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September 2024

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# FROM THE EDITOR



## Plant Utility Innovations

Today's commercial buildings and industrial plants enjoy an unprecedented array of technologies able to save energy, conserve water and increase reliability.

BEKO Technologies, dynamically led by President Tilo Fruth, has announced a first of its kind smart oil-water separator. Historically, these technologies have relied upon physical check-ups by maintenance. Our Senior Editor, Troy Dreier, had the opportunity to interview Fruth and learn more about a true innovation for this category of products, now able to intelligently ensure lubricants are properly separated from the compressed air condensate stream.

Achieving decarbonization goals is a top priority at Johnson Controls. The company has publicly made a 2040 net-zero commitment. When asked if we'd like to write about the innovative compressed air and chiller plant optimization projects done at its major Oklahoma manufacturing facility, we jumped at the chance. Please enjoy our interview with Harshvardhan Barve, the Executive Director for Sustainable Infrastructure at Johnson Controls.

IoT and AI are much more than innovation buzzwords when applied to compressed air. We thank Jayme Leonard from Atlas Copco Compressors for sending us an article titled, "How IoT and AI Transform Compressed Air System Management."

A corporate energy manager once told me the biggest enemy to energy- and water-saving projects is technology not performing as advertised. This is why we salute the CAGI compressed air and CTI cooling technology performance verification programs. This month, we are pleased to introduce Eurovent Certification to our readers with an article titled, "HVACR Cooling Products Certification Helps Rule Out Reliability Risks."

Speaking of Europe, please consider joining us at the inaugural Industrial Sustainability Best Practices Conference, taking place June 16-19, 2025, in Barcelona, Spain! Visit <https://cabpxpo.com>.

We have an incredible line-up of speakers and exhibitors displaying innovations at the Best Practices 2024 EXPO & Conference, taking place October 29-31 in Atlanta at Cobb Galleria. Please sign up right away at <https://cabpxpo.com/registration/atlanta-2024/>.

Thank you for investing your time and efforts into *Compressed Air and Chiller & Cooling Best Practices*.

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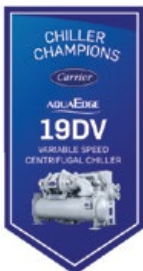
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# Readers From Around the World

We salute all Best Practices Magazine Subscribers from around the world who own, operate, maintain, engineer and provide expertise for the on-site utilities (compressed air, nitrogen generation, vacuum, blowers, chillers, cooling towers and pumps) powering modern plant automation. This subscriber-driven monthly column hopes to build community and recognize all subscribers!



↑ Doug Barndt is a Senior Manager, Engineering, for the Campbell Soup Company, where he addresses energy efficiency and sustainability challenges, and helps with utility systems. He's currently using total cost of ownership and an attribute comparison tool to assist with major equipment change decisions. Doug is based in Arvada, Colorado, which sits between Boulder and Denver. His favorite soup is Pacific Foods tomato basil (Yes, Pacific Foods is a Campbell's company). Visit <https://www.campbells.com>.



↑ A warm hello to our neighbors to the north, especially the staff of Air Unlimited, an Ingersoll Rand distributor in Manitoba, Canada. The company was founded in 1984, and is still locally owned and operated. With two additional locations in Saskatchewan, it expanded its reach to include Western Canada. The company provides solutions for a broad range of industries, including construction, railroads, mining, farming and factories. Shown here are General Manager Cody Tanner, Industrial Salesperson Kory Murphy and Applications Engineer Juan Londono (left to right). Visit <https://www.airunlimited.ca>.

## Submission Guidelines

We invite our subscribers to send in pictures so we can see the people who read our Best Practices magazines! Those holding a recent magazine issue will receive first consideration. Please send a high-resolution picture as a JPG or PDF file and a note describing the team and company to Troy Dreier at [troy@airbestpractices.com](mailto:troy@airbestpractices.com).



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FNA's NUAIR brand arrives in America backed by its history in Europe since 1948, which has made it one of the most important global leaders in the compressed air market. In 2024, FNA America will focus on the industrial market, with NUAIR brand screw compressor technology, which has been tested for many years in markets such as Europe and Asia. NUAIR industrial screw compressors range from 3 to 100 HP and are offered in various configurations: tank-mounted, tank-mounted with dryer, fixed speed, and variable speed with excellent energy performances. Today, through its new 104,000 square foot subsidiary in South Carolina, FNA AMERICA is launching even more innovative products for the consumer, professional, and industrial markets to expand the richness and diversity of its offerings, reinforcing its commitment in being the leading provider in the North American market.

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# Compressed Air Technology & Industry News

## Kaeser Announces Expansion of KAirFree Program

Kaeser Compressors, Inc. announced an expansion of its industry-leading KAirFree service to include 30, 50 and 100 hp options with guaranteed compressed air for a fixed monthly fee. This broader range of offerings provides even more businesses with the opportunity to benefit from KAirFree's innovative service across a wider range. It also makes KAirFree suitable for a wider range of compressed air applications.

KAirFree programs include all service costs and eliminate concerns of reliability, air quality issues, unexpected downtime and variable expenses associated with traditional compressed air ownership. Customers simply pay a monthly fee and Kaeser takes care of everything else, including installation, maintenance and repairs. KAirFree is ideal for businesses that are expanding their operations, considering replacing outdated equipment or testing out a new compressed air application.

"KAirFree is the fastest and easiest way to get compressed air," said one satisfied KAirFree customer. "We chose KAirFree because of the flexibility it offers – we don't need to worry about the hassle and expense of owning and maintaining our own compressor."

"With this expansion, we can now serve a broader range of compressed air users," said Matt McCorkle, Manager of Branch Operations for Kaeser Compressors, Inc.

*Kaeser Compressors announced the expansion of the KAirFree program with more options and even more flexibility.*

"Whether you're a growing business or looking for a more flexible solution, KAirFree offers a reliable and cost-effective way to get the compressed air you need."

### About Kaeser Compressors, Inc.

*Kaeser Compressors 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 gasoline and diesel screw compressors. Our national service network provides installation, rentals, maintenance, repair and system audits. Kaeser is an ENERGY STAR Partner. For more information, visit <https://us.kaeser.com>.*

## FS-Elliott Announces Comairco as Channel Partner

FS-Elliott is proud to announce Comairco Equipment as its new authorized Channel Partner in Canada, serving Manitoba, Ontario, Quebec, Nova Scotia, Newfoundland and Labrador, New Brunswick, and Prince Edward Island. The new partnership brings together two industry leaders to deliver energy-efficient and reliable centrifugal compressors to customers across Canada.

Comairco has over 50 years of experience ensuring reliable compressed air systems. It offers 24/7 on-site repair and emergency service, working on all makes and models of air compressors with access to both electric and diesel rental compressors. Comairco focuses on environmental and economic issues, specializing in designing compressed air systems that have the best power and energy savings.

As part of the partnership, Comairco will offer a range of services to support even more compressed air needs, including:

- New system consultation
- Centrifugal compressor repairs and overhauls
- Control system upgrades
- Oil-free rental equipment
- Engineering staff experienced on centrifugal compressors selection and optimization
- Comairco designed and built outdoor "AWA – All Weather Air" compressor rooms
- Local, OEM centrifugal parts
- Preventative maintenance programs
- Factory-trained service technicians

"We are thrilled to welcome Comairco as the newest channel partner. Their company mission



and proven history align with our strategic goal,” said Mark McCarthy, Industrial and Channel Sales Director at FS-Elliott. “We are confident this partnership will continue providing enhanced support to our valued customers.”

**About FS-Elliott**

FS-Elliott is a global leader in the engineering and manufacturing of oil-free, centrifugal compressors, with operations in over 90 countries. For 60 years, FS-Elliott has combined commitment to quality with advanced technology so its customers can increase their productivity and lower system operating costs. For more information, visit <https://www.fs-elliott.com>.



FS-Elliott has announced Comairco Equipment as an authorized Channel Partner in Canada.





## Highly Efficient Contamination Removal with the **GON-HC-US High-Capacity Series** Compressed Air Filters

The GON High-Capacity Series Compressed Air Filters ensure the highly efficient filtration of contaminants that affect the quality of compressed air such as oil vapor, particulates, and aerosols according to the customer’s needs and related to the ISO8573 standards. The filters are designed with zero clearance for easy element replacement and features a durable aluminum construction with anodized surface treatment for superior corrosion resistance. The High-Capacity filters can be an attractive alternative over the expensive ASME welded/fabricated filter styles.



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## Compressed Air Technology & Industry News

### Ingersoll Rand Highlights Sustainability Progress, Announces New Goals

Ingersoll Rand, a global provider of mission-critical flow creation and life science and industrial solutions, has unveiled its 2023 sustainability report. "Leading Sustainably through execution" details the company's commitment, action and accomplishments related to a more sustainable future, guided by Ingersoll Rand Execution Excellence (IRX) and an ownership mindset.

"We continue to grow and operate sustainably by developing innovative and sustainable products and services that deliver immediate value to our customers through efficiency, circularity and safety while improving our own operations," said Vicente Reynal, Chairman and Chief Executive Officer of Ingersoll Rand. "Our dedication to leading sustainably demonstrates our commitment to Making Life Better and I am excited about what we can achieve together in 2024 and beyond."

In 2023, Ingersoll Rand achieved measurable progress against its sustainability goals, including:

#### Grow Sustainably

- Employing a Design for Sustainability process for all new product development, with 80 new innovative products launched in 2023.
- Offering a portfolio of products in which 66% feature sustainable attributes.
- Anticipating products with sustainable attributes will account for more than 25% of the company's total revenue by 2030.
- Continuing to support customers in high-growth, sustainable end markets such as clean energy, food, life sciences and water.

INDUSTRIAL SUSTAINABILITY

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\*Plant utilities average 10-40% of total industrial  
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### Operate Sustainably

- Prioritizing employee safety and surpassing the industry average by 73%<sup>1</sup>, with a safety total recordable incident rate approaching world-class.<sup>2</sup>
- Upholding its commitment to employee ownership by granting equity to more than 1,800 employees through its Ownership Works program, growing the total number of employees who received grants to more than 23,000 since May 12, 2017.
- Powering 45 sites worldwide with renewable energy through the use of solar panels and green energy contracts.
- Achieving its water reduction goal seven years ahead of its 2030 target.
- Being named to the “A List” by CDP (formerly the Carbon Disclosure Project) and included on the Dow Jones Sustainability Indices<sup>3</sup>, among other awards for leadership in sustainability practices and results.

“As we continue to innovate climate solutions through our products and services, we believe that we are able to better provide the answers our customers need to reach their decarbonization goals,” said Reynal.

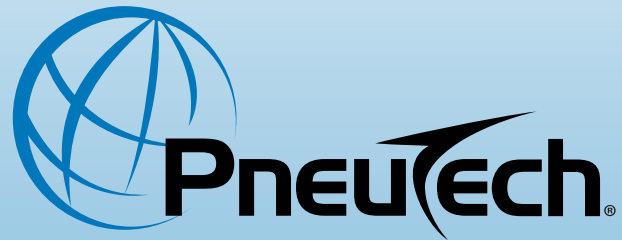
### About Ingersoll Rand

*Ingersoll Rand, driven by an entrepreneurial spirit and ownership mindset, is dedicated to Making Life Better for its employees, customers, shareholders and planet. Customers lean on the company for exceptional performance and durability in mission-critical flow creation and life science and industrial solutions. Supported by over 80+ respected brands, its products and services excel in the most complex and harsh conditions. For more information, visit <https://www.irco.com>.*

<sup>1</sup> Average Total Recordable Incident Rate (TRIR) for all Industrial Machinery Manufacturing companies in 2022 (most recent data available) was 2.6 according to the U.S. Bureau of Labor Statistics. At the end of 2023, Ingersoll Rand's TRIR was 0.69.

<sup>2</sup> World Class defined as top quartile of manufacturing companies with >1,000 employees per U.S. Bureau of Labor Statistics (2020).

<sup>3</sup> Receipt of an S&P Global ESG Score does not represent a sponsorship, endorsement or recommendation on the part of S&P Global to buy, sell or hold any security and a decision to invest in any subject company should not be made based on the receipt of any such note. S&P, S&P Global, and the S&P Global logo are trademarks of S&P Global Inc. or its subsidiaries, registered in many jurisdictions worldwide.



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## Compressed Air Technology & Industry News

### Technologies on Display at Best Practices 2024 EXPO & Conference

The Best Practices 2024 EXPO & Conference is bringing the largest American event for on-site utilities to the Cobb Galleria Centre in Atlanta, Georgia, Oct. 29-31. Equipment sales engineers, engineering firms and manufacturing personnel will have the opportunity to meet the leading global manufacturers of compressed air, vacuum and cooling/chilled water technologies on the EXPO floor and learn about the latest innovations in air compressors, compressed air purification, aluminum piping, pneumatics, leak detection, compressed air measurement instruments and more.

Here is a roundup of the technologies that will be on display at the Best Practices 2024 EXPO.



*The Best Practices 2024 EXPO will feature the latest innovations in compressed air, vacuum and cooling/chilled water technologies.*

#### Air Compressor Technologies

(fixed, VSD, variable capacity drives; water- and air-cooled)

- 15-58 psig (2-4 bar): low-pressure; lubricated and oil-free rotary screw
- 80-220 psig (5.5-15 bar): lubricated reciprocating, rotary screw
- 45-190 psig (3-13 bar): oil-free scroll, reciprocating, rotary screw, centrifugal
- 145-6,000 psig (10-408 bar): boosters; lubricated, oil-free, reciprocating, screw
- 435-1,500 psig (30-102 bar): medium pressure; oil-free reciprocating, centrifugal
- 1,000-7,000 psig (68-476 bar): high pressure; reciprocating, centrifugal
- 25-5,000 psig (2-340 bar): low, medium and high pressure rental air compressors
- Controls, heat recovery, containerized systems, inlet/oil filtration, lubrication

#### Compressed Air Purification and Aluminum Piping Technologies

- +38-50°F (3-10°C) dew point refrigerated dryers: non-cycling, cycling, VSD, HIT
- -20 to -100°F (-29 to -73°C) dew point desiccant and membrane dryers: heatless, heated, heat-of-compression, deliquescent, membrane
- 435-7,000 psig (30-476 bar) high pressure refrigerated and desiccant dryers
- Liquid, oil aerosol, oil vapor, particulate and sterile filters
- Electric-timed and zero air-loss condensate drains and oil-water separators
- Aluminum piping systems, < 232 psig (16 bar), ¾" to 10" diameter (20-350mm)
- Aluminum piping systems, 232-1,015 psig (16-70 bar), ¾" to 2 1/2" diameter (20-63mm)

#### Pneumatics, Leak Detection and Compressed Air Measurement Technologies

- Pneumatic actuators, directional control valves and components for pneumatic circuits
- Ultrasonic and acoustic imaging leak detection for compressed air
- Compressed air flow and dew point meters, pressure sensors, inlet and ambient temperature sensors

#### Blower and Vacuum System Technologies

(fixed, VSD, variable capacity drives; water- and air-cooled)

- PD rotary lobe blower (4-15 psig or 0.3-1 bar) and vacuum pumps (3" to 15" Hg)
- PD rotary screw vacuum pumps: 166 to 551 acfm, 10-29" HgV
- PD rotary screw blowers: 190 to 5650 cfm, 4.4 to 15 psig (0.3 to 1 bar)

- Turbo blowers: magnetic bearing, single stage geared, high speed gearless, multistage centrifugal
- Rental blowers
- 15-58 psig (2-4 bar): low-pressure; lubricated and oil-free rotary screw

**Chiller and Cooling Tower Technologies (induced and forced draft, anti-microbial)**

- Packaged cooling systems: closed-circuit, evaporative with pumps, closed loop chilled water with heat exchanger, dry coolers
- Industrial process chillers (0.6 to 150 ton cooling capacity)

Attendees can choose between several ticket options – the Full Conference pass, a Single Day Conference Pass or the EXPO Hall pass. To register, visit <https://cabpexpo.com/registration/atlanta-2024>.

The Best Practices 2024 EXPO & Conference is co-sponsored by the Compressed Air & Gas Institute and the Cooling Technology Institute.

**About Best Practices EXPO & Conference**

The Best Practices 2024 EXPO & Conference is the leading North American event focused on sustainable, safe and reliable on-site utilities powering automation. The event takes place Oct. 29 to 31, 2024, at the Cobb Galleria Centre in Atlanta, Georgia. Attendees come from engineering firms, manufacturing plants and equipment companies responsible for specifying, purchasing, operating, selling and maintaining on-site utility equipment in industrial compressed air, vacuum and cooling water systems. For more information, visit <https://cabpexpo.com/attend>.

**Atlas Copco Acquires AE Industrial**

AE Industrial has become part of Atlas Copco Group. The company specializes in sales, installation and service of compressed air systems. AE Industrial was founded in 1970. The company has 40 employees and serves a wide range of industrial companies in Leeds, Stoke, Birmingham and Blidworth near Nottingham.

“AE Industrial has a long history and a strong market presence in the UK,” said Philippe Ernens, Business Area President Compressor Technique. “This acquisition will strengthen our service to customers in the region and enable us to further develop the reach of our products from our brand ALUP Kompressoren.”

The purchase price is not disclosed. The company becomes part of the service division within the Compressor Technique Business Area.

**About Atlas Copco Group**

*Atlas Copco Group innovates to develop products, services and solutions that are key to its customers' success. Its four business areas offer compressed air and vacuum solutions, energy solutions, dewatering and industrial pumps, industrial power tools and assembly and machine vision solutions. In 2023, the Group had revenues of BSEK 173, and at year end about 53,000 employees. For more information, visit <https://www.atlascopcogroup.com>.*

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## BEKO Technologies Creates a Culture of Invention and Innovation

*The QWIK-PURE oil-water separator could change condensate management in the compressed air industry. For BEKO Technologies, that's business as usual*

By Troy Dreier, Compressed Air Best Practices® Magazine

► Long before smart was a technology buzzword, BEKO Technologies was making smart products. In 1982, founder Berthold Koch advertised “the drain with a brain.” The first step in making products that could manage themselves, the company introduced BEKOMAT®, an electronic sensor control drain.

The first compressed air systems didn't use drains at all, but accepted a certain amount of oil and water in the compressed air as a necessary evil. After that came a hand valve that let the operator drain moisture by hand at pre-determined collection points. That in turn led to the earliest drains, which opened and closed even when not needed, often creating pressure drop.

The search for a better drain led first to mechanical drains that used a float to open when needed, then Koch's electronic sensor control drain.

*Above: At its facility in Atlanta, Georgia, BEKO USA produces and assembles its DRYPOINT® M and CLEARPOINT® lines.*

“The difference between the floaters and the electronic was that the electronic is much smarter. So, it doesn't only know that it has to open, it also knows when it's not opening, or when it's failing,” explains Tilo Fruth, President of BEKO Technologies. “When mechanical float drains get stuck in the open

position – due normally to solid particles in the condensate – they become a significant compressed air leak source.”

While two to three times the prices of other drains, Koch's innovation was a success and came to dominate the market. Its intelligence



*Tilo Fruth speaking at the Best Practices EXPO and Conference.*

came from a capacitive sensor that measured the level of condensate in a reservoir. As the industry came to see the value of energy efficiency, plant operators understood the drain's price was easily justified by the money it saved.

"Berthold Koch was a little bit of an Elon Musk in the condensate technology world," Fruth says. "He took risks to invest constantly in new innovations."

### Solving Problems in Condensate Management

*Compressed Air Best Practices® Magazine* spoke to Fruth in his company's new Smyrna, Georgia, location. It recently purchased and renovated a facility where its desiccant dryers are now being made. With the company releasing its QWIK-PURE® line of oil-water separators, this felt like a good time to discuss the company's history of innovative products.

After the company's success with an electronic sensor controlled drain, the next problem in need of a solution was what to do with the collected condensate. It was too oily to run down a sewer system. Plant operators needed a simple way to remove the oil, and so the company became the first to mass-produce oil-water separators. Originally marketed as the ÖWAMAT – a name that came from combining the German word for oil and water – the debut model was nothing more than a container with an activated carbon insert that removed the oil and left clean water. It sold in the hundreds of thousands, but changes in industrial lubricants made oil-water separation more difficult. The company switched to polypropylene filters that could better capture these lubricants. Operators found oil-water separators often overflowed, creating an oily mess. In response, the company introduced a flow control retrofit that could detect overflow conditions.

### Compressed Air Desiccant Dryer Inspired by Innovation

At the same time, BEKO Technologies introduced the idea of self-managed devices to compressed air dryers, developing a desiccant dryer that could respond to environmental conditions and change how it worked. Introduced in 2022, the DRYPOINT® XFi was inspired by Fruth's test drive of a Tesla.

"I love innovative companies," Fruth says. "The Tesla fascinated me because I never drove one. I wondered how far it could really go. What technology is really in it? At that time, six, seven years ago, the car was already driving almost alone. You had to leave your



The DRYPOINT XFi



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hands on the steering wheel, but the car did everything by itself. I saw how it adjusts to its environment. It sees the red light, it sees the street, it sees other cars. I asked myself, why can't we build a dryer that does things like that, just translated into our needs?"

That was the start of the DRYPOINT® XFi, which uses an array of sensors to monitor its conditions constantly.

"We put so many sensors in that we completely measure everything, not only the pressure dew point," Fruth says. "We added over 10 sensors into the unit to measure everything from pressure, humidity, pressure dew point and temperatures of ambient conditions, as well as operating conditions. It takes those measurements on multiple spots."



If the dryer is in a humid environment, it adjusts to run one way, and if conditions are dry, it adjusts another way, controlling its blower, heater and the amount of purge air used, all without an operator.

The QWIK-PURE®  
oil-water separator

### Adding Intelligence to Oil-Water Separators

The next target for an intelligent offering was the oil-water separator. These devices have a problem, Fruth saw, in that they all eventually overflow if not properly maintained and they don't give you warnings if they fail or when they need to be maintained.

The goal was to create a smart system in sufficient quantities to be competitively priced. If BEKO Technologies could create a smart oil-water separator that only costs 10% more

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**Paul L. Baker, PE**  
Senior Mechanical Engineer,  
Jacobs



**Neil Mehlretter**  
Technical Director,  
Kaeser Compressors



**Tim Dugan, PE**  
President, Compression  
Engineering Corporation



**Martin Zeller**  
Country Manager, CS  
Instruments USA, Inc.

– or that costs more upfront but less for replacement cartridges – plants would welcome it.

The QWIK-PURE<sup>®</sup> was in development for five years, but in that time, the price of smart technology dropped so the company was able to create a competitively priced product. The initial plan was to control the system with a capacitive sensor and a pump. The separator would measure how much condensate went in and control the system with a pump, always pumping the same amount of condensate. However, the price of the pump was an obstacle, so the company instead used a belt, a more affordable option. The oil-water separator works with an inexpensive plastic piston valve with a few O-rings. It uses low-pressure compressed air, rather than an electric motor and belt, to open and close the system. The condensate is collected in a reservoir until it reaches a certain level. When the capacitive sensors show the tank is full, the unit closes it and pushes the condensate through the filter cartridge.

“We now have the capability of not only controlling the flow, we also measure how much condensate goes through the system,” Fruth says. “We can tell the system not only when you have to service it, we can also state when there’s an alarm and the system isn’t working.”

The unit’s intelligence comes from its Flow Regulation Control (FRC), a control panel mounted at the top of the unit. Its LED display lets the operator see the system status at any time. The FRC is Wi-Fi-enabled, so its data can be accessed remotely via a browser. LEDs on the FRC tell how saturated the cartridges are, and the system sends an alert when the cartridges need to be replaced. It will also issue an alarm in the case of a malfunction.

The QWIK-PURE<sup>®</sup> changes the standard oil-water separator architecture. Rather than condensate flowing into a large container with a filter in it, condensate passes through a depressurization chamber and then past the FRC, which monitors the amount. It then flows into cartridges that contain a pre-filter and a primary filter. Oil is trapped by the filters, while pure water passes through. The unit uses gravity and low-pressure compressed air (under 5 psig/0.3 bar) to move condensate through the chambers.

Maintenance is simple, as cartridges remove with a twist and new ones click into place. Replacing a pair takes 20 seconds. Because the system is modular, users can add more when needed. As a plant expands with new air compressors, it can grow its oil-water separator by snapping new filter cartridges in place. The standard unit can increase to nearly nine



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times the capacity. Changing cartridges is a no-mess operation as condensate is concealed in the cartridges.

### Many Models, but One Cartridge

The company has created two lines of QWIK-PURE® oil-water separators: the CS Series and the iCS series. The CS Series uses the same cartridges and modular design, but lacks the FRC control panel. The CS Series offers 100 scfm, 200 scfm, and 400 scfm flow rate coverage, while the iCS Series offers 550 scfm, 1,100 scfm, 2,200 scfm and 3,300 scfm flow rate coverage. Both lines have a minimum condensate temperature of 41°F (5°C) and a maximum of 140°F (60°C), and both have a maximum operating pressure of 232 psig

The QWIK-PURE® has a modular design for easy expandability.

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Project and Product  
Management, Ingersoll Rand



**Neil Mehtretter**  
Technical Director,  
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**Mark Krisa**  
Strategic Account Manager,  
Ingersoll Rand



**Frank Moskowitz**  
AIRScan Expert,  
Atlas Copco Compressors



**Jason Costigan**  
Director of Product  
Management,  
Gardner Denver

(16 bar). All units use the same cartridge, simplifying inventory management.

This oil-water separator also solves the challenge of varying environmental conditions, increasing flow and of certain lubricants needing longer to separate. In summer months, large condensate flows can overwhelm some separators. Additionally, certain lubricants, especially synthetics, need a longer filter contact time to separate. This unit's built-in intelligence ensures condensate gets the treatment it needs every time.

"A lot of systems don't see the need to adjust operations. They spill oily water in the system because they have a high demand of condensate. It's summer, they're running on the normal shift. In the morning, they turn everything on full-load, but then there's less condensate in the second and third shifts. The system does not adjust to them at all. Our system does because it is smart," Fruth says.

Part of the solution comes from BEKO Technologies' use of polypropylene filters instead of activated carbon. Whereas mineral oil separates from water and is easy to remove, synthetic oils or polyglycols tend to emulsify. The company's polypropylene filters

do a better job of dealing with emulsions. The material is also lightweight, so empty cartridges weigh seven pounds, and full cartridges weigh under 55 pounds.

"I would not easily say it's a great system if it isn't," Fruth says. "I think the QWIK-PURE® iCS is really something new to the world, and we are very proud of it." **BP**

**About BEKO Technologies**

*BEKO Technologies, Corp. (BEKO USA) is the American subsidiary of BEKO TECHNOLOGIES GmbH, which is headquartered in Neuss, Germany. As part of the organization's global operations, it maintains a 50,000-square-foot and 28,000-square-foot production facility in Atlanta and Smyrna, Georgia, respectively. BEKO USA is the American headquarters and has been responsible for producing products and providing superior customer service for all of the Americas since 1990. For more information, visit <https://www.beko-technologies.us/en-us/>.*

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An LED control screen shows the QWIK-PURE® unit's status.



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# Decarbonization Hits Close to Home for Johnson Controls

*An upgrade to Johnson Controls' own central utility plant, including modernizing its chillers and compressed air system, will reduce emissions and serve as a model*

By Chiller & Cooling Best Practices Magazine

▶ Johnson Controls' most recent decarbonization project has gone right to the heart of its 2040 net-zero commitment – working with its own Norman, Oklahoma, manufacturing facility on a chilled water plant and compressed air system upgrade that is projected to nearly halve its greenhouse gas emissions.

The timing could not be better for such an endeavor. Buildings account for roughly 40% of global emissions, finds the World Economic Forum, creating a greater need for more efficient HVAC systems and connected technology to track energy use. Production



Harshvardhan Barve, Executive Director for Sustainable Infrastructure at Johnson Controls

plant energy efficiency is one the most significant opportunities for industry to make a positive difference. With the net-zero target dates growing closer, it has become vital for industrial buildings and facilities to put measures in place.

“For decades now, scientists have been ringing the alarm bells and saying, ‘Hey, industrial activities, modern life is getting a whole lot of greenhouse gases.’ Johnson Controls is right in the middle of all of this,” said company Vice President, Chief Sustainability Officer and External Relations Officer Kathleen McGinty.

“We’re on the positive side, bringing forward incredibly compelling solutions so we can change that climate challenge into a real opportunity,” she added. “Johnson Controls is excited to provide proof positive that, when it comes to buildings, if you don’t decarbonize, you’re leaving cash on the table and hurting your bottom line.”

Executive Director for Sustainable Infrastructure Harshvardhan Barve told *Chiller & Cooling Best Practices Magazine* that Johnson Controls, known as a worldwide pioneer in smart, healthy and sustainable

buildings, took on the 900,000-square-foot flagship facility as a way to walk the walk. The project will serve as a model for other groups looking at building modernizations.

## Net-Zero by 2040 in Scope One and Scope Two Emissions

The Norman plant, which Johnson Controls uses for research, manufacturing and testing of its HVAC rooftop units, employs more than 1,200 people over three shifts, five to seven days per week. In 2023, it produced over 80,000 packaged rooftop units, ranging from 3 ton to 150 ton, under the Johnson Controls, York, Luxaire and Coleman brands. Its legacy central utility plant (CUP), built in the 1960s, included two YT constant speed chillers each rated for 600 tons, to support process and comfort cooling of the factory and administrative spaces. In 2005, Johnson Controls added two YK variable speed chiller units, upping its capacity to 2,400 tons when the campus was expanded. The facility’s CUP water usage profile dedicates 75% of its water supply to comfort cooling, and 25% to water-cooled air compressors.

“Fast-forward to 2017, 2018, the macroeconomic conditions are changing and decarbonization sustainability – specifically Scope One and

Above: Johnson Controls' 1.56 MW ground-mounted solar PV system provides power for its Norman, Oklahoma, facility.

Scope Two emissions – start gaining a lot more prominence,” Barve said. “Johnson Controls senior leadership made an audacious goal to be net-zero by 2040 in our Scope One and Scope Two emissions, and with that, we started finding out which of our factories are the biggest contributors to our emissions. Norman, Oklahoma, was in the top three in the country.”

The company outlined 15 to 20 Scope One and Scope Two projects, which evolved into a focus on upgrading 10 or 11 of them. At the top were changes to the heating and cooling plant that would deliver the most significant reductions. The company immediately got the backing of its senior leadership.

Johnson Controls Sustainable Infrastructure team developed the design and construction plan,

sharing it with the Production and Operations teams. “We asked, what can we change, where

can we change and how can we change without impacting operations?” Barve said.



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## Decarbonization Hits Close to Home for Johnson Controls

As work was performed on the upgrade, Johnson Controls' 80,000-unit production target for 2023 was met with no production downtime, despite overhauls to the entire central utility plant, the compressed air system and the heating plant, thanks to a significant team effort.

### Chiller, AHU and Cooling Tower Upgrades Drive Savings

The chiller plant supplies chilled water to the air handling units, which in turn provide heating and cooling. Barve and his team needed to understand the air-side distribution and how the flow went through the 900,000-square-foot space, powered by 30 air handling units, each of which has 15, 20 or 25-horsepower (hp) supply fans, plus a constant volume two-pipe system. As two-pipe systems have design limitations, the company upgraded to a four-pipe system.

"We upgraded the existing constant volume two-pipe air handling units with new York Solution™, variable air volume, four-pipe

units. That gave us the ability to control and vary the flows on the air side, and also the ability to provide outside air economizing



The pumping system distributes chilled water at the Norman plant.

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capabilities on all units. That was one of the key upgrades,” Barve said.

By making that adjustment, the building could more effectively vary the air volumes as the load in the building fluctuated, supplying conditioned air when it’s needed and reducing the final load. A digital twin design, once modeled, showed it could keep its 2,400 ton installed capacity moving forward even with its future expansion requirements.

The 1960s YT Millennium machines were replaced with two YMC<sup>2</sup> 600 ton units installed in their place. The YMC<sup>2</sup> machines are centrifugal, magnetic-bearing chillers. Barve’s team opted to keep the two YK units it had installed a decade earlier. The upgraded

Metasys™ building automation system will control all the central plant’s assets, including chillers, pumps, cooling towers and the new air handling units.

The company plans to perform an outside air reset on the air handling units and a condenser water reset on the cooling towers, and could optimize future flows. That flexibility gives it an effective way to operate one or more chillers without having to fire up all of the machines.

On the air side, all units were upgraded with economizer functionality, allowing for free cooling capabilities. This was crucial, as 75% of the output goes to comfort cooling, which made a significant difference in a large building and with 1,200 employees.

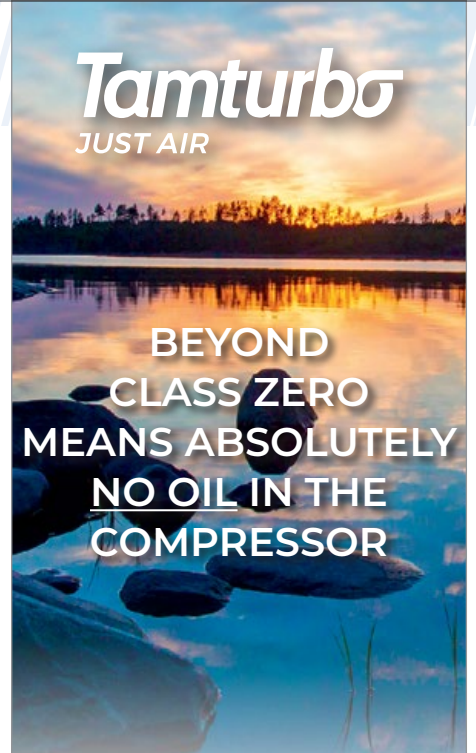
### About OpenBlue

OpenBlue, which Johnson Controls first released in July 2020, is a complete suite of connected solutions and services combined into an open digital platform to make shared spaces safer, more agile and more sustainable.

“Johnson Controls OpenBlue platform brings together traditional operational technology, existing IT systems and cloud applications infused with AI and cutting-edge technology such as digital twins, enabling insight, integration and collaboration,” the company said at the time. “OpenBlue will enable operating technologies to seamlessly communicate and integrate across a broad range of systems.”

OpenBlue customers have several options with the suite, including the flexibility to switch buildings into different modes and address critical situations. Modes including access, air flow, door locks and lighting are all options, along with environmental and safety settings. Additionally, OpenBlue contains a suite of tiered, AI-infused service solutions delivering advanced capabilities such as remote diagnostics, predictive maintenance, risk assessments, compliance monitoring and more.

Johnson Controls notes that OpenBlue was designed with safety at its core to enable customers to access secure solutions for boosted security and privacy processes. Finally, by connecting HVAC equipment with new data and AI, users can expect 20 to 60% cost savings by optimizing the performance of the full HVAC system across energy costs and IAQ parameters.



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## Decarbonization Hits Close to Home for Johnson Controls

The balance of the cooling is dedicated to the factory's water-cooled compressed air system. The Norman plant uses compressed air for multiple pneumatic tooling applications. Having a reliable cooling water supply to the air compressors' aftercoolers is critical to maintaining a stable compressed air supply at adequate pressures and temperatures.

"With the upgrades, the condenser piping was modified to facilitate the use of free cooling for the compressed air system, reducing the need to use mechanical cooling from the chilled water plant at all times," Barve noted.

"Leveraging the Metasys™ controls system, we can control the tower fans to make colder condenser water to satisfy process load

requirements," Barve added. "Now, the new air compressors don't require as cold a water temperature to stay operational, so the free cooled condenser water can actually keep the air compressors cooler."

Johnson Controls was glad to have its internal teams available for commissioning and factory testing of the upgraded systems. The company retained local partners for the systems' electrical and mechanical work.

### Monitoring Progress at the Norman Plant

Johnson Controls will monitor the performance of the central utility plant with its Metasys™ and OpenBlue platforms (see the sidebar for more on OpenBlue), which work in tandem

to provide emissions reporting. Part of that will be monitoring the progress of its water conservation efforts, as the company is targeting a savings of 3.5 million gallons of water annually. This reduction will be achieved by replacing water-cooled ice machines with air-cooled ice machines and upgrading fixtures with low flow devices.

The team at the Oklahoma facility closely monitored this project to meet an important goal: completing the upgrade with minimal disruption to operations. Barve cited overall coordination, setting realistic and clear expectations and the engineering design team of Alfonso Bortone, Craig Mays, James Jozefiny, David Evers and Jonathan Whitesides for its success.

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One key element that allowed the project to thrive was the use of process fluids through a sophisticated piping plan.

“There were two different mechanical rooms that we combined into one, so we saved some space for future expansion of the factory, which is valuable. But, as we were doing that, we had to change all the piping, and if we had run the piping inside the building, it would have created a lot of disturbance for the factory operations. Instead, we laid out the piping on the roof, and dropped down where needed.”

The CUP upgrade design used a glycol mix, specifically on the secondary side, to make the piping on the roof work: “That’s the idea here, the way we were looking at it. By using a glycol mix, we can prevent freezing. In Oklahoma, it can go into negative temperatures and still work effectively,” Barve said.

**Positive Results to Date**

Johnson Controls touts a number of metrics that resulted from its upgrade. Its greenhouse gas emissions could drop by 43% and its energy consumption by 26%. That equates to about \$960,000 in annual energy and operating savings at this facility alone. Of that 43%, Barve pointed out, 10 to 15% is a direct result of the new central plant infrastructure.

Using its OpenBlue platform, Johnson Controls was able to begin by understanding the baseline. It learned the essential needs and constraints, as well as the budget, timeline, reduction requirement and carbon footprint goals. In this case study, that knowledge and expertise was there internally.

Johnson Controls is practicing exactly what it provides to customers: energy efficiency,

decarbonization, energy transition and renewable energy via a modernized package. As Barve added, it makes for a unique showcase: “The sustainable infrastructure team can come in and deliver, design, build,

own, operate, finance and maintain solutions, and that is one of the ways we have done this particular project in an efficient way.”

*All images courtesy of Johnson Controls.*

**About Johnson Controls**

*Building on a history of nearly 140 years of innovation, Johnson Controls delivers the blueprint of the future for industries such as healthcare, schools, data centers, airports, stadiums, manufacturing and beyond through OpenBlue, its comprehensive digital offering. With a global team of 100,000 employees in more than 150 countries, it offers the world’s largest portfolio of building technology and software, as well as service solutions from some of the most trusted names in the industry. For more information, visit <https://www.johnsoncontrols.com>.*

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# How IoT and AI Transform Compressed Air System Management

*Tomorrow's smarter solutions will not only fix problems as soon as they happen, but fix them before they happen*

By Jayme Leonard, Digital Marketing Specialist, Atlas Copco Compressors

▶ In the rapidly evolving landscape of industrial automation, the integration of internet of things (IoT) and artificial intelligence (AI) is reshaping production and utility management. Compressed air system management stands out as an area undergoing significant transformation. Compressed air systems are critical in many industries, serving as a power source for tools, machinery and various processes. However, traditional systems are often plagued by inefficiencies, leading to high operational costs and energy waste. The advent of smart compressed air solutions powered by IoT and AI promises to revolutionize this domain by enhancing efficiency, reliability and overall performance.

## The Importance of Compressed Air Systems

Compressed air is often referred to as the “fourth utility” after electricity, water and gas. Its versatility and utility make it indispensable in manufacturing, pharmaceuticals, food and beverage production and many other sectors. However, maintaining and operating compressed air systems efficiently has always

been a challenge due to their inherent energy-intensive nature. Traditional systems frequently suffer from compressed air leaks, pressure drops and inefficient air compressor operations, leading to significant energy losses. According to the U.S. Department of Energy, compressed air systems in the industrial sector can account for up to 10% of total electricity consumption, with potential losses due to inefficiencies reaching as high as 30%.

*“The fusion of IoT and AI is revolutionizing the management of compressed air systems.”*

## The Role of IoT in Compressed Air Systems

IoT technology is fundamentally changing how compressed air systems are monitored and managed. IoT involves connecting physical devices to the internet, enabling them to collect and exchange data. In the context of compressed air systems, IoT devices such as sensors, actuators and smart controllers are deployed to monitor various parameters in real-time, including pressure, temperature, humidity, flow rates and energy consumption.

- 1. Real-Time Monitoring and Diagnostics:** IoT-enabled sensors continuously monitor the health and performance of a compressed air system. Real-time data collection allows for immediate detection of anomalies such as leaks, pressure drops or unusual temperature variations. This instantaneous feedback loop is crucial for identifying and addressing issues before they escalate into costly downtimes or system failures.
- 2. Predictive Maintenance:** Traditional maintenance practices often rely on scheduled intervals, which can either be too frequent or not frequent enough. IoT changes this by enabling predictive maintenance. By analyzing data trends and patterns, the system can predict when a component is likely to fail and alert maintenance teams to take preemptive action. This reduces unplanned downtimes and extends the lifespan of equipment.

*Above: This oil-free rotary tooth air compressor is paired with a central controller.*

- 3. Energy Management:** Energy efficiency is a primary concern in managing compressed air systems. IoT devices help in optimizing energy use by monitoring and adjusting the air compressor's operations in real-time based on demand. This ensures air compressors run only when needed and at optimal efficiency, significantly reducing energy consumption and costs.

**AI-Driven Enhancements in Compressed Air Systems**

While IoT facilitates comprehensive data collection and real-time monitoring, AI takes it a step further by enabling advanced data analysis and decision-making capabilities. AI algorithms can process vast amounts of data from IoT devices, uncovering insights that would be impossible for humans to detect.

- 1. Advanced Analytics and Optimization:** AI-driven analytics can identify inefficiencies in the system and recommend optimization strategies. For instance, AI can analyze compressed air demand patterns and optimize compressor operations to match these patterns, reducing energy waste. Additionally, machine learning models can continuously learn and improve the system's performance over time.
- 2. Fault Detection and Diagnosis:** AI algorithms excel in pattern recognition, making them adept at identifying subtle signs of faults or inefficiencies that might be missed by traditional monitoring systems. By analyzing historical and real-time data, AI can pinpoint the root causes of issues and suggest corrective actions. This proactive approach helps minimize downtime and maintenance costs.



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## How IoT and AI Transform Compressed Air System Management

### 3. Integration with Industrial

**Automation Systems:** AI can integrate compressed air systems with broader industrial automation platforms, enabling coordinated operations across different machinery and processes. This holistic approach ensures the compressed air system operates in harmony with other systems, further enhancing overall efficiency and productivity.

### Case Studies and Real-World Applications

The impact of IoT and AI on compressed air systems can be illustrated through several real-world examples and case studies.

**Automotive Industry:** In the automotive manufacturing sector, compressed air is used extensively for powering tools and machinery. A leading automobile manufacturer integrated IoT sensors and AI analytics into its compressed air systems, resulting in a 20% reduction in energy consumption. The system's ability to predict maintenance needs and optimize air compressor operations based on real-time demand patterns significantly contributed to these savings.

**Food and Beverage Industry:** A large beverage production facility implemented an IoT and AI-driven compressed air management solution to address the challenge of maintaining consistent pressure levels required for bottling processes. The smart system reduced pressure variability by 15%, leading to smoother operations and a 10% increase in production efficiency.

**Pharmaceutical Manufacturing:** In pharmaceutical manufacturing, where precision and reliability are paramount, a company adopted smart air solutions to monitor and manage its compressed

air systems. The integration of predictive maintenance and real-time monitoring reduced unplanned downtimes by 30%, ensuring uninterrupted production and maintaining stringent quality standards.

### IoT and AI Challenges and Considerations

While the benefits of IoT and AI in compressed air system management are clear, there are several challenges and considerations to keep in mind.

- 1. Data Security and Privacy:** With the increased connectivity of IoT devices, ensuring data security and privacy is crucial. Industrial systems are potential targets for cyberattacks, and safeguarding sensitive data from breaches is a top priority.
- 2. Integration with Existing Systems:** Retrofitting existing compressed air systems with IoT and AI capabilities can be complex and costly. Ensuring compatibility and seamless integration with legacy systems requires careful planning and execution.

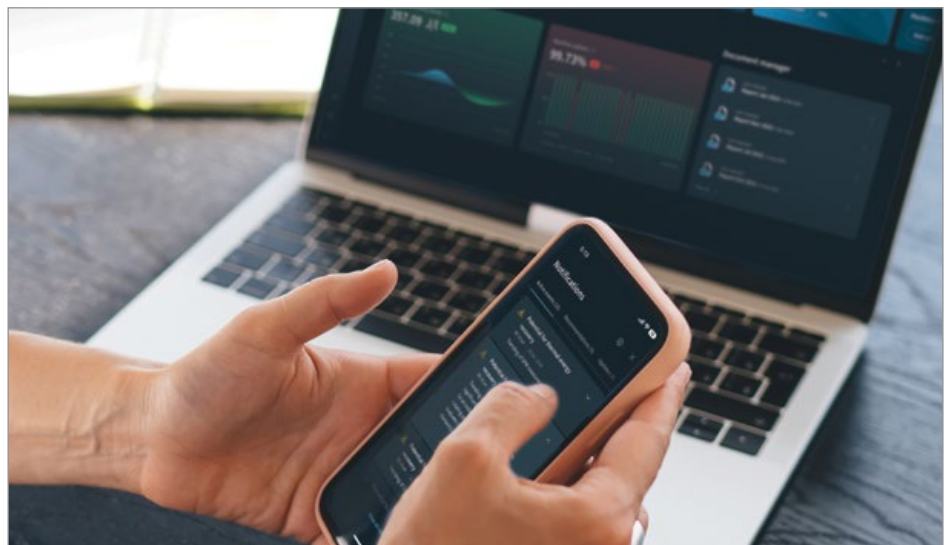
**3. Initial Investment:** The deployment of IoT sensors, AI software and other associated technologies involves a significant initial investment. However, the long-term savings in energy costs and maintenance expenses often justify this expenditure.

**4. Skilled Workforce:** Managing and maintaining smart compressed air solutions requires a workforce skilled in IoT, AI and data analytics. Continuous training and upskilling of employees are necessary to fully leverage the benefits of these advanced technologies.

### Future Trends and Developments

The integration of IoT and AI in compressed air system management is still in its early stages, with significant advancements anticipated in the coming years.

**1. Edge Computing:** The adoption of edge computing, where data processing occurs closer to the source of data (i.e., the IoT devices), will enhance the speed and efficiency of data analysis. This will



Atlas Copco SMARTLINK captures live data from compressed air equipment and translates it to insights. Operators can check uptime, energy efficiency and the health of the complete installation.

enable more responsive and real-time adjustments to the system.

## 2. Enhanced Machine Learning

**Algorithms:** As AI algorithms become more sophisticated, their ability to predict system behavior and optimize performance will improve. Advanced machine learning models will offer deeper insights and more accurate predictions, further enhancing system reliability and efficiency.

## 3. Integration with Renewable

**Energy Sources:** Future compressed air systems could be integrated with renewable energy sources, such as solar or wind power. AI can optimize the use of these renewable sources, ensuring that compressed air systems operate sustainably and cost-effectively.

## 4. Blockchain for Data Integrity:

Blockchain technology could be employed to ensure the integrity and security of data collected by IoT devices. This decentralized approach to data management can enhance trust and transparency in industrial operations.

The fusion of IoT and AI is revolutionizing the management of compressed air systems, bringing unprecedented levels of efficiency, reliability and cost-effectiveness. By enabling real-time monitoring, predictive maintenance and advanced optimization, these smart compressed air solutions address long-standing challenges associated with traditional compressed air systems. As technology continues to advance, the potential for further enhancements and innovations in this field is immense. Industries that embrace these smart compressed air solutions will be well-positioned

to achieve significant competitive advantages through improved operational performance and reduced energy consumption. The future of compressed air system management is undeniably smart, driven by the transformative power of IoT and AI. **BP**

All photos courtesy of Atlas Copco Compressors.

### About the Author

Jayne Leonard is a Digital Marketing Specialist for Atlas Copco Compressors.

### About Atlas Copco Group

Atlas Copco Group enables technology that transforms the future. The company innovates to develop products, services and solutions that are key to its customers' success. Its four business areas offer compressed air and vacuum solutions, energy solutions, dewatering and industrial pumps, industrial power tools, and assembly and machine vision solutions. In 2022, the Group had revenues of BSEK 141, and 49,000 employees. For more information, visit <https://www.atlascopcogroup.com/en>.

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# HVACR Cooling Products Certification Helps Rule Out Reliability Risks

By Ian Butler, Partnership Manager, Eurovent Certification

► It's a universal truth that no person or machine is infallible, yet when we buy a product, we expect 100% reliability. This isn't just in terms of avoiding a fault or breakdown, we expect the product to:

- Perform as advertised, so it works in real life as it does on paper
- Provide accurate product data for reliable system design
- Be compliant with regulations

To add to this, those making purchasing decisions for HVAC and refrigeration (HVACR) products can face a minefield. Not only do they have to deal with key factors such as installation cost and whole lifecycle cost, but selecting reliable, energy-efficient technologies is crucial as decarbonization and sustainability demands increase.

With a myriad of manufacturers and products to choose from, it's important decision makers know about the free and helpful tools at their disposal. In this article, the independent third-party product certification body Eurovent Certification explains how to aim for excellence and safeguard against reliability risks by using products with proven performance.



Ian Butler, Business Partnership Manager, Eurovent Certification.

## Underperformance Is a Hidden Issue

Even the best designed systems will underperform if real life product performance does not match manufacturer claims. Products that underperform can:

- Be non-compliant with regulations
- Use more energy
- Create a larger carbon footprint
- Incur high running costs
- Not meet end-user requirements
- Be more prone to faults and breakdowns
- Impact other parts of the system
- Result in penalties, litigation and reputational damage

How do you know which products to trust? Third-party product certification can mitigate risks by verifying manufacturers' claims, ensuring products perform as promised.



**BAC Case Study: The Impact of Underperformance**

A new cooling tower is required for use in an industrial HVAC application, operating year-round, with a load variation from 100% in summer to 80% in winter. The cooling tower for this application would be selected for a summer condition to cool 52 l/s (824 gpm) of water from 89.6°F (32°C) to 80.6°F (27°C) at an entering wet bulb temperature of 69.8°F (21°C). The cooling capacity to be rejected would be 1,090 kW.

The decision maker has the choice between two cooling towers. **Model A**, is a certified cooling tower, with performance data independently verified. **Model B** is uncertified. Unknown to the specifier, its actual performance is 80% of the required duty if using the specified conditions. Therefore, Model B has supply water 2.2°F (1.2°C) warmer than designed and the installation will be penalized the entire year by the higher supply water temperature. It will for example, take a wet bulb of 66.7°F (19.3°C) to supply the required 89.6°F (32°C)/80.6°F (27°C) water temperature as shown in Table 1.

Model B is available at a slightly lower price (approximately 10 to 15% cheaper). Note that the customer cannot tell Model B will underperform based on the dimensional data and face values for fan power and sound.

**Performance at Design Conditions**

Model A will perform to the specified design conditions as expected. Model B will have to operate slightly outside the design conditions to reach the 1,090 kW cooling capacity. Model B's underperformance will impact the whole system, because:

- The installed chiller will not totally stop due to excessive high pressure; due to the 2.2°F (1.2°C) warmer water the chiller will unload and capacity will

suffer, however it will not fail. The final result will be some loss of comfort, or in the case of industrial applications, some slowdown of the production process will take place.

- In typical Mid-European climates there will be less than 100 hours when the wet bulb temperature is higher than 66.7°F (19.3°C), spread over a few summer days.

Table 1. Two Cooling Towers Compared		
	Model A (certified)	Model B (uncertified)
<b>Cooling Capacity (Declared)</b>	1,090kW (310TR)	1,090kW (310TR)
<b>Summer water condition</b>	52 l/s (824gpm) @32°C (89.6°F) to 27°C (80.6°F)	52 l/s (824gpm) @32°C (89.6°F) to 27°C (80.6°F)
<b>Entering Wet Bulb</b>	21°C (69.8 °F)	19.3°C (66.7 °F)
<b>Size</b>	3.6m (11ft-10") (L) 2.4m (7ft-10") (W) 3.5m (11ft-6") (H)	3.6m (11ft-10") (L) 2.4m (7ft-10") (W) 3.5m (11ft-6") (H)
<b>Fan installed</b>	15kW (20hp), Absorbed Power = 14.2kW	11kW (15hp), Absorbed Power = 10kW
<b>Sound Power</b>	99 dBA	96 dBA
<b>Variable frequency drive with concentration factor</b>	2.5	2.5

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## HVACR Cooling Products Certification Helps Rule Out Reliability Risks

The underperformance may seem slight. In fact, there may be several years of bad summers, where design water temperature conditions are never exceeded. So why is it a problem?

The answer can only be found if we look at the annual economic impact. By comparing Model A and Model B, we see the fan kWh requirement for Model A will be 27,770 kWh and for Model B it will only be 25,400 kWh, due to the smaller fan motor. However, look at the electrical energy needed for the chiller: For Model A, we need 1,114,360 kWh, but for Model B the chiller

requirement goes up to 1,178,700 kWh, which is almost 6% more. Therefore, if we add up the chiller and fan kWh, Model B needs 5% more electrical energy on an annual basis.

See Table 2 for an example of additional operating costs for a non-certified cooling tower + chiller = **+\$13,517 (+€12,394)/annum** at a modest \$0.22 (€0.20)/kWh.

Note that energy prices have fluctuated wildly over the last couple of years. The increase

kWh rate, at its peak in January 2023, would have seen a rate of \$0.55 (€0.50)/kWh = **+\$33,792 (+€30,985)/annum!**

But it doesn't end there. In addition to electrical costs, there is more water consumption for Model B because the chiller has to work harder, hence more waste energy has to be dissipated and more water will evaporate. In our example, Model B will consume per annum 500m<sup>3</sup> water more. If we take the modest cost for water supply, sewage and chemicals \$3.94/m<sup>3</sup> (€3.61/m<sup>3</sup>), this adds another \$1,969 (€1,805) per year.

The total additional annual operating cost for water and electricity for the system with Model B is **\$15,485 (€14,199)**. This is around half

Table 2. Example Of Additional Operating Costs For A Non-Certified Cooling Tower + Chiller			
	Cooling tower + chiller (kWh)	Total (kWh & €)	Difference (kWh & €)
Model A	Fan kWh = 27770 kWh + Chiller power = 1,114,360 kWh	1,142,130 kWh €228,426	0 0
Model B	Fan kWh = 25400 kWh + Chiller power = 1,178,700 kWh	1,204,100 kWh €240,820	<b>+ 61970 kWh</b> <b>€12,394</b>

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the initial cost of the new cooling tower, and shows the small installation price advantage is a false economy. Long term, Model A offers a more energy efficient, effective, reliable and cost-friendly choice.

Certified thermal performance testing guarantees performance and removes both risk and guess work to obtain system economics.

**Eurovent Certification: The Ultimate Safeguard for Product Decisions**

Certification finds the truth of a product, creating trust between all players in the industry. However, not all certifiers or certification schemes are equal. Manufacturers can choose from a range of programs delivered by laboratories or certification bodies, so it's always wise to understand what each offers. With over 40 programs, including the flagship Eurovent Certified Performance mark, Eurovent Certification is a world leader in certifying HVACR product performance.

**Independent and Impartial Certification**

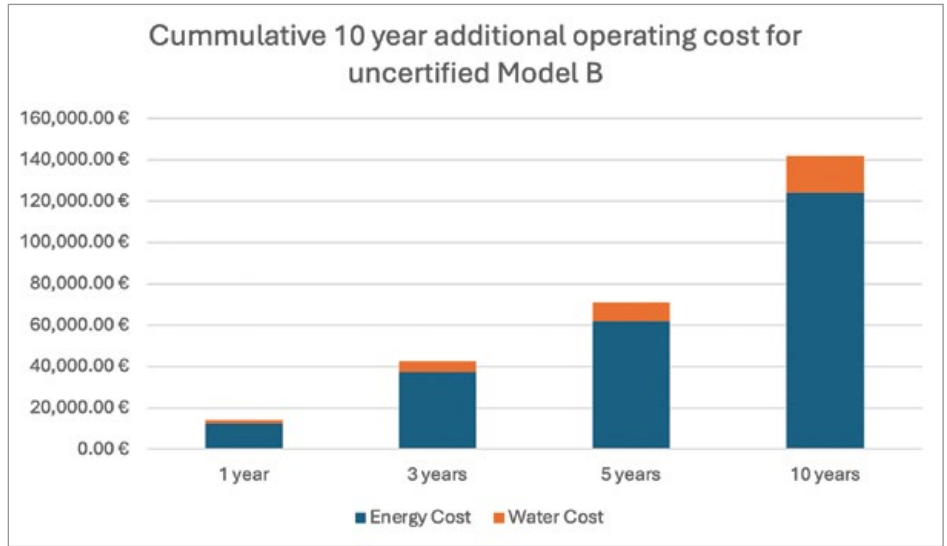
As a third-party certification body, Eurovent Certification works independently of manufacturers (first party) and their customers (second party), with no bias toward or against any other party. The value of third-party certification is that product performance is verified by an independent body without a vested interest. In fact, Eurovent Certification is obliged by its ISO IEC 17065 accreditation (by COFRAC\*) to provide certification programs that are non-discriminatory and impartial.

**Fair But Rigorous Certification Process**

The Eurovent Certified Performance mark cannot be bought. All products are rated against a common set of criteria. Using state-of-the-art evaluation protocols, products must pass

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## HVACR Cooling Products Certification Helps Rule Out Reliability Risks

Impartiality standards are kept high as manufacturers and laboratories have no direct contact, keeping the process clear of any bias.

### Enhanced Testing and Evaluation

Eurovent Certified Performance is elevated above laboratory testing alone, as Eurovent Certification also:

- Audits manufacturing site(s)
- Undertakes selection software checks
- Analyses the submitted data for technical credibility and continuity
- Undertakes yearly surveillance monitoring
- Every model in range under a certify-all program must be submitted and pass the certification criteria; this ensures quality throughout the range, and not just the flagship model

Crucially, the products tested can be taken from the production line, factory stock or point of sale, ensuring the product tested is the same as those leaving the production line.

### Certified Software

Most Eurovent Certified Performance programs include selection software certification, meaning it's not just the products themselves that are certified, but the tools to select them, as well. This offers reliability and reduced risk for system design, especially in applications where there is a 0% tolerance for modelling.

### Compliance with LEED Building Scheme

Where a specified drift rate is required to meet LEED 0.002%, Eurovent certified products provide assurance of compliance

and product performance, reducing the risk of litigation. Additionally, the Eurovent Certified Performance program for cooling towers measures pressure drop of the power input and power absorbed by the fan during operation, giving further assurance of performance.

### Customer Confidence

For specifiers, buyers, installers and end users, Eurovent Certified Performance provides peace of mind that chillers, cooling towers and other certified HVACR products will perform as expected.

### Certification Encourages Innovation and Competition

Manufacturer R&D teams can use certified data to provide a reliable baseline for product development, allowing them to evaluate the effectiveness of their innovations. Certifying new or improved products also creates confidence in new technology.

### Quality Control

For manufacturers, Eurovent Certification's factory audits aid in-house quality controls, ensuring standards on the production line remain high. Products are audited not only when initially certified, but most Eurovent Certified Performance programs demand annual audits, as well.

### Finding Certified Products

Eurovent Certification provides free, 24/7 access to transparent, accurate, universally understood performance data via its online

Certified Product Directory. Whether you are considering a product new to the market, a brand you haven't used before or want to check the credentials of your "go to" choice, you can use certified data to confidently compare products and make informed decisions.

Search HVACR products by product family, type, brand, model name or certificate number. If a product isn't there, it isn't certified. Visit <https://www.eurovent-certification.com> to let the power of proven performance rule out reliability risks. **BP**

### About the Author

*Ian Butler has 37 years' experience in HVACR, with 14 of those at Eurovent Certification. He is Program Manager for the Eurovent Certified Performance programs for both cooling towers and drift eliminators, and acts as U.K. Partnership Manager.*

### About Eurovent Certification

*Established in 1993, Eurovent Certification is recognized as a world leader in voluntary, third-party product performance certification. Eurovent Certification certifies over 40 HVACR programs, including the flagship Eurovent Certified Performance mark, the NF mark, QB mark, Keymark, CE Trade Mark and MCS for Heat Pumps. For more information, visit <https://www.eurovent-certification.com>.*

\* Eurovent Certification is accredited as a certification body compliant with ISO/IEC 17065:2012 standard by COFRAC (Accreditation N°5-0517, scope available on <https://www.cofrac.fr>.)

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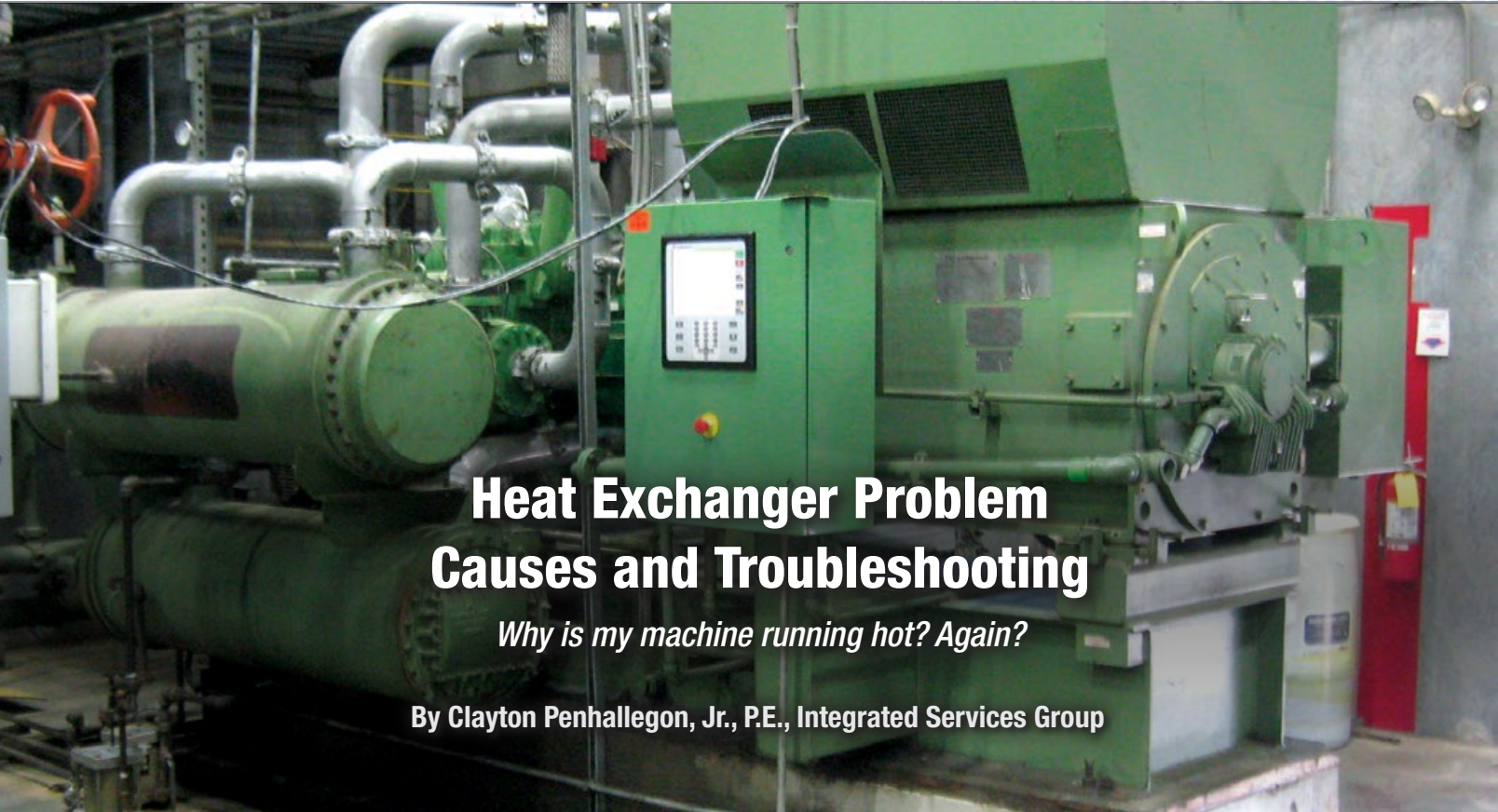
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# Heat Exchanger Problem Causes and Troubleshooting

*Why is my machine running hot? Again?*

By Clayton Penhallegon, Jr., P.E., Integrated Services Group

► It is unfortunately all too common in industrial plants to have machines suffering from high temperature conditions. Often, the same machines have repeat problems, even after changing parts or taking other steps to remedy the situation.

To solve these problems, it helps to have some understanding of heat exchanger application basics and how their use in real world situations can be assessed and improved; moreover, not every high temperature condition is a heat exchanger problem! Note this is not a formal treatise on heat exchanger design or applications. Instead, the following observations are intended to help plant personnel better identify high temperature causes and solutions instead of blindly replacing parts and hoping for the best.

## Industrial Heat Exchanger Applications Overview

Heat exchangers are critical components in many industrial devices including air compressors, hydraulic machines and many other machine and process cooling

applications. Of course, they are also inextricable parts of the cooling system equipment itself – chillers and cooling towers are literally heat exchangers with associated components. Fortunately, cooling system equipment is usually designed for easy maintenance and includes robust capacity relative to the heat loads.

Process machine heat exchangers, on the other hand, are designed to perform the needed machine cooling at reasonable cost and under normal conditions. The compromises often include heat exchanger type and location on a machine, which, in turn, substantially affects the maintainability of the heat exchanger over the life of the machine.



*Gearbox oil cooler equipped with thermostatic control valve (in box with gauge) and leaving oil temperature sensor in fitting at other end of heat exchanger.*

Common industrial machine cooling applications are typically oil cooling (either lubricant or hydraulic), which are typical in many industries on air compressors or machine gearboxes, and closed loop, treated water cooling for plastic molds, extruder barrel cooling systems and calendar roll stands. This article will use the closed loop, oil cooling application as the prototypical assumed case.

It is, unfortunately, quite common in plants to have high machine operating temperatures. Some equipment will fault from internal protective functions (e.g., air compressors) while others without these protections may continue to run but with highly undesirable outcomes. These can include significant damage to the machine (and expensive repair costs) and/or production of bad parts (which are costly to replace and may result in customer issues).

Remembering that equipment manufacturers are trying to provide adequate cooling for unknown and uncontrolled circumstances (in that they have little control over how a machine is actually cooled once in the customer's hands), they use two approaches – cooling design and cooling medium specifications.

First, they design the cooling systems for what are typically considered “near worst case” applications, so they can handle challenging but not impossible situations.

Second, they specify the minimum required cooling water conditions (temperature and pressure) conservatively so problems are unlikely if those conditions are maintained. This can be seen in temperature and flow requirements that calculate out to higher heat loads than the machine can produce, minimum required supply pressures much greater than the machine's design pressure drops at rated flows and other inherently padded requirements.

Before going into recommended evaluation steps, a brief review of heat exchanger basics will help put the suggestions in context.

### Heat Exchanger Fundamentals

There are a wide variety of heat exchanger designs and features that are beyond the scope of this article. Different types provide for heat exchange between different mediums (such as water to water, air to water and oil to water) and different pressures. The basis of this article is that the type of heat exchanger is already decided by the machine manufacturer and the plant is simply trying to get the system to perform properly.

For any given heat exchanger (HX) application there are several variables that govern the performance of the system:

- Hot side entering temperature
- Hot side flow rate
- Cool side entering temperature
- Cool side flow rate
- Heat exchanger effectiveness

HX effectiveness is a roll-up term that encompasses multiple factors for simplicity. Again, given that the design of the HX is already selected, including materials and thicknesses, physical features (smooth surfaces, fins) and flow paths, effectiveness basically boils down to “is it working like it should given the temperature and flow conditions?”



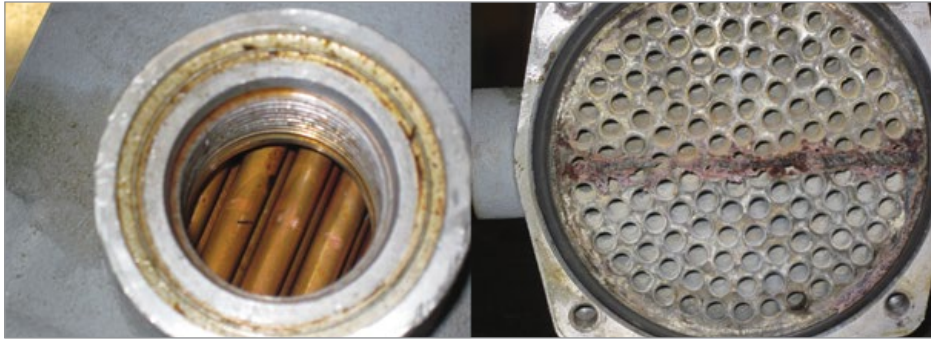
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## Heat Exchanger Problem Causes and Troubleshooting



*Oil cooler showing clean tubes on oil side and mineral fouling on water side. Thin layers of scale significantly impact cooling. Note more scale is on the warm leaving water half (bottom).*

It must be remembered heat exchangers are exactly that – exchangers – so the heat being removed from one side is invariably the same as the heat taken in by the other side. In other words,

$$\text{Hot side heat out} = \text{Cool side heat in}$$

Recognizing the equality requirement can be helpful to troubleshooting high temperature problems. This can be considered by answering three questions:

1. Is the machine heat being delivered to the heat exchanger?
2. Is the heat exchanger capable of transferring the heat?
3. Is the cooling system properly removing the heat?

See the sidebar for more details on heat exchange calculations.

### Heat Exchanger Fouling and Mitigation Methods

One common cause of poor HX operation is fouling, described as the accumulation of unwanted substances on the surfaces of heat exchangers. The unwanted substances could be mineral scales, sediment, corrosion products, organic matter or biological growth, and

may occur alone or in combination. Fouling is like putting a layer of insulation on the heat exchanger surface. It frequently leads to compounding conditions that get progressively worse with accelerating bad performance.

Fouling is frequently the issue when HXs have acceptable temperature and flow conditions but do not provide good cooling. However, while it is a frequent cause of poor machine cooling, it is not the only cause. Many other factors can cause machine cooling issues besides fouling and it is vital but sometimes difficult to determine the underlying cause of high machine temperatures.

Heat exchangers can sometimes be cleaned but, depending on the heat exchanger design, it can be difficult to completely remove minerals and

other contaminants. Consequently, the typical response is to replace the heat exchanger. While the new HX will often improve the conditions, in other cases it will not last or the problem will continue unabated, leading to frustrating situations.

Consistent and appropriate water treatment practices are critical to control heat exchanger fouling. Consistency is critical as poor-control events allow fouling conditions to start, which then become progressively worse over time. Note that the same treatment program that is fine for chiller condensers may not be good at all for air compressors or other higher temperature cooling applications, as potential for mineral scaling increases with operating temperature. Condensers practically never see hot-side temperatures over 100 to 105°F (38 to 41°C) while air compressor HXs may regularly face hot side temperatures of 200°F (93°C) or higher.

Because it's nearly impossible to eliminate fouling in open tower water systems, Integrated Services Group (ISG) strongly recommends converting to closed loop systems isolated behind parallel, redundant plate heat exchangers for tower water cooling applications (the redundancy supports cleaning one HX at a time with continuous



*Sediment on the open loop side of an isolation plate heat exchanger before cleaning. This material was kept out of the plant machine heat exchangers.*

operation). Our clients using these systems, which limit the dirty open loop tower water to one side of the isolation HXs, report vastly fewer problems with the various heat exchangers scattered throughout their facilities. This is due to both the improved water quality in the machine-side closed loop and the temperature-limiting effect at the point of the tower water heat exchange – the open loop tower water never sees the high temperature HXs and instead is only cooling the blended temperature closed loop water.

### Machine Operation Observations

Keep in mind that machines can't store heat in any meaningful amounts – heat in must equal heat out. Any machine with zero cooling will overheat quickly, potentially with catastrophic results. Long before that point, a machine will simply run hotter as the temperatures rise to an equilibrium condition where the heat being generated is transferred to the cooling medium (i.e., the  $T_{in} - T_{out}$  part of the heat transfer equation gets larger).

The time frame of overheating is typically in minutes. Documenting the operating conditions over time, particularly when a machine or its heat exchanger are new or recently cleaned, can be extremely helpful in evaluating these situations.

### Field Checks and Typical Heat Exchanger Operating Conditions

Machine cooling condition readings should include as many of the following as possible:

- Entering cooling water temperature
- Leaving cooling water temperature
- Cooling water flow (if available)
- Entering cooling water pressure (if flow is unavailable)

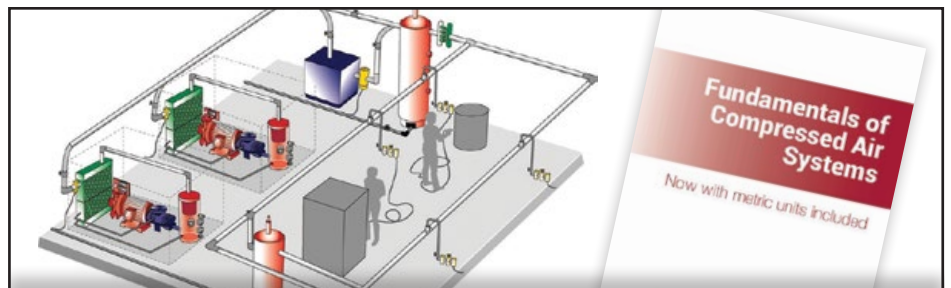
- Leaving cooling water pressure (if flow is unavailable)
- Supply and return header pressures
- Machine operating load (% , amps, other indication as available)
- Machine internal temperature(s)
- Machine internal valve positions, cooling loop flow control settings

Most plants don't have portable flow meters or good access to the flow piping, but it is helpful to make flow readings along with the temperatures and pressures listed above. Actual flow readings can be used with current and

future pressure readings to correlate flow values when the meter is not installed.

Under normal conditions, the cooling water temperature should change by  $\approx 10$  to  $15^{\circ}\text{F}$  ( $6$  to  $8^{\circ}\text{C}$ ), e.g., in at  $80^{\circ}$  ( $27^{\circ}\text{C}$ ) and out at  $90$  to  $95^{\circ}\text{F}$  ( $33$  to  $35^{\circ}\text{C}$ ). This should match up with a pressure drop of around  $12$  to  $20$  psi ( $0.8$  to  $1.4$  bar) for gauges connected immediately adjacent to the machine after any strainers or flow balancing devices (such as circuit setters).

Pressure drop through an inline strainer should not exceed  $3$  psi ( $.2$  bar) in normal operation and should be  $2$  psi ( $.1$  bar) or less when clean. For properly designed piping systems, the pressure at the supply and return headers to the machine drop should be  $20$  to  $30$  psi ( $1.4$  to



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## Heat Exchanger Problem Causes and Troubleshooting

2 bar) apart, or something like 60 psi (4 bar) supply, 30 psi (2 bar) return.

Piping drop pressure losses are efficiency penalties that don't provide any value to the plant. If the drop piping is made larger, for

example using 2 1/2-inch vs. 2-inch (i.e., one or two sizes larger in under 2-inch pipe and one size larger when over 2 inches), then the system can be run at lower pressures with significant pumping efficiency improvements. In many plants, 50% or more of the pressure

required is for distribution losses, while in a high efficiency system the distribution losses can be less than 20%.

Be sure to use high quality temperature sensors and pressure gauges. See the *Chiller & Cooling Best Practices Magazine* article "Vital Signs: Critical Instrumentation for Cooling System Health" (Sept. 2023) for more information on selecting and using instrumentation for cooling and other utility systems.

### Heat Transfer Equation Calculations

The heat flow (whether in or out but always from high to low) is described by the equation:

$$Q = U \times A \times (T_{in} - T_{out})$$

which for our interests in analyzing high temperature conditions is significantly simplified because of the existing situation we are evaluating.

A, for the heat transfer surface area, is defined by the existing heat exchanger.

$(T_{in} - T_{out})$  become defined in the operation and, as we will see, can be affected by application characteristics.

U is the overall heat transfer coefficient, and this is the part that can get squirrely. U is a function of several factors including the fluid properties involved, the material(s) used in the heat exchanger, the material thickness and the surface shape (smooth, grooved, finned), which, again, are predefined in a given application.

However, there are a couple factors that are variable in operation. The first is the fluid velocity over the surface, and this is a critical part of the calculation. The simplest way to comprehend this is to recognize (with extreme simplification of the math for a water-to-water application):

$$\text{Hot side GPM} \times (\text{Hot } T_{in} - \text{Hot } T_{out}) = \text{Cool side GPM} \times (\text{Cool } T_{in} - \text{Cool } T_{out})$$

The other variable aspect of U is the thermal conductivity, or the heat transfer capability of the HX. Technically, this does not change as the HX material and design are constant, however any surface fouling that occurs has the effect of changing the realized thermal conductivity. While they would be precisely analyzed as two separate layers of HX material, for our practical evaluation we can treat the HX material and any changes to it caused by surface fouling as a single property.

Consequently, when analyzing a high temperature situation, we have to consider both the heat exchanger condition (i.e., any fouling or area reduction from blocked tubes), as well as the medium conditions including the entering and leaving temperatures and also the flow rates and fluid velocities on both sides.

### Common Heat Exchanger Problems

When trying to troubleshoot high machine temperatures, the following are common potential causes:

- Heat exchanger fouling
- Warmer cooling water
- Reduced cooling water flow
- Increased machine heat load (higher running conditions)
- Internal cooling system issues

**Fouling:** While fouling is a common cause, it should be investigated along with the other cooling-side factors below, rather than assumed to be the issue.

#### Elevated cooling water temperature:

Warmer cooling water can occur from seasonal swings in tower-cooled systems, but these temperatures shouldn't be an issue with proper flow. Variations above normal may occur from failures in the cooling water loop such as loss of a tower fan or low tower water flow, and tower water supply temperatures above 87 to 90°F (31 to 32°C) are likely to cause problems. Also, switching machines from chilled water to tower water can reveal problems or even resurrect them, as many times machines are

shifted to chilled water due to high temperature problems. However, chilled water cooling is much more costly (typically five to eight times) and the machine cooling is almost certainly designed for operation at tower water temperatures, so cooling with tower water is preferable if possible.

**Cooling water flow problems:** Reduced cooling water flow is possible from multiple causes upstream and downstream of the machine and the heat exchanger. High temperature situations can arise from any of the following whether alone or in combination:

- Excessively long cooling water piping
- Too small diameter cooling water piping
  - (Note these first two are related
  - larger piping can offset greater length)
- Corrosion and/or other obstructions in piping (clogged strainers or filters)
- Too many devices connected to piping/taps/main header
- Partially closed valves or other devices in the line

Recognize that overall circumstances for a machine can change as new machines or other devices on the system are added, even with no changes to the original machine or its supply piping.

**Increased machine heat load:** The cooling system may be working perfectly but machines may experience high temperatures due to increased loading generating additional heat. This is generally unlikely with packaged equipment such as air compressors, but can occur with custom assembled systems such as extrusion line gearboxes being run faster for

greater throughput. It may also occur where the machine has been running at a lower heat load (for example a lower discharge psi or bar) and is changed to a higher output where the

*Remember that machines can't store heat in any meaningful amounts – heat in must equal heat out.*

previously marginal cooling was adequate but is not sufficient at the higher running load.

**Internal cooling system issues:** Because many machine cooling applications have closed hot side systems with oil or specially treated water, the closed side of heat exchangers are much less prone to fouling (at least compared to cool side fluids). The internal cooling system, which may include throttling or three-way valves, would be looked at after the other

potential causes were evaluated and ruled out. Internal cooling system side issues are fairly rare, and while they can and do occur, they aren't the place you normally look first.

**Machine Cooling Troubleshooting Examples**

Now that the different aspects of heat exchanger operation have been discussed, reviewing several machine cooling scenarios should help illustrate the effect various factors can have on cooling and high temperature conditions.

The following examples are all based on the system shown in the schematic drawing. An air compressor is cooled with water supplied from a nearby header that originates some distance away in the plant. There is a Y strainer in the

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## Heat Exchanger Problem Causes and Troubleshooting

drop to the compressor, thermometers in the drop and pressure gauges in both the drop piping and in the header pipes.

### Example #1:

**Situation:** An air compressor is running hot after getting progressively warmer over the last several months. Sometimes the compressor can run right at the high temperature limit, but at other times it exceeds the recommended running temperature, occasionally tripping off due to high temperature.

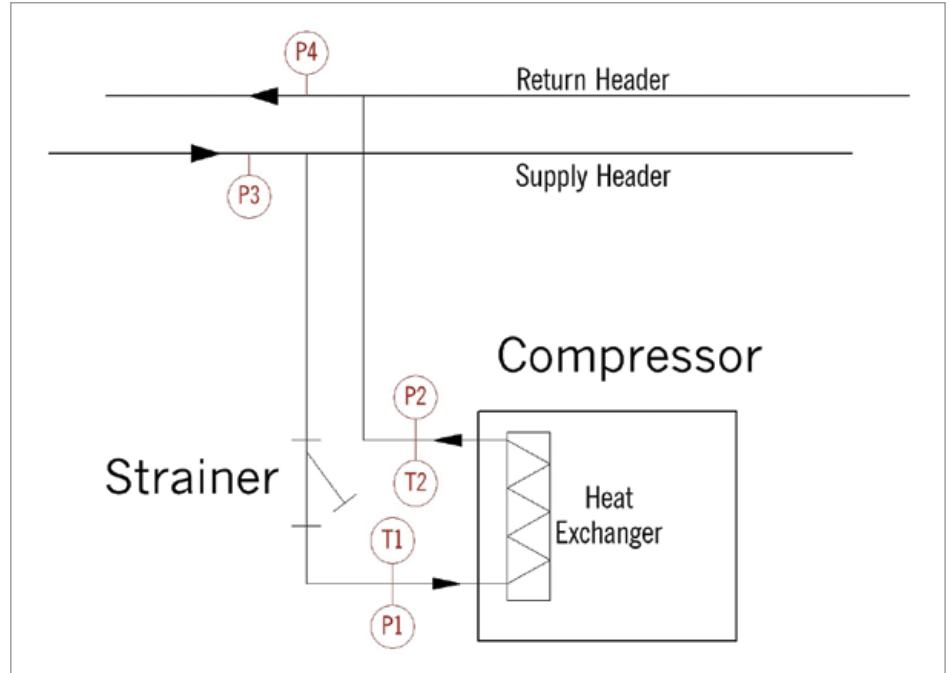
Conditions when examined:

T1 - Entering water temperature	82°F (28°C)
T2 - Leaving water temperature	94°F (34°C)
P1 - Entering water pressure	46 psi (3.2 bar)
P2 - Leaving water pressure	29 psi (2 bar)
P3 - Supply header pressure	56 psi (3.9 bar)
P4 - Return header pressure	23 psi (1.6 bar)

**Analysis:** The temperature difference is 12°F (6°C), which is a reasonable change. The pressure drop through the machine is 17 psi (1.2 bar), which is also typical. The supply pressure decrease from the header to the machine is 10 psi (0.7 bar), which is slightly higher than desired but may reflect a partially fouled Y strainer. Given that the cooling side metrics look good, the problem with this machine is likely fouling in the heat exchanger. The gradual increase in air compressor running temperature is concurrent with classic fouling over time getting worse.

### Example #2:

**Situation:** An air compressor is running hot after operating well for several years. A new compressor was added in the compressor room in the early spring and the temperatures on both are seen to be running warmer into the summer. The piping coming into the



Schematic of air compressor cooling system in troubleshooting examples

room has been installed for over 20 years and is unchanged except for adding the other compressor.

Conditions when examined:

T1 - Entering water temperature	83°F (28°C)
T2 - Leaving water temperature	105°F (41°C)
P1 - Entering water pressure	41 psi (2.8 bar)
P2 - Leaving water pressure	36 psi (2.5 bar)
P3 - Supply header pressure	45 psi (3.1 bar)
P4 - Return header pressure	34 psi (2.3 bar)

**Analysis:** In this case, the temperature difference is 22°F (13°C), which is well above typical design conditions. Conversely, the pressure drop through the machine is only 5 psi (0.3 bar), well below normal. Both this and the in/out temperature difference point toward low cooling water flow. Supporting this, the header supply pressure is lower (45 psi vs. 56 psi or 3.1 bar vs. 3.9 bar) and the return psi/

bar is higher (34 psi vs. 23 psi or 2.3 bar vs. 1.6 bar). These two indicate more total flow and greater pressure loss in the main header pipes. This makes sense given the new air compressor being added and drawing its own cooling water flow without any change to the header pipes. The new compressor also shows warmer temperatures but is not alarming, likely due to its new heat exchanger. The solution is enlarging the supply and return piping for greater cooling flow and possibly replacing the drop piping to the original compressor, if it's in poor condition.

### Example #3:

**Situation:** An air compressor is running hot after operating well for several years. A new compressor was added in the compressor room in the early spring. The new machine is running fine but the original compressor was noticed to be running warmer into the summer and now is tripping off on high temperatures. The piping coming into the room has been installed for over 20 years

and is unchanged except for adding the other compressor.

Conditions when examined:

T1 - Entering water temperature	83°F (28°C)
T2 - Leaving water temperature	105°F (41°C)
P1 - Entering water pressure	33 psi (2.3 bar)
P2 - Leaving water pressure	28 psi (2 bar)
P3 - Supply header pressure	53 psi (3.7 bar)
P4 - Return header pressure	26 psi (1.8 bar)

**Analysis:** In this case, the temperature difference is again 22°F (13°C) and the pressure drop is only 5 psi (0.3 bar). Together, these point to reduced flow through the air compressor. However, the header pressures are relatively unchanged from the original conditions and the new compressor is not having any high temperature issues, as would be the case with insufficient cooling water supply. The key indicator in this case is the large pressure drop from the supply header to the compressor inlet: 20 psi vs. 10 psi (1.4 bar vs. 0.7 bar) in the original case. More importantly, it is 20 psi vs. only 4 psi (1.4 bar vs 0.3 bar) drop in the low flow case where the reduced header pressures caused the lower flow. The high pressure drop occurred due to the strainer being plugged with pipe debris knocked loose in the work adding the new compressor cooling drop. Clearing the strainer solved the immediate problem but the compressed air piping should be closely examined for corrosion and possibly replaced.

**Example #4:**

**Situation:** An air compressor is running hot after a service visit several months ago. It was noticed to be warmer during cool weather, but as ambient temperatures have warmed the compressor is getting excessively warm and shutting down.

Conditions when examined:

T1 - Entering water temperature	82°F (28°C)
T2 - Leaving water temperature	89°F (32°C)
P1 - Entering water pressure	46 psi (3.2 bar)
P2 - Leaving water pressure	29 psi (2 bar)
P3 - Supply header pressure	56 psi (3.9 bar)
P4 - Return header pressure	23 psi (1.6 bar)

**Analysis:** The temperature difference is 7°F (4°C), which is low, however the pressure drop through the machine is 17 psi (1.2 bar), which is typical. The supply and return header pressures also are normal. Together, these point to normal cooling flow but reduced heat transfer into the cooling water. Examining the air compressor revealed that the oil cooling control valve actuator was damaged during the service resulting in choked oil flow through the closed side of the heat exchanger. When the cooling water was cool enough from outside conditions, the compressor stayed within satisfactory limits, but when the cooling water warmed up it could no longer stay within allowable conditions. Repairing the valve control mechanism fixed the oil flow to the HX and solved the problem.

**Conclusion**

Machine cooling high temperature problems are unfortunately all-too common in industrial plants. While the initial suspect is always the heat exchanger, there are several other factors that can be the underlying cause.

Important steps can be taken to minimize the potential for heat exchanger fouling, but when problems do occur, careful examination of the machine and the system can help identify the problem efficiently and with minimal wasted effort.

Please contact the author with any questions or comments. As may be guessed, this article reflects lessons learned from numerous real-world examples. I would be grateful to hear any reader experiences of these type problems and Hard Knocks U-learned solutions. **BP**

**About the Author**

*Clayton Penhallegon, Jr. is the Managing Member of Integrated Services Group, which specializes in industrial cooling water system operational effectiveness and cost reduction. He has worked for over 35 years with various industries including plastics, paper, wood products, metal containers and textiles.*

*He holds a Bachelor of Mechanical Engineering from Georgia Tech, an MBA from Georgia State University and is a registered PE in Georgia.*

**About Integrated Services Group**

*Integrated Services Group performs industrial cooling water system operational effectiveness and cost reduction technical services. Its services include system assessments, new and upgrade system design, system start-up and retrocommissioning, and high efficiency control design and implementation. ISG celebrated its 25th year anniversary in 2022 and serves clients throughout the USA and North America. For information, visit <https://www.isg-energy.com>.*

*Many other factors can cause machine cooling issues besides fouling.*

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# Chiller & Cooling System Technology & Industry News

## Carrier Announces Carrier Cooling-as-a-Service

Carrier is pleased to announce Carrier Cooling-as-a-Service, a portfolio of innovative solutions to help commercial customers simplify the operation of HVAC and other thermal or electricity-generating systems while meeting the challenges of the modern energy transition. Carrier is part of Carrier Global Corporation, a global leader in intelligent climate and energy solutions.

Carrier Cooling-as-a-Service allows customers to contract for long-term performance and predictable payments rather than incurring an up-front capital cost for system or equipment purchases. The new financial model allows customers to focus on their core business while relying on Carrier's turnkey expertise for comfort and operational efficiency.

With Carrier Cooling-as-a-Service, customers can benefit from bundled, high performing solutions while minimizing the need to invest their own capital. Carrier's design, engineering and project development teams become responsible for the project lifecycle – from system design to performance assessments and ongoing operations and maintenance – including achievement of key performance indicators.

The Carrier Cooling-as-a-Service portfolio trades the traditional heating and cooling models that require significant upfront expense to a subscription or service model. Carrier Cooling-as-a-Service provides a predictable cost solution that reliably delivers the latest energy-efficient technology and comfort through advanced controls, equipment and service, ensuring optimal performance and customer satisfaction across the lifecycle.



Carrier has launched Carrier Cooling-as-a-Service, a new service-based model for comfort and energy solutions.

“This marks a foundational shift from providing heating, cooling and energy systems to providing desired outcomes,” said Mead Rusert, Vice President, Building Technologies, Commercial HVAC at Carrier. “With contracts that cover heating and cooling performance, energy usage, sustainability and infrastructure, customers can count on Carrier's expertise to provide optimized building system performance and support to meet the needs of your business.”

Carrier Cooling-as-a-Service will help ensure customers have the latest, most efficient Carrier equipment, to include roof-top units, air handlers, controls and chillers.

“As a global leader in climate and energy solutions, Carrier can help building owners address upfront costs and the potential for maintenance backlogs to allow customers to focus on their core business while Carrier provides reliable operation and peace of mind,” Rusert said.

## About Carrier

Founded by the inventor of modern air conditioning, Carrier is a world leader in high-technology heating, air-conditioning and refrigeration solutions. Carrier experts provide sustainable solutions, integrating energy-efficient products, building controls and energy services for residential, commercial, retail, transport and food service customers. Carrier is a part of Carrier Global Corporation, a global leader in intelligent climate and energy solutions that matter for people and our planet for generations to come. For more information, visit <https://www.carrier.com/commercial/en/us>.

## ABB Launches Next Generation MicroDrive for HVACR Systems

ABB has introduced its next generation MicroDrive, ACH180, that complies with UL standards, including UL61800-5-1 for drives and UL60335-2-40 for HVACR (heating, ventilation, air conditioning and refrigeration) equipment. As the newest addition to ABB's HVACR drive portfolio, the ACH180 enables expert control of high-efficiency motors, while

using a compact design for space savings, lower capital expenditure and easier commissioning.

The ACH180 drive's design allows operators to run motors based on the HVACR process demands, rather than running them at full speed and reducing output using mechanical controls like throttles or dampers, which greatly reduce energy consumption and CO<sub>2</sub> emissions.

Packed with HVACR-specific features, the ACH180 includes industry-standard Hand/Off/Auto controls, fireman's override for smoke control and four start interlocks for remote troubleshooting, including high static, smoke, freezestat and fire stat. It supports the control of various motor types, including permanent magnet-assisted synchronous reluctance motors like IE5 EC Titanium™ by ABB, permanent magnet motors and conventional induction motors. Further, onboard communication protocols, including BACnet MS/TP and Modbus RTU, offer compatibility with a wide range of building automation systems or OEM controllers.

The ACH180 is suitable for a wide range of HVACR applications, including air handlers, fan arrays, heat pumps, compressors and pumps. Its operation up to 40C (up to 60C with derate) provides cabinet air conditioning cost savings and will help reduce energy consumption, aligning with increasing regulations around the energy efficiency of air handling equipment.

*ABB's next generation MicroDrive, ACH180, is designed specifically for HVACR equipment.*



“Increasing energy efficiency requirements for HVACR systems and buildings compel OEMs, specifying engineers, contractors and building owners to adopt energy-saving strategies, such as the usage of high efficiency motors and drives,” said Louis Hill, ABB Manager of Product Management for HVACR. “The ACH180 offers a perfect solution that minimizes the cost and complexity of using a drive.”

**About ABB Motion**

*ABB Motion innovates and pushes the boundaries of technology to enable the low-carbon future for customers, industries and societies. The company offers a combination of domain expertise and technology to deliver the optimum drive and motor solution for a wide range of applications in all industrial segments. Building on over 140 years of cumulative experience in electric powertrains, ABB Motion learns and improves every day. For more information, visit <https://go.abb/motion>.*

**Alliance Air Invests in Energy-Efficient Manufacturing Facility**

Alliance Air, a subsidiary of Daikin Applied, a leading global commercial and industrial HVAC manufacturer, broke ground for the construction of a new energy-efficient manufacturing facility in Tijuana, Mexico, to support sustainable data center growth across North America.

The new \$121 million USD, 460,000-square-foot facility is expected to support over 1,000 production jobs and over 1,150 total new permanent jobs in the northwest region of Mexico. This investment will expand on the established presence of Alliance Air and Daikin Applied in Tijuana as the company looks to

support significant data center market growth in Mexico and North America. Construction of the facility is expected to be complete by spring 2025 with production ramping up in June 2025.

This expanded facility allows the company to better serve customers in North America with a single supplier for end-to-end HVAC solutions. The expansion builds on the legacy of Alliance Air in Tijuana, which is also celebrating 20 years in the community and now partnered with the 100-year legacy of industry leader Daikin Industries.

“We started manufacturing in Tijuana 20 years ago with 30 employees. We were just a start-up. I’m proud to see this force of 1,000 team members who have become exceptionally talented in the design and production of energy-efficient, custom cooling solutions,” said Luis Plascencia, President and General Manager of Alliance Air Products. “We look forward to expanding our role in the community, and bolstering our partnership with the Baja California government and local Tijuana leaders to make this new facility a reality.”

The facility is being built to manufacture energy-efficient HVAC cooling solutions specifically for data centers. It is designed for maximum efficiency to meet the company’s – and customers’ – sustainability goals.

“This is a critical moment for the HVAC industry to meet the demand for data center cooling which is increasing exponentially with trends and economic forces like artificial intelligence and insourcing manufacturing,” said Yu Nishiwaki, Chief Operating Officer for Daikin Applied Americas. “Increasing our current capacity allows us to expedite delivery to help customers meet this demand. The

## Chiller & Cooling System Technology & Industry News



Alliance Air broke ground for the construction of a 460,000-square-foot, energy-efficient manufacturing facility in Tijuana, Mexico.

combined talent and technology of Alliance Air and Daikin Applied creates a new level of energy efficiency to help customers meet aggressive sustainability goals.”

Prioritizing high value industries and talent development, a coalition of Baja California’s economic leaders traveled to Japan to meet with Daikin Industries. Baja State Governor Marina del Pilar Ávila Olmeda welcomes this investment as it aligns with her goals for the state: “Baja California emphasizes foreign investment attraction with innovation and well-paid jobs.”

### About Daikin Applied Americas

Daikin Applied, a member of Daikin Industries, Ltd., designs and manufactures advanced commercial and industrial HVAC solutions for customers around the world. The company’s technology and services play a vital role in creating comfortable, efficient and sustainable spaces to work and live – and in delivering quality air to workers, tenants and building owners. Daikin Applied solutions are sold through a global network of dedicated sales,

service and parts offices. For more information, visit <https://www.daikinapplied.com>.

### About Daikin Industries, Ltd.

Daikin Industries is a leading global HVAC&R manufacturer, which now has 125 production sites worldwide, operating in more than 175 countries and regions. The company endeavors to make people and spaces healthy and comfortable through the power of “air”, while providing products and services that meet the needs of diverse cultures and values around the world. For more information, visit <https://www.daikin.com>.

### NAVAC Introduces NX1 NEXUS Digital Manifold Gauge

NAVAC, the world’s largest supplier of HVAC vacuum pumps in addition to a wide array of tools, gauges, hoses, recovery units and industry-specific items, has launched its NX1 NEXUS Digital Manifold Gauge, an innovative solution that combines advanced smart device technology with Bluetooth and wireless connectivity to enhance the diagnostics process for HVAC professionals.

As a smart manifold gauge, NAVAC’s NX1 NEXUS wirelessly integrates with the myNAVAC™ App, enabling remote control and monitoring. With Bluetooth connectivity for temperature probes and a micron gauge, it delivers comprehensive insights such as temperatures, pressures and vacuums for versatile applications. Aiming to deliver a superior user interface and experience, the NX1 offers the simplest and most accurate solution for diagnosing and monitoring HVACR systems.

The NX1 NEXUS Digital Manifold gauge caters to a wide range of needs with four operation modes.

**Manifold Mode:** Designed to resemble a traditional manifold gauge, the NX1’s intuitive interface ensures a seamless transition for users familiar with analog gauges. Its digital backlit display offers clear and easy-to-read measurements. All essential data, including pressure and temperature readings, as well as SH (SuperHeat) and SC (SubCooling) calculations, are conveniently displayed on a single screen, showcasing the product’s smart design.

**Leak Test Mode:** With the high side of the manifold gauge connected to the system, users can access live wireless pressure readings and track pressure changes over time. The same option can also be monitored through the myNAVAC™ App.

**Evacuation Mode:** Enable wireless readings by connecting to NMV1S NAVAC Premium Micron Vacuum Gauge, allowing users to monitor evacuation status directly through the NX1 or myNAVAC™ App.

**Decay Test Mode:** With a wireless vacuum gauge, the NX1 enables automation and easy

monitoring of the vacuum decay at any point of the system, not just at the manifold connecting location. A “PASS” or “FAIL” is displayed at the end of decay time for a quick and easy assessment.

The NX1 NEXUS is built with an aluminum body and is covered in durable double-molded rubber, making it impact-resistant and designed to withstand field challenges, ensuring prolonged, resilient work experience. The foldable hidden hook enhances portability, while its Class 0.4 accuracy and clear digital display offer precise readings. A 1/4 turn ball valve is designed for better user experience and durability.

The NX1 NEXUS is A2L ready and currently compatible with 72 types of refrigerants, which can be updated via the myNAVAC™ App.

“We are thrilled to launch the NX1 NEXUS Digital Manifold Gauge, which showcases NAVAC’s commitment to continuous HVAC innovation by integrating advanced smart device technology,” said Keith Keller, Director



NAVAC's NX1 NEXUS with smart technology enables remote control and monitoring to enhance diagnostics experience for HVAC technicians.

of Sales at NAVAC. “This launch represents a significant step forward in providing better testing instruments to HVAC professionals, providing them with comprehensive insights and remote monitoring capabilities.”

**About NAVAC**

*NAVAC is a global manufacturer that has dedicated over 20 years to the R&D and manufacturing of vacuum solutions and HVACR tools. NAVAC draws upon its commitment to technical innovation, strong customer service and robust R&D allocation to deliver solutions offering leading technology, superior quality, and best experience. At the heart of its innovation is a commitment to user-centric design, integrating advanced technology to meet the dynamic needs of the HVAC landscape without compromising on ergonomics or aesthetics. For more information, visit <https://navacglobal.com>.*

**Midwest Machinery Company Appoints Jay DiMinico as Solutions Advisor**

Midwest Machinery Company (MMCO) announced the hiring of Jay DiMinico as Solutions Advisor, marking its strategic expansion into Wichita, Kansas. This move strengthens MMCO’s technical expertise and customer support in the region.

Jay DiMinico, who started with MMCO in May 2024, brings over two decades of experience in the HVAC and hydronics industry, including roles in energy management, project management and field operations. His extensive background and knowledge make him a key addition to the MMCO team, enhancing the company’s ability to meet clients’ specific needs in Wichita.

“We are thrilled to have Jay DiMinico join our team,” said Ryan Miller, General Manager of



Jay DiMinico, Solutions Advisor

Midwest Machinery KC. “His industry expertise will significantly benefit our clients in Wichita and support our goal of expanding MMCO’s presence in that region.”

Founded in 1923, Midwest Machinery is a leader in the air and hydronics industry. MMCO offers an extensive product line and comprehensive support for HVAC systems. The local presence in Wichita and the hiring of Jay DiMinico underscore MMCO’s dedication to being the most capable and customer-focused hydronics company in the market.

**About Midwest Machinery Company**

*In 1923, L.T. Mart and Chester Smiley combined their names and resources to form the Marley Cooling Tower Company and that very same year Mart & Smiley became two of three founding members of Midwest Machinery Company. To this day, Midwest Machinery remains the first and oldest cooling tower sales representative in the United States. Since that time, the company has expanded its focus to the entire mechanical system, bringing energy efficient solutions to the building owner, contractor and engineer. For more information, visit <https://midwestmachinery.net>.*



# "Crazy" Systems & Maintenance

Edited by Troy Dreier, Senior Editor, Compressed Air Best Practices® Magazine



Manufacturing plants perform admirably under “crazy” profit expectations while dealing with “crazy” staffing reductions. Our editorial staff salutes our subscribers who keep on-site utilities up and running every day, with fewer resources at hand. These subscribers requested we publish some observed “crazy” system designs and maintenance practices, to encourage increased investments in staffing.

## Hire Experienced Compressed Air Piping Installers for the Best Results

Flavio Poenar is the President and Founder of Critical System Advisors, a manufacturing operations consultancy and service provider in Northern California, specializing in compressed air systems. Visit <https://www.criticalsystemsadvisors.com>.

Poenar discovered multiple compressed air piping system issues when called in at a California wood manufacturer that makes trusses for homes. To point them out, he created this labeled graphic.

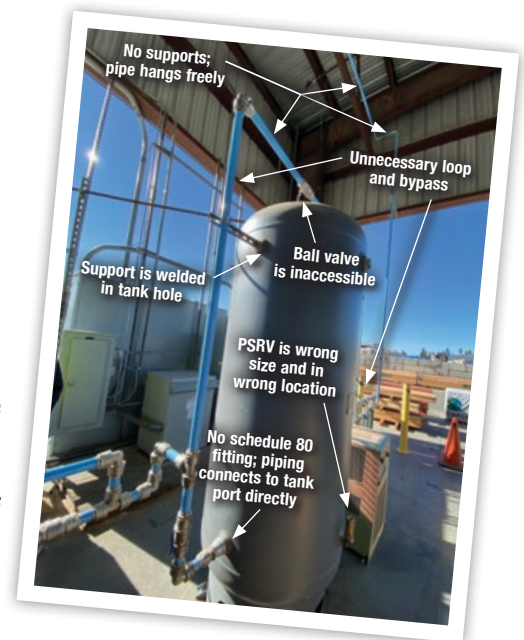
“This customer purchased everything online and decided to do the installation on their own to cut costs,” Poenar says. “Once the client failed city and OSHA inspections, they called Critical Systems Advisors to help. The costs associated with correcting the entire setup to

code and regulations plus the fines by local governing agencies were five times the original purchase price.

“Upon arrival, CSA noticed he compressed air piping was looped and supported with wire. The wire went under the pipe and was tack-welded to the overhead steel beam. On the day of the assessment, there was quite a bit of wind and the entire compressed air piping system, about 450 feet, was swaying back and forth. The correction included removing all compressed air piping, installation of new compressed air piping with proper supports, and a new air receiver as the original support was welded to the threads on the two-inch hole of the old tank.”

*Multiple problems can arise when companies don't rely on experienced professionals for compressed air piping installations.*

The lesson here is to hire experienced compressed air piping installers who are able to meet local and regional safety codes.



The U-turns in the steel piping leading to this refrigerated compressed air dryer cause pressure drop.

## To Avoid Pressure Drop, Skip U-Turns

Kiron Pande acquired his knowledge of compressed air systems with Godrej & Boyce India, where he was an Associate Vice President. He still advises startups on performing compressed air system audits. Visit <https://www.godrej.com>.

Pande came across this piping configuration during a compressed air audit at a manufacturing plant in China. Pipes and valves

were aligned to connect with the pipelines above, but included unnecessary 180° turns.

A better configuration would have included straight piping with long radius bends to avoid a costly pressure drop. That would also avoid the poor valve placement. “It was inconvenient to operate the valves, as the operators’ hand would get stuck while gripping the handles,” Pande notes.

## Submission Guidelines

We invite our subscribers to send their observed “Crazy” Systems & Maintenance experiences to Troy Dreier at [troy@airbestpractices.com](mailto:troy@airbestpractices.com). Please send a high-resolution picture as a JPG or GIF file and a note describing the installation, what was wrong and what the solution should be. We will edit the text and remove equipment brand names and references from all materials. If we publish your submission, we'll thank you with a \$25 Amazon gift card.



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