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December 2019

IoT & Industry 4.0

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FEATURES

QUALITY, SAFETY & RELIABILITY FEATURES

PRODUCTIVITY, SUSTAINABILITY & ENERGY CONSERVATION FEATURES

COLUMNS

FROM THE EDITOR | IoT & Industry 4.0

The holidays are upon us and our team here at Best Practices wishes all of our readers, around the world, an absolutely wonderful holiday season. We hope you are able to enjoy the season with your family and those you cherish.

In an era where, around the world, "division" seems more fashionable than unity, the holidays are also a time to try and restore dialogue and repair broken bridges. If we can better appreciate how fortunate we are and respect the different opinions and backgrounds of others, perhaps we will divert more energy into building a future together.

Speaking of energy, wouldn't it be cool if we could add up the hundreds of millions of 2019 kWh energy savings (and the resulting carbon footprint reduction) realized by the work of Best Practices readers? How about adding up the millions of gallons of cooling water saved? All of you are unsung heroes – we need an "App" for us to track this and recognize you-know anyone?!

I hope you enjoy our last issue of 2019 and want to personally thank you for allowing us the privilege of writing about the tremendous work you do every day, making industry more profitable and sustainable.

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

ROD SMITH, *Editor*
tel: 412-980-9901,
rod@airbestpractices.com

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INDUSTRY NEWS

Atlas Copco Compressors Acquires Multi-Branch Distributor in California

Atlas Copco Compressors LLC has acquired the assets of California based distributors Accurate Air Engineering, and sister company, Compressed Air of California. The acquired businesses will become factory direct branches of Atlas Copco Compressors. The acquired business has five locations throughout the region – with a footprint and presence from San Diego all the way to Sacramento.

"This acquisition is exciting for us, Accurate Air and for customers all across California," said Robert Eshleman, general manager for Atlas Copco Compressors. "This brings a completely new addition to our footprint and will complement our current direct and distributor presence across California. They have strong sales and service teams who will be joining us as part of the acquisition."

Accurate Air Engineering Inc. has been serving customers across California since 1961. More than 50 people will join Atlas Copco from the acquired businesses. The factory direct branches will be distributing the full line of solutions from Atlas Copco Compressors. As in all acquisitions, Atlas Copco has analyzed the territory and worked on a strategy that ensures we get closer to customers and serve them in the best possible way.

Atlas Copco Group & Atlas Copco Compressor Technique

Great ideas accelerate innovation. At Atlas Copco, we have been turning industrial ideas into business-critical benefits since 1873. Our passionate people, expertise, and service bring sustainable value to industries everywhere. Atlas Copco is based in Stockholm, Sweden, with customers in more than 180 countries and about 37,000 employees. In 2018, revenues were BSEK 95, approximately 10 BUSD.

Atlas Copco Compressor Technique partners with customers to turn industrial ideas into smart, connected air and gas solutions and leading-edge compressed air technology. By listening to our customers and knowing their needs, we deliver value and innovate with the future in mind.

Atlas Copco Compressors

Atlas Copco Compressors LLC is part of the Compressor Technique Business Area, headquartered in Rock Hill, South Carolina. Atlas Copco Compressors provides innovative solutions including world-class compressors, vacuum pumps, air blowers, quality air products, and gas-generation systems, all backed with full service, remote monitoring and auditing services. With a nationwide service and distribution network, Atlas Copco Compressors is your local, national and global partner for all your compressed air needs. Learn more at www.atlascopco.com/air-usa.

Accurate Air Engineering Inc. has been serving customers across California since 1961.

CompressAir Earns Spirit of Sullair Award

At the 2019 Sullair Distributor Conference located in San Antonio, Texas CompressAir received an award. For the second year in a row, CompressAir has received the Spirt of Sullair award.

What is the Spirt of Sullair award?

- Commitment to the full breadth of Sullair products and services, promotion of the Sullair brand, offers service and sales training to their employees, willingness to help Sullair and other distributors, and incomparable customer service and support

- Over the course of the last year, CompressAir shows their loyalty to Sullair by representing the Sullair products in the best possible way.
- Sullair looks at their brand promise – Reliability, Durability, Performance – and recognizes that these are the characteristics customers see in CompressAir.
- CompressAir focuses on excellent customer service to their customers.
- Not just this year but every year, CompressAir focuses on providing the best applications to their customers and that shines out to Sullair.

Andrew Crowl, Owner and President of CompressAir, expressed his gratitude on behalf of the company. "We're just doing our job, we do our best to provide all our customers with the best advice when it comes to their application," said Crowl, "We are loyal to Sullair and promote their brand in a positive way." "CompressAir is very appreciative to be the chosen Sullair distributor for the Spirit of Sullair award for the second year in a row," Crowl said. "I am thankful for our employees, who leave a positive impact when assisting our customers."

About CompressAir

CompressAir is an industrial compressed air service and sales center; they're an Authorized Sullair distributor offering their full product line. Family owned and operated, CompressAir's mission is to provide excellent sale offers and service. The company strives to help customers reduce energy costs and

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increase the efficiency of their compressed air systems. Since becoming a distributor of the Sullair line in March 2008, CompressAir has had consistent growth rates, over double digits, year after year. For more information, visit www.compressair.net.

About Sullair

Sullair is a major manufacturer of air compressors designed for commercial and industrial use. Just recently, they held their 2019 Distributor Conference in San Antonio, Texas, where they bestowed a variety of awards, including the Spirit of Sullair award given to CompressAir. The award was developed by Sullair to recognize distributors who best exemplify the behaviors the company wants all distributors – and all employees – to practice. For more information, visit www.sullair.com.

CompressAir has received the Spirit of Sullair award.

Purification Solutions LLC to Acquire Assets of Air/Tak, Inc.

Purification Solutions LLC d/b/a nano-purification solutions has announced the acquisition of the assets of Air/Tak, Inc. a New Bethlehem, PA company. Air/Tak is in the business of manufacturing compressed air purification equipment including desiccant air dryers, refrigerated air dryers, pressure flow controllers and filters as well as other unique, customer-specific products.

With more than 30 years in business and a full range of product designs and interesting intellectual property, Air/Tak will afford nano the opportunity to place more focus on traditional twin tower adsorption dryer and refrigerated dryer projects. Engineering and manufacturing will continue in the New Bethlehem, PA facility and support nano's efforts to be a key provider to their growing customer base.

"We are delighted by the prospects of joining forces with Air/Tak. Air/Tak has an excellent reputation relative to product and nano has a strong brand and distribution network within our industry. Combining our knowledgeable

Nano will place more focus on traditional twin tower adsorption dryer and refrigerated dryer projects.

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sales, marketing and technical support team with the capable engineering and manufacturing team in Pennsylvania, we are confident the new consolidated companies will build on our success," said David Peters, managing member for nano.

The acquisition of Air/Tak supports the nano Experience. Customer. Service. strategy by adding US-based design, engineering and manufacturing capabilities to a rapidly growing market-led business. The acquisition enables the company to enter new markets and serve its growing customer base with an expanded range of innovative products.

For further information, please contact marketing@n-psi.com.

FS-Elliott Celebrates 15 Years of Providing Compressed Air Solutions

FS-Elliott, a leading manufacturer of oil-free, centrifugal air and gas compressors will be celebrating 15 years in business this year. While their centrifugal compressor design has been in the industry for over 50 years, the company itself was formed at the end of 2003 after Fusheng Industrial, based out of Taiwan, acquired the Plant Air Package (PAP) centrifugal product line.

In the early days, FS-Elliott operated with 45 employees and has since grown to over 400 employees located in eleven offices around the world. The PAP product line was launched in 1962 before the formation of FS-Elliott as the first oil-free, integrally geared, multi-stage, centrifugal air compressors available on the market. Since then the original PAP product has evolved into FS-Elliott's PAP Plus line, custom-engineered to exact customer specifications, in addition to the requirements of API 614 and 672, and Polaris+ product lines. Polaris+ compressors feature the same durable design as PAP Plus units but have been standardized to provide Customers an economical, easy to maintain package. Both product lines are manufactured in their headquarter office in Export, Pennsylvania, USA.

"Although FS-Elliott has expanded over the years, we have remained true to our company vision – to deliver true value to our customers with superior products and services matched to their needs while providing an environment to attract, grow and retain our employees," said Paul Brown, CEO. "We have reached this milestone thanks to our valued customers that have trusted us with their compressed air operations, and the dedication of our talented channel partners and employees. Because of them, we look forward to the next 15 years of continued growth and success."

FS-Elliott, a leading manufacturer of oil-free, centrifugal air and gas compressors will be celebrating 15 years in business this year.

About FS-Elliott Co., LLC

FS-Elliott Co., LLC, is a leading manufacturer of oil-free, centrifugal compressors with sales, service, and manufacturing locations around the world. First introduced to the market over 50 years ago their energy-efficient machines incorporate the latest aerodynamic and control system technologies to ensure optimum performance with the lowest cost of ownership. For more information, please visit www.fs-elliott.com.

Ohio Transmission Corporation Acquires Tennessee-Based IDG Compressor

Ohio Transmission Corporation, an industrial equipment service provider and distributor headquartered in Columbus, Ohio, announces the acquisition of Tennessee-based IDG Compressor.

IDG Compressor, with locations in the Tennessee cities of Chattanooga, Knoxville and Nashville and remote operations in parts of Kentucky and Georgia, is a full-service distributor of high-quality Quincy Compressor products and repair services and has served the Tennessee and surrounding markets for several decades. Until this acquisition, IDG Compressor had been a part of what is now the Sonepar/Vallen Distribution network since 2001.

The company will become a division of Air Technologies, a compressed air system equipment and service provider that is part of the OTC family of companies. Air Technologies pioneered DirectAIR, the fourth-

INDUSTRY NEWS

utility concept of compressed air and is the largest independent compressor distributor in North America.

"IDG is an outstanding addition to the Air Technologies and OTC family," said Philip Derrow, president and CEO of Ohio Transmission Corporation. "The associates of IDG are committed to continuing to build the presence of the Quincy brand throughout their markets and Quincy is an important partner for OTC. Together we will deliver even better service to our customers."

"We are excited and committed to achieving sustained success with the IDG Compressor team," said Kurt Lang, president of Air Technologies. "This team has a long and rich history in these markets, and we will work diligently to keep creating an outstanding work culture, providing customers with an excellent experience and becoming firmly dominant in our new Tennessee markets. In addition, we are grateful to be working with Quincy Compressor. Our experience with the Quincy team has been terrific – they have consistently provided us a great customer experience over time coupled with a superior product portfolio."

IDG Compressor will continue to operate under the same name and with current local management, including Tim Huber, region manager, to lead the team.

"We valued our Vallen relationship and had been operating within an MRO supply company for around 50 years," said Tim Huber, region manager for IDG Compressor. "We are all so very excited to be part of a market-leading compressor sales and service organization like Air Technologies and look forward to the transition and the future."

"We are excited by the growth opportunities for the associates of IDG as well as for our Air Technologies group," said Matt Piatt, COO/CFO of Ohio Transmission Corporation.

With this acquisition, Ohio Transmission Corporation now has 47 locations throughout the South and the Midwest and Northeast regions, along with 14 service shops. The addition of IDG Compressor's 16 associates brings Ohio Transmission Corporation's existing workforce to about 1,100 employees.

"This acquisition is an important part of our rapidly growing compressed air footprint in the South," said Joe Beyer, vice president of sales and operations at Air Technologies. "Our goal is to earn the customer preference in all compressed air business channels in these new markets."

As a division of Air Technologies, IDG Compressor will have access to Air Technologies unique compressed air utility service group offerings as well as OTC's vast product and service offerings and support resources.

"IDG Compressor has been a great portfolio company for IDG and later Vallen for years," said Mark Doheny, senior vice president/finance for Vallen. "While we are sad to see the team go, we are pleased they will be joining a strong, well-established company like Air Technologies, which specializes in the compressor distribution market."

About Ohio Transmission Corporation

Established in 1963, Ohio Transmission Corporation is one of the largest industrial distributors and service providers in the United States. Its divisions include OTP Industrial Solutions, a provider of expert

solutions for industrial motion control, factory automation, fluid power, pumping systems, spray finishing, and power transmission, and Air Technologies, a compressed air system equipment and service provider and the largest distributor of Atlas Copco compressed air equipment in North America. Ohio Transmission Corporation maintains locations throughout the South, Midwest and Northeast regions. Ohio Transmission Corporation's approximately 1,100 associates share its founding vision of delivering excellent value through work with integrity. For more information, please visit www.otpnet.com and www.aircompressors.com.

About Air Technologies

Air Technologies, a division of Ohio Transmission Corporation, is a team of compressed air experts and one of the world's largest independent air compressor distributors and service provider as well as North America's largest Atlas Copco distributor. Air Technologies supports a full line of innovative Atlas Copco and Quincy Compressor products and provides expert installation services on everything from air compressors, compressed air dryers and filtration systems to industrial vacuum and blower systems, oil and water separators, receiver tanks, and mineral and synthetic lubricants. In addition, the company offers compressed air piping, nitrogen generation, cooling systems and air compressor rentals. Air Technologies aftermarket support services include a wireless service center, an expert parts team and customer service agreements. The company's unique Utility Services Group allows businesses to purchase commercial compressed air like a utility, manage and control air compressor systems, and lower overall compressed air costs. For more information, visit www.aircompressors.com.

QUALITY, SAFETY & RELIABILITY

BUILT FOR THE LONG-TERM

Kaeser Kompressoren Celebrates 100 Years

By Rod Smith, Compressed Air Best Practices® Magazine

Sometimes being a journalist is a tough job. During this calendar year of 2019, I have been honored by the invitation to witness the 100-year celebrations, in both Germany and in the United States, of the founding of Kaeser Kompressoren.

This story begins in Coburg, Germany in the year 1919. Coburg was first mentioned in a monastic document dated 1056, but to speed forward almost nine centuries, Coburg would join the Upper Franconia Region of Bavaria in 1920 where it remains today. Back here

100
1919 – 2019
TRADITION & INNOVATION

> "All staff are considered family at Kaeser. This is reflected in the high apprenticeship rates, in the average employee tenure of 30 years and most of all it's reflected in the 100 years of consistent business growth."
>
> — Thomas Kaeser, Chairman, Kaeser Kompressoren

in 1919, the United States passed the 19th Amendment allowing women the right to vote and Pancho Villa was attacking Juarez, Mexico. So it was in 1919 that in Coburg a gentleman named Carl Kaeser Senior would open a small workshop producing parts for the early automotive industry, along with gear wheels and special machines for the glass industry.

In 1947 the city of Coburg found itself surrounded on three sides by the Iron Curtain. Although feeling fortunate to be in the West (folklore says Coburg citizens walked outside the city to tell the approaching Russians that the Americans had already occupied the town!), the Kaeser business had to start over because their automotive clients were all on the east side of the Iron Curtain.

Kaeser Kompressoren Chairman Thomas Kaeser said, "Taking advantage of their automotive experience, my father, Carl Kaeser Junior, made the investment and decision to begin serial production of a standard range of piston air compressors."

Maybe that is one of the few things we can thank the Iron Curtain for.

A Family Business Celebrates 100 Years

I was invited to join the Kaeser Americas group during their April 2019 trip visiting the Hannover Messe and Kaeser's headquarters in Coburg. As always, I was impressed by the family feel of Kaeser Kompressoren.

"We are a 100% family owned firm present in over 100 countries and employing over 6,500 people," said Thomas Kaeser. "All staff are considered family at Kaeser. This

Tina-Maria Vlantoussi, Thomas Kaeser and Frank Mueller welcome the Kaeser Americas delegation to the Kaeser Kompressoren 100-Year Celebration at the 2019 Hannover Messe.

Kaeser Compressors, Inc. President, Frank Mueller, in front of a Kaeser DSD Series rotary screw air compressor at the 2019 Hannover Messe.

BUILT FOR THE LONG-TERM: KAESER KOMPRESSOREN CELEBRATES 100 YEARS

Kaeser compressed air refrigerated dryer technology, featuring R-513a refrigerants with a low Global Warming Potential (GWP) of 631, installed at the Kaeser world headquarters in Coburg, Germany.

Larry and Cindy Morton (Kaeser Memphis) and Pam and Jim Miller, from CASCO USA in Bamberg during the Spring 2019 Hannover Messe trip to Germany (left to right).

is reflected in the high apprenticeship rates, in the average employee tenure of 30 years and most of all it's reflected in the 100 years of consistent business growth."

The Kaeser Americas group consisted of a contingent from Canada, led by Kaeser Canada President Harold Wagner and a U.S. group led by Kaeser Compressors, Inc. President Frank Mueller. Mueller commented, "The U.S. business started with four employees and grew to 270 in 2007. Today, we have grown to 600 employees and the family business philosophy is still at the heart of our success."

A fellow traveler on the trip was Jim Miller, the owner of Pittsburgh, Pennsylvania based CASCO USA who said, "Kaeser is consistently honorable with their customers and business partners. They are also consistent in their desire to always improve themselves and everything they do."

The Kaeser booth at the 2019 Hannover Messe looked like a small tradeshow unto itself. There were cool history timeline displays including a 1969 "Apollo 6000" piston compressor featuring 6 pistons able to deliver 6 m^3/min! The Sigma Profile airend inside of a new technology called rotary screw air compressors was launched in 1973 and the first subsidiaries were formed in Austria and Switzerland in 1978. Located on the "other" side of the recently fallen Iron Curtain, the Gera plant for blowers and dryers was opened in 1993. Lastly, a massive expansion and modernization was completed to the "Coburg Smart Factory" in 2018.

Thomas Kaeser said, "We can be thankful, satisfied and proud of our history. As we look towards the future, together as a family, we know we will embrace the breathtaking opportunities which today may be disguised as challenges."

There have been no shortages of events to mark the company's 100th Year Anniversary, said Mueller.

"The anniversary of Kaeser Kompressoren has been celebrated by subsidiaries around the world all year," he said.

That includes the U.S. business and I was fortunate to be invited to their Oktoberfest party held September 30th at their headquarters in Fredericksburg, Virginia.

Long-Term Focus on Technology and Training

Whether it's the heart of a rotary screw air compressor, the airend, or an important component like a motor, Kaeser people say the priority is always placed on providing the best possible quality.

Bill Mehall, a Senior Manager for Key Accounts has worked for Kaeser since 1994, and before that, starting in 1984 at Goshen, Indiana-based Tri-State Compressed Air Systems, Inc.

"From Day One, the Kaeser Sigma Profile airend delivered more air per horsepower. This justified its position as a premium product," said. "When you combine market-leading technology with superior training on when, where and how to best apply it, then you have fantastic results for customers."

Bill Fitzell, President of Kenilworth, New Jersey based Air Center, Inc., expressed his pride in partnering with Kaeser.

"I'm the second generation in our family business which started with three employees in 1986. Kaeser has been our partner the whole way," Fitzell said. "Our customers make the best-informed decisions in the market due to Kaeser's long-term investments in superior compressed air system education and training."

Others like Chad Murray, the President of Greencastle, Pennsylvania-based Quad State, Inc., can't say enough about Kaeser's commitment to technological advancements.

"Kaeser keeps bringing new technologies, well ahead of the market, to help our clients run reliably and efficiently," Murray said. "We've been a distributor for 15 years and benefit over the years from always being one of the first to the market with air compressor features like IE3 motors, Wye-Delta starters, TEFC motors, built-in after-coolers and so on."

Murray said he appreciates the advantage of working with Kaeser.

"Our competitors normally follow suit three years later. Twenty-five years ago we sold air compressors, today we sell energy solutions," he said.

Chad Murray, Greencastle, Pennsylvania based Quad State, Inc. and Bill Fitzell, Air Center, Inc., from Kenilworth, New Jersey (left to right).

Keith Carley, Air Compressor Works, Inc., from Riviera Beach, Florida.

BUILT FOR THE LONG-TERM: KAESER KOMPRESSOREN CELEBRATES 100 YEARS

Mike Clark, Dave Guerrieri and Jim Casey, Air Center, from Madison Heights, Michigan in front of the Kaeser USA headquarters in Fredericksburg, Virginia (left to right).

Kaeser Compressors hosted a 100-Year Kaeser Kompressoren Anniversary Oktoberfest in Fredericksburg, Virginia. Pictured from left to right are Tilo Fruth (BEKO), Janni Sims and Frank Mueller with his daughter, Sophia, and wife, Ulli.

Long-Term Customers, Business Partners and Employees

For Keith Carley, Co-Owner of Riviera Beach, Florida-based Air Compressor Works, Inc., a hallmark of Kaeser is its dedication to customer service.

"Kaeser has always prioritized keeping our customers up and running," said Carley. "We've been a Kaeser distributor since 1985 and our customers have always benefited from quality products and strong communication channels. It's nice to know if my customers need help, the most senior Kaeser leadership is always one phone call away."

They say relationships are built one at a time and step by step, and this is certainly true when it comes to the compressed air industry.

Dave Guerrieri, from Air Center out of Madison Heights, Michigan said, "Our relationship with Kaeser is trusting, predictable and has kept growing since we started working together in 1984."

Guerrieri's partner, Mike Clark, added, "Besides our compressed air division, we have a big tool business supporting our automotive clients in Michigan. Our relationships with those vendors are completely different than our relationship with Kaeser."

The value of Air Center's strong relationship with Kaeser is invaluable, said Guerrieri.

"Without Kaeser, we would not have enjoyed the same level of personal business success," he said.

Kaeser Kompressoren's appreciation for employees – and the strong bonds formed – shines through at every company location.

Reiner Mueller arrived in 1982 to begin the Kaeser business in the United States. Starting from scratch, he hired people like Roy Stuhlmann and Bob Ryan in those early years.

"I was hired in 1986 as the National Accounts Manager," said Ryan. "We worked hard together and built a good business and had a rewarding career. I retired in 2012 fortunate to have become close personal friends with Reiner, Ruth and Frank Mueller."

Eva Pruett worked for Kaeser in the United States from 1985 to 2010. She carried out many roles over the years, from Marketing Manager to Executive Assistant to Reiner Mueller.

"I had never seen a person manage by truly walking around and who remembered and was genuinely interested in knowing every person's family life," said Pruitt. "This built a loyalty and feeling of family I had never seen or experienced before."

Lawrence Crews is the Director of Finance and Human Resources for Kaeser Compressors, and as such, has worked closely with President Frank Mueller in overseeing the explosive growth over the past twelve years.

"Kaeser creates long-term visions and plans and can stay the course when markets are in turmoil. We can also provide employees flexibility when it's needed," he said.

Long-Term Supplier Relationships

It's clear Kaeser extends their family philosophy beyond their immediate circle.

Tilo Fruth, President, Beko Technologies said, "The success Kaeser has experienced in the United States encouraged us, as a complementary German manufacturer of compressed air system products, to believe we could also build a significant business here. During our close 25-plus year partnership with Kaeser, they've also had a hugely positive influence upon our technology development by working closely with our engineering teams."

Jay Francis, National Sales Manager Industrial Products Americas, SPX Flow commented, "Both our firms believe in long-term partnerships. We've had a mutually beneficial relationship with Kaeser, starting in the 1970's in Germany and with Kaeser Americas since 1982. I've personally been fortunate to be their U.S. Key Account Manager since 1996."

Conclusion

It's a great feeling in life when you see people work hard, work with joy, work the honorable way – and come out ahead. This has been my personal experience, since 1992, working with Kaeser during the different chapters of my career. Kaeser continues to be a wonderful partner for our family firm, Smith Onandia Communications, and a template on how to conduct both personal and business life. For this we'd like to say thank you and congratulations to all of Kaeser Kompressoren.

I thought a gentleman I met at a Kaeser dinner said it best. Raul Castaneda is a District Manager for the Southcentral District and has worked for Kaeser for 9 ½ years. He said, "Kaeser communicates like a family. The standards are high and sometimes you might get a good talking to. Yet, Kaeser will still love you, like a family does, and help you learn to succeed." BP

For more information on Kaeser Kompressoren visit www.kaeser.com

To read similar ***Air Compressor Technology*** articles visit www.airbestpractices.com/technology/air-compressors.

QUALITY, SAFETY & RELIABILITY

THE EFFECTS OF AMBIENT TEMPERATURE on Centrifugal Air Compressor Performance

By Brett Griffin and Todd Quigley, Atlas Copco

"I don't think my air compressors are making the air they're supposed to, especially No. 3."

Those were the words of the maintenance manager as we sat talking to him in his office. We were at a plant in Arkansas and had spent the morning installing data-logging equipment on his compressed air system.

It was early summer, the air compressors were above the production floor on a mezzanine, and temperatures were heating up both outdoors and indoors. The compressed air system was comprised of three 500-horsepower centrifugal air compressors, and one 350-horsepower variable speed drive oil-free rotary screw air compressor.

All the air compressor intakes were inside, so ambient air on the mezzanine – not outside air – was being compressed. The normal operational configuration was to base load two centrifugal units, keep one on standby, and trim the plant with the rotary screw variable speed drive air compressor. It did work, but oftentimes all four air compressors would have to run to meet plant demand, leaving the system with no backup.

That morning, while installing power-monitoring equipment and a combination pressure transducer/mass flow meter, we noticed it was quite warm on the mezzanine. After installing the equipment, we had taken a lunch break, then returned to the facility

> "When it was hot outside, it turned out that the rotary screw air compressor was required to run nearly all the time, and oftentimes the third centrifugal unit would also run."
>
> — Brett Griffin and Todd Quigley, Atlas Copco

in the early afternoon to meet with plant personnel to discuss concerns, as well as to check on our equipment to ensure all was functioning properly before we departed. While performing checks on the logging equipment, ambient temperatures were also taken at the inlet of each air compressor. It was a typical summer day in Arkansas – sunny with outside temperatures over 90 °F. It was a good day to check how hot the air compressor area gets.

It turns out it got extremely hot!

As mentioned at the start, two of the centrifugal units (Air Compressor No. 3 and No. 4) and the variable speed drive rotary screw unit (Air Compressor No. 1) were clustered together on one end of the mezzanine directly above the production floor. The third centrifugal air compressor (Air Compressor No. 4) was in a separate room above the maintenance shop, on the same level as the other three units but in a slightly cooler location. The inlet ambient temperatures were recorded as follows:

- Air Compressor No. 1: 111 °F
- Air Compressor No. 2: 110 °F
- Air Compressor No. 3: 119 °F
- Air Compressor No. 4: 107 °F

Obviously, the ambient temperatures were having a drastic effect on air compressor performance. How much so became one focus of the audit report. One other factor in the air compressors' performance was operating pressure. The initial specification called for 110 psig discharge pressure. Plant pressure was being maintained at 118 psig. This also was having a detrimental effect on air compressor output.

Examining High Ambient Temperatures and High Discharge Pressure

It was believed two centrifugal units would provide all of the air required for much of the time, with the rotary screw unit occasionally trimming the plant during the periods of highest demand (a best-practice design, by the way).

When it was hot outside, it turned out that the rotary screw air compressor was required to run nearly all the time, and oftentimes the third centrifugal unit would also run. This wasn't what was meant to be happening, so we started to investigate how much air the facility was using, and how well the air compressors were performing.

So just how much did air compressor performance drop due to the high ambient temperatures and elevated discharge pressure?

Shown in Figure 1 is a curve showing air compressor performance at a 95 °F inlet temperature and 110 psig discharge pressure:

The four colored lines represent the operating curves of the unit at various inlet guide vane positions, by guide vane angle. The red line is the flow curve with the inlet valve 100% open (0 degrees and 0% throttled). The air compressor is rated for 2,313 scfm maximum delivery at these operating conditions. This is the curve that was utilized to initially size the air compressors and calculate load on them.

Figure 2 shows the curve for the same air compressor at 119 °F inlet temperature and 110 psig discharge pressure.

Notice how the operating curves have all shifted to the left (less flow at any given pressure). At 110 psig, maximum flow has been reduced from 2,313 to 2,092 scfm, a loss of nearly 10%.

But the customer was operating the air compressors at a higher pressure than 110 psig. Figure 3 is the curve adjusted for the actual 118 psig discharge pressure.

As seen, delivered flow has been reduced to 2,028 scfm, a loss from the original curve

THE EFFECTS OF AMBIENT TEMPERATURE ON CENTRIFUGAL AIR COMPRESSOR PERFORMANCE

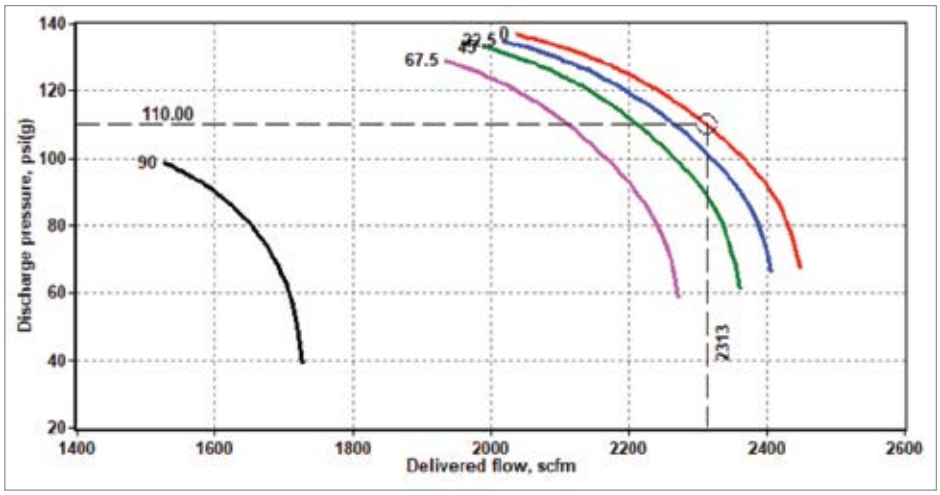

Figure 1.

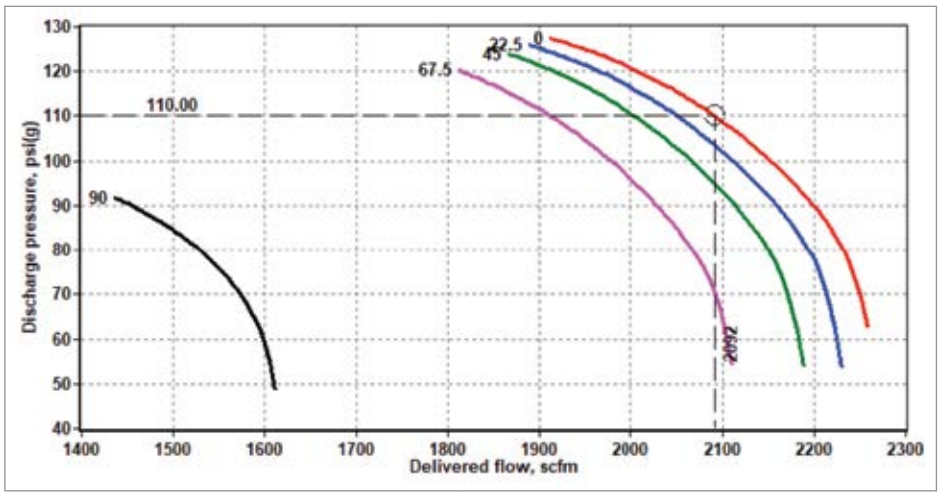

Figure 2.

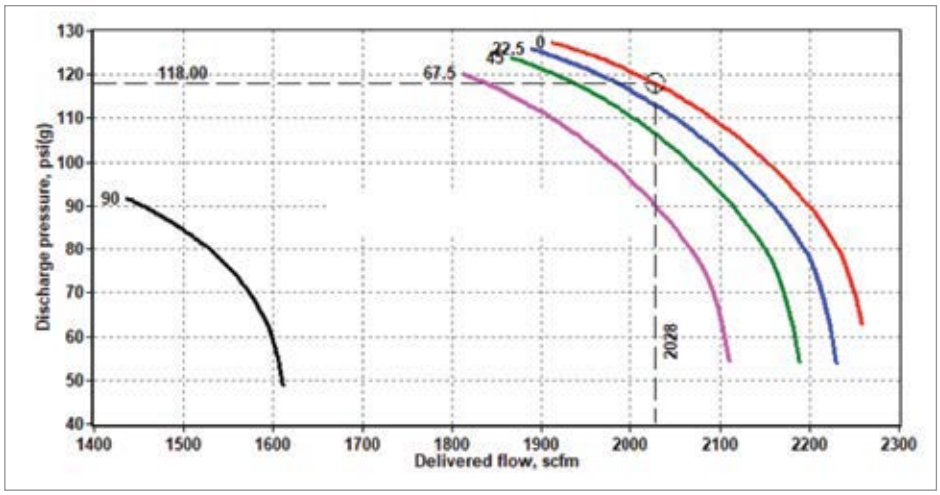

Figure 3.

of nearly 300 scfm. Perhaps just as bad, the pressure rise to surge (the pressure difference between operating pressure and surge pressure) has been reduced from the original 28 psig to 10 psig. This leaves the air compressor almost no room to turn down (turndown is the percentage that a centrifugal air compressor can operate at partial load, accomplished by throttling the inlet valve), rendering it essentially a load/unload unit. This caused further difficulties with air system operations.

Drive Motor Protection – Another Factor Affecting Performance

It didn't end there, though. The centrifugal air compressors have a safety feature designed to protect the drive motors. As winding temperature rises, the amperage rating of a motor will drop. If ambient temperature exceeds the motor nameplate amperage temperature rating, the controller will limit the maximum inlet guide vane position to prevent overloading the motor. This further reduces maximum air compressor flow output and pressure rise to surge.

Once the data was collected and analyzed, it was discovered that, indeed, Air Compressor No. 3 was running as a load/unload unit, with only a three psig rise from the load to the unload point. Air Compressor No. 3 spent much of the logged period in an unloaded condition while air compressors No. 2 and No. 4 were running fully loaded, with the rotary-screw unit trimming. This was extremely wasteful.

So why didn't Air Compressor No. 3 simply unload and shut down after running for the minimum unloaded time?

Part of the problem was back to the built-in safety feature to protect the drive motor. In this case, it is the minimum run time feature. Most of the wear on a large motor occurs during start-up. The heat built up from the

inrush current needs to dissipate to the level of normal motor operational temperature before the motor shuts off. Once the motor does shut off, it needs to cool further in order to allow for the temperature spike that will occur the next time it starts.

In this case, Air Compressor No. 3 needed to run in an unloaded state for a longer period of time than normal due to the high ambient temperatures. While running unloaded in "cool down," a slight drop in pressure would cause it to load up. The sudden addition of 2,000 scfm to the system would cause an immediate pressure rise greater than three psig, during which Air Compressor No. 3 would unload. This restarted the countdown for the unloaded run time.

Such an event happened often enough that the air compressor rarely got the chance to shut down, running in an unloaded condition almost constantly. When the unit did shut down, it would restart after a short period of time once another small decrease in plant pressure would occur.

Corrective Measures to Boost Air Compressor Performance

Obviously, the corrective action that would most benefit air compressor performance in this instance is to reduce temperatures at the compressor inlets. Ambient temperatures at the drive motors must also be reduced both to improve motor reliability, and to further enhance performance. Another recommendation was to reduce discharge pressure of the air compressors to the minimum required for proper production-equipment operation.

The first recommendation was to install fresh air intakes from outside the building and duct them directly to the air compressor inlet filters. Although summer temperatures in Arkansas regularly exceed 90 °F, this is still far better

THE EFFECTS OF AMBIENT TEMPERATURE ON CENTRIFUGAL AIR COMPRESSOR PERFORMANCE

than the 110 ˚F and higher temperatures observed at the air compressor inlets. Doing this would increase air compressor output capacity by 10%.

The next recommendation was to lower air compressor room ambient conditions by increasing the ventilation into the air compressor area. The entire production facility is climate-controlled, although air conditioning ducts in the air compressor room were inadequate to control temperatures. Since increasing A/C ducting to the air compressor room wasn't a viable choice, it was recommended to increase airflow through the room by using forced-air ventilation into and out of the area from outside the building.

Proper air turnover in the air compressor room could reduce ambient temperatures around the drive motors by 10 ˚F to 15 ˚F, reducing motor operating temperatures as well as eliminating the Elektronikon controller's inlet valve throttling to protect the drive motor. This would increase flow capacity by several more percentage points, allowing the air compressors to run more closely to the original flow curve. It would also create more pressure rise to surge, allowing the units more turndown before unloading. This would eliminate the load/unload operating condition observed on Compressor No. 3.

Don't Overlook Ambient Temperatures

This case study illustrates just how critical inlet and ambient operating temperatures are to centrifugal air compressor performance. When designing a compressed air system, it is necessary to understand not only the pressure and flow requirements of the production facility, but also the conditions under which the units will operate. Communication between the end user, system designer, and equipment supplier are critical to ensure proper system operation.

The end goal is always to design, install, and operate a compressed air system that meets the end user's flow and pressure requirements, provides adequate redundancy in case of a casualty or to perform maintenance, and maximizes reliability. Ambient temperatures are an often overlooked but a critical building block in designing such a system. BP

About the Authors

As Atlas Copco Centrifugal Auditors, Brett Griffin and Todd Quigley have worked with customers across the United States when it comes to compressed air audits and energy management studies. They specialize in large air installations and centrifugal air compressors.

About Atlas Copco Group & Atlas Copco Compressor Technique

Great ideas accelerate innovation. At Atlas Copco, we have been turning industrial ideas into business-critical benefits since 1873. Our passionate people, expertise and service bring sustainable value to industries everywhere. Atlas Copco is based in Stockholm, Sweden, with customers in more than 180 countries and about 37,000 employees. In 2018, revenues were BSEK 95, approximately 10 BUSD. Atlas Copco Compressor Technique partners with customers to turn industrial ideas into smart, connected air and gas solutions and leading-edge compressed air technology. By listening to our customers and knowing their needs, we deliver value and innovate with the future in mind.

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Atlas Copco Compressors LLC is part of the Compressor Technique Business Area, headquartered in Rock Hill, South Carolina. Atlas Copco Compressors provides innovative solutions including world-class compressors, vacuum pumps, air blowers, quality air products and gas-generation systems, all backed with full service, remote monitoring and auditing services. With a nationwide service and distribution network, Atlas Copco Compressors is your local, national and global partner for all your compressed air needs. Learn more at www.atlascopco.com/air-usa.

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PRODUCTIVITY, SUSTAINABILITY & ENERGY CONSERVATION

Modbus Transducers: Delivering Thorough and ACCURATE COMPRESSED AIR AUDITS

By David Parks, Logic Beach Incorporated

High accuracy of multiple measured parameters is critical for the development of a trusted compressed air system baseline audit. The same is true for follow-on performance validation after system improvements have been implemented. The use of data acquisition systems using Modbus-interfaced transducers can aid auditors in achieving a thorough and highly accurate system performance assessment.

There are many advantages to an audit using a network of Modbus transducers and a Modbus-capable data logging instrument. They include:

- Simplified transducer wire routing.
- Avoiding the need to compromise desired measurements due to instrumenting hassle.
- Improving measurement accuracy in an electrically harsh environment.
- Increased reliability due to fewer electrical wiring connections.
- Measured (not estimated) energy use with multi-function Modbus electrical meters.
- Collection of air compressor operation from Modbus-enabled air compressor controllers.
- Improved final audit accuracy.

What follows is a discussion about the basic function, advantages and real-world applications of Modbus transducers as deployed in data acquisition for compressed air systems, as well as other energy audits.

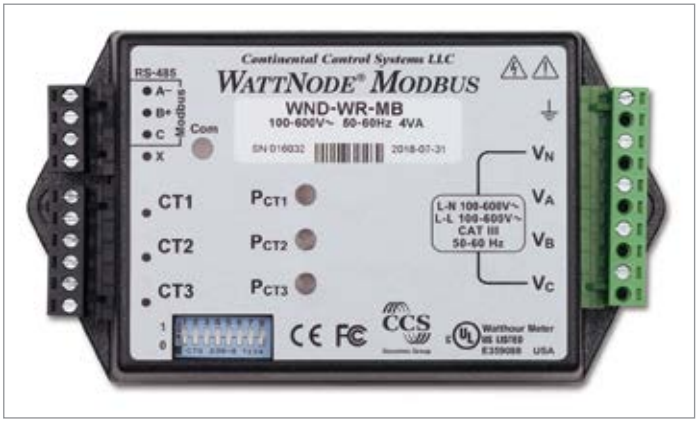
Modbus – A Proven Technology

Modbus is everywhere in the industrial world and for good reason: It is simple and proven over time!

Modbus is a serial digital communication protocol developed by Modicon (now Schneider Electric) in the late 1970's. Originally, it was for the company's serial data communication in its line of industrial Programmable Logic Controllers (PLCs).

The protocol was published and released for royalty-free industry use as a standard communication path between two or more instruments, including transducers and controllers. Over the years, it has become a de facto industrial bus standard. Modbus is now the most commonly used fieldbus protocol for communications between a large array of industrial instrumentation ranging from 'smart' transducers to controllers to data acquisition systems.

While many faster and more secure industrial serial communication protocols exist today, Modbus continues to be implemented into instrument, transducer and controller designs and will likely continue long into the future due to its simplicity in implementation, ubiquitous installed base and open architecture.



A Modbus RTU multi-phase electrical meter. (Photo courtesy of Continental Control Systems.)

MODBUS TRANSDUCERS: DELIVERING THOROUGH AND ACCURATE COMPRESSED AIR AUDITS

Modbus RTU is the Modbus protocol best suited for transducers with limited microprocessor power and is by far the most common Modbus protocol implemented in transducers.

Available Modbus protocols include:

- Modbus RTU – Master/Slave topology with binary message data serial communication over RS-232 or RS-485.
- Modbus ASCII – Nearly identical to Modbus RTU, however, message data is in ASCII character format instead of binary.
- Modbus TCP/IP – Client/Server topology quite similar to Modbus RTU, however, the communication is via TCP/IP over Ethernet.
- Modbus Plus – a unique peer-to-peer protocol that allows all devices to initiate queries and responses.

In essence, Modbus is the higher-level communication protocol used to define the message format of the actual communication. Meanwhile, RS-485 is the specification for the hardware communication link. Think of Modbus as being the language (English, French, Spanish, etc.) and RS-485 as the connection (e.g., a telephone line).

Modbus Transducers – Readily Available for Audits

Many transducers used in comprehensive compressed air applications and energy audits can be procured that include a Modbus interface. With the use of a mating Modbus-compatible data acquisition/data logging system, a thorough and accurate characterization of an energy consuming system can be simplified – with improvement in the quality of key measured parameters.

Unlike conventional analog output transducers (e.g., 4 to 20 mA), Modbus transducers sample the physical parameter (pressure, flow, power, etc.) and convert this signal into a numeric value which is stored in a memory location within the transducer. This numeric value can then be queried by a Modbus-enabled data acquisition instrument via a digital serial (typically RS-485) communication link.

Today, powerful multi-parameter electrical meters, flow meters and data logging/data acquisition instruments equipped with Modbus interfaces are available off the shelf and ready to be deployed into audit applications. The benefits of Modbus transducer technology includes:

- Excellent transducer signal immunity from punishing electromagnetic field effects.
- Ease of wiring multiple transducers.
- Fewer cost/benefit compromises in the "desired parameters versus wiring time/effort" decision.

Modbus RTU networks are comprised of Master and Slave(s) architecture. A typical network consists of one (and only one) Master device, one or more connected Slave device(s) and interconnecting network wiring. In a typical compressed air audit data acquisition system (Figure 1), the data acquisition instrument is configured as the Master and one or more transducers are configured as Slaves.

Modbus Slave Transducers and Compressed Air Audits

Modbus transducers with internal basic processing capability are available that measure many physical parameters needed in compressed air audits, such as pressure, flow, electrical power/energy and more.

In operation, these intelligent transducers sample the physical analog parameter (e.g., pressure) and perform local (i.e., within the transducer) analog to digital conversion. This digital resultant value is then stored to a memory location within the transducer called a Modbus Register, which has a unique identifying address associated with it.

Many Modbus transducers are capable of sampling multiple physical parameters as well as generating additional calculated parameters. For example, Modbus electrical meters can sample multiple phase currents and voltages on single- and 3-phase loads and

A Modbus airflow meter. (Photo courtesy of CDI Meters.)

then internally calculate 20-plus electrical parameters such as phase voltages, phase currents, power, energy, power factor, frequency and more.

Each of these calculated electrical parameters are then stored periodically to a Modbus Register memory location within the meter. In these multi-Register Slave transducers, each of the Modbus Registers will have a unique Register address.

Manufacturers of Modbus-enabled transducers provide a read-only Modbus Register Map unique to their transducer in their product manual. The map typically lists the available parameters, their data type, number of registers used to store the value (typically two), engineering units (e.g., Watt or kilowatt) and Modbus Register Addresses.

In addition to "read only" registers, many transducers will also have "Read/Write Registers," which may contain non-volatile calibration constants, sampling rate settings, output control, measurement units (e.g., temperatures in Fahrenheit and Celsius), or other settings configured by the user before deployment.

Slave devices may also have Read/Write registers that are updated during run-time. For example, an electrical meter may have a Register that totals energy consumed. In this case, it may have a "clear" option that resets the total to zero when a particular Modbus Read/Write register is toggled.

Before deployment, Modbus transducers all require some basic system configuration. Typically these settings are configured using generic Modbus or manufacturers' software running on a PC. The connection between the PC and the Slave device is commonly via USB or over the Modbus RTU connection (typically RS-485). Simple commands are sent to the Slave device to configure these settings.

In many simpler devices, some parameters (e.g., Slave device address) may be set via DIP switches on the unit. Basic parameters to be configured for all Slave devices residing on the network include:

- Slave device network address.
- Serial communication data rate.
- Serial data packet Stop bits and Parity.

In some installations, the actual air compressor controller is equipped with a Modbus RTU port and can be connected on the Modbus data acquisition network as yet another Modbus Slave device.

Armed with the Controller Register Map, users can configure the data logger to simultaneously garner valuable parametric data available from the controller, such as outlet pressure, run state, etc. This can save redundant installation of additional transducers to acquire those parameters. The resulting logged controller data can then be correlated with other measured compressed air system flows and pressures data.

Modbus Master Data Logger & Network Wiring

In an air audit data acquisition network, a Modbus RTU-capable data acquisition instrument, such as a Logic Beach IntelliLogger™, is utilized as the network Master. The Master instrument is then user-configured with details about the connected Slave devices and the desired Modbus Register addresses along with communication parameters. Users can also use Logic Beach's HyperWare-II™ programming software to specify data available on an airflow transducer's Modbus register.

Modbus RTU serial data communication between the Modbus Master and the Slave(s) is most common over a network using two

MODBUS TRANSDUCERS: DELIVERING THOROUGH AND ACCURATE COMPRESSED AIR AUDITS

or four-conductor, shielded twisted pair wiring utilizing RS-485 with a total distance of up to 4,000 feet.

Devices supporting RS-485 have internal RS-485 transceiver chips that allow multiple devices to be connected to a single-wire pair in a multi-drop topology without excessively loading the network. This allows up to 32 devices on one Modbus RTU network, typically far exceeding the Slave devices required for an audit data acquisition network.

As RS-485 is a digital hardware serial communication link, it has excellent immunity to stray electrical noise. Unlike analog signals, induced voltage fluctuations up to one Volt or more are ignored by the RS-485 transceivers. This extreme noise immunity is of great value in rejecting electromagnetic flux generated by multi-horsepower electric motors driving air compressors and adds to the accuracy and robustness of an audit data acquisition system.

Installation of the single multi-drop cable simplifies the installation of the data acquisition as one cable can be routed to allow reading of tens or hundreds of parameters. In contrast, running individual analog transducer wire pairs would result in vastly more conductors with the associated decrease in reliability due to potential conductor damage, connection failures and wire harness routing difficulty.

Data Acquisition Network Operation

Slave transducers will asynchronously and periodically sample their inputs, such as pressure, and current, perform basic analog to digital conversion and store the result in the appropriate Modbus Register. The frequency of this sampling and register update depends on the transducer. Some transducers allow users to program update rates.

While the Slave devices are sampling inputs and updating their internal registers, the Modbus Master data logger will periodically transmit a "Read" request onto the network, which will include both a Slave device network address as well as the desired internal Modbus

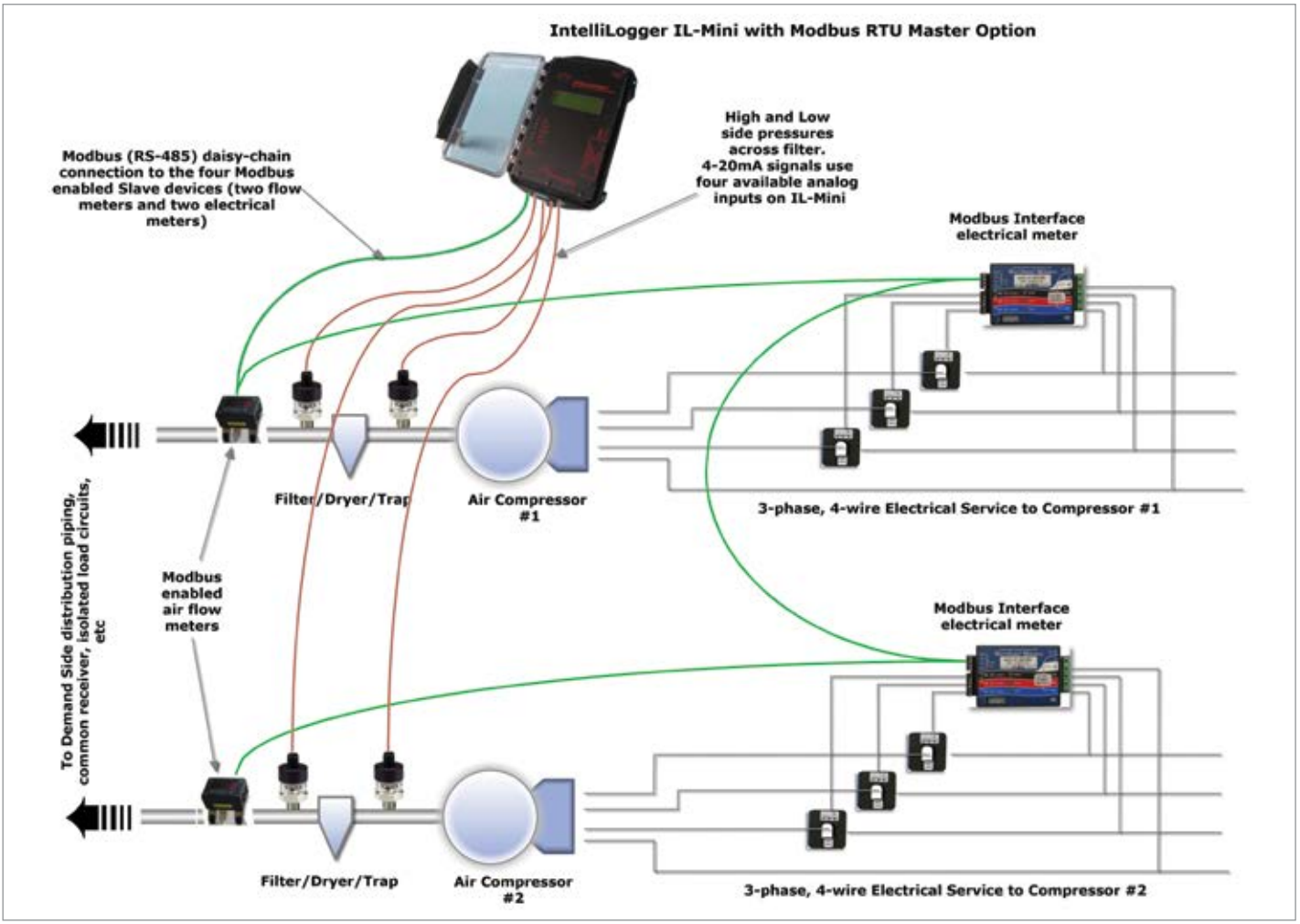


Figure 1: Illustrated is an instrumented compressed air system utilizing both Modbus and analog transducers. (Diagram courtesy of Logic Beach Incorporated.)

Register address. The Slave device at the specified network address will then reply with the value in the requested Modbus Register.

The data logger receives and processes this value based on the programming defined by the auditor. Processing may include unit conversion, inter-channel calculations, time integration, min/max/averaging, summation, alarm rule checking, etc., and after processing calculations are done, the result will be stored to data logger memory or reported to the Cloud.

With a versatile data acquisition instrument, analog transducers with common analog signal outputs (4-20mA, 1-5Vdc, etc.) can also be utilized in an audit data acquisition system to measure parameters not requiring or benefitting from the power of a Modbus transducer. Modbus slave transducers and analog transducers can be installed and configured for simultaneous data acquisition, combining all acquired measurements into a single audit result file for later download and analysis.

Putting Modbus in Your Toolbox

Modbus transducers can be a powerful audit, test and troubleshooting addition for both auditors and facility managers to put in their instrumentation toolboxes. The Modbus protocol, wiring and use configuration are straightforward, making the learning curve very low – and the highly beneficial protocol is everywhere. BP

About the Author

David Parks has been in the instrumentation and controls industry since he graduated Iowa State University in 1977. He is President and Founder of Logic Beach Incorporated, email: dparks@logicbeach.com.

About Logic Beach Incorporated

Since 1986, Logic Beach Incorporated has been designing innovative stand-alone, network enabled and most recently Cloud-connected data acquisition, alarming and reporting instruments. Known for their intuitive icon based HyperWare-II™ programming software, simple to complex data acquisition routines can be quickly developed and deployed into their rugged IntelliLogger™ line of data acquisition instruments. Additional Modbus and instrumentation information is available at www.logicbeach.com.

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PRODUCTIVITY, SUSTAINABILITY & ENERGY CONSERVATION

CELL-CONNECTED COMPRESSED AIR Monitoring Systems Save Time and Money

By Ron Marshall, Marshall Compressed Air Consulting

➤ In my 24-year career monitoring of compressed air systems for energy efficiency, I have spent many hours of dashboard time, traveling by air and car, to and from my customer's sites both within my territory and beyond, even sometimes on other continents. Sometimes due to unforeseen circumstance I will download data from previously placed loggers only to find the data is unacceptable, meaning the time spent traveling has been wasted, this is a constant source of frustration. Recently, with the advances in instrumentation and cell-connection technology, it has become possible to make this exercise much more efficient, reducing wasted travel time, and yielding much more valuable real-time information about the working of the customer's equipment.

These improvements not only reduce my travel time, but also the time spent processing the downloaded data, which often contains hundreds of thousands, sometimes millions, of time-stamped samples needing to be carefully analyzed. This article discusses some of my experiences in trialing some new cell phone-connected compressed air data logging equipment and data visualization software.

Data Logger Types Explored

Like any system, to properly manage compressed air equipment some measurements have to be taken. Typically, some sort of data logging equipment is installed to measure various pressures, amps or power, flow, and sometimes temperatures and dewpoints. Placing this equipment on a system is like putting an electrocardiograph machine on a human heart, the heartbeat of the compressed air system in a plant can be analyzed to determine

Figure 1: This chart shows pressure (magenta), power (purple) and flow (blue) at a bean processing facility. The power signal is from a common feed, halfway through the sample a new more efficient air compressor is started. Within an hour high pressure and less than optimal operation was detected based on remote readings and adjustments were made to correct the situation before the technician left the site. (Source: CALMS Air.)

if everything is normal or if there is a problem, all without interrupting the system.

The shape of the squiggly lines, say the pressure profile when compared to the air compressor power consumption, tells an educated auditor many things about the compressed air equipment. Things like lack of air capacity, high pressure, poor control, large pressure drops, and inefficient air compressor operation all become obvious when the traces for the various parameters are compared side by side on a time-based chart.

There are many types of data loggers, and I have tried quite a few. Generally, the loggers available are either one of two design philosophies: self-contained independent, or central multichannel.

The self-contained designs are usually battery powered and lightweight, often designed to measure only one or two of the required parameters, the user must have a number of pressure, amp and flow loggers to be used to concurrently collect the various required readings. These data loggers typically have their own power supply, making them easy to place anywhere, but usually have limited onboard memory and selectable data sampling rates. There is often a trade-off between the frequency of samples and the measurement time span, due to limitations in memory size. The lower the sample frequency the harder it is to analyze system data.

The other type, central multi-channel loggers, are usually some sort of electronic enclosure connected by control wires to the various temporary transducers required for measuring the important system parameters. The use of this logger type is less convenient because of the many wires that need to be run to a central location in larger compressed air installations. These boxes usually need to be connected to AC power to work, or a larger battery pack, adding the risk of accidental interruption.

Central data collection boxes often have huge memory capacity, capable of collecting months of data at frequent sample rates, making data analysis clearer.

Both design styles require some sort of data download. After placing the loggers, and waiting a period of time, the compressed air auditor will return to site and download the data loggers. The data will then be organized into some sort of database where visualization of the data can be done, and energy calculations performed. The processing and visualization of the data is very important since the auditor must be able to easily scan the data to look for any problems. Having the ability to zoom in and out of the data to take a close look at any abnormalities is paramount. This operation, or the lack of it, is what makes some data logging systems easy to use and others almost impossible. The least convenient type of data logger is one with no data visualization program at all, forcing the compressed air auditor to dump everything into a spreadsheet and struggle from there.

Web-Based Systems Evolve

Of course, with any electronic circuitry, there are problems. Batteries go dead, wires are pulled off, power supplies unplugged and open valves closed, all with negative consequences to the data collection exercise. And without the ability to see real-time data, the auditor must wait for the one or two weeks of data collection before he can determine if his data is bad or good. Many times I have been forced to emit a stream of expletives after finding,

CELL-CONNECTED COMPRESSED AIR MONITORING SYSTEMS SAVE TIME AND MONEY

after a six-hour drive each way, that my data loggers have failed to collect the data correctly.

These struggles have forced me to look for the perfect compressed air data logging system, something that will make my life easier, and in the past number of years I have tried about a dozen system, some very good, but none perfect.

Advances in electronic instrumentation and data connectivity, however, have finally allowed me to find the near-perfect product I was searching for: a cell-connected data logging system designed for compressed air systems. This system I am currently using, available from CALMS AIR (www.calms.eu) is a central box system, capable of using multiple, multi-channel loggers working together on the same database, with live cell modem Internet data connection.

The device connects to various transducers via wiring and collects the data in ten-minute packets, which are sent to a central database. The incoming data is scaled and processed within web-based software. Each data point is subject to mathematical calculation, which makes it possible to calculate power from amps using the power formula and "if, then" statements to select the proper power factor.

The available web platform allows any auditor who is assigned to a project, no matter their location, to look at any connected monitoring system or historical data from anywhere in the world that has an internet connection. This makes it possible to view real-time data from my customers (delayed by a maximum of 10 minutes) from my desk or laptop, and even my smart phone if desired.

I have been fortunate to have been able to trial this system, and in the few short months I have been using it, I have already saved myself an estimated 30 hours of dashboard time. I'm also proud to say that, due to the excellent connectivity and real-time data, the system has allowed me to advise my customers from afar, and on four occasions I have been able to help improve my customers' system efficiencies by an average of 10% by doing no cost adjustments to air compressor settings.

The system has also allowed me to very quickly diagnose system problems as they happen, or within few short hours after the initial installation of the equipment. And of course, because much of the data processing is automatically done after each sample is taken, much of the spreadsheet work I usually do in calculating system efficiencies and flows is already done for me, saving me many additional hours of work. The following examples illustrate some interesting uses of this excellent measurement system.

Saving Time, Improving Results at Bean Processing Plant

The first use of the system was in a bean processing plant, about a two-hour drive from my office.

This is a single air compressor system with a desiccant dryer. The customer was changing the plant air compressor from a load/unload-

Figure 2: This shows the pressure, power and flow profile at a meat processing plant. The three VSD air compressors at this site were not running optimally. Based on the readings, the pressure setting was adjusted on one of the VSD air compressors causing a less efficient unit to shut down. The specific power graph on the top of the chart shows this adjustment improved the efficiency. (Source: CALMS Air.)

controlled unit to a Variable Speed Drive (VSD) design. The existing air compressor was extremely inefficient because it was rapidly cycling and had very high unloaded power consumption. This project was being funded by the local power utility, so they had an interest in verifying the savings gained by the equipment change.

The old and new air compressor were connected to the same power supply, so the same current transformers could be used to measure both old and new operation. The data logger was set up to measure basic parameters of air compressor discharge pressure and amps. During installation the power factor was measured with a handheld power meter in both loaded and unloaded conditions. This is to internally calculate the power consumption using a mathematical calculation on the amps input.

The customer was unsure when the air compressor replacement was going to take place so the data logger was pre-installed well ahead of time and left collecting data. This gave a good set of data to calculate a baseline energy and flow profile. Once the new air compressor was installed, I could quickly see the result from my office. Figure 1 shows the pressure/power/ flow profile of the load/unload air compressor in the first half of the chart, then similar measurements when the new unit was first started up.

Above the main chart is a calculation of the specific power of the system. We can see for the load/unload operation the specific power was off the chart. Operation in this range had a power consumption of 28.4 kilowatt (kW) while producing an average of 14 cfm. This calculates to a specific power reading of over 200 kW per 100 cfm, very poor. Operation after consumed about three kW while producing 15 cfm, for a specific power of 21.7 kW per 100 cfm, a much more reasonable number.

A pressure excursion can be seen midway through the data, when the new air compressor was started up, the service technician assumed the pressure should be set at around 110 psi, when the desired pressure was lower. The technician's set-up also allowed the air compressor to run unloaded between cycles, consuming power, but producing no air. Since I was receiving data remotely, I was able to quickly diagnose the problems and advise the technician to lower the pressure and reduce the unload timer. This saved me a trip to site and increased the energy savings for the project.

A bit later on, the measurement system was able to help me diagnose a problem with the air dryer dewpoint control. The site personnel had switched the dryer to fixed-cycle mode, this problem was noticed during my daily checks, but not by the customer. A phone call to site corrected the issue, saving another wasted trip. Overall, I was able to collect about a month of data without the need for extra trips to download data. My old data loggers had a capacity of only eight days per download. As such, this would have required four separate trips to site to download data.

Pinpointing Savings of $10,000 Annually at Meat Processor

At a meat processor I got the first opportunity to use two logging boxes connected together to the same database via cell modem.

The plant has three VSD air compressors and one fixed-speed unit. Air drying is heatless

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desiccant, which is needed due to cool ambient temperatures in the plant. One of the air compressors is installed remotely from the main powerhouse to provide pressure support to a critical process area. This required two measurement boxes as it was too far to run wires to a central location. Two of the four air compressors have just recently been purchased and were premium efficiency units. One older VSD unit is nearing the end of its useful life and had very poor efficiency when it was in the low range of its variable adjustment.

It was difficult to adjust this system by local observation due the fact that there is no compressed air monitoring system and the remote air compressor operation could not easily be checked. The remote unit is isolated from part of the plant through a check valve. This was done so the critical process could run independently from the main plant if the main production pressure went down.

After the loggers were placed, it was obvious things were not adjusted as expected. The older inefficient VSD was running most of the time in its lower range, its least efficient point, and the new premium efficiency VSD was very lightly loaded or off. The fix was a simple adjustment of the target pressure of the new VSD, all done through recommendations from my office while watching on my computer screen.

The monitoring system also allowed a diagnosis of another problem. Due to the remote check valve, and a check valve within the associated dryer, the remote air compressor could not turn off on standby for more than a few minutes, even though it was not required to run during non-productive hours. The check valves prevented it from seeing the true system pressure, its local control pressure was being pulled down by dryer purge as soon as the air compressor turned off. A bypass line was installed to allow the air compressor to directly see line pressure, reducing its operating time substantially.

Excessive leakage and dryer purge were also detected by the system. This is being addressed by the maintenance department. Estimated operating cost savings for the combined adjustments here reduced the energy consumption by an estimated 10%, saving about $10,000 per year in energy costs.

Quick Diagnosis, Adjustments Save Sawmill $22,000 Per Year

The monitoring system was installed on a sawmill located about 1,200 miles from my office, where a VSD air compressor had recently been added to a system of three load/unload air compressors. The measurements were done on request by the local power utility since they were funding the system upgrade with a financial incentive.

On inspection of the installation, it appeared the pressure setpoint coordination was adequate, based on the air compressor setpoints, however, when the VSD historical data was viewed it looked like the VSD was spending very little time in its variable mode, it ran mostly fully loaded. Hour meter readings also showed two of the fixed-speed units had higher than expected unloaded power consumption.

A look at the data collected by the monitoring system (Figure 3) showed the VSD running fully loaded and fixed-speed units loading and unloading during plant production. This is opposite of what should be happening in an efficiently controlled system, the air compressor setpoints needed to be adjusted.

Had I used my standard loggers, I would have downloaded the data after returning to be plant, only to have been faced with another

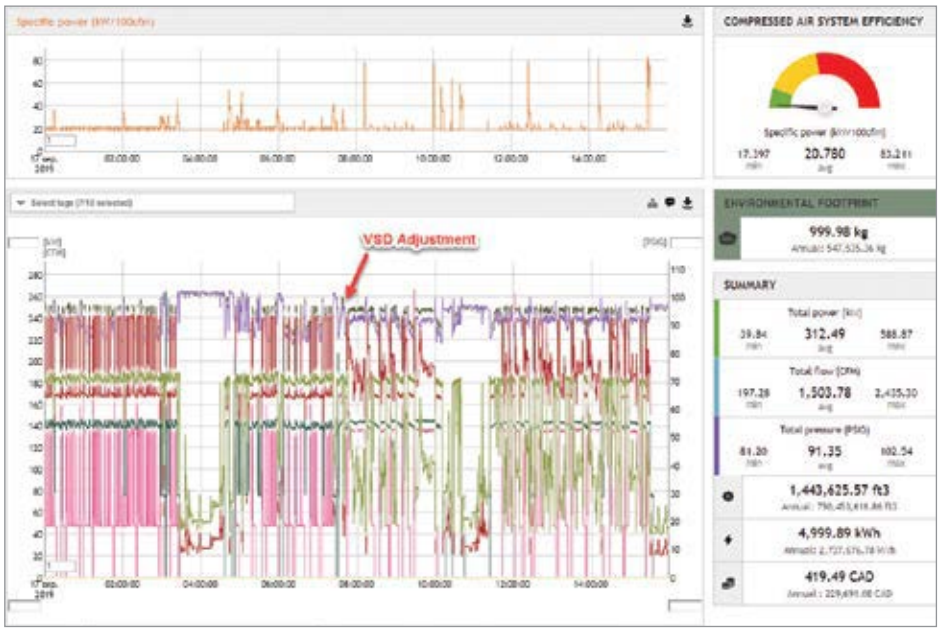

Figure 3: This chart shows the full dashboard of this sawmill system. The VSD air compressor was running at full load during full production causing a fixed-speed unit to load and unload. A change to the VSD setpoint improved system efficiency and the pressure profile (black and magenta traces). This dashboard shows at a glance if the system is running optimally. The air compressor load/unload status can be tracked (bottom chart) and the key parameters are shown for the sample timespan, as well as being projected to an annual span. The information even tracks the carbon footprint. (Source: CALMS Air.)

three-hour plane ride and four-hour drive to come back to verify the air compressor adjustments. But, because I could easily see the data, I could instruct the local operators to adjust the air compressor setpoints to a properly coordinated condition.

After adjustments, the VSD air compressor became the trim unit and the fixed-speed units would go to full load, or when not required, would time out and turn off, which is typical of a correctly controlled multiple unit system.

The system dashboard (Figure 3) shows a full range of pressures, power, flows and energy costs, so it was easy to determine the adjustment of the air compressor saved an average of 25 kW of wasteful unloaded run time, saving about $22,000 in annual power costs, not bad for a few minor pressure adjustments. The adjustments also helped stabilize the plant pressure, bringing it closer to the VSD setpoint, rather than having a constant saw-toothed waveform typical of a load/unload-controlled system.

It's All About Efficiency

These brief success stories illustrate how useful Internet-connected compressed air data monitoring systems are in helping compressed air professionals very quickly assist their customers in becoming more efficient.

The system is able to create pressure, power and flow baselines in each case, and automatically calculate system specific power. Based on these readings, and analysis of the time-based data, improvements can be recommended, often within a few hours of the request, and the results of the changes very quickly verified. Having a constant stream of live data available on the Internet saves travel time and money – and keeps customers happy and working efficiently. BP

For more information about this article, contact Ron Marshall, Marshall Compressed Air Consulting, tel: 204-806-2085, email: ronm@mts.net.

To read more ***air compressor control technology*** articles, please visit www.airbestpractices.com/technology/air-compressors.

PRODUCTIVITY, SUSTAINABILITY & ENERGY CONSERVATION

SHOW REPORT: The 2019 Best Practices EXPO & Conference – Another Success!

By Mike Grennier, Compressed Air Best Practices® Magazine

Nashville, Tennessee, will forever be known for great music and hospitality – yet attendees of the BEST PRACTICES EXPO & Conference held October 13-16, 2019 will also remember it as a place where they discovered numerous ways to save energy, conserve water and improve plant profitability by optimizing industrial utilities, including compressed air, steam, motors, vacuum, blower and cooling systems.

The Best Practices event drew 850 attendees – representing a 15% increase from the inaugural event in 2018 – and took place at the Nashville Music City Center. This year's EXPO portion of the event grew to 100+ exhibitors, climbing 35% vs. prior year. EXPO attendance was free for qualified industry personnel.

The event brought together technology experts, systems assessment professionals, and manufacturing leaders – all of whom shared best practices and ideas manufacturing plants can use to save energy, improve sustainability initiatives and increase the overall reliability and quality of on-site utilities.

We didn't forget music in The Music City! Attendees were treated to networking events including an Opening Reception at the Skye Lounge, offering a 360 degree sunset and night of Nashville, and a fun Closing Party at Jason Aldean's Kitchen & Rooftop Bar on Broadway in the middle of all the honky-tonks!

The publishers of Compressed Air Best Practices®, Blower & Vacuum Best Practices and Chiller & Cooling Best Practices magazines produced the three-day event. Rod Smith, Show Producer and Publisher of Smith Onandia Communications, said the event was a success by every measure. "We are very pleased to see this event gain momentum as a premier destination for optimizing industrial on-site utilities like steam, motors, compressed air, vacuum, blower and cooling systems – all in one place." Smith continued, "It's exciting to hear manufacturing and technology leaders share knowledge on how managing these inter-related utilities can improve profitability, quality, reliability and protect the environment. It's also promising to see industrial sales channels engineer multiple technologies to help manufacturing achieve these

Application Engineers determine our energy future! On Day 2 of the Daily $1,000 Treasure Hunt Raffle, Tate Engineering Systems had two raffle winners! Pictured are Mike Lattanzia and Edward Moran receiving their Treasure Chests, with $250 each, from Rod Smith!

critical goals. This is why we hold the Treasure Hunt Raffle recognizing factory personnel and sales engineers."

The Best Practices Educational Conference

The conference consisted of four highly focused educational tracks running simultaneously for 2½ days featuring nearly 100 expert speakers from both the factory side and the technology/system assessment side:

- Track 1: Quality, Safety & Management
- Track 2: Facility Maintenance & Reliability
- Track 3: Energy Conservation/IoT Monitoring
- Track 4: Water Conservation/Energy Management

Conference speakers included leading systems assessment experts from the United States and Canada, as well as representatives of Compressed Air & Gas Institute, Compressed Air Challenge®, the U.S. Department of Energy Better Plants® Program, U.S. Environmental Protection Agency ENERGY STAR® for Industry program, Tennessee Department of Environment & Conservation (TDEC), Tennessee Tech University Industrial Assessment Center, and Nashville Electric Service.

Leading managers from well-recognized manufacturing companies, such as General Mills, Baxter Healthcare, AMCOR, Volkswagen, Jack Daniels, Eastman, Nissan North America, and Ball Beverage Packaging among others, provided invaluable insights and best practices for both challenges – and successes – with a variety of optimization projects.

Co-Sponsors: The Compressed Air and Gas Institute and TVA EnergyRight® Solutions for Business & Industry

The Compressed Air and Gas Institute (CAGI) is celebrating 100 years of industry leadership – and much success – which is no surprise given its passion for initiatives that offer immeasurable value. At CAGI's booth, Chad Larrabee described CAGI's newest offering: The Certified Compressed Air System Specialist (CCASS) program. It provides a means of verifying the capabilities of professionals in the industry. It also helps qualified experts differentiate themselves as certified air professionals, while giving customers, utilities and employers confidence in their skills. CAGI is also hard at work developing its Certified Compressed Air System Assessor (CCASA), which is designed for practitioners who perform assessments, or audits, of compressed air systems. It also serves as a means of verifying an assessor's understanding of and the ability to apply the ANSI/ASME EA-4 and ISO 11011 standards. The certification programs are in addition to CAGI's well-known work in equipment performance verification, as well as providing a wealth of educational

Patrick Britton, Chris Johnson, Bruce McFee, Rob Haseley, and Chad Larrabee at the CAGI booth (left to right).

Virginia Barry, Clay Hoover and Jason Snyder at the TVA EnergyRight® Solutions for Business & Industry booth (left to right).

Mark Valencia, Caleb Powell and Vaughn Cassidy at the TDEC booth (left to right).

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Joe Ghislain at the Compressed Air Challenge booth.

Greg Ashe, Michael Camber, Stephen Horne, Frank Mueller and Wayne Perry at the Kaeser Compressors booth (left to right).

Josh Borrego, Jason Hobbs, Russ Jones and Adrian Fernandez at the BEKO Technologies both (left to right).

resources, including its e-Learning program and its downloadable Compressed Air & Gas Handbook. Visit www.cagi.org to learn more.

One of the "Coolest Booth Awards" has to go to TVA EnergyRight® Solutions for Business & Industry (TVA ERSB+1). The coffee-shop themed booth served made-to-order coffee with the organization's logo stamped onto the foam of the coffee itself! Of course, a hot refreshment was only a bonus for booth visitors who learned how TVA ERSB+1 supports companies that adopt smart technologies to increase productivity, reduce their carbon footprint or enhance their competitiveness. One form of support is guidance and tips about energy use and productivity offered by energy experts. Additionally, experts perform on-site evaluations and provide recommendations for improving industrial processes. All that, plus TVA ERSB+1 offers financial incentives for qualifying companies to help cover the costs. Most importantly to our event, they generously sponsored a Compressed Air Challenge Level 1 Fundamentals Course attracting customers (including Jack Daniels!) to the show.

Supporting Organizations

One of our highlights this year was working together with the Tennessee Department of Energy & Conversation (TDEC). TDEC team shared insights into its many services and programs, such as the Tennessee Green Star Partnership (TGSP) program. Thanks to the program, which focuses on knowledge sharing and recognition of successful sustainability efforts, TGSP members have achieve impressive results. During TDEC's fiscal years 2017-2018, participating members reduced energy use by 144,925 MWh for a savings of $23,645,267. They also reduced solid waste by 294,049 tons.

Compressed Air Challenge (CAC) instructors taught a Level 1 Fundamentals Course for TVA ERSB+1 customers. In addition, at the CAC booth, Joe Ghislain explained how the non-profit organization is opening up new levels of sponsorship opportunities. Led by President Steve Briscoe, CAC continues to help compressed air users realize the benefits of improving the performance of their compressed air systems, through the delivery of their excellent training seminars.

The BEST PRACTICES EXPO

This year's EXPO portion of the event grew to 100+ exhibitors, climbing 35% when compared with the inaugural event in 2018. Attendance was free for qualified industry personnel. Technologies on display included all types of air compressors, controllers, measurement instruments, as well as motors, pneumatics, air purification, piping and lubricants. Numerous booths featured blowers and vacuum pumps. There were also

six cooling system technology booths, exhibiting everything from chillers and heat exchangers to unique water treatment solutions.

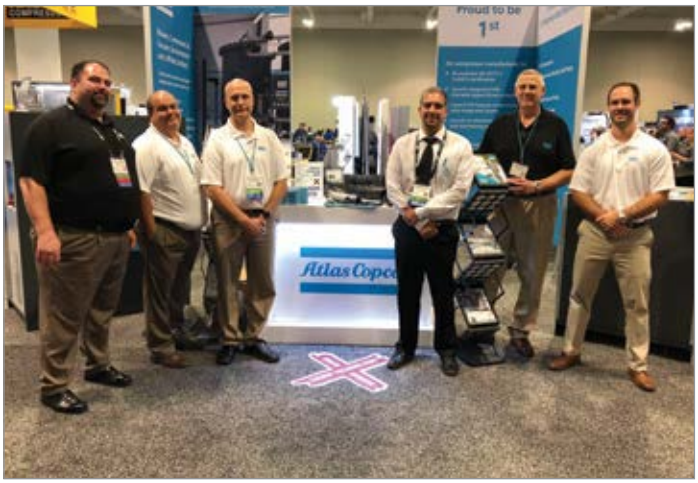
What follows is a report recognizing the major sponsors of the event plus a sampling of booths the editorial team visited in the allotted hours. Keep an eye out for our e-newsletters with more reports to come on specific technologies. Our apologies to all exhibitors not mentioned or photographed here.

Diamond Sponsors: Kaeser Compressors and BEKO Technologies

This year marks the 100th Anniversary of Kaeser Compressors! And it's clear the company continues to deliver innovation after innovation. An example was its Custom Engineered Solution on display at the Kaeser booth. These complete turnkey and cost-effective compressed air, blower and vacuum systems are built to specification, meaning there is no need to build a new room to house the system, or add on to an existing building – reducing onsite planning and installation. In addition to these benefits, Marketing Services Manager Michael Camber said other benefits include the ability to place the system in a favorable location and ambient environment or even to address safety concerns. Often, Camber added, the solution also eliminates delays in the process of designing and installing a complete system.

At the Kaeser booth, Greg Ashe talked about the excitement building for the company's acquisition of PillAerator GmBH earlier this year. The acquisition adds turbo blowers to the Kaeser line of rotary lobe and rotary screw blowers. Ashe described key features of the PillAerator Series blowers (available with flows up to 10,000 cfm), including a direct-drive magnetic bearing motor and intelligent control system. The blower can reach isentropic efficiency of up to 84%, which achieves energy savings up of to 25% when compared with conventional rotary blowers. The blowers are well suited for use in wastewater applications and industrial applications with pressures up to 20 psi.

BEKO Technologies lit things up at EXPO, but not only because the team wore electric name tags. Instead, it displayed innovative products like the DRYPOINT® RA VSD Variable Speed Refrigerated Dryer. The highly efficient dryer line has models rated from 800 to 6,000 scfm. Among the many features are two VSDs, including one on the refrigeration compressor and another on the condenser fan. The end result, said Russ Jones, is the dryer's ability to match the demand of the compressed air system – in turn saving energy. The unit is also equipped with an integrated, level controlled BEKOMAT® condensate drain, which is specifically designed to drain off condensate without the loss of compressed air, to reduce energy costs and CO_2 emissions.



Walter See, Chris Dominick, Jarett Lieser, Chris George, Steve Bos and TJ Estes at the Atlas Copco booth (left to right).

Stephanie Brockman, Bob Groendyke and Sergio Lopez at the Hertz Kompressoren booth (left to right).

Bill Kennedy, Dale Mays, Silvia Barone and Andy Brinka at the Mattei booth (left to right).

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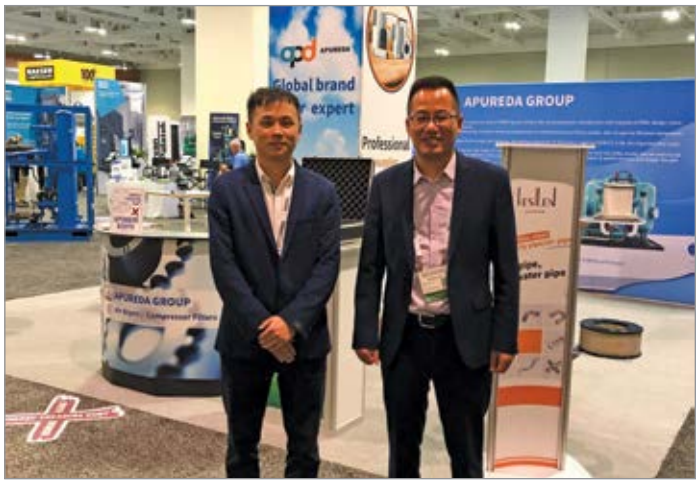
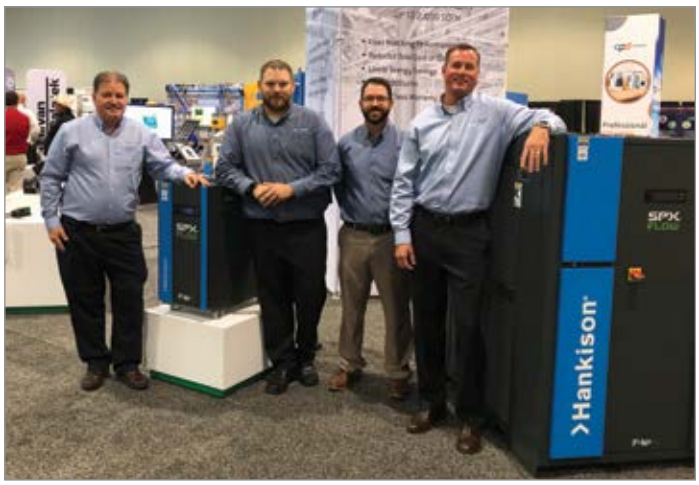


Austin Wang and Jackey Lee at the Apureda Group booth (left to right).

Brad Taylor, Anina Diener, Derrick Taylor, Jeffrey Vaughn, Natasha Taylor and Trevor Kendall at the PneuTech booth (left to right).



Vic Zanchetta, Russell Martin, Ryan Remington, and Chris Spainhower at the SPX Flow booth (left to right).

Platinum Sponsors: Atlas Copco, Hertz, Mattei, SPX FLOW, PneuTech and Apureda

At the busy Atlas Copco booth, TJ Estes walked me through the SF range of oil-free scroll air compressors, rated from 3 to 30 hp. Designed as a complete package, the air compressors combine the scroll element, drive motor, aftercooler and starter in a single compact unit. The SF scroll air compressors are also available as full-feature units equipped with an integrated refrigerant air dryer. In addition, the air compressors are built with a sound-insulated canopy to keep noise levels as low as 53 dBA. These air compressors are for use wherever the need for oil-free, energy-efficient and quiet-running air compressors is at a premium.

Atlas Copco also displayed its GHS 730 VSD+, oil-sealed rotary screw vacuum pump, which taps into the continued growth in demand for energy-saving variable Speed Drive (VSD) technology. At the booth, Walter See described how the VSD vacuum pump (rated from 40 to 430 acfm) uses a unique setpoint control to optimize energy use while maintaining process vacuum levels. The unit is specifically designed to deliver the lowest possible flow to match the required level or speed so nothing is wasted. Additionally, the GHS 350-1900 VSD+ Series are equipped with a patented oil separator design that ensures filtration to less than three (3) mg/m^3 - even under the greatest load.

The team at Hertz Kompressoren proudly showcased its portfolio of Eagle Series oil-free rotary screw air compressors. Bob Groendyke said the new line of air compressors, which is validated to ISO 8573-1 Class 0 Quality Classes, ranges from 50 to 430 horsepower. Highlights of the new air compressors include a proven airend and a range of Variable Speed Drive models, making them suitable for a host of applications where oil-free air is essential, such as the food, beverage and electronics industries.

Another company marking a major 100-year milestone is Mattei, which has been manufacturing air compressors since 1919! Mattei is also well known for its "bearing-less" propriety rotary vane technology. Bill Kennedy took time at the booth to describe how their Blade air compressors are well suited for a wide variety of small and medium-size businesses, especially given the units' ability to produce compressed air at a low specific energy cost (scfm per kW) – and at noise levels as low as 61 dBA.

At the booth of Apureda Group, excitement was everywhere as the company introduced itself to the North American compressed air industry. Based in China, Apureda Group manufactures a broad line of quality compressed air dryers and filters, as well as air-oil and air-water

separators. It also offers a stainless-steel line of piping. Jackey Lee described how their air-oil separators are engineered with an innovative technology comprised of a pleated and wrapped structure with a high-quality media. The result is a maximum service life of 8,000 hours.

Complementing their line of rotary screw air compressors, the buzz at the PneuTech booth was the new Unipipe™ line of modular aluminum piping for compressed air, inert gases, high pressure oil lines and vacuum. Derrick Taylor of PneuTech was clearly "pumped" about the new piping system, noting it represents the broadest range of sizes in the market. The heavy-wall pipe, which requires no special tools for fast assembly and installation, is available in 13 sizes from three-quarters to 10 inches in diameter and suitable for wide pressure ranges from high vacuum to 1,000 psi.

SPX Flow drew a crowd with its expanded line of Flex Series refrigerated air dryers, which are now available with flow rates from 75 to 2,000 scfm. Just one of the many energy saving features of the cycling dryers is an innovative way in which they efficiently remove liquid contaminants from compressed air. It involves the use of patented 4-in-1 heat exchangers and a Phase Change Material (PCM). The results, said Chris Spainhower, is the need to cycle the refrigerant compressors less often than conventional dryers for improved energy savings.

Walking the Show

David Andrews at Sullair was excited to outline the latest enhancements of the LS Series lubricated rotary screw air compressors rated from 126 to 200 hp. This includes the introduction of the LS160 model (up to 150 psig), featuring an enhanced airend package with a 260-millimeter rotor profile and improved inlet valve designed to boost free air delivery and increase efficiency compared with previous models. The units are also engineered for ease of service and feature Sullair's capacity control options, including the company's proven Spiral Valve Technology, as well as a VSD option.

Congratulations are also in order for Sullivan-Palatek, which celebrates its 25-35 Anniversary! Bruce McFee explained the 35th year anniversary marks the company's founding as Palatek in Michigan City, Michigan. Meanwhile, the 25th anniversary celebrates GHS Corporation's purchase of Palatek. GHS previously owned Sullivan, a maker of diesel-powered portable air compressors. The company then became known as Sullivan-Palatek, which now has more than 185 employees, along with a booming OEM airend division, as well as one of the widest ranges of industrial electric and portable diesel air compressors available.

Brian Mann, Nate Price, David Andrews, Amanda Hunter, Amy Offord and Manhar Grewal at the Sullair booth (left to right).

David Smith, Andrew McFee, Mike Kropp, Bruce McFee, Mike Gonder and Jerry Rodriguez at the Sullivan-Palatek booth (left to right).

Britney Bond, Waverly Wituski, Mike Popielec, Nate Holliday, Scott Scheuerlein, Jim Treadway, Ellen Baranack, and Bill Duffel at the Parker Hannifin booth (left to right).

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Keith Beatty and Paul Heston at the HydroThrift booth (left to right).

David Swartz, Crystal Wilson, Jim Riley and John Temple at the Sauer Compressors USA booth (left to right).

Scott Folsom, Matt Smith and Kevin Miller at the FS-Curtis booth (left to right).

Parker Hannifin displayed its new Magnum Series PLC Controller, which Scott Scheuerlein explained, takes its Magnum Series of large capacity compressed air dryers from 4,000 to 25,000 scfm to the next level. The Allen-Bradley® controller features a seven-inch HMI touch interface with full color graphic display. Just some of the benefits include automatic data logging and trending, along with user-friendly help screens to aid in trouble shooting. Next, Bill Duffel walked me through the Parker Transair aluminum piping system for compressed air applications, available from one-half inch to six inches in diameter. Aside from providing ease of use and cost-savings, the system can be equipped with an air system condition monitoring system. It lets users monitor their system in real-time from anywhere to ensure uptime and improved performance.

At the HydroThrift booth, Paul Heston explained how the company's PCX closed-loop cooling system improves uptime and longevity of equipment such as water-cooled air compressors. Unlike an open cooling tower that often contains dirty water, the engineered, liquid-to-liquid PCX system uses a plate-and frame or a shell and tube type heat exchanger to cool equipment via a closed loop configuration. The system then uses a water-glycol mixture, or other clean heat transfer fluid, for cooling. Doing so prevents scaling and fouling of the air compressor's heat exchangers. The ability to control flow, temperature and pressure also contributes to uptime and longer equipment life.

At the Sauer Compressors USA booth, David Swartz explained why they have earned a reputation as a leader in high-performance, high-pressure piston air compressors used in shipping, naval equipment and other offshore activities, in addition to other demanding industrial applications. One reason is quality products like the Mistral WP22L, two-stage air-cooled and direct drive air compressor on display. The compact unit delivers high-pressure air (up to 600 psig) and is commonly used on ships for engine starting air. Swartz said the company backs its quality claim with the availability of guaranteed replacement parts for 35 years! They also have technical service support and service engineers located on all continents and in major ports.

The FS-Curtis booth displayed an impressive two-stage airend, the key feature of their line of NxHE two-stage, oil-lubricated rotary screw air compressors. Scott Folsom explained how the two-stage airend can save up to 15% in energy when compared with air compressors using a single-stage airend, while also delivering more airflow. The end results, he said, is the ability to support their goal of helping customers save energy while ensuring the continued reliability of their systems.

Visualizing Key Performance Indicators on computer screens will drive more and more compressed air system efficiency improvements. With matching pants and vests with neon shirts underneath, the Airleader team turned heads on the EXPO floor and the Opening Reception. The firm recently released its new Cloud Service technology, which works with their Master Controller and allows people to connect to their Airleader units and compressed air systems remotely from anywhere in the world. It's an especially important technology since every compressed air system should be monitored to achieve the best results!

At the Mikropor booth, the new buzz was their preliminary announcement of their investment into a new 26-acre headquarters for the Americas in the Michigan City area! On the product front, their focus is on how their MK Series cycling refrigerated dryer can address all three contaminants covered in a ISO 8573.1 compressed air quality specification: solid particulates, moisture and oil – and at what pressure drop. An innovation here is the decision to create an ISO 8573.1 Quality Classes 1.4.1 air treatment package with an overall pressure drop of less than 3 psi – remarkable! This is possible because they use oversized 1 micron pre-filters and 0.01 ppm post-filters inside the cabinet.

Jorc Industrial is a well-known leader in condensate management and proud to have been making condensate drains since 1997. On display at the booth was the Smart-Guard-Mini Zero Air Loss Condensate Drain. Ideal for use with filters or refrigerated dryers of up to 350 scfm, this level-sensing drain has a maximum working pressure of 230 psi. The Smart-Guard-Mini also features a test button to verify the drain is functioning and an internal sensor to detect potential drain blockage. In the case of a blockage, the Smart-Guard-Mini internal sensor will pulsate the valve to attempt to clear the drain.

Conclusion

All in all, the level of excitement and knowledge sharing shown at the 2019 BEST PRACTICES EXPO & Conference in Nashville can only mean one thing: next year's event in Chicago on September 20-23, 2020 is not to be missed. Mark your calendar!

More information about the 2020 event will be posted soon at www.cabpexpo.com. For the 2020 Exhibitor Prospectus, or to propose a Presentation Abstract please contact Rod Smith at email: rod@airbestpractices.com. BP

To read more about ***Optimizing Compressed Air Systems***, visit www.airbestpractices.com; for ***Blower & Vacuum Systems,*** visit www.blowervacuumbestpractices.com; and for ***Cooling Systems,*** visit www.coolingbestpractices.com.

Werner Weidner, Nick Skupien, Uwe Kottman, Joe Holaday, Marius Hoetzel and Jan Hoetzel at the Airleader booth (left to right).

Jeff Crutchfield, Nitin Shanbhag and Volkan Ayhan, next to a Mikropor MK Series Refrigerated Dryer (left to right).

Darren J. de Bie, General Manager, with the Jorc Smart-Guard-Mini Zero Air Loss Condensate Drain.

RESOURCES FOR ENERGY ENGINEERS

TECHNOLOGY PICKS

Sauer Compressors Presents Oil-Free HAUG High-Pressure Compressor

The HAUG.Sirius NanoLoc is the first compressor to combine two of Sauer Compressors' core competencies: high-pressure know-how and oil-free expertise. The completely dry-running and hermetically gas-tight solution is designed for applications that require absolute process safety and purity. With final pressures of up to 6500 psi, the compressor offers oil-free compression of virtually any gas. With the integration of the former HAUG Kompressoren AG, Sauer Compressors has significantly extended its portfolio to include solutions by the industry's leading expert in oil-free air and gas compression. The HAUG.Sirius NanoLoc marks the latest addition to the product range and is the first compressor that combines high pressure with oil-free compression.

Both the crankcase and the compressor stages operate without any oil. This ensures highest gas and process purity. Therefore, the compressors are an ideal choice for sensitive applications such as industrial gases, medical applications and biotechnology as well as the chemical, pharmaceutical and food industries.

With its hermetically gas-tight construction, the HAUG.Sirius NanoLoc achieves extremely low leakage rates of <0.001 mbar l/s and enables 4-stage compression of almost any gas. The compressor delivers a flow rate of max. 40 SCFM and a final pressure of up to 6500 psi with an inlet pressure of up to 435 psi. Depending on the configuration, it comes with a motor power of 14-40 HP. In addition, the HAUG.Sirius NanoLoc is ideally suited for booster applications of gases such as helium, natural gas or hydrogen.

The HAUG.Sirius NanoLoc combines the high-pressure expertise and the oil-free know-how of Sauer Compressors.

The well-proven magnetic coupling drive adds to the machine's exceptional gas-tightness both at standstill and during operation. The technology is a core feature of the HAUG.Sirius series. Due to the newly developed and unique NanoLoc® piston design's friction-free sealing, wear and friction losses in the cylinders have been reduced significantly. Likewise, all the compressor's components are designed for a particularly long service life.

Even in operations with long standstills, frequent interruptions and cold starts, the HAUG.Sirius NanoLoc is highly dependable. The absence of oil serves to significantly lower operating and maintenance costs. Due to its unparalleled process purity, the compressor reduces the need for gas treatment and filtration after compression to a bare minimum. Often, treatment and filtration are not required at all, resulting in significant time and cost savings.

About Sauer Compressors USA

Sauer Compressors USA specializes in the manufacturing of medium and high-pressure air and gas compressors for naval, commercial maritime, offshore, research & development, and demanding industrial applications. In addition to air, Sauer Compressors is saturated in the CNG, N2, He, and inert gas markets. Sauer USA, located in Stevensville, MD is an affiliate of J.P. Sauer & Sohn, headquartered in Kiel, Germany.

The four product lines SAUER, HAUG, Girodin and EK focus on specific fields of application. The SAUER line comprises oil-lubricated high-pressure compressors for a wide variety of applications, while HAUG stands for oil-free and hermetically gas-tight compressors. The Girodin and EK lines offer special compressors for the naval market. Sauer Compressors' modern reciprocating compressors for the compression of air and various gases reach pressures of 290 to 7000 psi. Besides standard products, it offers customized solutions for individual customers, OEMs and companies that operate on a global stage. With a global network of agents and representatives, Sauer maintains close proximity to its customers. By supplementing the compressor range with high-quality accessories, engineering services, assembly and service concepts, Sauer offers system solutions right up to complete turnkey installations. For more information, visit www.sauerusa.com.

TECHNOLOGY PICKS

Atlas Copco Expands Rental Fleet with ZT 90 VSD

Atlas Copco Rental North America (Atlas Copco Rental) serves customers across a variety of industries by matching industry-specific rental demands with the ideal equipment and accessories for the job. The provider recently expanded its rental fleet by adding the legendary Atlas Copco ZT 90 VSD compressor, which was developed especially for applications demanding the highest levels of purity, such as pharmaceutical production, food processing and the production of critical electronics.

The ZT 90 VSD offers certified, 100% oil-free air. It was the first compressor to earn ISO 8573-1 CLASS 0 (2010) certification, commonly referred to as simply "CLASS 0." CLASS 0 means zero risk of contamination, zero risk of losses from operational downtime, and zero risk of damaging a company's hard-won reputation.

"Re-engineered to run 24/7 and to deliver a wide range of volume flows, even in extreme weather conditions, the ZT 90 VSD is ideal for industrial manufacturing applications," said Maggie Rios, VP of Marketing for Atlas Copco Rental. "Its reliability, easy installation and ready portability – along with its low power consumption, soft start and stable pressure – make it a solid addition to our rental fleet, and a great fit for a range of industrial applications."

The product itself is extremely popular among companies seeking ultra-reliable, 100% contamination-free air, as well as a range of other features.

"The ZT 90 VSD offers a long list of attractive features for plant managers looking to fill temporary equipment needs and eliminate production downtimes," said Jowell Olaivar, Product Manager, Oil-free Compressors at Atlas Copco Rental."Among the many value-adds the ZT 90 VSD delivers are added reliability with its Nema 4-reinforced Elektronikon® enclosure, its electrical canopy that's designed with an adaptive temperature control, its single-point-connection layout that ensures quick and easy installation, its high-performance crash frame for added durability, and its mobile chassis assembly, which allows for convenient maneuverability anywhere in the plant.

With the 24/7 support offered by Atlas Copco Rental, the ZT 90 VSD presents an attractive option for companies seeking emergency air, bridging lead times, dealing with demand fluctuation or working with projects under construction.

The Atlas Copco ZT 90 VSD offers certified, 100% oil-free air.

For more information about Atlas Copco Rental and the ZT 90 VSD, please contact Jowell Olaivar at 346-233-2748 or via email at jowell.olaivar@atlascopco.com.

Atlas Copco Group

Great ideas accelerate innovation. At Atlas Copco, we have been turning industrial ideas into business-critical benefits since 1873. Our passionate people, expertise and service bring sustainable value to industries everywhere. Atlas Copco is based in Stockholm, Sweden, with about 37,000 employees and customers in more than 180 countries. In 2018, revenues were BSEK 95, approximately 10 BUSD.

Atlas Copco Rental North America

Atlas Copco Rental North America is headquartered in La Porte, Texas. Atlas Copco Rental Group maintains an industry-leading fleet, a global network of rental depots, and service centers in more than 50 countries, and is fully equipped to meet any planned or emergency needs. Learn more at www.atlascopco.com/en-us/Rental.

RESOURCES FOR ENERGY ENGINEERS

TECHNOLOGY PICKS

Oil-Free Screw Compressors Available from Hertz Kompressoren

Oil-free compressed air is used in a wide range of applications. It is especially important to industries where compressed air is subject to clean air requirements/regulations. Applications where oil-free compressed air is needed include chemicals, medical & pharmaceutical sector, food and beverage and many more.

hertz Kompressoren Eagle Series offers the highest performance with unrivaled productivity thanks to its innovative design and high technology engineering as well as durable parts. The Eagle Series oil-free screw compressor offers 100% pure and clean, high-quality compressed air that is compliant with ISO 8573-1:2010 Class 0 certification. hertz Kompressoren's product range has been tested and certified by TUV Rheinland, Germany.

The Eagle has an advanced control system which allows for continuous monitoring of the compressors working conditions. This control system has the option to set critical level parameters to protect the work environment and the compressor. Controller is suitable for multi-compressor installation which can reduce the pressure band and achieve the lowest overall energy cost. In addition, the frequency-control option or inverter addition provides added user control lowering energy consumption costs, decreasing total cost of ownership and boosting ROI.

hertz Kompresoren offers long lasting, reliable equipment solutions for its partners. In order to provide excellent quality, service and customer satisfaction, hertz Kompressoren offers a 2-year warranty that ensures peace of mind when it comes to system operation. Eagles series is available in air-cooled and water-cooled, 37kW to 315kW fixed speed and 55kW to 315kW in variable frequency controlled. Due to energy efficiency and durable parts, hertz Eagle Series oil-free compressors offer low total cost of ownership.

hertz Kompressoren Eagle Series oil-free screw compressors are now available in the US from our Charlotte Headquarters.

About hertz Kompressoren USA, Inc.

hertz Kompressoren USA, Inc. is the premium brand of Dalgakiran Group Company. The global sales and service network of Dalgakiran has developed into one of the leading air compressor producers in the world. Founded in Germany, hertz Kompressoren, began providing reliable, innovative products and compressed air solutions combined with exceptional customer experience. Our ISO 9001 certified manufacturing facility assures the highest quality standards. Hertz Kompressoren is providing world class customer satisfaction, ensuring the most

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www.airbestpractices.com

Advertising & Editorial: Rod Smith
rod@airbestpractices.com
Tel: 412-980-9901

Subscriptions & Administration: Patricia Smith
patricia@airbestpractices.com
Tel: 412-980-9902

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TECHNOLOGY PICKS

reliable, energy efficient products with the lowest life-cycle cost in the industry. We believe in keeping customers happy and providing them with competitively priced products. For more information visit Hertz Kompressoren at www.hertz-kompressoren.com/us.

SCB Introduces Guardrain

Guardrain is an IIoT device capable of connecting the condensate drains installed on compressed air systems and making them intelligent. Easy to install and configure, Guardrain moderates the communication within the system and monitors its global efficiency, offering a detailed status of the system in real time. It makes predictive diagnoses and signals the onset of problems.

Guardrain is an IIoT device capable of connecting the condensate drains installed on compressed air systems.

Constantly monitoring the health of the plant, Guardrain allows considerable savings in terms of installation time, energy and money. It acts as the sole power source for all the drains in the plant and the single low-pressure point reduces the risk of fire. SCB offers a whole range of Smart drains.

About SCB

SCB srl is an Italian company that produces electronically controlled condensate drain systems, with a leading position in original equipment applications (OEM) thanks to a verticalization-driven range of products and know-how gained in 35 years of activity. Founded in 1995, SCB has always developed innovative products in step with the times. The efforts of recent years in research and development have been focused on the theme of Industry 4.0 and led to the introduction of Guardrain, the new way of condensate management. For more information on GUARDRAIN or on our wide range of products, please visit www.scb-italy.com or write to info@scb-italy.com.

New from Festo – Electric Drives for Simple Motion

Festo introduces the Simplified Motion Series of electric drives that combines the simplicity of pneumatics with the benefits of electric automation. These new electric drives equipped with Digital I/O and IO-Link® enable a range of operational and productivity benefits and deliver intelligent IIoT communication.

The actuators in this series are built for simple motion between two mechanical end positions. The drives offer optimized motion characteristics, including gentle cushioning, while advancing and retracting into the end positions and pressing and clamping functionality. Units in the initial release include toothed belt axis, spindle and toothed belt axis, mini slide, electric cylinder, and rotary drive.

The drives are plug and play for fast startup. No additional software or specific know-how is required. The parameters for advancing and retracting speed, as well as pressing and clamping force, are set directly on the drive. End position, cushioning path, and manual operation are also set on the drive.

Each drive in this series is controlled via Digital I/O. End position feedback, which is similar to feedback from a standard proximity sensor, provides information about the completion of the motion task. IO-Link enables remote control, parameter copy, backup function, and read functions for process parameters.

"For those machines and lab instrumentation where compressed air for pneumatics is simply not feasible, the Simplified Motion Series provides a cost effective, easy to apply, and well-featured electric solution," said Sandro Quintero, Product Manager – Electric Automation, Festo.

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 about the Simplified Motion Series call 800-993-3786 and to see the full range of Festo products and solutions visit www.festo.us.

The solutions of the Simplified Motion Series from Festo.

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