. Venturis create the vacuum on our smaller machines. Pumps are used in higher speed applications or for large or complex cases. Pneumatic actuators are used to fold flaps and may perform other functions as well. Large air requirements require large replenishment capabilities so machines that used less air would yield major benefits.

Weight reduction is a basic efficiency improvement strategy – lighter systems require less energy to operate. Consequently, the team started by rationalizing the component materials on a basic case erecting machine. As they replaced cold rolled steel with aluminum and sized the bearings properly for the lighter workload, they turned to their pneumatic component suppliers to help identify current

> "A good example of an innovative improvement project was the conversion to a new venturi. The team proposed a more efficient three-stage design that spills far less air than the previous version."
>
> — Mike Castelli, Director Global Business Development, Case Handling Products, Lantech

best practices as well as efficient components based on actual engineering requirements.

Consequently, every pneumatic component is now selected based on the actual engineering performance required. Pneumatic efficiency is viewed as so fundamental to machine value that Lantech has developed substantial in-house pneumatic expertise even though it continues to work closely with its component suppliers.

A good example of an innovative improvement project was the conversion to a new venturi. The team proposed a more efficient three-stage design that spills far less air than the previous version.

The team also improved efficiency by using gravity to manage the downward segments of pneumatically driven vertical movements. A flow-controlled air outlet manages the upward speed and downward motion is initiated by letting the system just "fall." The fall speed is regulated with a flow-control valve. This saves about 40 percent of the air historically required for these movements.

Other design innovations include adding buffers to capture the exhaust from pneumatic cylinders. This air is used for the "blow off" which ensures that corrugated cases are fully released by the vacuum cups after they're pulled from the magazine. The blow off cleans the cups as well. A "sleep mode" now hibernates electrical components and shuts off the main air supply valve when the machine's not in use.

Saving Compressed Air

The net result was, that on the company's basic case erector, operating pressure decreased from 88 psi (6 BAR) to 44 psi (3 BAR), a 50 percent improvement. Vacuum pressure increased from 11.6 pounds per square inch to 12.3 pound per square inch, a six percent improvement. And overall air usage decreased from .9 cfm to .57 cfm, an

Lantech Model C-2000 Case Erector

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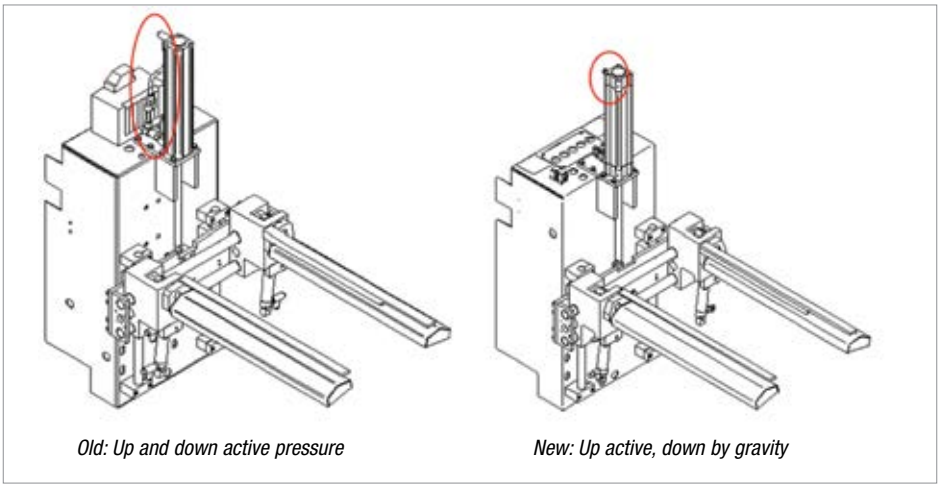
LANTECH CASE ERECTORS ENGINEERED FOR COMPRESSED AIR EFFICIENCY



Old: Up and down active pressure

New: Up active, down by gravity

improvement of almost 37 percent. Similar improvements were realized across the entire case erector product line.

A by-product of using air more efficiently is that machine operating noise attributed to pneumatics has decreased. As the European Union (and other regulatory bodies) imposes stricter factory wide noise limits (currently 75db), this is an important step to facilitate compliance without resorting to cumbersome and expensive enclosures.

All of these design improvements have the same goal: increasing customer value through more efficient energy use. All too often compressed air systems evolve into complex, irrational, leaky and inefficient monsters. Therefore it's critical to reduce air consumption by ancillary equipment like case handling machines.

Continuous improvement is an ongoing process to do just that. But increasingly, Lantech finds customers paying more attention to managing their air supply, even to the point of requesting in-line detection and warnings for leaks. As industry continues to evaluate total energy costs and expand environmental initiatives, air efficiency continues to evolve as a promising area for improvement.

About Lantech

Founded in 1972, at the peak of an energy crisis, Lantech made an impact on the world by inventing stretch wrapping and sparking a packaging revolution that spread around the globe and changed the way pallets of products are unitized for shipment. Now, billions of pallet loads are stretch wrapped every year. Our passion to do things better, faster, safer and at lower costs led to a culture of innovation and generated 277 patented inventions to date that create enormous value for our customers by eliminating waste from their supply chains. We have sales and technical support offices in North America, Europe, Australia, and China as well as a global network of independent distributors, integrators and service technicians. Where our customers are, we are. BP

For more information contact Lantech at www.lantech.com or call tel: 502.815.9108

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A Compressed Air Piping SYSTEM ASSESSMENT

By Gary Wamsely, Engineering Consultant, JoGar Energy Services

During an Energy Review at a relatively new health care garment factory, in the Southwest, we found all three of the 100 psig nominally rated rotary screw air compressors were operating at 115-120 psig continuously. We asked the Production Superintendent if this was normal or if something had recently changed. He explained that initially they operated two air compressors but had to begin running the 3rd unit in 'trim' mode after some converting machines were up-graded. Then, a new larger converting machine was recently installed and air pressure quickly became a production issue. Since capital funds were tight, the project engineering team determined the third air compressor had sufficient capacity.

Why Are the Air Compressors Running at 120 psig?

Our preliminary investigation had revealed that all three air compressor systems were running at 120 psig (with no significant operational issues). System air pressure, however, out on the production floor was marginally low and causing on-going production quality issues. The air compressor motors had high 'amps' and high air temperatures and the dryers were overloaded due to high air temperature.

The project team apparently had not conducted a thorough due diligence of the entire system to determine if it could adequately supply a relatively higher system demand. At first glance, it did appear the three robust air compressors and dryers, with a 4 inch size main air header, should work!

Piping Restrictions Causing Down-Stream Pressure Problems

The air compressors and dryers had been installed in parallel mode to provide system flexibility. Piping restrictions (fittings and valves) at the compressors and the in-line filter and dryer connections were causing down-stream pressure problems with all three air compressors in service. More review confirmed the original design of the system was for only two air compressors to be in normal operation.

But, since the 3rd unit was not fully loaded, the project team had determined (theoretically) it should be able to provide the additional capacity for the new converting machine. But, these unforeseen piping restrictions were causing compressors performance issues.

These relatively new air compressors (150 hp, 750 CFM) were capable of supplying over 2,000 CFM to the plant. However each compressed air dryer line could handle only about 600 CFM before incurring excessive pressure loss. In addition, 400 feet of 3 inch main air line to the production area had a nominal capacity of about 1,600 CFM. The new converting equipment (300 CFM air usage) had overloaded the plant piping distribution system.

Piping System Recommendations

We recommended changing the valves and fittings at the compressors and dryers (from 2 inch to 3 inch size) and running a new 2 inch air line from the 4 inch main header (after the flow meter station) to the new converting machine. Pressure storage options were not viable because of the 3 inch header in Converting. We also recommended a formal Rental Compressor delivery "Plan" be established for major maintenance service and emergencies.

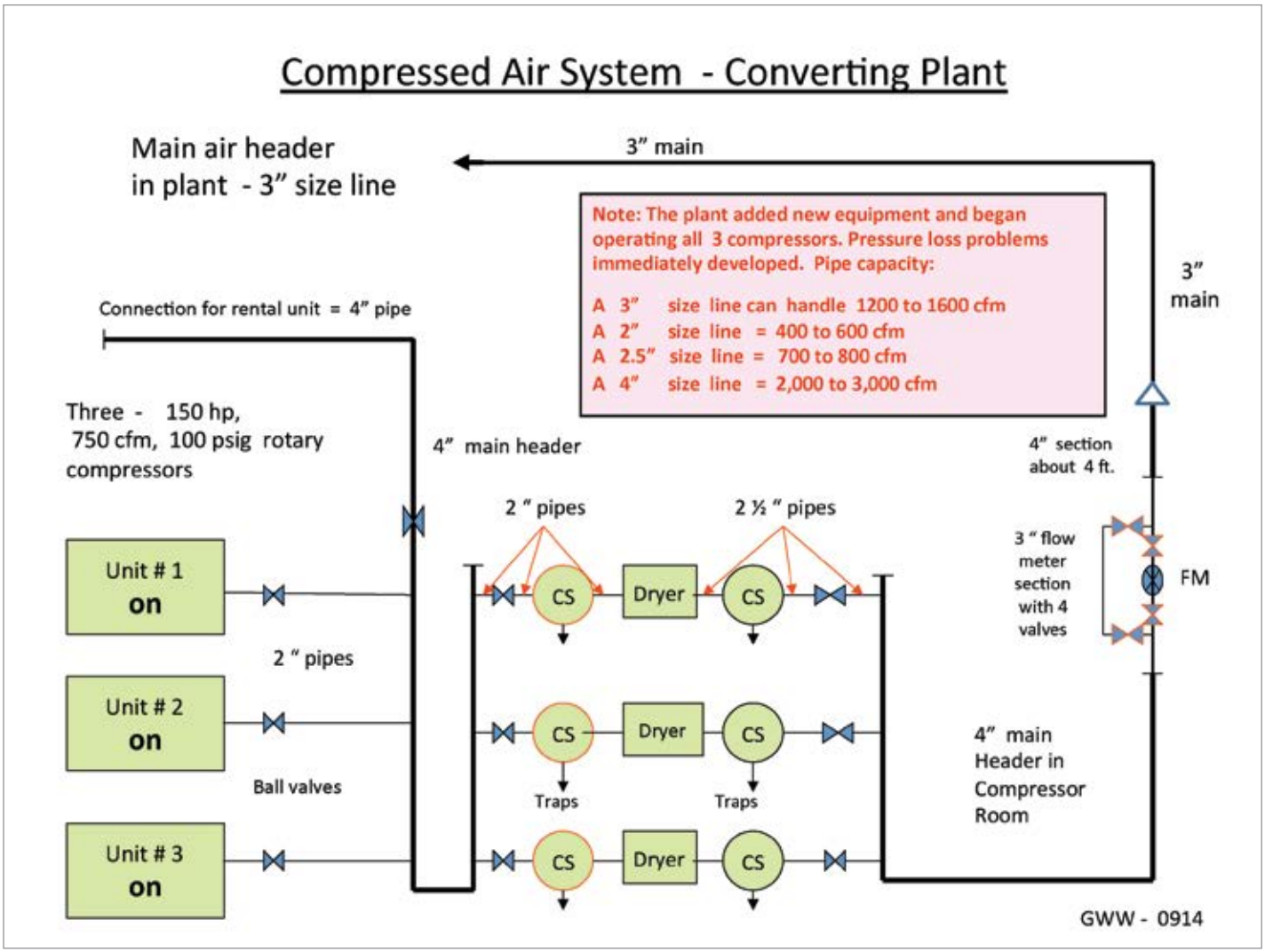
It took a few weeks to get funds approved and make the changes. Some preventative maintenance work also improved dryer performance. Later the compressors were back to operating at 95-100 psig (with 85-90 psig in Converting) and production returned to normal.

The main benefit to the plant was the production issue was resolved. Clearly running the air compressors at 20 psig lower discharge pressures was going to be more efficient and

Compressed Air System Review Recommendations

- ❒ Review the entire plant air system – both supply and demand
- ❒ Establish plant 'base load' usage with minimal production
- ❒ Compare your system usage to other similar facilities
- ❒ Learn the operating and maintenance costs of your air system
- ❒ Evaluate the reliability and efficiency of the compressors
- ❒ Review maintenance program to assure complying with Mfg. Specs
- ❒ Review auxiliary systems: coolers, dryers, traps & local devices
- ❒ If your plant incurs wet air conditions, request assistance to resolve
- ❒ Evaluate system pressure variation. Determine the causes
- ❒ Study the piping distribution system. Identify bottlenecks
- ❒ Identify areas and / or processes that are huge consumers
- ❒ Identify areas and / or systems that suffer from low air pressure
- ❒ Determine if local piping system changes may be appropriate
- ❒ Conduct 'air leaks' survey to determine the extent of losses
- ❒ Establish a few objectives that may be appropriate
- ❒ Get 'er done. And, have fun doing it!

A COMPRESSED AIR PIPING SYSTEM ASSESSMENT



generate energy savings. Moreover, every two psig drop in the compressor discharge pressure produces a 1 % reduction of motor power (kWh). 20 psig = 10 % power savings on the 400 hp load. In addition, compressors and dryers operating at 95-100 psig will have a much longer life and fewer maintenance issues than those operating at 115 to 120 psig.

Conclusions

Does your facility operate the plant compressed air system at 120 psig or higher? Is it really necessary to operate above 100 psig ? Do you know what critical plant process requires unusually high air pressure? Should you expect energy usage and production quality issues when utility systems are operated beyond their initial design conditions?

This type of situation can occur occasionally when manufacturing systems engineers manage plant expansion projects. They occasionally have tight project budgets and do not always conduct a thorough assessment of the plant utility equipment. It is the responsibility of site plant engineering to be involved and identify how new loads could impact the utilities: i.e., Electrical MCCs, Air Compressors, Process Water, HVAC, the Steam System, etc.

Our experience is that compressed air is the most-often overlooked utility. BP

Gary Wamsley is an Engineering Consultant at JoGar Energy Services in South Florida with over 40 years of industrial utility systems experience. To contact him please visit www.jogarenergy.com

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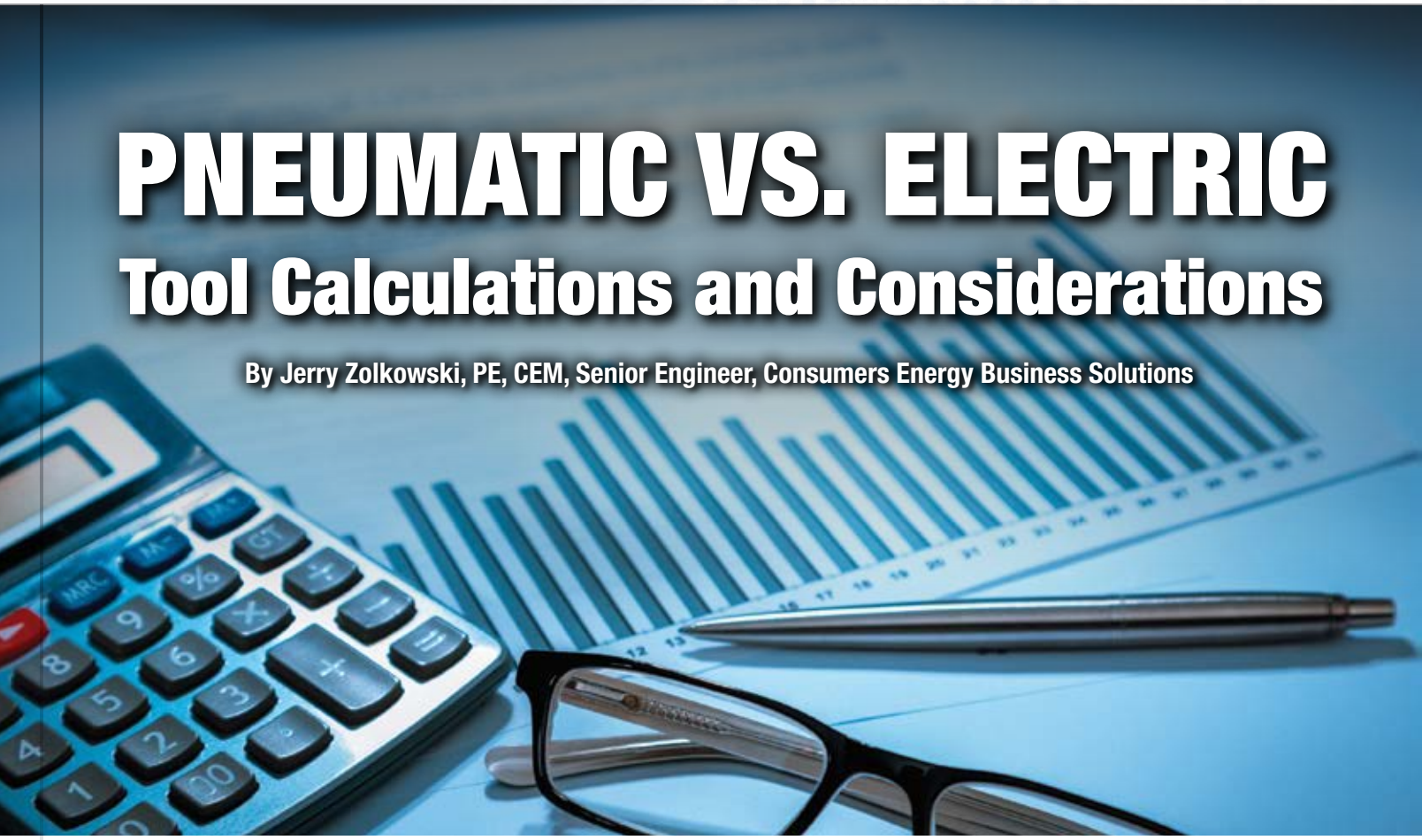
PNEUMATIC VS. ELECTRIC

Tool Calculations and Considerations

By Jerry Zolkowski, PE, CEM, Senior Engineer, Consumers Energy Business Solutions



Pneumatic tools are powered by compressed air, while electric tools are powered by electricity as the motive power. Pneumatic tools are commonly used throughout chemical process industries, construction, woodworking, metalworking and many other applications. Compressed air systems are a necessary part of most plant operations. However, according to the U.S. Department of Energy Compressed Air Challenge compressed air systems are:[1]

- Often the least efficient source of energy in a plant
- Often the biggest end use of a plant's electricity
- Frequently used inappropriately

To operate a 1-horsepower compressed air motor, approximately 7 horsepower of electrical power requirement is put into the air compressor. Even more power is needed when the pressure is higher than a typical pressure of 90 psi.

For this example, 0.5-horsepower pneumatic and electric tool energy uses are compared. A tool run time of 400 hours/year is used—and all the calculations are presented so the savings for other cases can be easily substituted when considering other variations.

Figuring out the energy savings for the switch from pneumatic to electric tools requires an estimate of energy use for each case. The effect of replacing a few tools in a large compressed air system may be too small to detect using power monitoring on the air compressors. However, it is still a good practice, and when part of a larger program to reduce air consumption, the combined efforts will amount to something measureable. Another positive aspect may be that reduced compressed air use frees up needed air compressor capacity.

Calculating Compressed Air Tool Energy Use

Some assumptions are made in this process. One is that the tools run at capacity—full-rated flow in the pneumatic case, and full-power draw in the electric case. Obviously that is not true all the time, and if a closer load profile is known, then the energy use for

each load at its annual hours of operation can be added together to obtain a better estimate.

In addition, whenever considering load reductions, there is the issue of part-load air compressor efficiency, and where the facility operates on the air compressor efficiency curve. While this example uses a value close to typical full-volume efficiency, the actual results could be much different. If the site merely moves down the efficiency curve of a modulated inlet vane air compressor, the savings would be modest. However, if enough compressed air-powered tools are taken out of the system to allow a lightly loaded air compressor to shut off completely, then the savings are much larger.

In a recent plant energy audit, the recommendation was made to replace pneumatic tools with electric. The site had two 125-hp, load/no-load air compressors, and the second air compressor ran unloaded most of the time. The site only had dryer capacity to serve one air compressor. In addition to the basic savings recommendation (assuming full-load efficiency), it was emphasized that changing out enough tools to allow the second air compressor to remain off would bring larger-than-calculated savings and bring the benefit of allowing the site to use dry air everywhere without an additional capital expenditure. Savings after that point would be a little less than calculated.

Analysis

The following equation can be used to calculate the annual electrical demand of the existing pneumatic tool:

$$AED_{Pneumatic} = ED_{Pneumatic} \times t$$

Where:

$AED_{Pneumatic}$ = Annual electricity use of the pneumatic tool in kWh/year

$ED_{Pneumatic}$ = Electrical demand of the pneumatic tool in kW

t = Annual hours of operation of the pneumatic tool (400 hours/year, in this particular plant)

*t can be considered 20 percent utilization for one shift (2,000 hours/year) operation, 10 percent utilization for a two-shift (4,000 hours/year) operation, 6.7 percent utilization for three shifts (6,000 hours/year), and so on.

The following equation can then be used to calculate the electrical demand of the existing pneumatic tool:

$$ED_{Pneumatic} = CFM_{Pneumatic} \times \eta air\ comp$$

Where:

$ED_{Pneumatic}$ = Electrical demand of the pneumatic tool in kW

$\eta air\ comp$ = Compressed air generation efficiency (0.16 kW/cfm)[2]

$CFM_{Pneumatic}$ = cfm usage of the pneumatic tool

The average cfm of a typical 0.5-hp pneumatic tool is calculated in the following table:

Rated CFM of Typical Pneumatic Tools During Operation

Pneumatic Tool Make/Model	CFM
Speedaire/2YPR1[3]	18
Chicago Pneumatic/CP9288[4]	24
Desoutter/DR350 P20000[5]	20
Average	20.7

The following calculations reveal the electrical demand of a 0.5-horsepower pneumatic tool consuming an average of 20.7 cfm.

$ED_{Pneumatic}$ = 20.7 cfm x (0.16 kW/cfm) = **3.31 kW**

The following calculation reveals the annual electricity use to supply compressed air to this pneumatic tool:

$AED_{Pneumatic}$ = 3.31 kW x (400 hours/year) = **1320 kWh/year**

Corded Electric Tool Energy Use and Savings

Some applications are not suitable for conversion from pneumatic to electric tools. One reason is higher powered tools use larger electric motors that can get too heavy for frequent use without a tool balancer. Another reason is the durability between electric and pneumatic may also be an issue. Frequently used hand tools may get replaced every few months, so in those cases it may be wise to track the tool cost and replacement frequency to create a total operating cost comparison, including the compressed air and electricity use. While corded electric tools will always win on the energy front, the total cost of operation may present a different story—if the electric tools have a different lifespan and cost than the pneumatic tools.

Analysis

The following equation can be used to calculate the annual energy savings associated with replacing pneumatic tools with electric tools:

$$AES_{Electric} = AED_{Pneumatic} - AED_{Electric}$$

Where:

$AES_{Electric}$ = Annual electrical energy savings in kWh/year

$AED_{Pneumatic}$ = Annual electrical energy use of pneumatic tool in kWh/year

$AED_{Electric}$ = Annual electrical energy use of the electric tool in kWh

PNEUMATIC VS. ELECTRIC TOOL CALCULATIONS AND CONSIDERATIONS

The electricity required for a corded electric tool with the same 0.5-horsepower output as the pneumatic tool considers the output and the motor efficiency. The typical motor efficiency for a 0.5-horsepower electric motor is 65 percent.[6] The full-load electric demand then becomes the following:

$$ED_{Electric} = (0.5 \text{ hp})(0.746 \text{ kW/hp}) / 65\% = \mathbf{0.574 \text{ kW}}$$

The following equation can be used to determine the annual electrical demand of the electric tool:

$$AED_{Electric} = ED_{Electric} \times t_{Electric}$$

Where:

$AED_{Electric}$ = Annual electrical energy use of the electric tool in kWh

$ED_{Electric}$ = Electrical demand of the electric tool (0.574 kW)

$t_{Electric}$ = Annual hours of operation of the electrical tool (400 hours/year)

The following calculation reveals the annual electricity use of an electric tool:

$$AED_{Electric} = 0.574 \text{ kW} \times (400 \text{ hours/year}) = \mathbf{230 \text{ kWh/year}}$$

The following calculation reveals the annual electrical energy savings associated with replacing a pneumatic tool with an electrical tool:

$$AES_{Electric} = (1320 \text{ kWh/year}) - (230 \text{ kWh/year}) = \mathbf{1090 \text{ kWh/year}}$$

For this example, if the average power cost was $0.10/kWh, the annual savings would be $109 per tool.

Calculating Energy Consumption of Battery-Powered Tools

Battery-powered tools are as efficient as corded tools, but the battery charging system introduces some losses. Battery-powered tools can (but may not) offer greater efficiencies than compressed air and may be preferred in some cases. The Environmental Protection Agency's Energy Star program publishes the amount of energy lost by the charging system, and this measure qualifies chargers using Energy Star's published values.[7]

Energy Star's "average energy ratio" is the amount of energy lost by the charging system

CHART 1												
QTY	HP	ACTUAL CFM EACH	TOTAL CFM	PRICE EACH	DESCRIPTION	REPLACEMENT	AMPS	INPUT WATTS	WATTS TOTAL	HP OUT CALC	PRICE EACH	PRICE ALL
1	1.1	36.0	36.0	$700	5" 12,000 rpm angle grinder	DeWalt D28114N	13.0	1287	1287	0.9	$154	$154
1	2.3	68.0	68.0	$950	4.5" 12,000 rpm angle grinder	DeWalt D28115N	13.0	1287	1287	0.9	$140	$140
1	3	60.0	60.0		9" 6000 rpm sander	Milwaukee 6078	13.0	1287	1287	0.9	$300	$300
1	0.2	15.5	15.5	$105	6"orbital sander	DeWalt DW443	4.3	426	426	0.3	$219	$219
2	0.45	25.0	50.0	$70	5" sander	DeWalt DWE6401DS	6.0	594	1188	0.4	$100	$200
2	0.5	7.0	14.0	$80	500 rpm 1/2" reversible drill	DeWalt DW130V or DW246	9.0	891	1782	0.7	$180	$360
6	0.2	15.5	93.0	$105	6"orbital sander	DeWalt DW443	4.3	426	2554	0.3	$219	$1,314
5	22-38 ft-lb	19.0	95.0	$180	3/8" high speed reversible drill	Bosch 1030VSR	7.5	743	3713	0.5	$150	$750
		Total CFM	432					kW Total	13.52		Total	$3,437
		Total CFM	432		volts	110						
		Average CFM	216		Motor Efficiency	55%						

While it might not be possible to replace all the pneumatic tools with electric tools, an evaluation as shown in this chart can get the discussion started on where to begin.

divided by the useful energy in the battery. The ratio varies from nearly zero to about 15. As a savings example, consider a tool with a charger that has an Average Energy Ratio (ER) of 2.5. The calculation for corded tools above shows the energy required by the tool when motor efficiency and run time are considered, and that is 230 kWh/year. An ER of 2.5 means the amount of non-active energy used in charging is the following:

Non-active Energy = (Energy Ratio) (Useful energy in the battery)

For this example, the non-active energy can be calculated using the following:

(2.5) (230 kWh/year) = 575 **kWh**

The total energy includes the useful energy in the battery, resulting in the following calculation for total energy use:

(230 kWh of useful energy) + (575 kWh of non-active energy) = **805 kWh**

To obtain the annual energy savings as opposed to using pneumatic tools, the compressed air energy of 1320 kWh/year is plugged into the following equation:

(1320 kWh/year) – (805 kWh/year for battery tools) = **515 kWh/year in Energy Savings**

If the average power cost is $0.10/kWh, then the annual savings would be $51.50 per tool, for this example. Be sure to check the charger efficiency before assuming a battery-powered tool is more efficient than a pneumatic tool.

Making the Switch to Electrically Powered Tools

A first look at the facility's opportunity can be evaluated using a spreadsheet. This survey and initial analysis can get the effort started by showing where the efforts of trying new tools will be most productive. An example of this survey is shown in chart 1.

Using a corded electric tool in place of a pneumatic tool offers energy savings, and that should be pursued as a best practice wherever possible. A planned approach would identify where pneumatic tools are used, their run time, cost, and the load on the tool if possible. Then replacement electric tools can be selected and tested. The energy use of the replacement tool can be projected and the cost considered to calculate a payback for each tool. The tools that get replaced will bring savings and reduce the amount of compressed air required by the plant. BP

For more information, contact Jerry Zolkowski, tel: (517) 481-2972, email: Gerard.Zolkowski@dnvgl.com, or visit www.new.consumersenergy.com.

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SYSTEMS APPROACH CUTS FABRIC MILL ENERGY COSTS

By Ron Marshall for the Compressed Air Challenge®

KNOW PRESSURE COMPRESSED AIR CHALLENGE

A large fabric mill has implemented an energy management system based on the ISO 50001 standard to track their compressed air system efficiency. As a result of information gained from this system, and measures learned in some recent compressed air training, the company has reduced their compressed air system costs while at the same time achieving increased fabric production output. The savings were gained by not only optimizing the supply side of the system, but by also addressing the end uses.

Background

The large fabric mill is located in Asia and is one of four integrated textile-manufacturing facilities owned and operated by a private company. Mill 2, the subject of this article, produces about 5.5 million yards of fabric annually.

The compressed air system consists of ten large turbo compressors ranging in size from 375 kW to 500 kW. Two smaller rotary compressors were used for seal air duty for the turbo compressors and other auxiliary uses. The age of the turbo compressors varied, with some units over twenty years old.

The compressed air is conditioned using refrigerant style dryers. Starting in 2008 the company started replacing their dryers with units with inverter drives to save energy, and improving environmental impact because these dryers contain non-ozone depleting refrigerants.

Data taken in 2014, as a result of the company's energy management system, showed compressed

> "As a result of information gained from this system, and measures learned in some recent compressed air training, the company has reduced their compressed air system costs while at the same time achieving increased fabric production output."
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> — Ron Marshall for the Compressed Air Challenge®

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Join Compressed Air Challenge for the next session of ***Fundamentals of Compressed Air Systems WE*** (web-edition) coming soon. Led by our experienced instructors, this web-based version of the popular *Fundamentals of Compressed Air Systems* training uses an interactive format that enables the instructor to diagram examples, give pop quizzes and answer student questions in real time. Participation is limited to 25 students. Please visit www.compressedairchallenge.org, to access online registration and for more information about the training.

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air accounted for about 61 percent of the total facility annual electricity consumption, averaging a total of 26 Gwh per year costing $2.2M annually. As a result of this knowledge the firm's management set a goal to try to better optimize the production of compressed air and to reduce compressed air consumption.

Management Goals

The facility management team set some specific goals in addressing their compressed air system:

- To optimize the production of compressed air
- To reduce electricity cost and energy consumption
- To reduce CO_2 emission by reducing energy consumption
- To upgrade and modernize production machinery

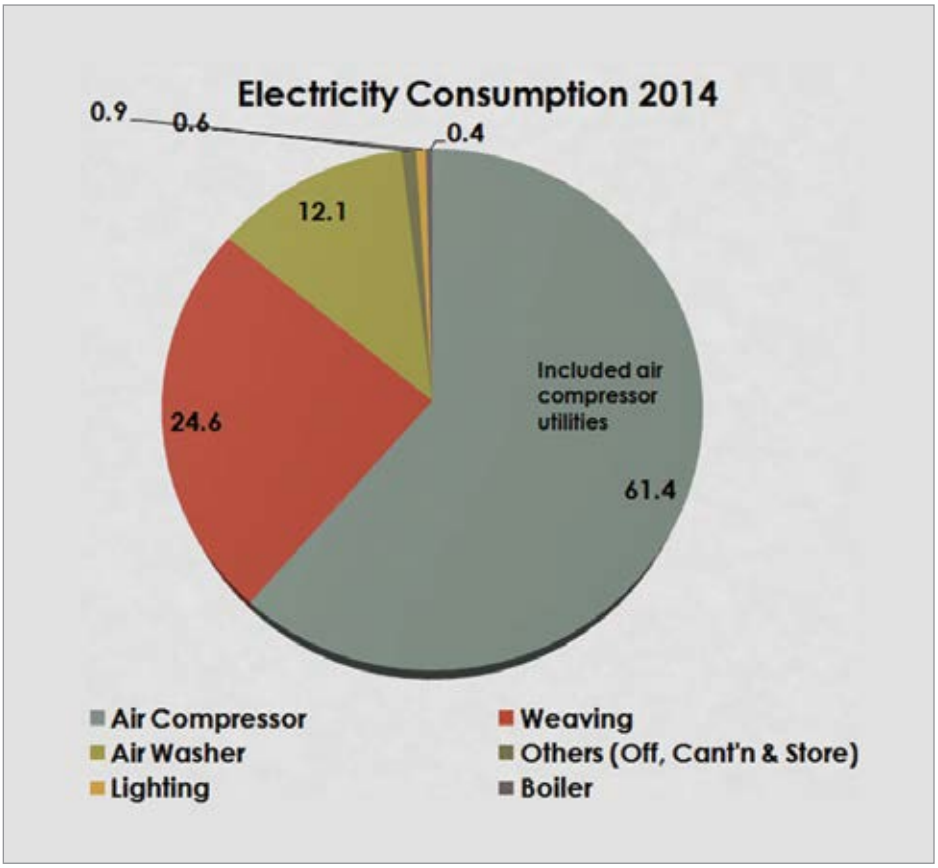

Figure 1: Identifying Significant Energy Users (SEU's) focused efforts towards compressed air

SYSTEMS APPROACH CUTS FABRIC MILL ENERGY COSTS

Location		Compressor	Capacity NM³ / kwh	Status	
				Before	After
Compressor Room Phase 1		IHI 1	3400/360	RUN	RUN
		IHI 2	3400/370	RUN	RUN
		IHI 3	3400/370	RUN	Standby
		IHI 4	4000/440	RUN	Standby
		IHI 5	4000/440	Standby	Standby
		CAMERON 6	3700/370	RUN	RUN
		IHI 10	3400/360	RUN	RUN
Compressor Room Phase 2		IHI 7	4600/560	Standby	RUN
		CAMERON 8	3700/360	RUN	RUN
		IHI 9	4400/460	RUN	RUN
Total	Units	10		8	7
	NM³		38000	29400	26400

Figure 2: Conservation measures reduced the number of running compressors

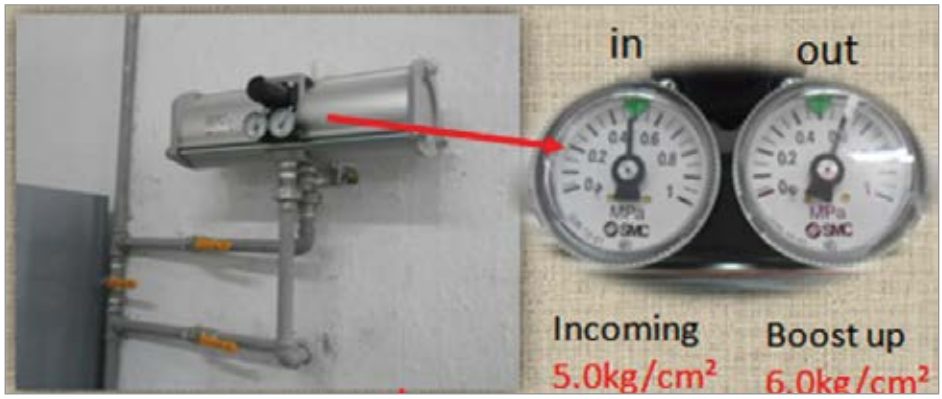

Figure 3: Booster eliminated the need for a separate electric compressor

Activities identified for attention were:

1. Purchase and installation of air saving options for existing looms (e-REED) to reduce air consumption and required pressure
2. Upgrade production looms to more efficient model
3. Reduce compressed air main pressure from 80 psi to 73 psi
4. Shut down 1 compressor by optimizing unit combinations
5. Install a booster for auto drawing machine
6. Overhaul underperforming compressors
7. Replace faulty compressor

Upgrade Air Jet Looms

The company's production method uses air jet looms to produce their textiles. Within the jet loom there are precision nozzles that direct the yarn for various weaving operations in producing the fabric. The company received

> "As part of a production improvement project the company replaced 63 of their less efficient looms with 40 more efficient models. The newer looms produced wider rolls of fabric, work faster, and produce more product for a reduced amount of energy."
>
> — Ron Marshall for the Compressed Air Challenge®

information that their loom supplier had developed a more efficient reed (comb-like item in a loom) for their existing looms that achieves lower compressed air flow and allows lower pressure to be used, with projected savings of 20 percent. A total of 130 looms were retrofitted resulting in a compressed air flow reduction of about 680 cfm. These conversions also reduced the minimum required main system pressure for the plant allowing the air pressure to be reduced to a more efficient level.

New Looms

As part of a production improvement project the company replaced 63 of their less efficient looms with 40 more efficient models. The newer looms produced wider rolls of fabric, work faster, and produce more product for a reduced amount of energy. Each loom consumes slightly more air per unit but there are a reduced number of units (23 less). The change increased the amount of fabric produced per day by 50% while consuming about 600 cfm less in average compressed air flow.

Reduced Pressure

As a result of the installation of the energy saving reeds the company was able to reduce the header pressure in the plant by about 7 psi. The reduced pressure, and changes as a result of other energy conservation measures, reduced the flow of compressed air to the point where the number of running centrifugal compressors could be reduced from 8 to 7. The system was reconfigured so the compressors better matched the compressed air consumption, in terms of energy consumption, resulting in a nameplate capacity reduction of 250 kW.

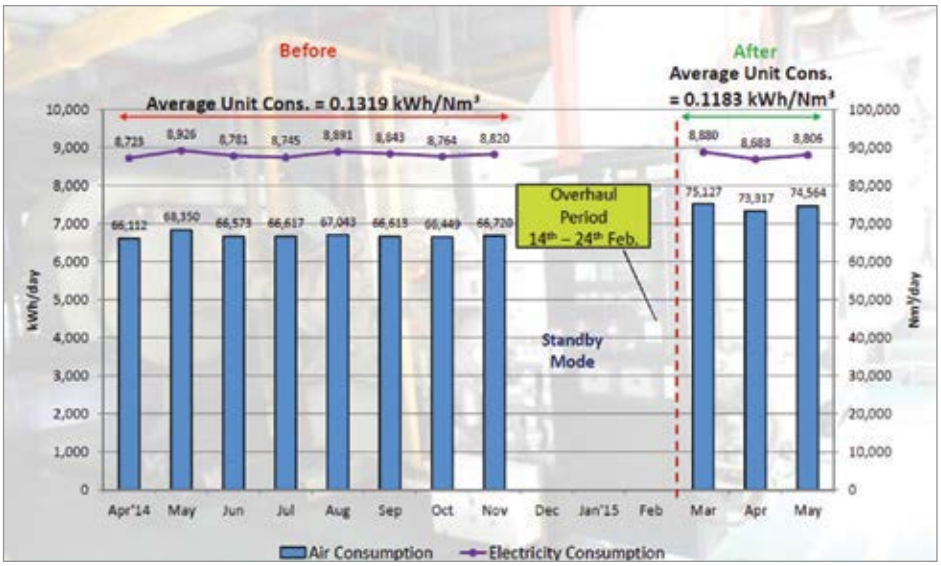

Figure 4: Energy Management System tracks air compressor performance before and after overhauls

Compressor	Unit Consumption (kWh/Nm³)		Different (Saving)		
	Before	After	kWh/Nm³	%	kWh
IHI 2	0.1319	0.1183	0.0136	10.3	46.24
IHI 3	0.1292	0.1146	0.0146	11.3	49.64

Figure 5: After overhaul the air compressors performed much better

Best Practices for Compressed Air Systems Second Edition

Learn more about optimizing compressed air systems

This 325 page manual begins with the considerations for analyzing existing systems or designing new ones, and continues through the compressor supply to the auxiliary equipment and distribution system to the end uses. Learn more about air quality, air dryers and the maintenance aspects of compressed air systems. Learn how to use measurements to audit your own system, calculate the cost of compressed air and even how to interpret utility electric bills. Best practice recommendations for selection, installation, maintenance and operation of all the equipment and components within the compressed air system are in bold font and are easily selected from each section.

Installed Booster

When the main line pressure was reduced it was discovered that an auto drawing machine started to malfunction due to low pressure events. The first solution to this problem was to feed this machine with a separate screw type air compressor at higher pressure, but this was estimated to consume about 14,650 kWh of electricity per month because the compressor was oversized and was working

SYSTEMS APPROACH CUTS FABRIC MILL ENERGY COSTS

with minimal storage receiver capacity. Instead, the company purchased and installed a compressed air powered booster that takes already pressurized compressed air at 5 bar pressure and increases the pressure to the required 6 bar. This eliminated the separate electric compressor and saved $1,500 per month in electrical costs.

Overhaul Underperforming Air Compressors

The energy management system the company implemented tracks the air compressor energy and compressed air output. Energy meters were installed on each compressor to track power consumption. In addition, vortex flow meters were installed to measure air output. The output of these meters is then used to calculate the efficiency of each compressor in kWh/Nm^3.

When analyzing the data, two air compressors in particular were identified as low performers and scheduled for inspection. During subsequent overhauls a number of internal

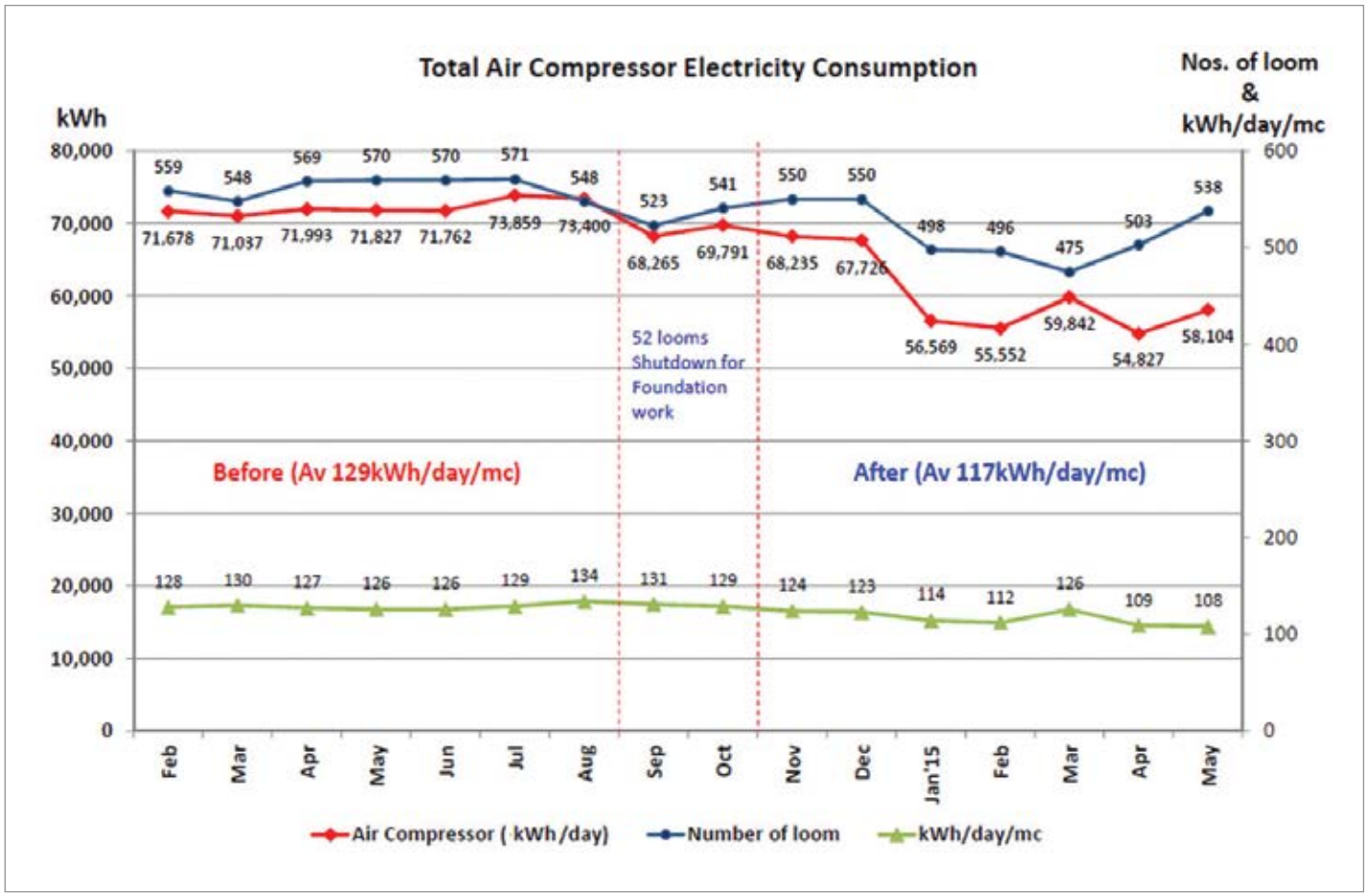

Figure 6: Improvements have reduce cost and increased productivity

> "An important part of this successful project was the initial tracking of the plant electricity costs through the energy management system. Both the reduction of compressed air consumption and optimization of the air compressors reduced the overall compressed air system costs significantly."
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defects were found and corrected. After the work was done, as shown in Figure 4, it was found the efficiency of both compressors improved by about 10 percent – saving 69,000 kWh per month totaling $70,000 per year. Since overhaul costs were about $72,800, the payback for this measure is slightly over one year.

One of the facility's compressors was identified as a low performer but it was too expensive to repair, with estimates totaling $154,000. Since the cost of a new compressor was $186,000 the decision was made to replace the unit. The new air compressor is 16 percent more efficient that the old unit and therefore saves energy per unit output. This compressor saves an estimated 64,565 kWh per month worth $65,600 per year in savings. Simple payback on the complete project costs is 3.1 years.

Conclusion

Savings Results

Using the energy management system the company was able to track the resulting savings from energy conservation measures.

An important part of this successful project was the initial tracking of the plant electricity costs through the energy management system. Both the reduction of compressed air consumption and optimization of the air compressors reduced the overall compressed air system costs significantly. This company has not only reduced their electricity costs but has also experienced increased product output volumes due to the replacement of inefficient and outdated equipment. These improvements increase plant profitability and reduce production costs.

Energy efficiency measures have reduced the consumption of compressed air by 64,800 m^3/day and increased compressor system efficiency, resulting in 5,532,800 kWh per year in decreased energy consumption leading to annual savings of $468,000 per year. This calculates to 21% savings. BP

For more information about the Compressed Air Challenge, contact Ron Marshall, email: info@compressedairchallenge.org

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Sustainable Energy Savings with Compressed Air Best Practices®

Compressed Air Best Practices® is a technical magazine dedicated to discovering **Energy Savings** in compressed air systems — estimated by the U.S. Department of Energy to represent 30% of industrial energy use. Each edition outlines **Best Practice System Assessments** for industrial compressed air users — particularly those **managing energy costs in multi-factory companies.**

"We're in 75 to 80 locations. We've done literally hundreds of compressed air modifications, changes, upgrades and audits."
– William Gerald, CEM, Chief Energy Engineer, CalPortland (feature article in August 2015 Issue)

"Compressed air is essential to any manufacturing process, particularly in the automotive industry, and it accounts for about 23 percent of total energy costs at our powertrain facility."
– Mike Clemmer, Director/Plant Manager-Paint & Plastics, Nissan North America (feature article in October 2015 Issue)

"Demand Side" and "Supply Side" information on compressed air technologies and system assessments is delivered to readers to help them save energy. For this reason, we feature Best Practice articles on when/how to correctly apply **air compressor, air treatment, piping, storage, measurement and pneumatic control technology.**

Industrial energy managers, utility incentive program managers, and technology/system assessment providers are the three stakeholders in creating energy efficiency projects. Representatives of these readership groups guide our editorial content.

"Each of our 10 production plants has an Energy Coordinator who is part of the corporate energy team."
– Michael Jones, Corporate Energy Team Leader, Intertape Polymer Group (feature article in July 2014 Issue)

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RESOURCES FOR ENERGY ENGINEERS

TECHNOLOGY PICKS

Sullair® FlowLogic™ Flow Pressure Controllers Maximize Air Efficiency

Sullair has introduced a redesigned air controller—the FlowLogic™ Flow Pressure Controller—to improve productivity by analyzing, managing and controlling the compressed air system, which helps to reduce energy costs. The controller is an optional, yet extremely beneficial, component in the total air system.

The new Sullair FlowLogic is available from 150-5500 cfm. The units include a compact integrated assembly, inlet and system pressure gauges, tamper-resistant servo-pilot controls outlet pressure and a one-year warranty.

The demand profile for almost all compressed air systems are extremely dynamic. Frequently, there are periods in which the demand exceeds the available compressor capacity. In turn, there are almost always periods in which there is excess compressor capacity. In fact, many typical compressed air systems waste up to 50 percent of the air produced, providing a tremendous opportunity to reduce production costs. FlowLogic allows users to gain back system control.

The Sullair FlowLogic Controller takes advantage of the peaks and valleys in the demand cycle by storing compressed air whenever excess capacity is available. The controller then releases the stored air to satisfy the demand peaks, allowing compressed air to be drawn from storage rather than directly from the compressors. The Sullair FlowLogic Controller provides efficient volume and pressure regulation of compressed air delivery, ensuring the system delivers the required flow, at the right pressure and level of air quality, and at the lowest cost.

The new FlowLogic product line is now available from 150-5500 cfm. The units include a compact integrated assembly, inlet and system pressure gauges, tamper-resistant servo-pilot controls outlet pressure and a one-year warranty.

For more information, visit www.sullair.com.

New nano GEN2 Gas Generators Preserve Coffee

nano purification solutions unveiled their new range of GEN2 Gas Generators at the Specialty Coffee Association of America Expo.

Used throughout the coffee industry, nitrogen flushing preserves the flavor and freshness of coffee while providing a longer shelf life. As well as keeping your coffee in perfect condition, the new GEN2 range can provide significant cost savings over nitrogen cylinder or liquid supply and delivers a typical return on investment of less than 24 months.

The new range boasts a wide range of flow rates and purities to suit all applications (Oxygen contents from 5% to less than 10 ppm). What didn't change is our unique multi-bank design that enables additional generators to be added in the future as demand increases. Your GEN2 nitrogen generator can grow with your company.

The new nano range of GEN2 Gas Generators

RESOURCES FOR ENERGY ENGINEERS

TECHNOLOGY PICKS

nano's Tony Hergert exhibiting the new GEN2 Gas Generators at the Specialty Coffee Association of America Expo.

The advanced nano GEN2 plus range of Nitrogen Generators use integrated drying cartridges to provide dehydration of the compressed air prior to separation. This innovative feature eliminates the need for a separate desiccant dryer – saving up to 20% purge loss, significantly reducing capital and installation costs and reducing overall pressure drop by 10 psig or more over traditional nitrogen generators.

Nitrogen is a dry, inert gas used in a wide range of applications where Oxygen may be harmful to the product or processes. Nitrogen generators use compressed air to deliver a continuous supply of high purity Nitrogen – offering a cost effective and reliable alternative to the use of cylinder or liquid Nitrogen across a wide range of applications.

For more information visit www.n-psi.com

VPInstruments Introduces new VPVision Basic Model

VPInstruments is proud to introduce a new model VPVision Basic, similar to Software As Service (SAAS), paid for in small monthly fees combined with a low initial investment. This makes advanced energy monitoring available for any budget.

Applications of VPVision are monitoring compressed air usage, technical gases, electricity, steam, natural gas and water. By default, VPVision comes with an easy-to-configure web interface. The user is able to add sensors, create screens and configure reports.

Software as a Service?

Energy management is never just a software investment. Sensors and data acquisition need to be installed on-site. VPInstruments has made a very convenient start-up package, called VPVision Basic, consisting of pre-installed energy monitoring software and data acquisition hardware. Up to 12 channels (4 analog, 4 virtual and 4 Modbus (TCP)) can be monitored simultaneously.

The system can be expanded with additional channels and I/O modules. Optional modules include:

Alarm Module: The alarms module sends out e-mails when a signal or a signal combination is out of bounds. Configuration is intuitive, with a drag/ drop graphical interface.

SQL Connector: The SQL connector enables one to access the VPVision system via standard SQL queries. The VPVision live data can be combined with other operational intelligence software.

P & ID Module + Plant Map: In the P & ID module, one can place real time widgets on a background diagram. The P & ID module includes a clickable plant map, onto which one can upload a picture of the plant, and create clickable areas leading to the specific department pages.

VPInstruments has introduced a new VPVision Basic model.

At VPInstruments, we believe real-time insight into the usage of compressed air and technical gases is the key to energy savings. Our easy to use equipment shows where, when and how much compressed air is consumed. Investments in permanent energy monitoring very quickly pay for themselves.

For more information visit www.vpinstruments.com

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ENMET Offers Continuous Respiratory Air-Line Monitor

ENMET's CO-GUARD, a compressed air line carbon monoxide (CO) monitor for supplied breathing air, meets OSHA 1910.134 monitoring requirements for compressed breathing air.

CO-GUARD is a compact and easy-to-install compressed air line CO monitor that meets OSHA monitoring requirements for Grade D breathing air. CO-GUARD uses a state-of-the-art electrochemical carbon monoxide sensor with a life expectancy of up to 3 years.

ENMET CO-GUARD compressed air line carbon monoxide (CO) monitor for supplied breathing air.

The instrument is specifically designed for trouble-free operation. CO-GUARD is designed for use in a wide variety of applications, ranging from automotive paint spray operations to wood finishing. This monitor can be used in virtually any commercial or industrial process that requires carbon monoxide monitoring of compressed breathing air for personnel working in such operations.

Supplied with a regulator assembly and 5-foot sample hose, the CO-GUARD is factory pre-calibrated. The device incorporates a rotameter for confirmation of proper airflow, and has an easy-to-use software interface for allowing users to change alarm points, program relays and perform calibrations in the field.

For more information, visit www.enmet.com.

Spectroline's Marksman II Three-Step Ultrasonic Tool "Hears" Problems Before They Lead to Breakdowns

Fugitive emissions cause production slowdowns, require expensive repairs and can even lead to environmental contamination. But what if you could hear the problem before you could see it?

Whether you're "looking" for compressed air leaks, natural gas and propane leaks, vacuum leaks or refrigerant leaks the Spectroline® MDE-2000NC Marksman™II ultrasonic diagnostic tool converts and amplifies inaudible ultrasonic sound into audible, natural sound. Now technicians can "hear" even the smallest leaks…before they lead to big concerns.

This cutting-edge tool uses a three step approach to ensure accurate diagnosis

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Step 2: Sound Signature Technology "fine tunes" the audible sound into the natural sound emitted by the leak itself.

Step 3: The unit's 5-LED signal intensity indicator and audible alarm then pinpoints the exact source of the problem, while an Internal Noise Control (INC) feature shuts out ambient noise sources.

The Marksman II comes complete with: *an ultrasonic receiver, full-sized/heavy duty noise-canceling headphones, a hollow air probe* (to isolate leak sources in cramped places), *a solid contact probe* (to find component wear in internal parts and motors), and *an ultrasonic emitter* (to locate faulty seals, gaskets and weatherstripping in doors, windows, ductwork and other non-pressurized enclosures). The whole kit is packed in a sturdy carrying case.

For more information, call toll-free 1-800-274-8888. Outside the U.S. and Canada, call 516-333-4840. Please visit www.spectroline.com.

The Spectroline® MDE-2000NC Marksman™ II ultrasonic diagnostic tool.

TECHNOLOGY PICKS

Titus Air Systems Designs Nitrogen Package for Monsoon Conditions

In the rapidly growing natural gas industry, several well-known compressed gas companies are enjoying great success in building large, multi-stage booster compressors for the transport of the gas from their remote drilling operations to more centralized processing centers.

The nitrogen generation system from Titus Air Systems was designed to weather harsh conditions during monsoon season in Bangladesh.

These booster compressors oftentimes require nitrogen as a seal gas, and on-site nitrogen generation has proved to be the most cost-effective approach to service this requirement.

Titus Air Systems, located in Morgantown, PA, has been one of the primary suppliers of compressed air dehydration and nitrogen generation systems to this burgeoning market. The company recently supplied a nitrogen generation system for a rather extreme environment in Bangladesh.

The application called for a system that would be installed outdoors in a part of the country that would be exposed to a marine environment, low temperatures and very high winds during the monsoon season. This was a very challenging application to say the least.

The critical design points for Titus were constructing a package that could withstand the extreme environment, provide the purity and pressure required for sealing within the booster at all times,

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The turnkey nitrogen generation system included PLC-based instrumentation for local and remote control, along with nitrogen storage tanks.

and continuously monitor the system, so that, in the event of an out-of-tolerance condition, switchover to a standby unit could be quickly performed without loss of pressure or purity. In addition, the booster compressor supplier required that the system provide both local and remote monitoring and control.

A standard shipping container proved to be the most cost-effective and durable solution for housing the nitrogen generation system. From there, Titus engineers developed a turnkey package that included dual nitrogen generation systems for 100 percent redundancy, a PLC-based instrumentation package for local and remote control and nitrogen storage tanks to ensure smooth switchover.

For more information, visit www.titusair.com.

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SOLUTION:

Kaeser performed a complete Air Demand Analysis (ADA) to identify the plant's current compressed air needs and to develop a plan for implementing the most energy efficient solution possible. Additionally, Kaeser recommended a Sigma Air Manager (SAM) master controller to properly control the system and ensure the most energy efficient combination of units would be selected to meet current plant demand.

RESULT:

Thanks to better controls and adding an energy efficient variable frequency drive compressor, the customer was able to reduce their annual maximum power consumption by 865,440 kWh—the equivalent of removing 100 homes from the power grid for one year—all without compromising stable system pressure. With the older compressors relegated to back-up, annual maintenance costs have been reduced from $37,000 to $18,000. Less maintenance also means less downtime, for increased productivity.

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