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August 2014

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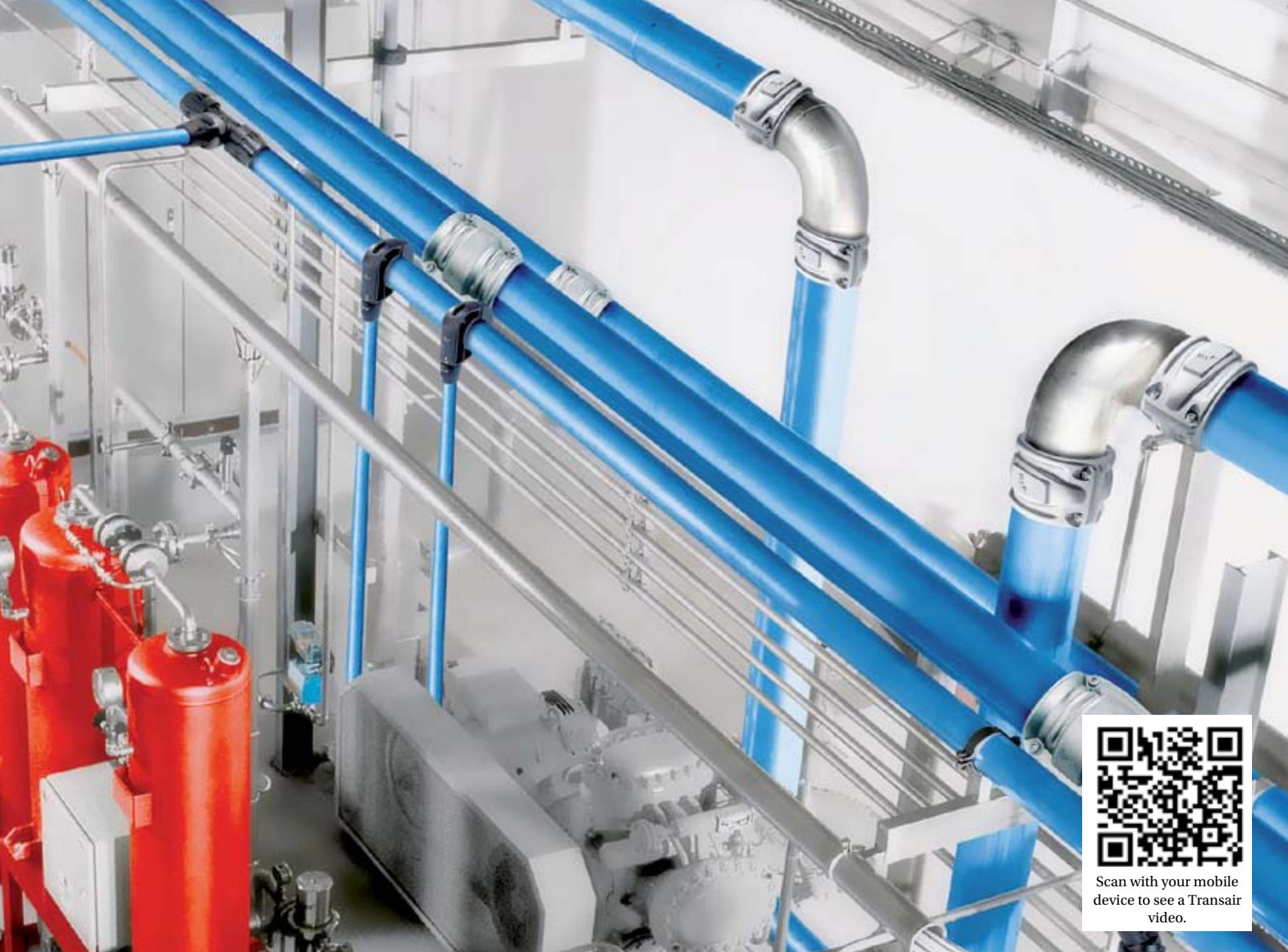
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FROM THE EDITOR

Compressed Air Measurement



It's remarkable how dynamic the compressed air industry is — really! There are always new companies plus new technologies and trends to keep track of. One of the fastest moving segments is the measurement of compressed air system key performance indicators; power, flow, pressure and air quality - and using this knowledge to address the system components so they can perform optimally.

This month we profile a new company to the U.S. market — ELGi Compressors. Based in Charlotte, ELGi has assembled a staff of experienced executives from the U.S. air compressor market. Dr. Jay Varadaraj, the Managing Director of ELGi Equipments, details the investments his company has made in product technology, engineering and manufacturing resources, and international expansion in this interview article.

Whirlpool Corporation's production facility in Ottawa, Ohio manufactures trash compactors, freezers and refrigerators. Four separate air compressor stations have provided the required compressed air for the plant. This case study details how EnerAir's Metcentre SX management system allowed all four compressor stations to be intelligently controlled while reducing the associated energy bill by \$50,000 annually.

For what it's worth, I believe compressed air flow measurement is a technique in its' infancy. We profile a leading flow meter manufacturer, VP Instruments, to learn more about their vision of the future. The company founder and CEO, Pascal van Putten, shares his insights with us with regards to technology, application techniques and the change-process he's observing as end users transition from "no-measurement" to full measurement.

Factories are measuring and managing their water consumption more than ever. Industrial water consumption, over the past ten years in the U.S., has decreased significantly but doesn't quite offset the increases in public water consumption. Nitin Shanbhag, from Hitachi America, reviews these macro trends along with how cooling system selection impacts water consumption in an article titled, "Evaluating Air Compressor Cooling Systems."

Perhaps the most positive trend affecting our industry is that more factories are simply measuring the energy consumption of their air compressors. Ron Marshall, on behalf of the Compressed Air Challenge®, provides us with an article titled, "Six Reasons to Log Your Compressed Air System."

These are exciting times and the compressed air industry is on its' game to support end users. Just today an Energy Manager from a huge corporation wrote me saying, "I'm so energized by our energy projects, sometimes I can't sleep"! Thank you for investing in *Compressed Air Best Practices*®.

ROD SMITH

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

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INDUSTRY NEWS &

Atlas Copco USA Donates \$100K to Charity: Water on World Water Day

In honor of World Water Day, the Atlas Copco USA employee-run Water for All organization has donated \$100,000 to New York City based charity: water, a global non-profit dedicated to bringing clean and safe drinking water to people in developing nations. World Water Day is held annually on March 22 as a means of focusing attention on the importance of freshwater and advocating for the sustainable management of freshwater resources.

"We are proud to support organizations, like charity: water and their partners, that raise awareness and take action around the issues of unsafe drinking water and global water scarcity," said Jim Levitt, president of Atlas Copco North America. "Atlas Copco is committed to global sustainability and the Water for All program is just one way our employees act on that commitment."

"charity: water is honored to receive support from Atlas Copco and its generous employees who participate in the Water for All organization. These funds will help us move forward towards our ambitious goal of ending the water crisis in our lifetime by providing clean, safe water access to the 700 million people in need," said Scott Harrison, CEO and Founder of charity: water. "The diverse range of projects and countries that Atlas Copco has supported over the past four years, shows their deep commitment to solving this global issue."

Atlas Copco's employee-run Water for All organization raises money to support projects and organizations that provide people in need with access to safe, clean water and sanitation. The \$100,000 donation will fund two projects: two new hand-dug wells serving 1,000 people in the West Pokot county of Kenya and five school filtration systems serving 2,000 people in a community in Nepal. One-third of the donation was given directly from employees' salaries and double matched by the Atlas Copco Group.

In just the past four years, the Atlas Copco USA Water for All program has helped more than 10,000 people gain access to clean water and sanitation and has donated nearly \$500,000 to fourteen projects across the world. Since the founding of Water for All in 1984, Atlas Copco and its employees have helped more than 1.5 million people gain access to clean drinking water.

Atlas Copco is a world-leading provider of sustainable productivity solutions. The Group serves customers with innovative compressors, vacuum solutions and air treatment systems, construction and mining equipment, power tools and assembly systems. Atlas Copco develops products and service focused on productivity, energy efficiency, safety and ergonomics. The company was founded in 1873, is based in Stockholm, Sweden, and has a global reach spanning more than 180 countries. In 2013, Atlas Copco had revenues of BSEK 84 (BUSD 12.8) and more than 40 000 employees. Learn more at www.atlascopco.com.

Atlas Copco operates 116 locations and employs more than 4,800 people in the United States. Globally, Atlas Copco had revenues of approximately \$12.8B in 2013. The United States represents the largest single-market for Atlas Copco globally. Learn more at www.atlascopco.us.

Festo Partners with TSI Solutions in Georgia

Festo pneumatic and electric automation solutions will now be distributed in Georgia by TSI Solutions. Festo products are utilized by OEMs and manufacturers for electronic and pneumatic motion actuation, motion control, motion diagnostics, and safety. Festo products are also used in process automation applications.



SUSTAINABILITY REPORTS

TSI Solutions is a factory automation systems house located in Stone Mountain, Georgia, just east of Atlanta. Founded in 1978 as a distributor of air tools, TSI has grown into a full service provider of automation components and systems for manufacturers and machine builders. In addition to the Festo line, other major products distributed by TSI include Banner Engineering, Turck, 80/20 Inc., Kollmorgen, and Piab Vacuum Products. Major industries served by TSI include food & beverage, plastics, packaging, carpet, aerospace, automotive, medical, and pulp & paper. The company's stated goal is, "to increase its customers' competitiveness in a global economy by helping them optimize the performance of their machinery and equipment."

"TSI stands for technology, service, and integrity, which is certainly in line with Festo core values,"

said Bill Oliver, Head of Festo US Distribution. "TSI Solutions has an exemplary reputation for offering the highest quality industrial automation components, systems, and service."

"Festo invests seven percent of its annual revenues into research and development," said Charlie Post, President, TSI Solutions. "Everything the company does, from automation product design to energy savings, safety, and productivity enhancements, reflects a dedication to innovation. We are pleased and excited to be appointed the Festo automation distributor for the State of Georgia."

For more information on Festo, call 800-993-3786 and visit <http://www.festo.us>. TSI Solutions can be reached at 800-342-4874 and <http://www.4tsi.com>.

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.

Michell Instruments Celebrates 40 Years of Innovation

Precision sensor and instrumentation manufacturer, Michell Instruments, is celebrating 40 years of business this year. Established in 1974 in Cambridge, UK, the company started off in a small building with just a few employees but now has three



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INDUSTRY NEWS & SUSTAINABILITY REPORTS



40 YEARS OF INNOVATION

manufacturing locations and several offices in ten countries.

In addition to manufacturing sensors and systems, Michell is a pioneer in the field of humidity calibration. In the 1980s, Michell worked closely with the National Physical Laboratory to develop the UK's first humidity transfer standard. In 1986 Michell's calibration laboratory became the world's first accredited humidity calibration laboratory, with accreditation from the British Certification Service (a forerunner of UKAS — the United Kingdom Accreditation Service).

Another first for Michell was the development of the 'dark spot' technique to measure

hydrocarbon dew point in natural gas. Hydrocarbon dew point is a key parameter in ensuring the quality of natural gas, especially at points of custody transfer. Michell worked closely with Shell Research to create the sensor, which was an adaption of their chilled mirror sensor used to measure water dew point. The resulting instrument, the Condumax, became the most reliable automatic method of measuring hydrocarbon dew point and was only superseded by the Condumax II which was introduced in 2006. Currently the majority of the online hydrocarbon dew-point analyzers installed around the world today are either the Condumax or Condumax II.

In the mid 1990s, Michell launched the world's first two-wire dew-point transmitter, the Easidew Transmitter. This moisture sensor was both a highly accurate and reliable way to measure low dew points (i.e. trace moisture) and also very

simple to use. This combination of accuracy and simplicity enabled moisture measurements to be incorporated into a wide range of processes across many industries, increasing efficiency and helping to reduce costs.

The world-wide growing awareness of the benefits of monitoring moisture for energy efficiency, safety and quality has continued to support Michell's growth. In the 1990s, Michell expanded into Europe, opening offices in Germany and the Netherlands and eventually opening offices in France, China, Japan, Italy, the US, Middle East and Brazil. The manufacturing side of the company grew rapidly, to keep up with demand for its products, Michell opened the doors to its current headquarters located in Ely, Cambridgeshire.

Looking to the future, Michell is committed to introducing new sensing technologies to its impressive portfolio. Some of these technologies include tunable laser diode analyzers to measure moisture in natural gas, a new generation of quartz crystal microbalance sensor as well as new techniques for measuring oxygen and other gases.

Visit www.michell.com

About Michell Instruments

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

The Group has multiple manufacturing locations with their international headquarters located in Ely, UK and a North America sales and service headquarters located in Rowley, MA. It has its own facilities in 10 countries

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New EXAIR Catalog 27

EXAIR's new Catalog 27 is our best catalog yet; a full color technical guide offering solutions to common industrial cooling, drying, conveying, blowoff, cleaning, coating, and static electricity problems. This 168 page catalog includes many new products that can help companies conserve compressed air, reduce dangerous noise levels and eliminate harmful dead end pressures. Featured products include our new one-piece Long Super Air Knives™, High Lift Reversible Drum Vac™, Internal Mix Deflected Flat Fan Atomizing Nozzle and Internal Mix 360° Hollow Circular Atomizing Nozzle, along with

No Drip versions of the same. We have also expanded our selection of Cabinet Cooler® Systems, Super Air Nozzles™, Safety Air Guns, and Static Eliminators. Eighty percent of our product categories are newly recognized as conflict mineral free in support of Section 1502 within the Dodd-Frank Wall Street Reform and Consumer Protection Act and our own commitment to a sustainable future. A detailed technical explanation, performance data, application photos, and dimensional drawings are provided for each product. A price list is also included.

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ELGi Goes GLOBAL

By Rod Smith, Compressed Air Best Practices® Magazine

Compressed Air Best Practices® Magazine
interviewed Dr. Jay Varadaraj, (Managing Director)
of ELGi Equipments Ltd.

► We all like entrepreneurial stories, how did ELGi get started?

ELGi today is one of the world's leading manufacturers of air compressors. Like most companies, however, it started with one ambitious person. My grandfather, Lakshminaickenpalayam Govindaswamy (this where the "L" and "G" in ELGi come from) was a bus driver for the British in 1918. He purchased one bus and proceeded to build a fleet peaking at 300 buses. He believed he was in the transportation business so he entered the airline business ultimately withdrawing however when this industry was nationalized.

A family-run business, his brothers and sons were also involved. Since they were repairing their own fleet of buses in their own shops, they got into the automotive repair and parts manufacturing business. This business was founded in 1960 and was named ELGi. The company manufactured small reciprocating compressors for tire inflation, lifts, and greasing and washing equipment needed in the automotive repair market in India.

ELGi is the #1 supplier in the automotive supply industry in India holding a 45 percent market share. We offer a large range of products ranging from lifts to paint

booths and painting solutions and any type of equipment for automotive service. We are the leaders in India for that, Mercedes, BMW. Nevertheless, ELGi today is predominantly an air compressor manufacturer where we continue to accelerate our growth.

How has ELGi evolved from a domestic to an international company?

In the 1990's, as the Indian market was opened up, we knew international air compressor competitors would enter the market. When we honestly looked at our organization, quality, technology — we saw we had some gaps compared to the

international competition. We were used to being in a protected market.

We decided to invest in modernize our manufacturing processes and product technologies. We also realized we needed to invest in gaining market share internationally. We were a big fish in a small pond and we had to look at opportunities worldwide.

So we set about building a new company. What should we not do? We set a global aspiration and said we wouldn't license our technology to others. We had grown both our piston and rotary screw air compressor businesses, using licenses from German and U.S. companies, from the 60's to the 80's. We were licensing technology that was becoming old-fashioned. We also realized that a company builds know-how but not "know-why" when licensing.

Is this why ELGi has become so strong in compressor airend manufacturing?

Yes, this fundamental desire for "know-why" has driven our strategy and investments over the past 25 years. Today, we build ten different airend sizes for lubricated rotary screw air compressors. The range is from a 35 mm to a 310 mm rotor. Next year we will produce a larger size. We also manufacture our own oil-free airends.

It's been a wonderful journey technically. We assembled a group of engineers with strong scientific backgrounds and not just engineering capabilities. We went and partnered with universities and organizations all over the world, to develop our knowledge. Today, we possess the capabilities to design and build airends for any specific flow and pressure.

If a customer comes to us wanting a specific pressure, flow, power, we can design an air-



ELGi's current lubricated compressor product offering consists of belt drive 3-40 hp, and direct drive from 15-200 hp.



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ELGI has largest range of lubricated airends in the industry, from 35 mm to 310 mm male rotor sizes.

end in less than an hour, Not that we would do it, but we have the capability to do airend profiles. We can simulate thermodynamics of compressors, we know potential failure modes, the engineering we have built is at a very high level.

Please describe your airend manufacturing process and facilities.

Today we build close to 14,000 airends per year. Our quality allows us to offer a market-leading airend warranty (more on that later). It's been quite a journey! Getting to this level, however, hasn't been easy.

Airend manufacturing is about machining housings and rotors. We are probably the only company with it's own foundry where we make our own special castings. We believe our custom-designed castings set the new international benchmark for quality in terms of thermal distortion and deflection. We do all machining of housings in-house using some of the best machining center technology in the world from Makino and Mazak.

On rotors, you have to mill and grind the rotors. We have built and designed our own milling machines specifically for rotors. You can't take a milling machine, designed for something else, and achieve the same quality. We know because we tried. We decided to create a 7-man team of engineers dedicated to building machining centers and tools just for rotors. We now have our own design machining center and we know there is a quality difference.

We have the technology to produce high performance air compressors that don't have to be high priced. We are not hiding behind low labor costs in India. We use our technology to bring costs down. All products brought to America are high performance and comply with all U.S. standards. They are also very competitive.

Another example is the motor. We have a team of electrical and design engineers

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focusing on motors. The motors almost all other air compressor manufacturers use are not designed for air compressors. They are standard industrial motors simply used by air compressors and they carry unnecessary costs because they're designed for general use. Customers want a reliable motor that can be fixed locally if it fails. We have significant plans to design and build our own motors to reduce manufacturing costs.

So would you consider yourself to be a global company?

Absolutely. We operate in a true global market place. While our international business has expanded steadily for many years, it's grown rapidly this decade. Our international growth has exceeded our expectations. Over the past twenty years, our global footprint has expanded to 63 countries, 20 regional offices and more than 280 distributors. Currently, more than 2 million ELGi air compressors are installed all over the world including at world-class companies such as Coca-Cola, Cummins, GM and Halliburton. We have worldwide close to 1500 employees, our total manufacturing campus covers 140 acres of land, with over 1 million square feet of manufacturing buildings. We have made the transition.

Now, fifty percent of our business is coming from outside of India, and that trend will continue to grow. There are multiple reasons for this.

We have acquired two European compressor companies: Belair in France and Rotair in Italy. This has provided us with greater access to these and other markets. But acquisition is only part of the story.

We've been the market leader in India for many years. Since the millennium, many global manufacturing and tech companies are building plants and facilities in India. This not only helps grow our domestic market, but has

given us exposure to these customers. That's motivated us to invest heavily in our company resources, such as R&D, manufacturing, and product support.

We're implementing aggressive expansion plans in China, southeast Asia, Brazil, Europe, and of course, the United States.

We now have centrifugal machines and are a full product range company. One of very few who can design and manufacturing a full range of air compressors.

Why is ELGi entering the U.S. market?

We see a great opportunity, and quite frankly, a need for what we offer. U.S. companies see the value of emerging market content, yet they also demand a high level of product quality and local support. At ELGi, we are poised to

provide all of these elements while removing any risk our customers may have with their compressed air systems. And with the launch of our new electric Global Series rotary screw compressors, the timing is ideal.

What type of presence does ELGi have in the USA?

We understand that first and foremost, customers want dependable support for their compressors. They hate to wait on parts. And they only want to deal with experienced and knowledgeable technicians. That's why we've worked so diligently to build a solid infrastructure prior to selling our products.

We currently have nearly 30 distributors established across the U.S., with the highest concentration in heavy manufacturing areas. We ensure that all our distributors stock a full



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inventory of parts and supplies and are fully trained on our products.

We have established a dedicated support and distribution center in Charlotte, North Carolina, where we ship products and parts. This location also includes experienced service technicians dedicated to handling any service issues.

Of course, we know it's all about the people you have working for you. We've assembled a "who's who" of the compressor industry to join our team, one of the most experienced and well-respected teams in the industry. They include: Hannu Heinonen, Vice President, Americas; Gary Valvo, President; Keith Sportsman, Director of Sales; Bob Phillips, National Service Manager; our Regional Sales Managers are Frank Brookshire, Dean Chew, Curt Greifer, and Grayson Biggins, Product Manager.

What market segments does ELGi serve?

Whether you're running an assembly line, welding shop, food processing plant or even a railroad, ELGi has the right product for your business.

We offer one of the widest product lines in the industry: portable, rotary screw, oil-free, diesel, reciprocating, centrifugal, marine, defense industry and railroad compressors. Plus, we make the widest range of oil-lubricated air ends-worldwide.

We cover your compressed air needs from a small to a very high air flow and from low to high pressure. We have products from 10 to 14,000 cfm (0.25 - 400 m³/min) at pressures from 30 to 450 psig (2 to 30 bar).

At this time, for our U.S. customers, we offer rotary screw, diesel and reciprocating models.

However, we will be bringing our full product line to the U.S. in the future.

You mentioned the importance of support, how else do you convey it?

We're all about removing our customer's risk. That's really the major pain point any customer has. They want assurances that their air compressor will stay up, so their business can stay up and running to fulfill their customer's needs.

That's why we have created our UPTiME Assurance program, which features a 48-hour Air Up promise.

It's simple, really. If a customer's machine ever experiences any unwanted downtime, we'll have them running in 48 hours. And we'll stop at nothing to do this. We accomplish this in many ways: with excellent parts availability, local support and we even provide loaner machines if needed.

How else does ELGi live up to this UPTiME commitment?

Our entire business model is based on UPTiME. Starting with our R&D, to manufacturing, distribution, support and even marketing. We've built this pledge on what we call our three pillars of UPTiME. These are the UPTiME Assurance Plan, which we just discussed, UPTiME Design and UPTiME Components.

UPTiME Design is how our products are engineered. We want them to run cooler and cleaner, so they run longer. For example, we have developed a Thermo-Zone layout for our rotary screw compressors, so that hot areas are separated from cool areas. This way, the more sensitive components are always protected.

And since no detail is too small, we've even placed service interval stickers on our machines to assist technicians. We know that there will always be planned downtime. But we want to ensure this is minimized. We've received lots of praise from customers about

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this. It seems small, but it's just another example of our approach to ensuring UPTiME.

The second pillar is UPTiME Components. On an ELGi compressor, every part is a premium part. That starts with our exclusive Axis air ends. They're the largest and most robust in the industry.

And, as said, the UPTiME Assurance Plan completes the pillars and backs up the product.

Speaking of air ends, don't you offer a unique warranty?

We guarantee our air ends for life. It's the industry's first ever, to our knowledge. And it shows how much confidence we have in our



As part of their "UPTiME Design" philosophy, Elgi uses the highest quality, name brand components in their packages.

products. Once again, it's all about removing risk for our customers.

What's the first thing people tell you about your products?

We've recently introduced a new Global Series, and during this launch phase, we've unveiled the product to customers in the U.S. and all over the world. The one thing we keep hearing is how impressed people are with the look and quality of our machines.

On the outside, we they say we have the feel of a high-end European design. But it's on the inside where it really counts. This includes our air ends and major component details such as rigid, stainless steel piping and leak-free hoses.

What surprises people about ELGi?

Without a doubt, it's our vast array of proprietary technologies. Unlike other Asian-based companies, we are not assemblers. We are developers of exclusive embedded technologies, and utilize our own manufacturing plants and processes to build the entire compressor.

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For more information please contact Grayson Biggins, Product Manager, ELGi USA, tel:704-943-7966 ext. 275, email: gray.biggins@ELGi.com, www.ELGi.com

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THE COMPRESSED AIR SYSTEM ASSESSMENT

EnergAir Manages Multiple Air Compressors at Whirlpool

By Nicolas De Deken, EnergAir USA

► EnergAir's unrivalled expertise in compressed air management is helping to save in excess of \$50,000 per year at Whirlpool Corporation's Ottawa, Ohio production facility. Whirlpool is the largest global manufacturer of home appliances and employs almost 70,000 people in more than 60 production and technology centres around the world. The Whirlpool plant in Ottawa manufactures a market-leading range of trash compactors, chest freezers, upright freezers and refrigerators.

The Compressed Air Audit at Whirlpool

When the company suspected that efficiencies were not being optimized at Ottawa, EnergAir was called in to identify where energy was being lost within the compressed air system and to recommend how these losses could be eliminated. Compressed air systems are a major source of wasted electricity in manufacturing facilities and this is often overlooked for very long periods of time. EnergAir and their partners are vastly experienced in compressed air technology

and have developed a unique ability to quickly highlight inefficiencies before implementing highly cost-effective solutions.

EnergAir worked closely with plant personnel to audit the Ottawa plant's compressed air system in the Summer of 2012. EnergAir's Nicolas De Deken explained, "the audit revealed that multiple compressors were loading and unloading simultaneously and many stayed on running unloaded during periods of low air demand. We also found that the difficulties in synchronizing compressors



Whirlpool Corporation's Ottawa, Ohio production facility.

were resulting in pressure varying from 110 – 123 PSI which can again be highly wasteful.”

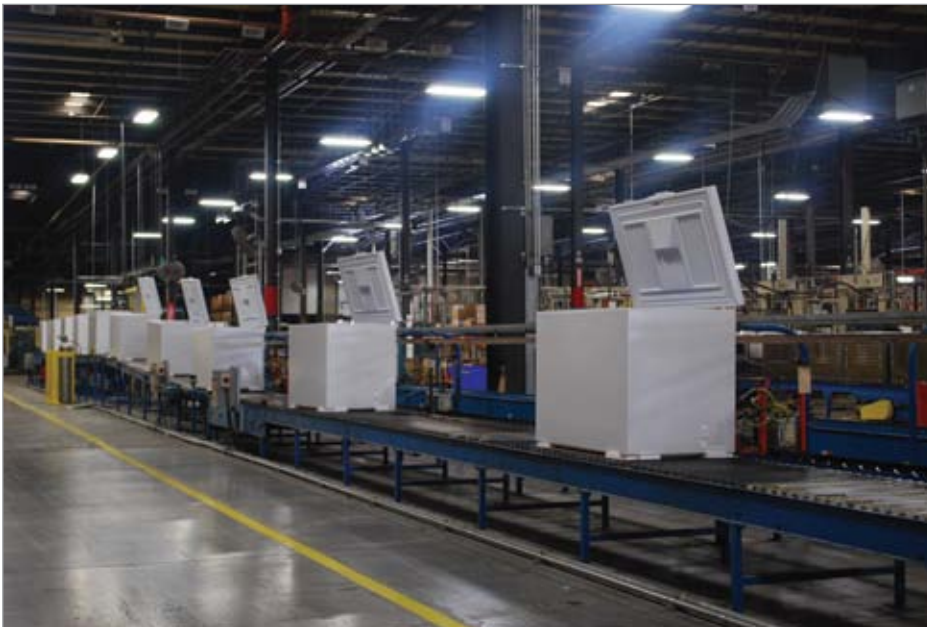
The consultants from EnergAir began by talking to Whirlpool’s management team and engineers in order to establish a clear understanding of the company’s objectives. The following compressed air installations were then comprehensively reviewed:

Compressor 1 - a Quincy PowerSync QSI-1250 Model QSI1250ANA41EC – 250 HP.

Compressor 2 - a Gardner Denver Model EBQQOC – 150 HP.

Compressor 3 - a Gardner Denver Model EAQ99K – 150 HP.

Compressor 4 - a Gardner Denver Model EB 100 MA – 100 HP.



The Whirlpool plant in Ottawa manufactures a market-leading range of trash compactors, chest freezers, upright freezers and refrigerators.

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THE COMPRESSED AIR SYSTEM ASSESSMENT | **EnergAir** Manages Multiple Air Compressors at Whirlpool



Measurements of compressed air pressure, flow and energy consumption were taken at the four separate air compressor installations.



Before the installation of the Metacentre SX, multiple air compressors were running between shifts, during weekends and at other times when air demand was relatively low.



“The powder paint, plastic vacuum forming and nitrogen generation sections are the main users of compressed air at our Ottawa plant. We began noticing savings within a week of the improvements being implemented.”

— Glenn Kaufman, Senior Engineer, Whirlpool Corporation

The Key Audit Findings and Recommendations

All of the air system's core components were carefully examined including compressor rooms, compressors and associated pipework. Energy consumption was recorded at each point throughout the system and the findings were presented to Whirlpool along with EnergAir's suggested improvements.

The key audit findings included:

- The compressors were being inefficiently controlled with air production not being aligned with demand throughout the plant.
- Because pressure was not being balanced and consistently maintained, it was varying from 110 – 123 PSI.

Compressed Air System Improvements at Whirlpool

- Overall compressed air system efficiency has improved by 3.68 kW/100 cfm for a total annual savings of 589,121 kWh.
- Annual energy savings exceeded \$50,000 with a 6 month simple ROI.
- CO₂ emissions have been cut by more than 919,000 lbs., helping to reduce the factory's carbon footprint.

- The Power\$ync wasn't trimming with its lift valves to maintain a target pressure.
- Multiple compressors were running between shifts, at weekends and at other times when air demand was relatively low.

The New EnergAir Metacentre SX Management System

EnergAir configured a solution around the proven Metacentre SX management system. This was installed to allow all four compressor installations to be intelligently controlled so that output could be matched with demand to reduce unloading. Metacentre TX, EnergAir's dedicated host server, was

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THE COMPRESSED AIR SYSTEM ASSESSMENT | **EnergAir Manages Multiple Air Compressors at Whirlpool**

also specified and provides remote access to Metacentre visualization screens. This allows the performance of the compressed air system to be monitored and reviewed by employees working across the plant.

As such, there is now real time visibility of key performance indicators such as line pressure, flow and compressor status together with unrivalled controllability over the distribution of compressed air. Corrective actions can

therefore be quickly taken to minimize operational costs at any given time.

In addition, Metacentre SX is now operating the lift valves on the Quincy PowerSync QSI-1250 compressor on a PID loop. This is helping to consistently maintain target pressure at around 112.5 PSI.

Compressed air output is now also strategically balanced with demand. The Gardner Denver 150 HP and/or 100 HP compressors are running fully loaded in conjunction with the Quincy PowerSync compressor and no unloading takes place.

Glenn Kaufman, Senior Engineer at Whirlpool concluded, “we are delighted with our decision to employ the skills of EnergAir and with the exceptional results that have been achieved. The powder paint, plastic vacuum forming and nitrogen generation sections are the main users of compressed air at our Ottawa plant and we began noticing savings within a week of the improvements being implemented. During quieter periods, we now only operate one compressor rather than the two or three that were previously used. The savings in energy and carbon dioxide also support Whirlpool’s long-term objective to operate in the most efficient and environmentally responsible manner.” **BP**

For more information contact Nicolas De Deken, Chief Operating Officer, EnergAir USA at email: Nicolas.de.deken@energair.com or tel: 855-289-9317.

Visit www.energair.com or to find a certified Metacentre partner visit www.metacentre.eu

To read similar articles on **Air Compressor Control Technology** visit www.airbestpractices.com/technology/compressor-controls



Metacentre TX, EnergAir’s dedicated host server provides remote access to Metacentre visualization screens allowing the performance of the compressed air system to be monitored and reviewed by employees at their desks.

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VISUALIZING COMPRESSED AIR FLOW AT VP INSTRUMENTS

By Rod Smith, Compressed Air Best Practices® Magazine

Compressed Air Best Practices® Magazine interviewed Pascal van Putten (CEO) of VP Instruments.

► Good morning. How did VP Instruments get started as a company?

Good morning. My father, Anton van Putten invented the world's first solid state thermal mass flow sensor in 1974. He developed the unique Thermabridge™ sensors that are integrated circuits, just like computer chips. They combine a heater with a Wheatstone bridge. The heater keeps the sensor at a constant temperature and the Wheatstone bridge is used for temperature control and direction measurement.

Originally these meters were used for natural gas. My brothers helped my father with further developments. I helped him with some engineering work when I was a student. So, I grew up working with sensor technology for industrial applications.

We founded VP Instruments, in 1999, with the mission being to apply our experience with flow sensor technology to compressed air and gas flow applications in laboratories with a "one size fits all applications" concept. We did some trade shows and sold one unit during the first year — a tough start. So we hired a consultant who helped

us re-package the technology completely. This led us to launch the VPFlowMate, in 2002, in a small and easy to use package. The company has taken off since then.

The first consistent clients were machine builders, here in Europe, wanting to test the flow consumption of the pneumatic circuits of the machines they were building. They would install the VPFlowMate in their test laboratories.

How is demand for compressed air flow measurement progressing?

Factory demand for knowledge about their compressed air system has grown tremendously and we are still just at the beginning. As production facilities look to manage energy costs, compressed air systems are now high on the priority list. We see significant demand for compressor room flow measurement and a growing demand for downstream flow measurement at production lines.

Has this impacted your product development?

Of course. As mentioned, we are primarily technology developers. Our main product line today is the 3-in-1 VPFlowScope able to measure mass flow, temperature and pressure simultaneously. It incorporates a display



“As production facilities look to manage energy costs, compressed air systems are now high on the priority list.”

— Pascal van Putten, CEO, VP Instruments

and data logging module making it the ultimate tool for a compressed air auditor and for permanent installation.

This sensor is bi-directional allowing it to be installed in a ring network. Compressed air flow is a tricky thing to measure. We have case studies and training sessions where we teach auditors and users about the negative, partial and full flows passing through piping systems. Some flow meters get “confused” by this reality and users are puzzled by the data they receive. This is because most flow meters aren’t bi-directional.

This goes back to our patented Thermabridge™ sensor technology present in all of our products. We are able to measure bi-directionally, understand what is happening, and provide read-outs that make sense and reflect reality to the end user.



VPFlowScope probe with display and integrated data logger



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VISUALIZING COMPRESSED AIR FLOW AT VP INSTRUMENTS



Measuring compressed air flow heading to different production areas

How important is application knowledge with flow meters?

Understanding the capabilities of the flow meter and selecting the correct installation location is very important. Below is a list of twelve “tricks and tips” we recommend users keep in mind.

1. Install in sufficient straight pipe lengths for optimal results
2. Thermal mass: make sure that the air is dry, without droplets
3. Differential pressure and vortex meters: be aware of limited range, leakage cannot be detected in most cases
4. Mount sensors in a 2 o' clock position, so incidental water and dust can drip off/ all off
5. Always check temperature and pressure, avoid large temperature fluctuations when possible
6. Installation in ring networks? Use a Bi-directional flow meter (VPFlowScope)
7. Installation downstream of receiver (demand side) with multiple receiver/compressors? Be aware of back-flow situations
8. In vertical lines: it might rain condensate when the air is wet. Avoid these installations when possible
9. Temperature drops below dew point: rain and even snow/ ice may be present in the air flow
10. Short meter runs: expect deviations up to 100% of the measured value
11. Desiccant dryers may use (too much) air. And it is not always 10% of the actual flow. It's 10% of the max capacity. Or more. Flow meters downstream of these dryers can indicate a lower value than the compressor output
12. Compressors can leak internally. A low flow reading is an indication of failing non-return valves or leaky condensate drains

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VISUALIZING COMPRESSED AIR FLOW AT VP INSTRUMENTS



VPVision allows users to visualize flow, pressure, power, temperature and dew point data from the compressed air system on computers or tablet devices

How do factories evolve from no measurement to full measurement?

Normally we observe a two or three-step process. Factories will begin with installing a VPFlowScope at the header pipe after the dryer and receiver tank. This provides them with a total flow number that they can compare with compressor kW consumption.

The second step involves measuring the compressed air flow heading out to different production departments. This allows factories to start charging the painting area (for example) for their actual compressed

air use — rather than allocating a cost based upon square footage or some other rule of thumb.

The third step measures point-of-use compressed air flow use. This is very valuable as it allows factories to identify and correct air leaks immediately. We just finished a project at a chewing gum factory where they installed 40 VPFlowScope In-line meters. We all know the terrible energy costs created by compressed air leaks. Establishing and monitoring a “best practice” flow, for each machine, assures a factory that the leaks, which spring up inside the machines where no-one can hear or see them, will be detected.

This ties into visualizing the system on your computer right?

Absolutely. Last year we launched VPVision to make permanent monitoring of multiple sensors easy and intuitive. When a user installs multiple sensors, in a compressed air system, the challenge is to make permanent data logging and monitoring available on the desktop computer or the portable tablet. VPVision is installed on a web technology-based mini server so data is safely kept within the factory's premises. Data can be accessed within the factories network using a standard browser. The user can connect power meters, flow meters, dew point sensors and virtually any 4...20 mA based sensor to VPVision.

Is the compressed air industry readily adopting these new technologies?

The response has been tremendous from air compressor OEM's, air compressor sales and service companies, and independent auditors. We have established a sales and application engineering office, in Ohio, to support the demand in the U.S. A potential glimpse of the future is provided by a Scandinavian company specializing in compressed air leak management. They use our flow meters in their daily leak audits and also as part of the permanently installed leak maintenance solution for their clients. Coupled with VPVision, they have created a successful business, nationwide, monitoring and managing compressed air leaks for their industrial clients.

Thank you for your insights.

For more information please contact Pascal van Putten, Chief Executive Officer, VP Instruments, email: pascal@vpinstruments.com or visit www.vpinstruments.com

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Evaluating Air Compressor Cooling Systems

By Nitin G. Shanbhag, Senior Manager,
Air Technology Group, Hitachi America

Population growth in the U.S. has fueled a 33% (since 1980) increase in demand for Public-Supply water.

► Introduction

As the population continues to grow in the United States, industrial water use will need to continue to fall to help offset the increases in public-supply water use. Water-cooled compressed air systems provide an opportunity for sustainability managers to reduce associated cooling water consumption and costs. If switching to air-cooled air compressors is not possible, understanding the costs and the alternative types of liquid cooling systems is important.

Offsetting the Increase in Public-Supply Water Use in the U.S.

Total water use in the United States in 2005 was estimated at 410 billion gallons per day by a 2009 study conducted by

the U.S. Geological Survey.¹ This study, “Estimated Use of Water in the United States”, has been conducted every five years since 1950. Data for 2010 water use will first become available in 2014.

The report indicates that national water use remained roughly the same as in 2000 and that water use has declined 5 percent from the peak in 1980. This leveling off of demand has occurred despite the population growth

TABLE 1: TOTAL WATER USE IN THE U.S.

TOTAL WATER USE IN THE U.S.	BILLION GALLONS PER DAY IN 2005	% OF TOTAL	% CHANGE 1980-2005
Thermoelectric Power	201	49%	-4%
Irrigation	128	31%	-15%
Public Supply	44	11%	+33%
Industrial	31	8%	-31%
Rural Domestic/Livestock	6	1%	-7%
Total	410	—	-5%
Population	230 million in 1980	301 million in 2005	+31%

Source: 2009 Circular 1344, U.S. Geological Survey, “Estimated Use of Water in the United States in 2005”. Note: Data for 2010 water use will first become available in 2014.

of 31 percent from 1980 to 2005 (230 to 301 million people).² This population growth has led to a 33 percent increase in public supply water use over the same period. Fortunately, water use for thermoelectric power generation, irrigation, self-supplied industrial uses, and rural domestic/livestock have stabilized or decreased since 1980.

Power Generation and Irrigation Water Use Stabilizes

Thermoelectric power has been the category with the largest water withdrawals since 1965, and in 2005 made up 49 percent of total withdrawals.³ Thermoelectric-power water withdrawals peaked in 1980 at 210 billion gallons of water per day and were measured in 2005 at 201 billion gallons per day. Partially due to sections of the Clean Water Act, that were amended in 1972, power plants have

increasingly begun to use wet recirculating cooling systems (cooling towers or ponds) and/or dry recirculating cooling (air-cooled) systems instead of using once-through cooling systems. This has played a leading role in reducing demand for water in power plants.

Irrigation is the second largest category for water use and is also declining. Estimated water use in 2005 was 128 billion gallons of water per day — down 15 percent from the peak in 1980 and representing 31 percent of total use.

- The average application rate for irrigation water has declined steadily from 3.55 acre-feet per acre in 1950 to 2.35 acre-feet per acre in 2005.
- This decline is attributed to greater use of more efficient sprinkler systems rather than flood systems.

Public Supply Water Use Increases

Public supply refers to domestic, commercial, and industrial users of public water supply systems. Public supply water use was 44.2 billion gallons of water per day in 2005 — up 33 percent from 1980. This is a reflection of the population increase over the same period of 31 percent.

- Domestic use made up 58 percent of the total while commercial/industrial made up 42 percent.
- The commercial/industrial number is a catch-all including industrial facilities, wastewater treatment plants, firefighting, pools, parks, system losses, and all buildings with more than 15 connections.⁵

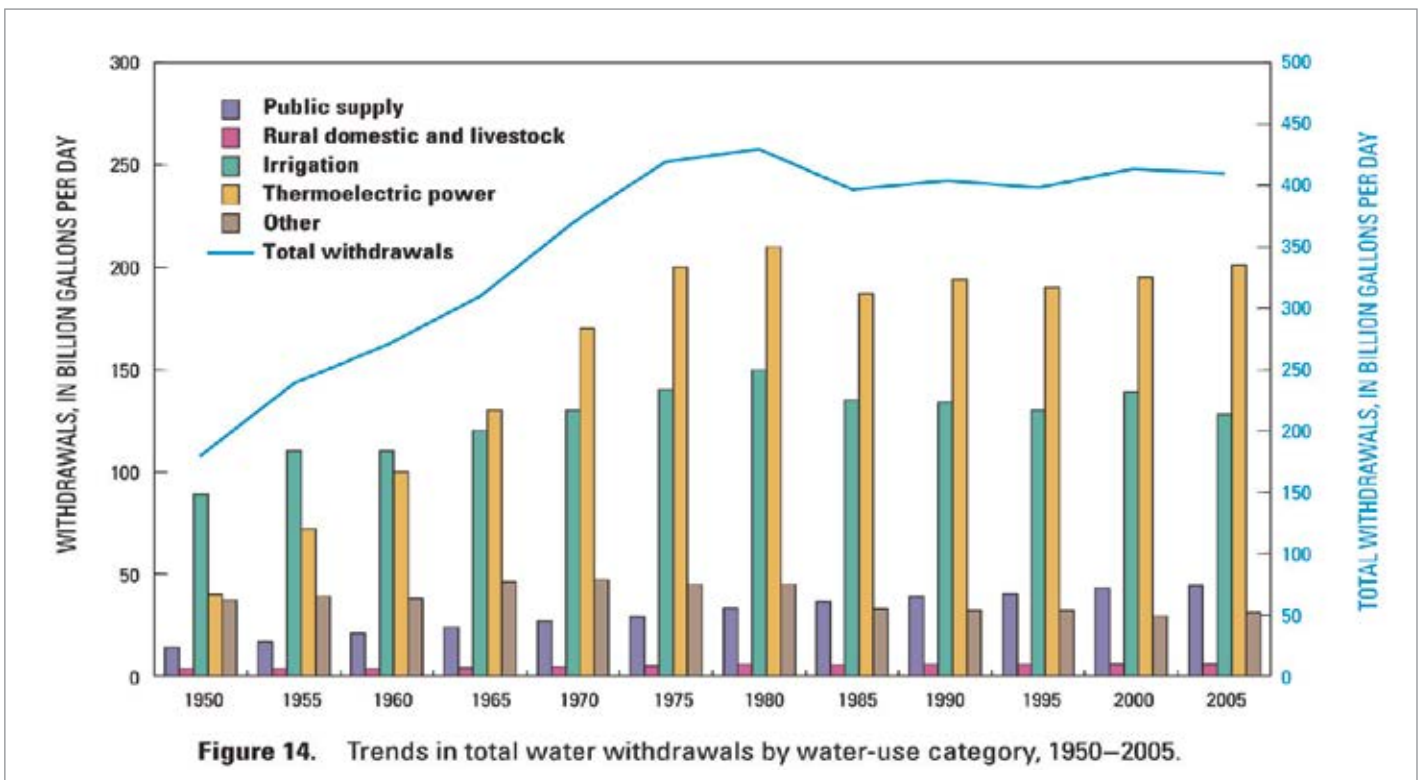


Table 2: Trends in Total Water Withdrawals by Water-Use Category (U.S. Geological Survey)

Source: 2009 Circular 1344, U.S. Geological Survey, "Estimated Use of Water in the United States in 2005". Note: Data for 2010 water use will first become available in 2014.

EVALUATING AIR COMPRESSOR COOLING SYSTEMS

Self-Supplied Industrial Water Use Decreases

Industrial water use includes water used for such purposes as fabricating, processing, washing, diluting, cooling, or transporting a product; incorporating water into a product, or for sanitation needs within the manufacturing facility. Some industries that use large amounts of water produce such commodities as food, paper, chemicals, refined petroleum, or primary metals. Water for industrial use may be delivered from a public supplier or be self-supplied. Stricter water-quality standards for water discharges, mandated by the Clean Water Act, may have also encouraged water conservation. The data taken from this U.S.

Geological Survey looks at self-supplied industrial water.⁶

- Self-supplied industrial water use was 31 billion gallons of water per day, a decrease of 31 percent from 2005 to 1980.⁷
- Significant growth in water use has been seen in the “Aquaculture” industry — the farming of fish.
- The use of water in the mining industry remained relatively flat
- This reflects a decrease in manufacturing employment

of almost 19 percent from 1990-2005.

- Employment in several major water-using industries showed even larger declines:
 - Primary metal manufacturing declined 31 percent
 - Paper manufacturing and petroleum industries declined 26 percent
 - Employment in the chemical manufacturing industry declined 12 percent.

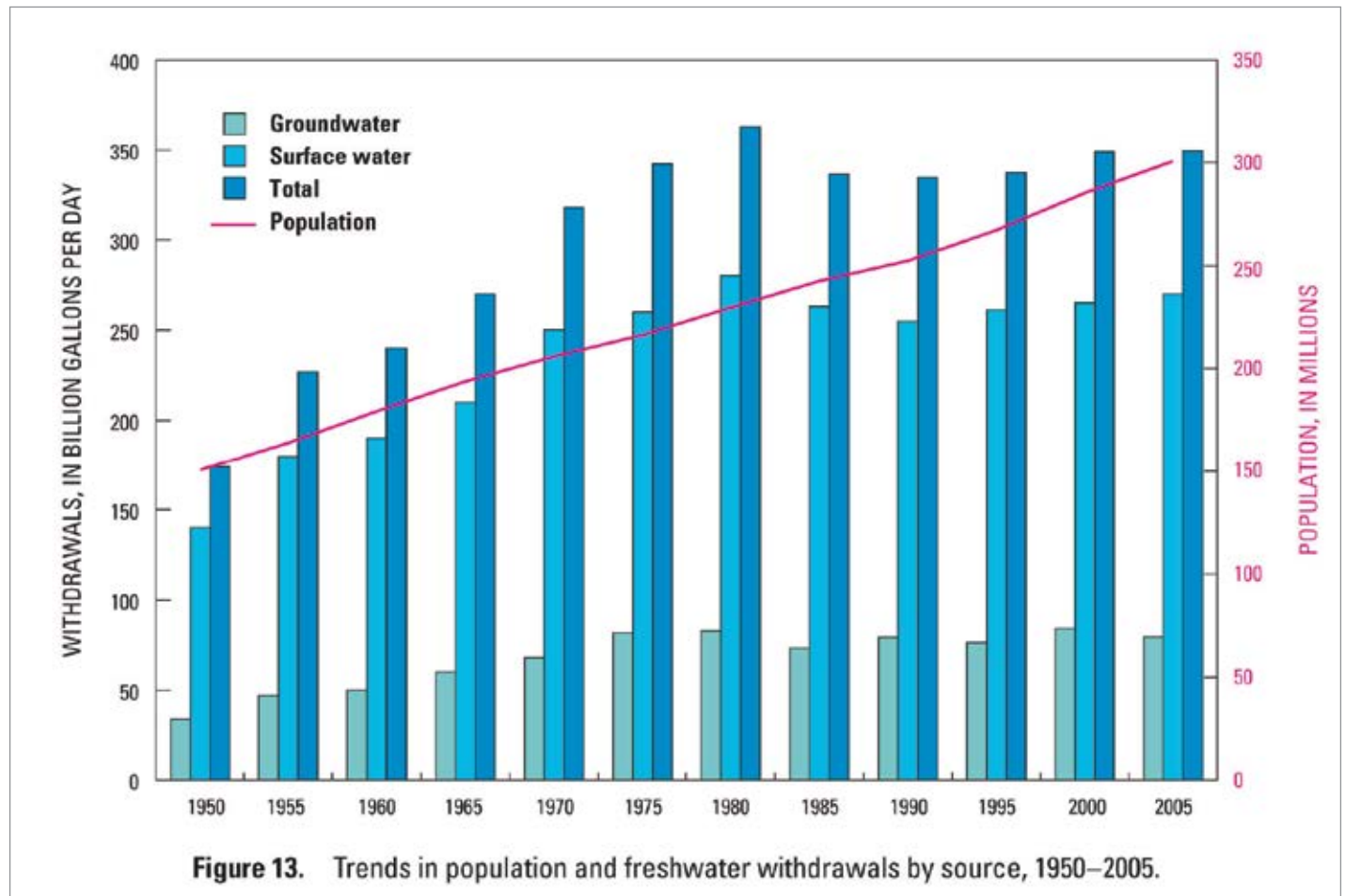


Table 3: Trends in Population and Freshwater Use by Source (U.S. Geological Survey)

Source: 2009 Circular 1344, U.S. Geological Survey, "Estimated Use of Water in the United States in 2005". Note: Data for 2010 water use will first become available in 2014.

Reviewing Six Different Types of Cooling Systems for Air Compressors

Most air compressors are designed to receive cooling water, at the required flow, with a maximum inlet temperature of 100 °F and expect maximum discharge water temperatures of 120 °F to 130 °F. These values should be kept in mind when evaluating any compressor cooling system.

Evaluation of the cooling system for the compressor should include the after-cooler performance as it relates to the inlet temperatures it will provide to the compressed air dryer. Compressed air dryers are almost all designed to receive inlet air to be dried at 100 psig and 100 °F. With temperatures to the dryer above 100 °F (the rated inlet temperature), the moisture load per scfm to the dryer will increase significantly reducing the flow rating drying capability. For proper application, be aware of the inlet air temperature to the dryer and the design approach temperature to the incoming cooling media temperature — air or water.

With the exception of large water-cooled reciprocating compressors, most rotaries and centrifugal air compressors have relatively high pressure losses through them when compared to many others commonly fluid-cooled industrial pieces of equipment. Whenever possible, each compressor (or group of compressors) should be on their own system to avoid other pressure losses affecting the flow to the air compressors.

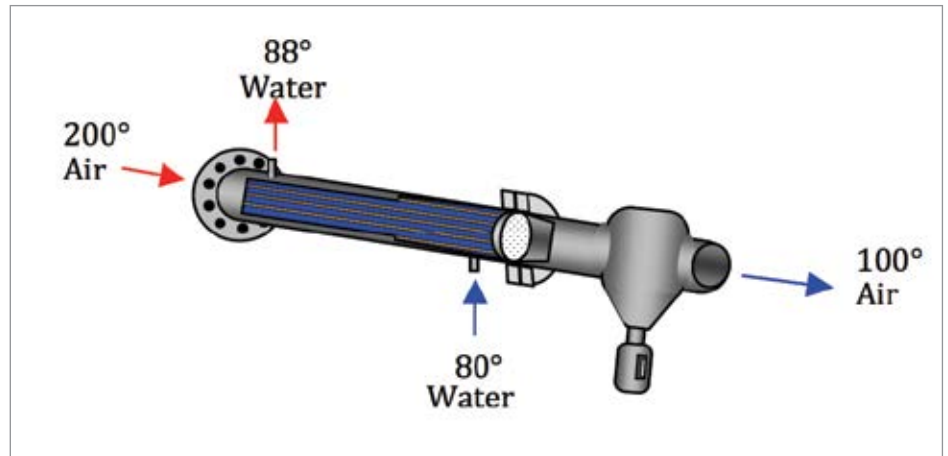


Figure: A water-to-air trim cooler

An effective trim cooler should be well controlled to effectively modulate the flow and manage the power use. Often these trim coolers are sized to be able to handle 100% of the load and keep the equipment running in the case of an emergency.

The energy use of the circulation pumps is a function of the flow volume and the head. Poor fluid piping, sizing and configuration can add pressure loss and head. Installing the cooler farther away from the compressors or on the building roof will also usually increase the cooling fluid “head” and require larger pumps.

Cooling System #1: Recirculation Ponds

Recirculation cooling water ponds are an option for a locally controlled cooling water system supply. As long as the pond is large enough to handle the heat load under the worst condition and maintain an acceptable

temperature, it can be very effective, particularly in large installations. They do have some inherent limitations:

- Significant water loss due to ambient evaporation
- Continued buildup of silt in the pond may significantly reduce heat absorption capability and not remain usable
- Water treatment is still necessary
- Makeup water is usually with some kind of expense — i.e. well pump, etc.
- A pumping station is still required to circulate the cooling water

“The energy use of the circulation pumps is a function of the flow volume and the head. Poor fluid piping, sizing and configuration can add pressure loss and head.”

— Nitin G. Shanbhag, Senior Manager, Air Technology Group, Hitachi America



EVALUATING AIR COMPRESSOR COOLING SYSTEMS

TABLE 3: DIRECT COOLING WATER/FLUID COMPARISON OF A 600 HP, 3-STAGE CENTRIFUGAL COMPRESSOR, 2,750 SCFM AT 100 PSIG AT 290 BHP

COMPRESSOR COOLING		1,000 BTU/HR			GPM
AFTER-COOLER	1,000 BTU/HR	1,547			—
	GPM AT 85 °F	—			124
OIL-COOLER	1,000 BTU/HR	145			—
	GPM AT 85 °F	—			29
TOTAL	1,000 BTU/HR/GPM	1,692			153
		ONCE – THROUGH MUNICIPAL WATER	OPEN EVAPORATIVE WATER	CLOSED LOOP EVAPORATIVE TOWER	DRY COOLER WITH TRIM
Water cooled for compressor cooling – gpm/\$yr.		153 \$236,844	Recirculated	Recirculated	N/A
Total gallon/year at \$3.00/1,000 gallons		78,948,000	N/A	N/A	N/A
Spray circulation pump motor at \$.06 kW/8,600 hrs/yr.		N/A	kW/100% \$516	kW/30% \$155	
Main cooling system fan driver motor kW/yr. at \$.06/8,600 hrs/yr.		N/A	75 hp 60 kW \$30,960/yr.	11 hp 10 kW \$5,160/yr.	(12) 1.5 hp 18 hp at 50% use 9 kW \$4,644/yr.
Evaporative make up water – gpm \$/year gallons/year		N/A	3.4 gpm \$5,264/yr. 1,754,400	1.2 gpm \$1,858/yr. 619,200	N/A
Flushing blow out water – gpm (\$3.00/1,000 gallons) \$/year gallons/year		N/A	45.9 \$71,052/yr. 23,684,400	1.7 \$2,632/yr. 877,200	N/A
Total Gallons of Water for Water Treatment		78,948,000	25,438,400	1,496,400	N/A
Water treatment costs at 42 grains hardness, 10 alkalinity, with biocide treatment at \$1.20 per 1,000 gallons		\$94,737	\$30,526	\$1,795	N/A
Trim cooler costs to operate during extreme hot weather; chiller cooler kW/% time at \$.06 kWh/8,600 hrs/yr.		N/A	N/A	N/A	30% utilization 9 kW \$1,393/yr.
Pump station electric motor kW – based on 160 gpm, 100 ft of head specific gravity 1.0 100% of time at \$.06 kWh/8,600 hrs/yr.		7 kW \$3,612	7 kW \$3,612	7 kW \$3,612	7 kW \$3,612
Total Operating Cost Water \$/yr.		\$335,039/yr.	\$136,666/yr.	\$13,350/yr.	\$9,649/yr.

Cooling System #2: Trim Coolers

A trim cooler is a smaller heat exchanger to be used only in times of excess or peak heat loads. They are installed to complement a larger system designed to handle all cooling need 85-90% of the time. A trim cooler can allow a facility to go with a lower water consumption system by being there as an emergency back-up during high heat load periods. A trim cooler might be a shell and tube heat exchanger or a cabinet-enclosed chiller.

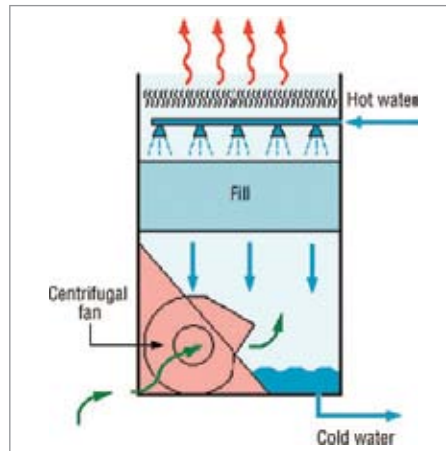
Cooling System #3: Dry Air Cooling — No Water Required

These coolers are closed loop cooling systems usually using an appropriate water (60%) and polyglycol (40%) mix (one-time fill) passing through finned tubes. The coolers are in modules — each with a small fan for air-cooling. As the heat load is reduced, the fans are shut-off individually as required and brought back on when needed. Dry air cooling systems are usually available from 160,000 btu/year rating at 250 cfm class to 4,000,000 btu/hr rating at 6,000 cfm class — with special sizes for other levels.

The air-cooled heat exchangers can be manufactured to deliver a 2 °F approach temperature but economics usually dictate a 5 °F approach. This means in parts of



Typical Dry-Air Fluid Cooling System — Usually uses an appropriate water/glycol mix



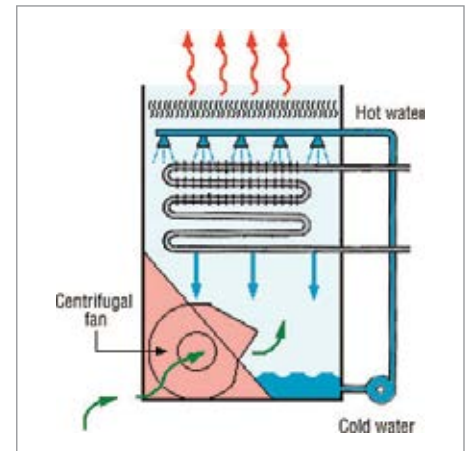
Typical Evaporation Open Tower with Counter Flow

the country they may be able to handle a reciprocating compressor's cooling needs with little or no trim cooling. Dry air cooling systems, when combined with a trim cooler, can provide factories with a very low-cost and reliable alternative to water-cooled machines.

Cooling System #4: Open Evaporative Cooling Tower

The cooling water system requiring the lowest capital costs is the *open tower type*. In this system, the heated return water flows down a controlled open path where it is cooled by continual evaporation by moving ambient air from a fan and pulling an evaporating water percentage into the ambient air. These towers will have a smaller circulating pump to move the water through the cooling area and a large horsepower electric motor fan to move ambient air over and through the cooling water to optimize the evaporation cooling. There is also a flushing or blow out system using water.

The primary benefit of this type of system is that as the ambient temperatures increase, generally so does the evaporation rate which means, in most North American locations, they will deliver about 85 °F temperature cooling



Typical Closed Circuit Cooling Fluid Tower with Evaporator

water when operating properly within their design limits.

Open tower coolers are very prevalent throughout industry and are often known affectionately as very effective “air washers” meaning they remove the dirt and impurities from the ambient air, generating a continual cleaning of the tower.

The contamination factor, along with the high level of make-up water required, makes proper and diligent water treatment and condition monitoring a prerequisite for a successful installation. Open towers also inject oxygen into the process water system which may or may not create corrosion or other maintenance issues.

Cooling System #5: Closed Circuit Cooling Tower with a Auxiliary Evaporation Cooling Assist for Hot Weather

In this type system the primary coolant is sealed in a closed loop system — unexposed to ambient air, it may be water — but it more often is a glycol water mix appropriate to the local ambient cold temperature limitations. This is very good for the equipment being cooled since it runs for a significantly long

EVALUATING AIR COMPRESSOR COOLING SYSTEMS



“If a facility can’t simply convert a water-cooled air compressor to an air-cooled air unit, a dryer-cooler system (with trim) has the lowest costs and very predictable results.”

— Nitin G. Shanbhag, Senior Manager, Air Technology Group, Hitachi America

time without significant water treatment requirement or replenishment.

The cooling system is equipped with a motor driven spray pump and spray header which delivers a spray over the air cooled heat exchangers during hot weather and creates evaporation auxiliary cooling similar to the open tower described earlier.

Cooling System #6: Closed Loop Cooling with Evaporation

Closed Loop Cooling with Evaporation systems experience additional water use, the magnitude very much dictated by the ambient conditions. There is also a motor driven coolant circulation pump and motor drive main cooling air fan similar to the open tower. The standard pumping station is also required. Some flushing or blow may also be required.

Depending on design and operating conditions, this type of cooling towers use parallel flow or cross flow or counter flow. Compared to an open tower with evaporative cooling, the closed circuit cooling system has a higher initial cost but also some advantages which may be significant when the operating conditions dictate.

In a compressed air system the process water must be capable of full capacity throughout the year. This means maintaining a clean, reliable cooling fluid loop is critical. To do this in an open tower requires proper and diligent water

treatment and maintenance. The closed loop system is basically isolating the compressor cooling fluid from all air ambient out borne contaminants:

- This reduces the frequency of the need to shut down the cooling system for cleaning.
- This type cooler has a lower volume of recirculating water requiring water treatment filtration
- The compressor cooling fluid usually requires minimal treatment
- During periods of dry operation (cooler weather) the need for spray evaporation and therefore makeup water is eliminated
- These units, like many central cooling water systems, are set up with either another cooling water source or chiller cooler. These trim coolers cool the fluid from the primary cooler when required by too high a temperature.

Conclusion

As the population continues to grow in the United States, industrial use will need to continue to fall to help offset the increases in Public-Supply water use. Compressed air systems provide an opportunity for energy

managers to reduce associated cooling water consumption and costs. Understanding the costs and the alternative types of cooling systems is an important first step.

All options are preferable to “once through” municipal water. The ever-growing regulations and controls will just further increase these costs. The true cost of the open evaporative tower and the closed loop evaporative tower can be driven much higher with more significant water treatment cost, water disposal regulations, sewer costs and surcharges. If a facility can’t simply convert a water-cooled air compressor to an air-cooled air unit, a dryer-cooler system (with trim) has the lowest costs and very predictable results. **BP**

For more information, please contact Mr. Nitin G. Shanbhag, Senior Manager, Air Technology Group, Hitachi America, tel: 704-972-9871, email: airtechinfo@hal.hitachi.com, www.hitachi-america.us/airtech

To read similar **Cooling System** articles, visit www.airbestpractices.com/sustainability-projects/cooling-systems

Endnotes

- 1 Estimated Use of Water in the United States in 2005, Joan F. Kenny, Nancy L. Barber, Susan S. Hutson, Kristin S. Linsey, John K. Lovelace, and Molly A. Maupin, U.S. Department of the Interior, U.S. Geological Survey, Reston, Virginia, 2009, Circular 1344, page
- 2 Ibid, Table 14, Trends in estimated water use in the U.S. page 43
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6 REASONS TO LOG YOUR COMPRESSED AIR SYSTEM

By Ron Marshall for the Compressed Air Challenge[®]



► The compressed air system in most industrial and commercial facilities is vital to production machinery and processes. When it goes down so does the plant output. This important utility is often one of the most costly energy consumers in a facility. Yet most compressed air system operators have little knowledge of how their compressed air system is performing and, if problems have happened, do not have an accurate record of what went wrong.

Proper monitoring of compressed air system is an area of weakness in the compressed air industry. True, there is usually accurate measurement of pressures and temperatures, two very important parameters to the operation of air compressors, but the tracking of these levels, and others like flow, power and energy over time is very rarely done.

In the past, the instruments required to accomplish proper monitoring and tracking of compressed air system characteristics were very expensive. But recently there have been many types and styles of inexpensive

instruments developed that can accurately measure compressed air system parameters and also log these parameters in memory or a database for later analysis. This article explores 5 good reasons to log compressed air data.

Developing a Baseline

The results of data logging can be used to develop a system baseline; a point of reference from which comparisons can be made. When Lord Kelvin, said in 1883 "If you cannot measure it, you cannot improve it",

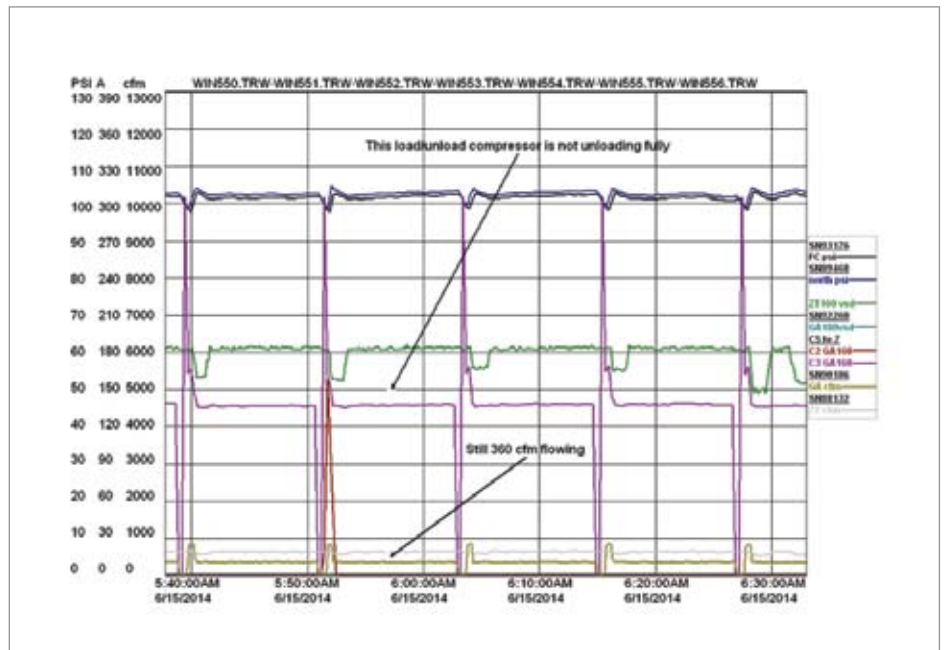


Chart 1: Data logging flagged a serious issue with the unloading circuit of Compressor 3

Fundamentals of Compressed Air Systems WE (web-edition)



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it is doubtful that he had only compressed air systems in mind, however, this statement is so very important to ensuring proper system performance. It is a fact that what gets measured, gets managed, this is an accurate phrase commonly used in industry. This is a guiding principle in the new ISO 50000 series of standards intended to guide the management of energy consumption.

The Compressed Air Challenge's Fundamentals of Compressed Air Systems seminar mentions one of the one of the most important steps of managing the proper operation of a system is to develop a baseline. A baseline, in terms of compressed air systems, includes not only the power (kW) and energy (kWh) performance of a compressed air system, but also important indicators such as specific power (kW/100 cfm) and pressure. Other parameters such as dew point and key temperatures can also important.

A baseline is typically developed using sets of data captured over a period of time, typically annually, from which the operation of a system can be compared to past or future operation.

The numbers captured in the baseline can be used to determine how well the system is performing. For example if the pressure, power, and flow of a system is captured, the system specific power can be calculated for example on a weekly basis. For example the system consumed 35 kW per 100 cfm over its baseline period, but when it was commissioned the level was 20 kW per 100 cfm, this could be an indicator that something has gone wrong with the compressed air production equipment.

Often, if system optimization is a goal, and utility financial incentives are available, one of the requirements of accessing the funding will be to measure this system with data loggers and develop an energy consumption baseline.

An example of the value of baselining was shown recently at an aerospace company that produced rocket fuel. The company compound had three separate buildings located at a distance in blast zones. In each building was a small 30 hp compressed air system operating in modulation. The compressors in use had rated specific power of about 22 kW per 100

cfm at full load and full pressure. When data loggers were placed on the systems it was found that these very lightly loaded compressors were consuming about 200 kW/ 100 cfm, almost ten times rated levels. The system operator was unaware of the poor efficiency because no power or flow measurement had previously taken place. Right sizing the compressors and operating in a more efficient control mode has reduced the specific power significantly to more normal values.

Monitoring System Control

Data logging can be used to monitor system control and ensure air compressors are operating correctly. The control of compressed air systems is very important to trouble free operation. The system should be capable of producing a stable supply of clean, dry compressed air at the appropriate pressure in the most efficient manner possible. But some facilities use the telephone to manage their air systems. If plant production is having pressure problems then they telephone the compressor operators, who then jack up the pressure.

6 REASONS TO LOG YOUR COMPRESSED AIR SYSTEM

This method is unsophisticated and inaccurate and usually results in system pressure that is much higher than necessary, leading to wasted artificial compressed air flow and higher than desired energy costs.

Measuring a compressed air system with data logging equipment allows the operation of the compressor controls to be verified. By analyzing the compressor response to system pressure or system flow changes the user of the data can ensure the system is operating correctly to maintain system efficiency.

An example of the value logging to ensure correct control is a problem that was discovered at small paint manufacturer. The operators of the compressed air system religiously turned on their three compressors at 7:30 am each production day, and then for the evening shift turned off one main compressor to save energy at 4:30 pm each day. All compressors were turned off after midnight. As a service to this customer the local power utility funded a study of the system using data loggers. The data loggers showed two of the three compressors had

good response to system pressure, however, the third had no response whatsoever. This was evident when the system auditor analyzed the data and noted that turning off the third compressor made no difference to the system pressure profile. The compressor, a vane style unit, had internal problems and subsequent testing revealed it was producing almost no compressed air, yet was consuming near full power.

Ensuring Pressure Stability

Data logging can be used to monitor system pressure stability. Compressed air systems are very dynamic; conditions are constantly changing over time. During these changes the compressors must react correctly to maintain adequate system pressure. Sometimes low pressure events can be experienced at random and cause the system pressure to vary widely. It is difficult to closely monitor system pressure manually to detect these problems, but placing data loggers on the system allows the data to be downloaded and analyzed at convenient times. If multiple parameters are logged, such as pressure,

flow, and compressor power the response of the compressors to pressure changes, or the response of the pressure to compressor changes can be determined.

An example of the value of data logging in solving pressure problems was seen at a metal foundry. The foundry was experiencing random low pressure events that affected plant production. The adequately sized load/unload style of screw compressor appeared to be operating adequately, and no end uses were found that could be causing the drawdown of the system pressure. Data loggers were placed on the system and analysis found that a characteristic of the compressor control type was causing the problem. The type of compressor installed at the facility had a starts per hour counter that turned off the compressor between cycles if the allowable number of motor starts had not been exceeded. Unfortunately the system receiver capacity was inadequate and the compressor was operating on short cycles. Whenever the compressor turned off between cycles, which occurred more or less randomly, the pressure would fall rapidly. The compressor could not restart fast enough once the load signal was received to save the plant from low pressure. The data logging clearly showed this problem was compressor related, the problem was solved by adding enough main storage receiver capacity to prevent pressure issues during compressor shutdown.

Troubleshooting Problems

Data loggers are very useful for troubleshooting, especially after system problems have occurred. If the collected data remains in a database the important parameters can be reviewed to determine what was happening at the time of the problem.

An example of this occurred at a large bus manufacturer. A new compressor had been

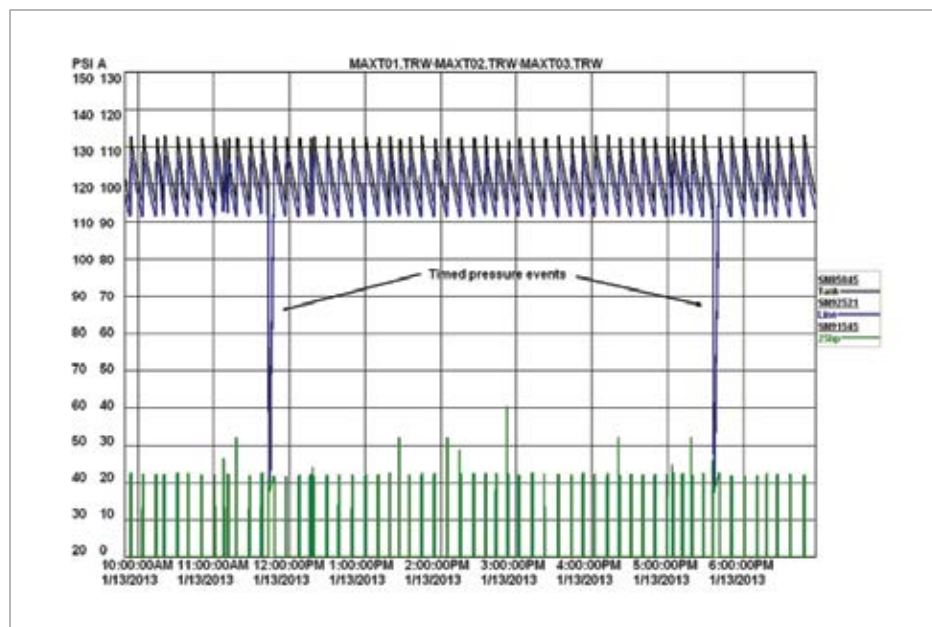


Chart 2: A previously unknown pressure problem was tracked using data loggers and found to be a faulty drain valve

installed but had been experiencing months of shutdowns due to an unknown cause which affected the reliability of the system. The supplier of the compressor had exhausted every known way to solve the problem, at significant cost, and still the unit was shutting down. The system data logging files were reviewed and it could be seen that the compressor shut down was occurring more or less at the same time each day, about the time of shift change. The data logs also showed whenever the unit shut down it was always as a result of the loss of voltage to its input, yet none of the other compressors on the same electrical feed experienced this same problem. The cause was a disconnect switch on the input to the compressor.

This compressor was installed on an unsecured mezzanine out in the plant. The mezzanine was above the change room area. The compressor often ran during the hours leading up to shift change, and the noise of the running compressor disturbed the workers who were changing. One of the workers had made it a habit to run up the mezzanine stairs and open the compressor disconnect switch to stop the noise. The compressor area was then secured and the problem went away.

Verification of Savings

Data logging is often necessary to ensure new equipment is operating properly and predicted savings have been achieved, especially for system that have been upgraded as a result of energy projects. In most cases the equipment will run as expected, however, there are occasional issues in commissioning equipment. These can be detected and corrected if the system is monitored using data loggers.

An example of this was at company producing plastic film. The company had installed both fixed speed compressors and a variable speed drive unit. The variable speed compressor was

Best Practices for Compressed Air Systems Second Edition



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

expected to supply the trim load and the fixed speed units were to provide base load. When data loggers were placed on the system it was found that the fixed speed compressors were loading and unloading in trim operation with the variable speed compressor ramping rapidly up and down its adjustable range at high cycle frequency. The calculated system specific power was twice the expected level due to this inefficient operation.

The data logging showed that the system had inadequate storage, resulting in rapid changes in system pressure during compressor switching when a base compressor needed to unload. The pressure was changing at such a rapid rate that the variable speed compressor could not respond fast enough. As a result the fixed speed compressor had to constantly run to maintain adequate system pressure, even though it was not needed.

More system storage capacity was added to slow down the pressure changes. Subsequent data logging showed smooth transitions whenever base compressors came on or turned off, and that the VSD compressor was operating as a very efficient and effective trim compressor. Regular analysis of this system had ensured the excellent system efficiency has been maintained.

Sizing Equipment

Data loggers can be used to size compressors and associated equipment before replacement projects. It is often difficult to assess if the existing system is correctly sized for the existing load and if a smaller or larger system is required to maintain adequate capacity and efficient system operation. Taking a snapshot of system operation before starting the purchasing process can prevent incorrect sizing decisions.

An example of this use is for a metal products fabricator looking to purchase a failing compressor. The 150 hp unit was running at 20 % of its capacity leading the plant personnel to believe that a much smaller compressor could be purchased. A 30 HP size was being considered, however, the data logging showed that peak flows that were pushing the existing compressor to 50% flow for short periods of time due to a seldom run, but important piece of production machinery. If a 30 HP compressor had been purchased it would have been too small. A 100 HP VSD compressor was purchased instead which provided enough peak capacity and efficient operation at low flows. **BP**

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New Kaeser Kryosec Refrigerated Dryers

Kaeser Compressors, Inc. has released a new line of refrigerated dryers for use with rotary compressors up to 40 hp. Kaeser's Kryosec TAH-TCH series of refrigerated dryers feature the best in German engineering and handle flows from 12 – 159 cfm.

Kryosec dryers have copper-brazed stainless steel plate heat exchangers for excellent heat transfer and low pressure drop. These units provide dependable drying at ambient temperatures up to 122 °F. The air-to-air and air-to-refrigerant heat exchangers are combined with the condensate separator in a single assembly to save on space and weight. As a result, these dryers have an exceptionally compact footprint. With their low profile, they can easily fit under machine platforms and in tight corners. The TAH models can also be wall-mounted for even greater convenience.

Other features include an Eco-Drain electronic demand drain for dependable condensate drainage without pressure loss and a hot gas bypass valve that adjusts cooling capacity to match varying conditions.



Maintenance for these dryers is very simple. All components, including heat exchangers, refrigerant circuit, condensate separator, and drain are easily accessible when the side panels are removed.

To learn more about the new Kryosec dryers, visit

www.kaesernews.com/Kryosec. To be connected to your local representative for additional information, please call 877-586-2691.

About Kaeser

Kaeser is a leader in reliable, energy efficient compressed air equipment and system design. We offer a complete line of superior quality industrial air compressors as well as dryers, filters, SmartPipe™, master controls, and other system accessories. Kaeser also offers blowers, vacuum pumps, and portable diesel screw compressors. Our national service network provides installation, rentals, maintenance, repair, and system audits. Kaeser is an ENERGY STAR Partner.

Thermal Mass Flow Meter Manufacturer Releases New Video

In a new video, Bob Steinberg, president of Sage Metering, describes the Sage Prime® Thermal Mass Flow Meter features and demonstrates the meter's extreme low-end sensitivity and rangeability.

The Prime is often used to measure gas flow rate and consumption in a wide range of applications, such as monitoring compressed air or natural gas flow for energy management, or to sub-meter gas for cost allocation. Sage meters are also installed to monitor digester gas or biogas for carbon credits to help reduce greenhouse gas emissions.

Sage is a pioneer in technology development. Mr. Bob Steinberg (President) said, "We introduced the first hybrid-digital bridge circuit to the industry over ten years ago, which provided a quantum leap in flow meter performance and long-term reproducibility." Sage also introduced the high contrast, easy-to-read graphical display of the Sage Prime, with its compact design, low power dissipation, high resolution and wide rangeability.

According to Steinberg, "Sage Metering's most notable contribution to the industry was the introduction of an onsite calibration verification, over five years, which eliminates the cost and inconvenience of periodic factory recalibrations."

The new video can be viewed on the Sage Metering website at <http://sagemetering.com>

About Sage Metering

Sage Metering is an innovative manufacturer of high performance thermal mass flow meters for gas flow measurement. The company has brought to market the first thermal mass flow meter to utilize graphical displays, a hybrid digitally driven circuit and the industry's first in-the-field calibration verification system.

Parker Veriflow Introduces CNG Fuel Dispensers

Parker Hannifin Corporation introduced to the North American market complete industrial and fleet fuel dispensing solutions for high-flow, high-cycle compressed natural gas (CNG) applications, featuring a 4:1 safety factor on all pressure-rated metal parts. Central to the solutions is the new Parker Industrial Bulk CNG Dispenser, the only entirely integrated fuel dispenser on the market. It features

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Parker Veriflo Industrial Bulk CNG Dispenser

best-in-class certified components from Parker; ANSI NGV 4.1/CSA 12.5 compliant design; and ANSI/NGV 4.2/CSA 2.52 certified hoses, all designed to work together, ensuring time savings, exceptional durability, minimal downtime, safety, and consistent, reliable service.

The CNG dispenser was designed by Parker's Veriflo Division. Veriflo is a leading manufacturer of precision gas flow management products with over 85 years of industry experience.

Breakthrough features of the dispenser include: 4X burst pressure rating components; ball valves with a high cycle life of 100,000 full cycles, reducing maintenance and minimizing downtime with a cycle life more than 2 times the industry standards; integrated system design resulting in 15-20% fewer leak paths; a robust enclosure and high-strength stainless steel frame with integrated hanging hardware for fueling hoses; as well as advanced diagnostics and monitoring using low-power electronic components.

Parker launched the fleet and bulk CNG dispenser to the North American market on May 7 in Long Beach, California, at the 2014 Alternative Clean Transportation (ACT) Expo (Booth #1151), where compressed natural gas is being highlighted as an alternative fuel choice that is safer, cleaner, and greener. Parker already has over 500 dispenser installation sites in other parts of the globe.

In North America, the dispenser is targeted at private industrial, commercial, and fleet customers with a range of CNG vehicles, such as county vehicles, taxis, delivery and day cab trucks, cement trucks, school and transit buses, and waste refuse/recycling vehicles. This market segment is growing at a CAGR (Compound Annual Growth

Rate) of 30% and reflects 50% of the North American natural gas fueling market.

While Parker offers industrial and fleet dispensing solutions which are fully customizable and configurable to customer requirements, the Industrial Bulk CNG Fuel Dispenser is an out-of-the-box option designed and assembled by Parker engineers to the toughest design and build requirements. The complete dispenser assembly consists of: CNG hose, breakaway and filling nozzle using the most flexible ANSI/NGV 4.2/CSA 2.52 certified hoses on the market; low-energy electronics used on display and keypad set and advanced diagnostics and monitoring components; A-LOK® or CPITM leak-free tubes and fitting joints; actuated B Series ball valves, check valves, and relief valves certified as required with a high flow and long-lasting reliability; a Snap-tite breakaway for emergency shutoff; standardized and tested nozzles; specially designed 7CP and J Series filter elements for delivering oil and particulate-free gas; CNG solenoid or high-cycle actuators coupled with high-flow CNG ball valves; and choice of one to three inlet lines with 35 kg/min and 70 kg/min flow rate options. All tubes, fittings, and connections are made of stainless steel. Other optional components are available.

According to Anil Raina, Engineering Manager, Parker Veriflo/Instrumentation Group, "The Parker CNG dispenser was designed with safety as a top priority, and uses a specially designed frame, series of unique protective sensors, breakaway couplings, and hose disconnects to eliminate the risk of mechanical or user malfunctions. It also provides shut off switches for gas flow on both sides of operation. Both delivery and vent hoses are rated for 5,000 psi to set the highest safety standards on the market."

As the industry's only provider of complete industrial and fleet fuel dispensing solutions for high-flow, high-cycle compressed natural gas (CNG), Parker also offers a wide range of class-leading CNG dispenser kits, subsystems, and components to meet all customer

TECHNOLOGY PICKS

needs and requirements. Parker leads the industry in the design and manufacture of multi-technology systems, subsystems, and components that filter, regulate, control, and convey CNG.

Tamara Horne, General Manager of Parker's Veriflo Division, noted "As a multi-technology provider with a global footprint assuring local availability, Parker saves customers time and money by reducing the need for multiple suppliers. The Industrial Bulk CNG Dispenser is a model example of Parker's ability to leverage its premium components and engineering expertise to develop a complete system."

There are over 14.8 million natural gas vehicles in use worldwide, according to the U.S. Department of Energy (DOE), and natural gas as a transportation fuel has many advantages, including domestic availability, widespread distribution in infrastructure, low cost, low flammability, and inherently clean-burning qualities, with low emissions and particulates.

For more information regarding Parker's Industrial & Fleet Dispensing Solutions, as well as other alternative fuel solutions, visit <http://solutions.parker.com/alternativefuels> or contact the Veriflo Division at 800-962-9590 or ngv@parker.com.

About Parker Hannifin's Veriflo Division/Instrumentation Group

Veriflo is a leading manufacturer of precision diaphragm and bulk gas valves, regulators, and flow control components for the control and application of liquids and gases.

About Parker Hannifin

With annual sales of \$13 billion in fiscal year 2013, Parker Hannifin is the world's leading diversified manufacturer of motion and control technologies and systems, providing precision-engineered solutions for a wide variety of mobile, industrial and aerospace markets. The company employs approximately 58,000 people in 49 countries around the world. Visit the company's website at www.parker.com

New Globally Certified Explosion Proof Moisture Transmitter from Michell Provides Universal Solution

Michell announced the latest addition to its Easidew line of moisture transmitters, the Easidew PRO XP. This new hazardous area transmitter meets the requirements of moisture measurement applications where explosion-proof rather than intrinsically-safe certification is needed.

The transmitter is housed in a tough, explosion-proof casing, which is rated NEMA 4. It is certified to $C_{CSA_{US}}$, ATEX and IECEx specifications, making it acceptable in hazardous areas world-wide. As with its sister product, the Easidew PRO I.S., the Easidew PRO XP is capable of measuring moisture in both gases and liquids with outputs in dew point or ppm. This versatility makes it an ideal option for systems integrators and others, as they now can stock one moisture meter or hygrometer for all moisture measurement applications in hazardous areas.

Typical applications for the Easidew PRO XP include olefins production, oil refining and water dew point during production of compressed, liquefied or pipeline quality natural gas. The transmitter is rated for Class I, Div. 1, Groups A, B, C and D, so it may be used in hydrogen applications as well.

The Easidew PRO XP uses the latest ceramic moisture sensing technology from Michell, and is capable of measuring dew points in gases from -110°C to $+20^{\circ}\text{C}$ and 0-3000 ppmV. For dissolved water in liquids the measurement range is from 0-1000 ppmW. With a 450 bar (6527 psi) pressure rating, EN10204 3.1 material certified parts and NIST/NPL



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13-point calibration certificate, it meets all the current demands of the processing industries.

The Easidew PRO XP is part of Michell's service exchange program, which ensures that your process is virtually never offline. Visit www.michell.com

About Michell Instruments

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

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

Spectronics OPK-411 Industrial Leak Detection Kit

Spectronics Corporation has introduced the OPK-441 Industrial Leak Detection Kit, a new starter kit designed to effectively pinpoint the exact source of all leaks in hydraulic equipment, compressors,

engines, gearboxes and fuel systems. The kit features the OPTIMAX™ 400 violet light LED flashlight, a compact, high-intensity unit that quickly reveals all leaks in small to medium-sized industrial systems — even in cramped areas that are inaccessible to larger lamps.

Also included is an 8 oz (237 ml) twin-neck bottle of patented OIL-GLO® 44 concentrated fluorescent oil dye, which is compatible with all synthetic and petroleum-based fluids. When a leaking system is scanned with the OPTIMAX 400 flashlight, the dye glows a bright yellow/green at all leak sources to reveal the precise location of each and every leak!

Rounding out the kit is an 8 oz (237 ml) spray bottle of GLO-AWAY™ dye cleaner, dye treatment tags, and fluorescence-enhancing glasses. All components are packed in a rugged carrying case.

For more information about the Spectroline® OPK-441 Industrial Leak Detection Kit, call toll-free 1-800-274-8888. Outside the United States and Canada, call 516-333-4840.

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Festo Reimagines Actuator Control Valve Design

Festo design engineers reimagined pneumatic actuator control valve design to create multi-functional units that are less expensive to purchase than comparable solutions, more than 50 percent smaller in terms of height, save energy, and are easier and faster to install, troubleshoot, and maintain. Festo now offers the new space saving VFOF, VBNE, and VBQF multi-functional pneumatic control valve series.

If an OEM wanted additional control functionality for a pneumatic actuator, then traditionally multiple components would have been added. For example, the OEM would use a one-way flow control valve for speed control, an air-piloted check valve for stopping cylinder movement and maintaining position, and a manual override valve to release trapped air when servicing. This meant that three different components were purchased and bolted together.

This added height to the actuator. Bringing together multiple components into the mix also made installation, trouble shooting, and maintenance more complex. Additional components increased the potential for compressed air leakage. And, there were issues of ordering and stocking multiple part numbers.



TECHNOLOGY PICKS



VFOF features three functions in one unit

The new Festo VFOF, model LE-BAH, adds control functionality without these problems by providing one-way speed control, manual override, and emergency stop functionality — holding

a piston's position even in the vertical position — in a single compact unit. The unit bolts directly to the actuator port and lies flat against the actuator for space savings in terms of height. The unit's multiple ports are clearly labeled for fast, accurate installation, trouble shooting, and maintenance. Another model of the VFOF offers straightforward speed control in one direction in the compact form of the new series.

The new VBNE control valve delivers emergency stop and manual override in one unit. The new VBQE offers two options — manual override with a silencer and manual override without a silencer.

“This new series of control valves demonstrates the power of functional integration combined with a keen eye for industrial design,” said Frank Langro, Director Marketing and Product Management at Festo. “From space savings and acquisition cost to installation, operation, and maintenance, these units define a whole new way of approaching pneumatic actuator control.”

For more information on this new series of space saving multi-functional control valves VFOF, VBNE, and VBQE, call Festo at 800-993-3786 and visit <http://www.festo.com/us>

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.

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Article published in the Jan/Feb 2013 Edition of Compressed Air Best Practices® detailing a compressed air energy-savings audit saving \$422,000 annually at ADM.

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