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November 2021

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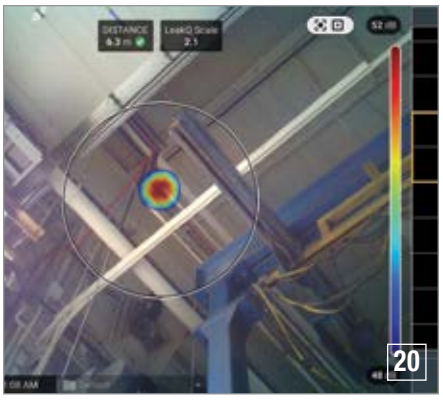


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# FROM THE EDITOR

## Quality, Safety and Reliability

Ultrasonic leak detectors are the go-to technology in noisy manufacturing environments. Veteran compressed air auditor Ron Marshall has written about using visual acoustic imagers in situations like hard to reach locations, which he believes make finding leaks easier and more accurate.

Front Row Motorsports achieved a first-place finish in the 2021 Daytona 500. Our own Mike Grennier was able to interview their people, based at their Mooresville (NC) car and fabrication shop, about their newly installed compressed air system.

Industrial vacuum system assessments continue to gain momentum and interest. We are very pleased to once again welcome Hank van Ormer to our pages as he provides us with a 2-part article about this topic. "Part 1-Measurement" is a useful review of vacuum measurement terms and his advice on where to measure.

## Sustainability & Energy/Water Conservation

Changes are in the air with the comparisons between oil-free and oil-injected air compressors. We thank Brian Mann, from Sullair, who has written a very interesting article comparing the total ownership costs of the resulting systems, not just the compressors.

A Chicago-based cleaning products plant is operating 700 horsepower of rotary screw air compressors. Greg Good, from EcoPlant, and Ron Marshall have sent us an interesting case study article about the implementation of an innovative compressed air monitoring and control system.

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

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# CORPORATE GHG-REDUCTION NEWS*

Featuring: Procter & Gamble, FMC, Target and Cintas

* Scope 1 and 2 GHG Emissions from Direct Operations

## P&G Accelerates Action on Climate Change Toward Net Zero GHG Emissions by 2040

CINCINNATI, September 14, 2021; Procter & Gamble (NYSE:PG) announced a comprehensive plan to accelerate action related to climate change. P&G has also set a new ambition to achieve net zero greenhouse gas (GHG) emissions across its operations and supply chain, from raw material to retailer, by 2040 as well as interim 2030 goals to make meaningful progress this decade.

The climate crisis affects every home and family, everywhere in the world. The majority of consumers globally now want brands they buy to help them live a more environmentally conscious lifestyle and the latest science has made it clear that urgent, decisive action must be taken to avoid the worst impacts of climate change.

"We are fully committed to use P&G's innovation and ingenuity to unlock new solutions to address climate change," said David S. Taylor, Chairman, P&G President and Chief Executive Officer. "The task ahead of us is urgent, difficult and much bigger than any single company or country. P&G is tackling these challenges head-on by reducing our footprint and leveraging our scale to foster unprecedented collaboration across our value chain."

P&G's actions on climate began over a decade ago, and we know there is more work to do. Our science-based plan to net zero will prioritize cutting most of our emissions across our operations and supply chain, from raw material to retailer. For residual emissions in these categories that cannot be eliminated, we will use natural or technical solutions that remove and store carbon.

Our 2030 goals to pace our progress toward net zero were submitted to The Science Based Targets initiative (SBTi):

- Reducing emissions across our operations by 50%
- Reducing emissions across our supply chain by 40%

We have joined the UN's Race to Zero and the Business Ambition for 1.5°C campaigns and are also sharing our new Climate Transition Action Plan, which outlines a comprehensive approach to accelerating climate action and the key challenges ahead. More perspective is available here. We will continue to communicate our successes and setbacks along the way so others can learn with us and advance collective progress.

"While no one has all of the answers on how to bring a net zero future into focus, we will not let uncertainty hold us back," said Virginie Helias, P&G Chief Sustainability Officer. "To achieve these goals, we will leverage existing solutions and seek transformative new ones that are not available in the marketplace today. This will require partnership across the private, nonprofit, and public sectors and involve every aspect of our business, from the very beginning of our products' lifecycle to the very end."

### Acting with Urgency to Reduce Emissions

Our top priority is to significantly reduce GHG emissions as quickly as possible with solutions that exist today.

- **Reducing emissions across our operations.** From 2010 to 2020 we have reduced absolute emissions across our global operations 52% through energy efficiency and renewable electricity. As we continue to reduce emissions, we are also advancing natural climate solutions to balance any remaining emissions from our operations that cannot be eliminated by 2030. These include new projects that help protect and restore forests and other ecosystems essential to the people and wildlife that call them home.
- **Accelerating renewable electricity.** We are nearing our 2030 goal of purchasing 100% renewable electricity by already purchasing 97% globally. In 2021, the United States Environmental Protection Agency recognized P&G as #5 on its National Top 100 list of green power users and #2 on its Top 30 list for on-site renewable power generation nationwide, making us top-rated in the consumer products industry.
- **Decarbonizing our supply chain and logistics.** Our supply chain and logistics emissions from raw material to retailer are about 10 times that of our operations and we have set a goal to reduce emissions 40%1 by 2030. We are also planning to increase transportation efficiency of outbound finished products 50% by 2030. Pampers is actively working with suppliers to reduce their carbon footprint and avoided an estimated one million metric tons of GHG from

the production of its materials over the past five years. P&G established a new Product Supply Innovation Center (PSIC) in Kronberg, Germany as a hub for a network of local suppliers, tech companies, and top universities, developing solutions that are global and scalable to help decarbonize our supply chain.

### Tackling Challenges by Inventing New Solutions

We know there are some operational emissions we cannot eliminate yet and our teams are working hard to develop the next generation of low-carbon technologies and materials. Our efforts in this area include:

- **Leveraging renewable thermal energy.** We use geothermal, solar, and renewable steam at some manufacturing sites, but continuing to reduce emissions will require more innovation. We have partnered with the World Wildlife Fund, manufacturers, and local governments to create the Renewable Thermal Collaborative to identify and scale renewable, cost-competitive thermal energy solutions. "Thermal energy represents a significant challenge for many industries as they chart a path towards net zero," said Marcene Mitchell, Senior Vice President, Climate Change, World Wildlife Fund. "The Renewable Thermal Collaborative can help unlock sustainable, scalable solutions that cut emissions. P&G is a founding member of the RTC and has shown strong leadership in this space."

## Corporate GHG-Reduction News

- **Advancing low-carbon technologies, materials, and packaging.** To unlock new ways to decarbonize our supply chain, we are partnering to advance innovation in materials derived from renewable, bio-based, or recycled carbon across brands including Head & Shoulders, Pantene, Ariel, Tide and Pampers.

- **Exploring Ingredients made from captured $CO_2$.** Our Tide brand is working with Twelve, a Silicon Valley start-up, to explore their carbon capture technology to incorporate $CO_2$ from emissions into ingredients that could be used across Tide.

### Creating a Decarbonized Future Through Transformative Collaboration

We are going beyond our net zero ambition and doing more to make a collective impact – partnering with consumers to reduce GHG emissions from the use phase of products, creating alliances for carbon-efficient homes, and advocating for policy solutions to decarbonize energy infrastructure. Our efforts here include:

- **Making sustainability effortless at home.** P&G and its brands will continue to provide consumers with tools and information on how small actions at home can make a world of difference for the planet.

- **Reducing 15 million tons of carbon through cold water washing, and accelerating impact with an additional 30 million tons by 2030.** We have leveraged innovation and sustained consumer education to help reduce the largest portion of our carbon footprint – the energy needed to heat water during product use. P&G brands Tide and Ariel have helped consumers increase their use of low-energy laundry cycles to avoid roughly 15 million metric tons of carbon dioxide. Tide and Ariel continue to drive greater use of cold water washing through new education campaigns to help avoid an additional 30 million tons of carbon emissions by 2030 – more than ten times that of P&G's yearly global operations.


*P&G's Ambition to Net Zero Roadmap (Graphic: Business Wire).*

- **Creating the home of the future.** We are advancing solutions to make everyday living more sustainable, with industry partners via the 50L Home Coalition. By helping people reduce hot water use without trade-offs, the Coalition is creating more efficient homes that can use 10 times less water than most use today.

"Caring for our consumers and our planet is core to all of us at P&G," Taylor added. "There is no action too small, and no vision too big, as we all work together to preserve our shared home for generations to come."

*To learn more about P&G's ESG efforts, visit https://www.pginvestor.com/esg/environmental/environmental-overview/*

## FMC Corporation announces Net Zero Greenhouse Gas emissions by 2035

PHILADELPHIA, Aug. 4, 2021: FMC Corporation (NYSE: FMC), a leading global agricultural sciences company, announced its goal to achieve net-zero greenhouse gas (GHG) emissions by 2035. The company will use science-based targets aligned with keeping the global temperature at 1.5°C above pre-industrial times.

"FMC's net-zero emissions target is a bold step in our continuing commitment to sustainable innovation and operations," said Karen Totland, FMC vice president and chief sustainability officer. "We are engaging key organizations across our company – including Manufacturing, Supply Chain, Environment, Health and Safety, Procurement and R&D – to improve efficiencies, invest in renewable energy sources and engage with third-party suppliers to reduce their emissions. We are proud to build on FMC's past successes in energy and resource reduction, and look forward to working together with suppliers and other partners to achieve this ambitious goal."

The company has committed to set science-based targets through the Science Based Targets initiative (SBTi), a partnership between CDP, the United Nations Global Compact, World Resources Institute (WRI) and the World Wide Fund for Nature (WWF). SBTi defines and promotes best practices in emission reduction and net-zero targets, and provides technical assistance and expert resources to companies like FMC that set science-based targets in line with climate science.

## Corporate GHG-Reduction News

FMC will pursue carbon neutral operations through emission Scopes 1, 2 and 3 as defined by the GHG Protocol. Scope 1 includes direct emissions from company-owned and controlled resources, such as production facilities and automobile fleets. Scope 2 focuses on indirect emissions, which are typically from the generation of energy that is purchased from a utility provider. Scope 3 includes indirect upstream and downstream emissions within a company's value chain that are not included in Scope 2. Scope 3 covers broad areas, including business travel, employee commuting, emissions from the production of goods and services purchased by the company, and emissions associated with the distribution and transportation of goods to and from suppliers and customers, to name a few.

"As a leader in the global agricultural industry, we see firsthand the impact climate change has on farmers and the world's food supply," Totland added. "We have an obligation to meet climate challenges head on and to find solutions that benefit all of our stakeholders."

*To learn more about sustainability at FMC and to read the company's latest sustainability report, Resilient Ready, visit https://www.fmc.com/en/sustainability*

### New Solar and Wind Projects Are Big Strides Toward Target's Renewable Energy Goals

March 4, 2021: In 2019, Target set a big goal, announcing our aim to source 100% of Target's electricity from renewable sources by 2030. The inspiration? As always, a brighter, more sustainable future for our guests, team members and the planet. Fast forward to today, and we're proud to share the next big step toward that goal: three new renewable energy projects that will address nearly a quarter of our electricity use with solar and wind power. That means, along with our existing partnerships, we'll purchase *nearly 50%* of our electricity from renewable sources once these projects are operational.

"As we strive to create a more sustainable future for all, our renewable energy efforts are critical to maintaining vibrant communities for years to come," says John Leisen, Target's vice president of property management. "Our new solar and wind contracts represent a big step toward reaching our climate goals and nurturing a healthier planet for the communities we call home."

These latest efforts include renewable power purchase agreements for two solar projects in Texas, including the **Golden Buckle Solar Project** with Savion, and we'll be purchasing renewable power from the **Haystack Wind Project,** based in Nebraska, with Ørsted. Together, our portion of the projects will generate the equivalent electricity required to power 101,000 homes each year and will pace Target ahead of schedule in meeting our 2030 goal. But we can't tackle climate challenges alone: Major Target suppliers, including PepsiCo and Hormel Foods, have also signed on to at least one of these projects. With their partnership, we'll take an important step toward another of Target's climate goals: reducing our greenhouse gas emissions from operations, purchased goods and services by 30% below 2017 levels by 2030.

And we're all about helping our guests make more sustainable choices, too. One recent

example: completing our 114th electrical vehicle charging site at a Target store at the end of 2020, exceeding our goal set in 2018 and enabling guests to drive up, plug in at more than 1,000 charging spaces and shop. From reducing plastics to installing rooftop solar systems on over 540 stores to date, we're committed to using our size and scale together with our guests, team members and stakeholders to make a positive impact. For more on our efforts, check out our sustainability initiatives and commitments for the years ahead.

*Learn more about the Target Forward sustainability strategy at https://corporate.target.com/corporate-responsibility/sustainability-strategy*

## Cintas Corporation Announces Ambition to Achieve Net Zero GHG Emissions by 2050

CINCINNATI, September 9, 2021: Cintas Corporation (Nasdaq: CTAS) has announced its ambition to achieve Net Zero greenhouse gas (GHG) emissions by 2050.

The company is also in the midst of a comprehensive, enterprise-wide review of its business model as it relates to environmental, social and governance (ESG) opportunities, improvements, and efficiencies. Cintas has been built on sustainable business practices, and the continuous improvement of its sustainability measures has been key to the company's operational success over the years.

As its business review continues for the next 12-18 months, Cintas expects to better define its ESG journey, including identifying strategies to reduce its Scope 1 and 2 GHG emissions and potential avenues to reduce Scope 3 GHG emissions from its supply chain. The review will also focus on opportunities to further reduce its overall environmental impact through continued reductions in energy, water, raw materials, and waste throughout its business.

"Cintas was founded on a sustainable business model and has grown to a $7-plus billion-dollar company by recycling, reducing, and reusing our products and materials for our customers, and helping them reduce their environmental impact. Our corporate culture

## Corporate GHG-Reduction News

is based on doing what's right and challenging ourselves to be better, so we view announcing our ambition to reach Net Zero GHG emissions by 2050 as a natural extension of our culture and how we conduct our business," said Todd Schneider, Cintas President and CEO. "We believe that climate change is a real issue, and that as a good corporate citizen, we must actively engage in activities and initiatives that help reduce our impact on the environment. We understand that reaching Net Zero GHG emissions by 2050 is ambitious given our business and industry, but we are committed to doing our part to innovate and explore new technologies that will be necessary in this journey.

"We continually develop and implement new processes to reduce our energy and water consumption while still maintaining our industry-leading quality and service. Our Net Zero ambition will challenge our entire company to think even more critically about our business and create more sustainable means to help our customers get Ready for the Workday. To successfully achieve our ambition to reach Net Zero GHG emissions by 2050, we'll need to think differently about our own operational processes – including the energy sources we use and our delivery fleet – and we'll need the support and buy-in of our supply chain," Schneider said.

The company's sustainable business practices date back to the company's origins in 1929 when Doc and Amelia Farmer gathered dirty shop rags from local businesses that otherwise would've been thrown away, brought them home to wash them and sold the clean rags back to companies in the Cincinnati area. As the company grew, their grandson, Richard "Dick" Farmer, created a burgeoning uniform rental operation in 1959 that provided an easy, affordable, and sustainable option for companies to outfit their employees.

Further business line expansions under CEOs Bob Kohlhepp (1996-2004) and Scott Farmer (2004-2021) into facility services, first aid and safety, and fire protection deepened the company's sustainable business model. These provided product offerings based on reusing and recycling goods and reducing the use of natural resources, as well as the development of products and services to help customers keep their own facilities, employees, and facilities cleaner, safer, and healthier.

Cintas' ambition to achieve Net Zero GHG emissions by 2050 builds on the company's history of demonstrating environmental impact improvements year over year.

Between the fiscal years 2016 and 2020, Cintas improved its water efficiency rate by 16% while increasing its sales by almost 48% in that same time frame. In the last three years, the company has reduced its energy consumption by almost 13% as sales rose by 10%. Further, Cintas' laundry process is the most efficient in the industry, while traditional at-home laundry processes consume 55% more water and 204% more energy than Cintas' process.

Cintas' organizational business review began in 2019 when the company implemented processes to help it start publicly reporting on its ESG priorities – including its environmental impacts – and now continues with due diligence and the analysis of historic data.

The results of Cintas' ongoing business review will guide its ESG journey, and the company has established the structure and processes to take it into the future. In August 2021, Cintas appointed Christy Nageleisen as its new Vice President of ESG and Chief Compliance Officer, and re-organized several departments to create a new Risk and Compliance Department. This new department will work cross-functionally under Nageleisen as she develops and leads the company's ESG-related strategy, activities, monitoring and compliance. This strategy is expected to include further environmental impact improvements, as well as opportunities related to diversity and inclusion, human capital, safety and health, and governance objectives, among other areas.

In November 2021, Cintas expects to release its 2021 ESG Report, which will further detail the company's efforts in corporate responsibility, environmental stewardship, social initiatives, and its governance strategy.

*About Cintas Corporation*

*Cintas Corporation helps more than one million businesses of all types and sizes get Ready™ to open their doors with confidence every day by providing products and services that help keep their customers' facilities and employees clean, safe, and looking their best. With offerings including uniforms, mats, mops, towels, restroom supplies, workplace water services, first aid and safety products, eye-wash stations, safety training, fire extinguishers, sprinkler systems and alarm service. More information about Cintas' history of sustainability is available at https://www.cintascares.com/esg-report/*

FOOD & BEVERAGE PROCESSING & PACKAGING MONTHLY FEATURE

# Exploring the Total Cost of Ownership of Oil-Injected vs. Oil-Free Compressed Air Systems

By Brian Mann, ME, PE, Air Systems Manager, Sullair

The purity of the compressed air that contacts finished goods and their packaging is scrutinized more than ever before. As a result, oil-free air compressors comprise a larger segment of the compressed air market than ever before. In fact, Grand View Research, Inc. projects a CAGR of 4.8% for the oil-free market as compared to a CAGR of 3.8% for the market as a whole (2019-2025).

Despite the growing desire for improved compressed air purity and its association with oil-free air compressors, many end-users are reluctant to transition from oil-injected to oil-free air compression technology because oil-free compression technology is perceived

*A Sullair DSP Series oil free rotary screw air compressor at a pharmaceutical facility.*

to be less economical to own and operate than oil-injected technology.

## Oil-Injected vs Oil-Free Debate

There is much more to the oil-injected vs. oil-free discussion than the perceived economics of the compressor itself. The purchase price of the compressor is often a small part of the total cost of ownership.

The total life-cycle cost of the two systems should be considered, along with the environmental impact of the discarded lubricant, contaminated separator and in-line filter elements, as well as the inconveniences associated with the disposal of contaminated condensate.

When the total cost of ownership is considered, including maintenance and power, the difference between the cost of operating an oil-injected and an oil-free system can be less than many users perceive.

The purpose of this article is to raise awareness of the implications of selecting an oil-injected compressed air system in lieu of an oil-free compressed air system.

## Comparing Oil-Injected vs Oil-Free Compressed Air Systems

Consider two compressed air systems; one employing oil-injected compression technology, the other employing oil-free compression technology. Both systems are configured to provide similar capacity and ISO 8573-1 Class 0:2:1 compressed air purity.

The system comprising oil-injected compression technology requires more air treatment components than the comparable oil-free

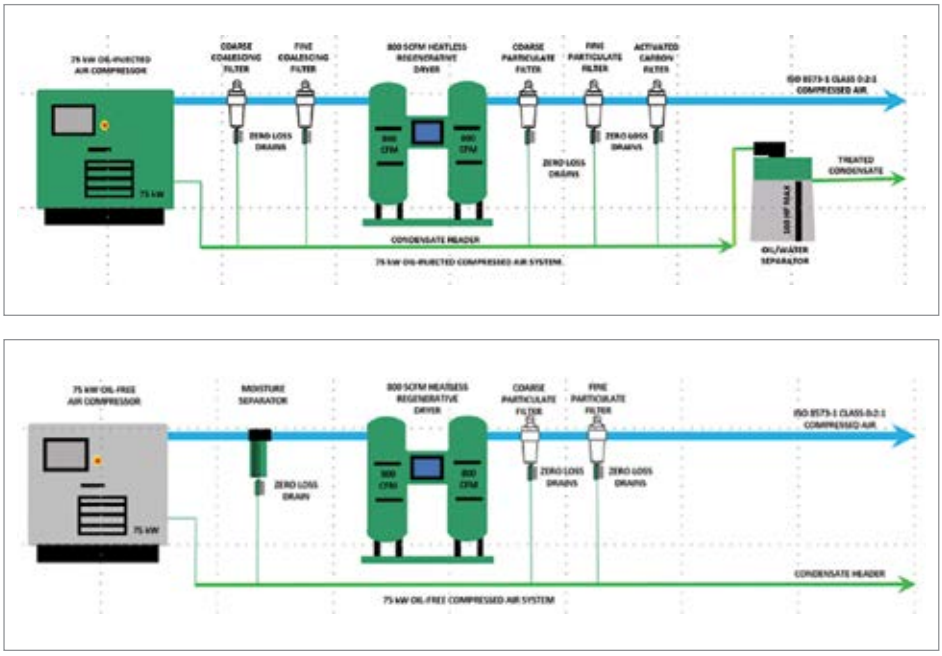


*Figure 1 – Oil-Injected and Oil-Free compressed air system components*

# Exploring the Total Cost of Ownership of Oil-Injected vs. Oil-Free Compressed Air Systems

system. The oil-injected system requires coalescing filters as well as an activated carbon filter to achieve the same air purity as the oil-free system.

A moisture separator is included in the oil-free system to remove any condensate that results from cooling in the compressed air piping downstream of the aftercooler.

## Lubricant Management in Oil-Injected Air Compressors

The typical industrial rotary screw air compressor lasts 15 years or more if properly maintained. Over that life span, the volume of lubricant consumed, both in terms of regular fluid changes and top-off fluid, is significant.

Modern compressed air lubricants are capable of lasting 8,000 hours or more under normal operating conditions. However, the life span of a lubricant may be severely curtailed if the lubricant is subjected to contamination or elevated operating temperatures.

Outside contaminants collect and become concentrated in the compressor lubricant, potentially rendering it harmful to the internal compressor components. Many preventative maintenance programs and manufacturer warranties require regular fluid sampling and analysis.

If the fluid sample indicates contamination or low pH (acidic lubricant), a lubricant flush and change is in order, often well before the anticipated lubricant change date. Each lubricant change requires replacing the separator element, in-line lubricant filter, control line filters and disposing of the spent lubricant.

The need for top-off fluid in the oil-injected compressor results from lubricant carry-over. Lubricant carry-over impacts operation in two ways; the fluid must be replaced to maintain proper lubricant level in the sump and the lubricant that is carried over must be removed by coalescing and carbon filters downstream.

Lubricant carryover can be as much as 3-4 ppm, or more. Compressor short-cycling and draw-down operation can increase carryover significantly.

*A Sullair centrifugal air compressor at a glass manufacturer in Georgia.*

## Technically Oil-Free Air

It is possible, based on the rated filtration effectiveness provided by some manufacturers, to supply technically oil-free air using oil-injected compressors. By using multiple coalescing filters and an activated carbon filter in the oil-injected compressed air system, the air purity rating can exceed ISO 8573-1 Class 1 requirements for oil content.

The filter ratings are provided by reputable testing labs in accordance with applicable standards, and the filters can be expected to provide the needed level of filtration under normal operating conditions.

**TABLE 1 – COMPARISON OF LUBRICANT USAGE IN OIL-INJECTED AND OIL-FREE ROTARY SCREW AIR COMPRESSORS**

| | Oil-Injected | | Oil-Free | |
|---|---|---|---|---|
| | Annual | 10-Years | Annual | 10-Years |
| Top-Off Fluid, 4 ppm carry-over, 500 ACFM, 8,000 hours per year | 9.6 Gallons/year | 96 Gallons | 0 Gallons/year | 0 Gallons |
| Lubricant change, 8,000 hours, 1 change per year | 5.5 Gallons/year | 55 Gallons | 6.0 Gallons/year | 60 Gallons |
| Total Lubricant Consumption | 15.1 Gallons/year | 151 Gallons | 6.0 Gallons/year | 60 Gallons |

It is the abnormal conditions that should give pause. What happens if the coalescing or activated carbon filters are unable to remove the lubricant from the air stream?

If carryover becomes excessive, it is entirely possible that the filtration system becomes overwhelmed, and the delivered air does not meet the anticipated standard. Something as simple as a failed drain on a coalescing filter could create such a scenario.

Once lubricant is present in the system, it is very difficult to remove. One upset condition could contaminate large quantities of raw or finished product and result in significant clean-up efforts and costs and process downtime.

## Power Consumption

Oil-injected compressors often enjoy the benefit of being more efficient than their oil-free counterparts, if Specific Energy (kW/100 CFM) is considered at face value.

If the oil-injected and oil-free compressed air systems are intended to deliver the same pressure to the plant, the oil-injected compressed air system must overcome additional pressure loss associated with the coalescing and activated carbon filters required to provide comparable air purity to the oil-free system.

If the pressure loss across the additional in-line filters is estimated as 2.8 psid, the oil-injected compressor discharge pressure must be set to 2.8 psi higher than the oil-free compressor, thus increasing the power consumption of the oil-free compressor by approximately 1.4%.

Regular monitoring of the sump lubricant level and the addition of the correct lubricant are common maintenance tasks required by an oil-injected air compressor. Properly adding lubricant to an oil-injected compressor is sometimes more complex than it appears.

Most facilities have many industrial fluids on hand; gear oils, coolants, cutting fluid, and lubricants. It is easy for the well-intentioned maintenance technician to add the wrong fluid to the compressor sump. Incompatible fluids

# Exploring the Total Cost of Ownership of Oil-Injected vs. Oil-Free Compressed Air Systems

often foam, leading to excessive carryover and the need to completely flush the compressor and replace the downstream air treatment components, sometimes including the media in a regenerative dryer.

In summary, managing the lubricant in an oil-injected compressed air system is no simple task. The total volume of lubricant used by an oil-injected compressor over its life span is significant and should be part of the discussion when considering oil-free vs oil-injected compression technology.

## Oil-Injected Compressed Air System Condensate Management

Oil-injected compressed air systems generate contaminated condensate that is either collected in an oil-water separator before being released to a waste water stream or is discharged directly to a waste water stream. In either case, the end-user must obtain a permit for the effluent associated with the compressed air system.

If an oil/water separator is used, the filtration elements must be monitored and changed on a regular basis. Proper selection of an oil/water separate requires in-depth knowledge of the application, including the type of lubricant, climatic conditions, and compressor capacity.

The oil-contaminated condensate causes the end-user to incur maintenance costs and/or administrative burdens that are not present with an oil-free compressed air system.

Please note that proper permits must be obtained prior to discharging any effluent to a municipal sewer system.

**Condensate Generation: At 84°F, 61% RH, a 500 ACFM oil-injected compressor generates 4 gallons/hour of lubricant-contaminated condensate that must be properly treated**

## Risk Management

Manufacturing personnel considering oil-free compression technology may be evaluating the decision from the perspective of risk. What is the risk of using oil-injected compression technology in my plant?

For a manufacturer of food, pharmaceutical, beverage, or electronic products, the risks may be

**TABLE 2 – COMPARISON OF REQUIRED AIR COMPRESSOR DELIVERY PRESSURE**

| | 75 kW Oil-Free | 75 kW Oil-Injected |
|---|---|---|
| Required System Pressure | 90 psig | 90 psig |
| Moisture Separator | 0.87 psid | Not Required |
| Coarse Coalescing Filter | Not Required | 0.73 psid |
| Fine Coalescing Filter | Not Required | 1.90 psid |
| Coarse Particulate Filter | 0.44 psid | 0.44 psid |
| Fine Particulate Filter | 0.73 psid | 0.73 psid |
| Activated Carbon Filter | Not Required | 1.02 psid |
| Total Pressure Drop | 2.0 psid | 4.8 psid |
| **Required Compressor Delivery Pressure** | **92.0 psig** | **94.8 psig** |


*A Sullair SRL Series oil free scroll air compressor at a brewery in Seattle.*

**TABLE 3 – COMPARISON OF MAINTENANCE TASKS**

| | Oil-Injected | Oil-Free |
|---|---|---|
| Coalescing Filters | YES | NO |
| Activated Carbon Filters | YES | NO |
| Moisture Separator | NO | YES |
| Oil-Water Separator | YES | NO |
| Lubricant Top-Off | YES | NO |
| Lubricant Disposal | YES | YES |
| Separator Element | YES | NO |

substantial. From potentially contaminating raw materials to finished goods, an excursion in the oil-removal system of an oil-injected compressor system poses significant financial risk.

The risk goes beyond the immediate financial risk to the manufacturer. Potential product recalls and damage to the reputation of the manufacturer are also risks presented when applying oil-injected compression technology in sensitive applications.

## Conclusion

Oil-injected air compressors represent the lion's share of the industrial compressed air market today. And for good reason, as oil-injected rotary screw air compressors are a proven, reliable, efficient and cost-effective means to generate compressed air.

The risks to many industrial processes of lubricant carry-over and contamination are minimal, or easily addressed with point-of-use air treatment. For those applications, oil-injected compression will likely continue to be the chosen technology for many years to come.

When choosing oil-injected compression technology for a compressed air system, consideration should be given to the entirety of maintenance tasks that will be required.

When air purity is essential to product safety or quality, oil-free compression technology should be given serious consideration.

Perhaps the question to ask is not "Is the oil-free system more expensive," but rather "Is the money saved using the oil-injected technology worth the risks and environmental impact?" BP

*About the Author*

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*About Sullair*

*Sullair, founded in Michigan City, Indiana, in 1965, is a leading global provider of compressed air solutions. The company was one of the first to execute rotary screw technology in air compressors, and its machines are known throughout the world for their reliability, durability and performance. Sullair became a Hitachi Group Company in July 2017. For more information, visit www.sullair.com.*

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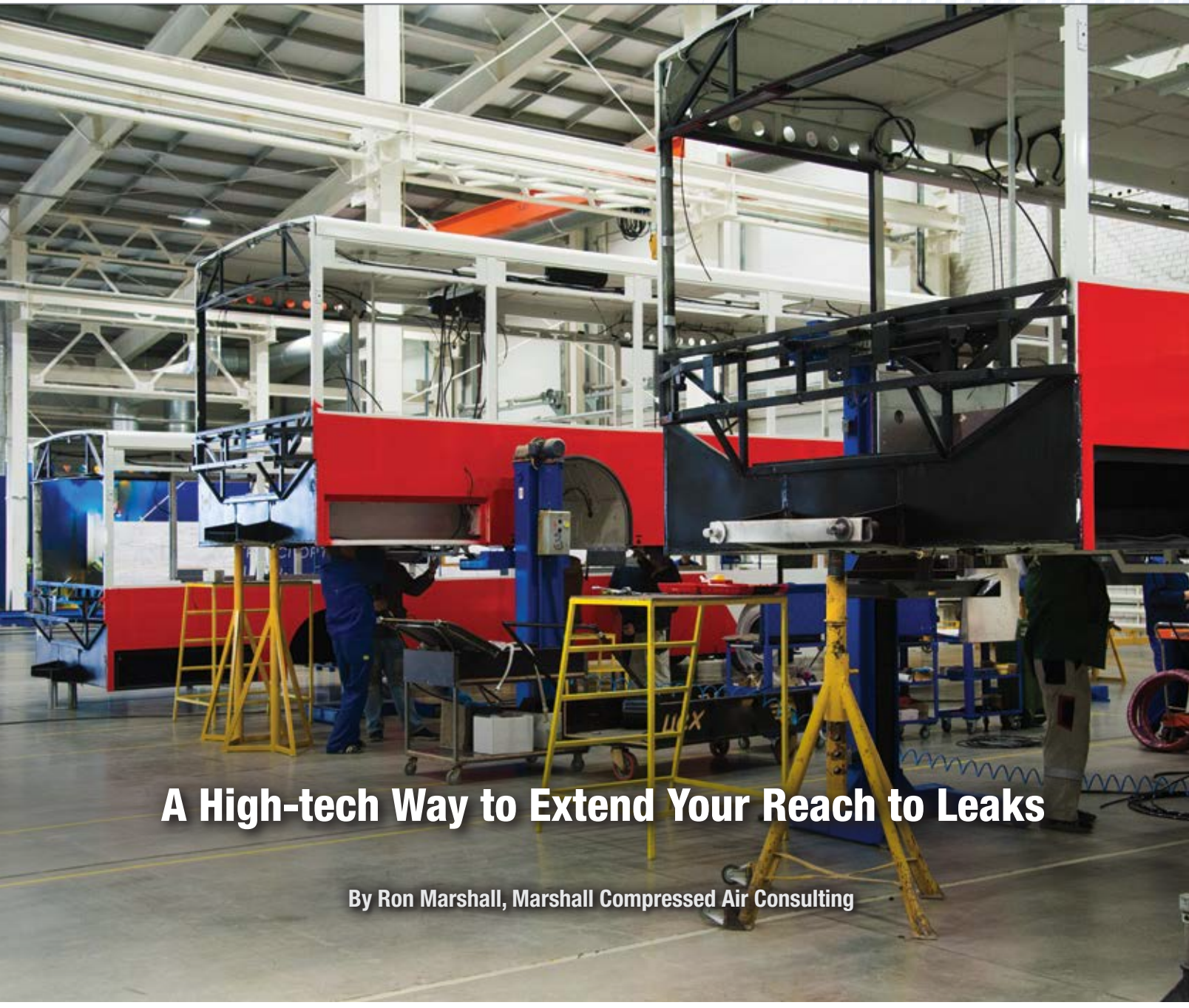

# A High-tech Way to Extend Your Reach to Leaks

By Ron Marshall, Marshall Compressed Air Consulting

Imagine what you could do if you were 30 feet taller! A newly developed style of leak detector can greatly extend your reach and help precisely locate and estimate hard to find leaks, even in the rafters of your plant. This article discusses some recent experiences in using an acoustical imaging leak detector.

Ultrasonic leak detector guns have long since been the best line of defense against compressed air waste. Studies have shown in the average plant about 25 percent of all the compressed air produced by the air compressors leaks out of the system piping before getting to the destination. In plants without leak management programs this number can reach astronomical level of 80 percent or higher.

One of the best ways to reduce compressed air costs is to look for ways to reduce leakage flow, an unnecessary load that is a constant demand on the compressed air system. This flow is never-ending and occurs during production periods, and during quiet times at night or on weekends. Reducing the flow in a well-controlled compressed air system will result in the reduction of compressor energy consumption, usually by about $1,750 per every 10 cfm, and often reduces pressure loss, allowing your machines to run better.

## Ultrasonic Leak Detection

Many people simply find leaks using the human ear. In quiet facilities, this exercise is guaranteed to result in good energy savings. But unfortunately, most industrial sites are

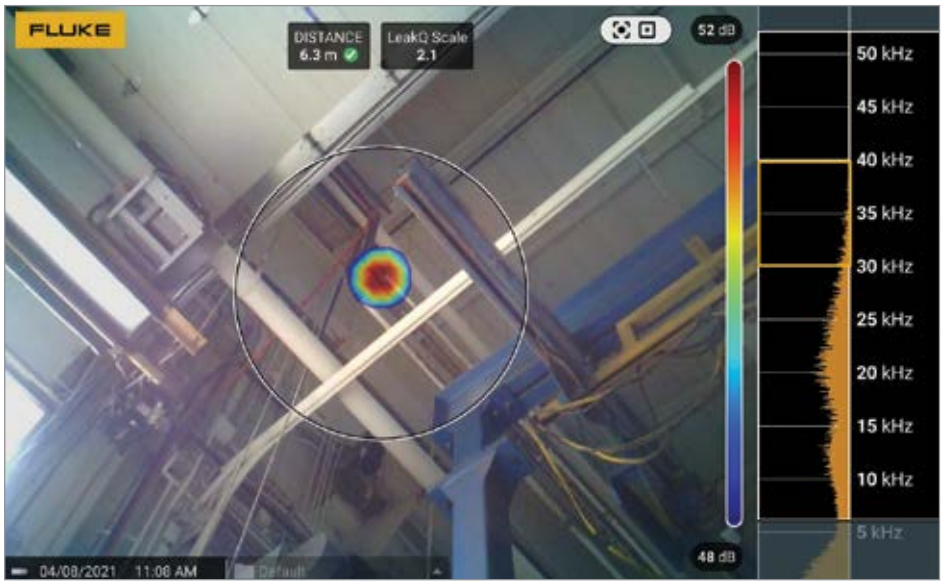


*Figure 1: This leak was detected in the ceiling 30 feet up. The operator was able to identify the leak was Argon costing $24,000 per year in gas costs. (Source: Fluke ii900 Industrial Acoustic Imager)*


*Figure 2: This hidden leak, located above a paint booth, behind a roll up door, was detected by an acoustic imager and had been missed by two earlier scans with a standard leak detector.*

very noisy, drowning out any hint of sound from audible compressed air waste. To be able to better detect gas leakage some sort of ultrasonic detector must be used. These detectors block ambient low frequency noise and help to amplify the telltale high frequency audible signal emitted by the expansion of gas from a pressurized source. These detectors also pick up signals from other ultrasonic emitters like cathode ray tubes, fan blades, pumps, vacuum pick-ups and other things, which can be problematic.

Typical ultrasonic devices are hand-held style that look like handguns. The trigger is pulled, enabling a directional microphone mounted on

## A High-tech Way to Extend Your Reach to Leaks

the front of the unit to connect with operator worn earphones. The detector is then directed in a sweeping motion towards various areas of the plant, and the leaks are detected by observing the change in amplified signal. The signal change, and the waving motion, will lead the operator in one direction or another, enabling them to find even the tiniest of leaks of a fraction of a cubic foot.

This type of directional detection is highly effective if you have good access to the leak locations. Typically, when a leak is found, the operator must feel around for the air leak

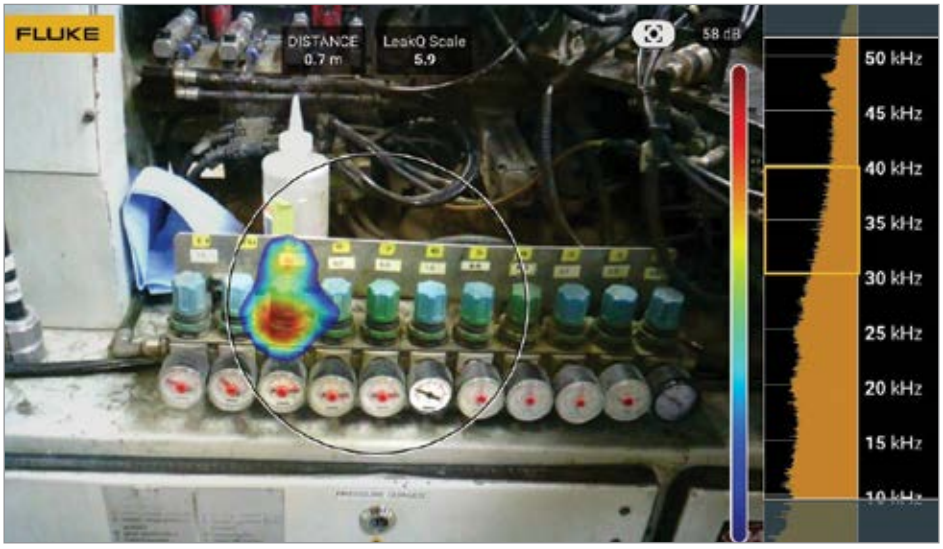


*Figure 3: Leakage in complex pneumatic component block is very difficult to pinpoint with typical leak detector guns.*

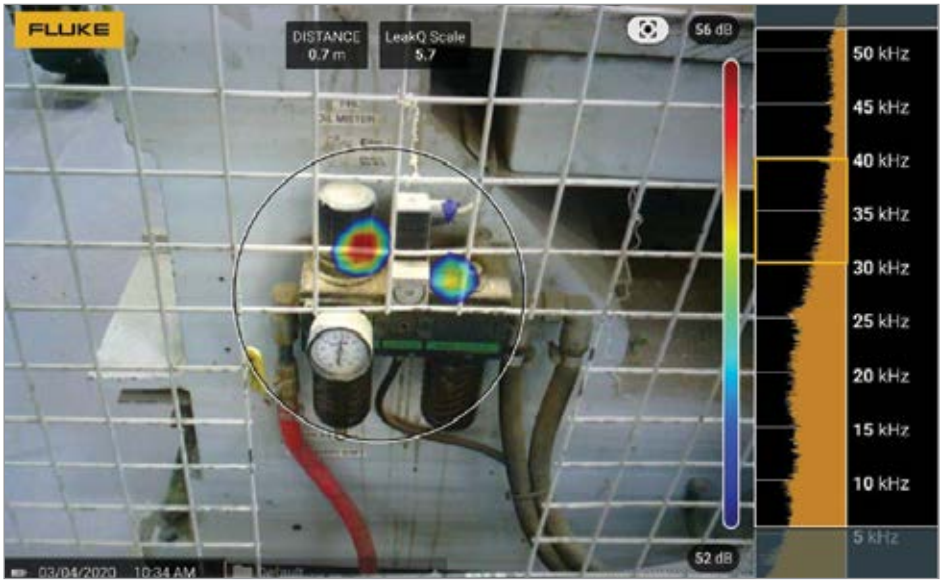


*Figure 4: Safety barriers sometimes require the production to be shut down to detect the exact position of the leak when using a standard gun.*

by hand to detect the exact location on the component. This is problematic when the leak is, for example, near the roofline of a large industrial building some 30 or 40 feet up, or within a fenced off area behind safety barriers.

## Technological Advance with Visual Acoustic Imagers

Recently there has been huge technological advances in leak detection. Sophisticated visual acoustic imagers have now been developed that overlay a digital picture of a sound pattern onto a video screen image taken with a video camera. These detectors use not one, but many directional microphones that all feed into a complex processing system. The microphones detect the exact position of the signal by triangulation is allows the operator to quickly pinpoint exact leak locations and distance from the detector. The decibel level of the signal is analyzed, and since the distance is known a good estimate of the leakage flow can automatically be calculated based on a calibration table. This type of detector can be extremely useful where common leakage points are not normally accessible, such as for piping run along the ceiling, or where pneumatic components are installed behind safety shields.

Acoustic imagers can find leaks not only in compressed air systems, but other systems like industrial gasses, vacuum, and steam. Many are also useful in detecting electric discharge caused by failing high-voltage electrical insulators.

Leak detector guns using one microphone have some usage challenges. Many auditors have found that leak detection in a working plant is difficult, especially if there are many compressed air uses running during production activities. During a recent audit, a sanding booth was encountered with a dozen or so tools being used to condition components. The air consumption of the compressed air powered hand tools swamped out any signal from leakage from connectors and hoses when a gun was used. However, when an acoustic imager was used these random compressed

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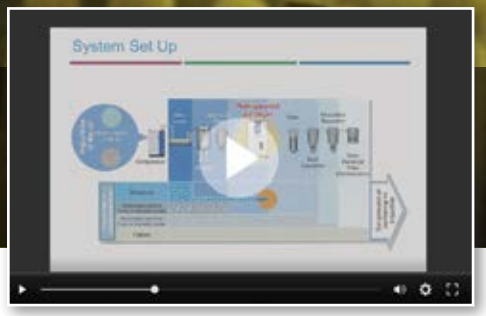


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# A High-tech Way to Extend Your Reach to Leaks

air demands were easily differentiated from constant demands consumed by leaks.

Reflections from leakage sources can be an issue with standard guns. Quite often, during an audit, the operator can be lead away in the wrong direction because a leak near a wall, or at the ceiling causes a reflection off another flat surface, causing a false signal. These false signals are again easily discounted when using a visual detector by moving the camera left and right and seeing how the image changes. If the point doesn't change location on the screen, then it is likely a legitimate leak.

## Finding Leaks in Hard-to-Reach Locations

And leakage in hard-to-reach spots such as piping running along the ceiling can be hard to identify with standard guns. Often the general direction of the leak can be detected but not the exact spot. This then requires the operator to find a way to reach 30 feet up to get a better location. Safety rules often prevent work at heights unless a carefully planning and setup is done, often requiring scaffolding to be erected, all the while there is a chance of a false signal negating the effort.

Recently, during a leakage audit at a large highway bus manufacturer using an acoustic imager, a leak in a mess of piping was detected at the ceiling levels above an entrance door. The leakage flow, automatically calculated by the acoustic imager using the distance and sound level, was estimated at only one cubic foot per minute, not a hugely significant cost if it was a compressed air leak. But since the detection showed the exact position of the leak the operator determined it was a leak in the Argon welding piping. Because the cost of Argon is about 230 times more than compressed air, and the leak flow was continuous, the leak calculated to an eye-popping $24,000 per year in wasted gas.

This recent audit turned up similar finds in the compressed air, nitrogen, argon and $CO_2$ systems. In all, after about two hours of visual scanning, the facility was found to have numerous precisely located leaks totaling about $72,000 in annual costs proving it pays to detect and correct gas leaks.

Acoustic imagers are very good tools to assist in finding gas leaks faster and safer, and assessing the resulting flows more accurately. BP

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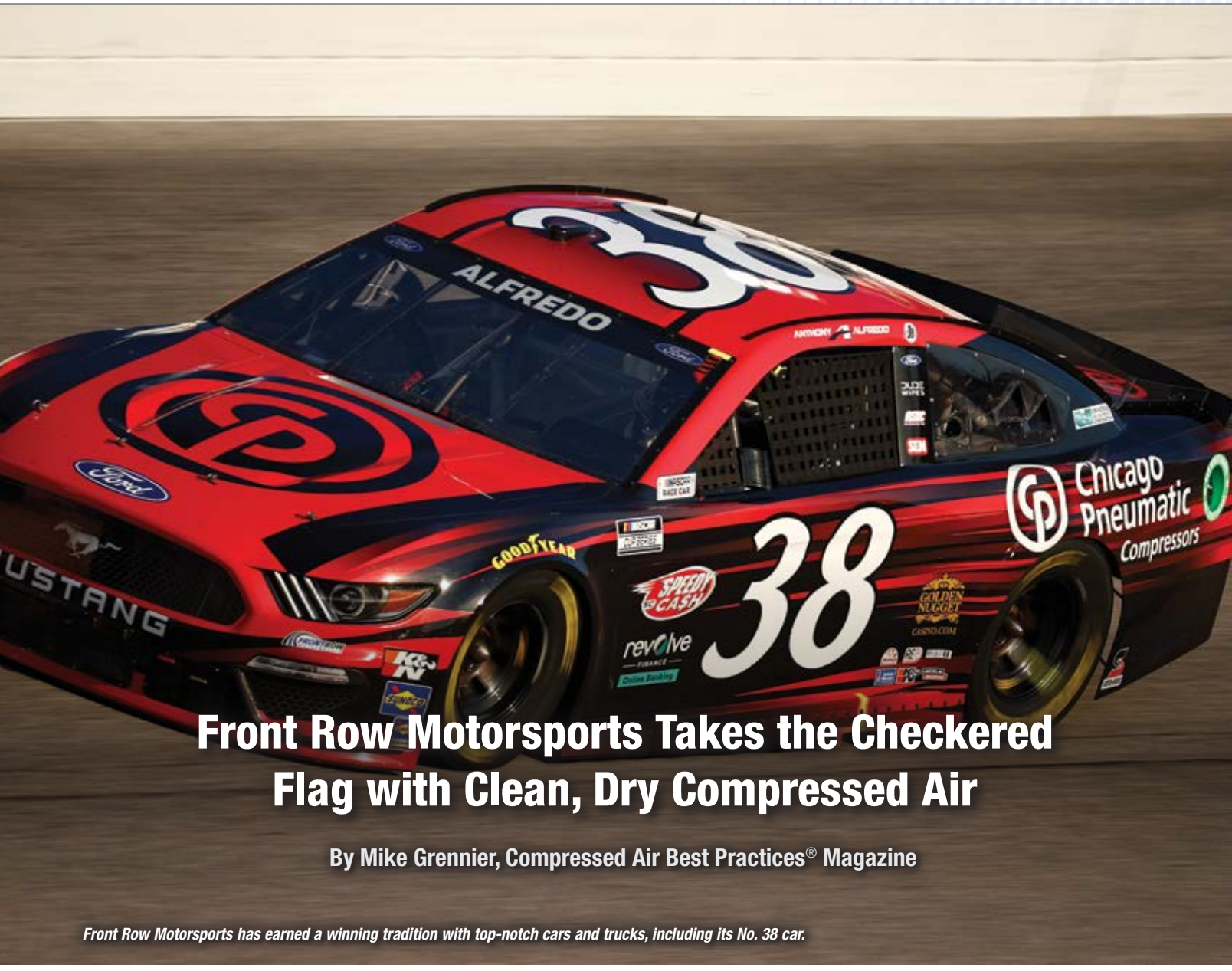


# Front Row Motorsports Takes the Checkered Flag with Clean, Dry Compressed Air

**By Mike Grennier, Compressed Air Best Practices® Magazine**

*Front Row Motorsports has earned a winning tradition with top-notch cars and trucks, including its No. 38 car.*

By every measure, Front Row Motorsports (FRM) is a stock car racing team to be reckoned with given its first-place finish in the 2021 Daytona 500 – which is in addition to other impressive wins in its relatively short racing history.

Key to FRM's winning formula is a dedicated team of experienced professionals and a passion for achieving perfection in every aspect of the sport – including the quality work it puts into the cars it races in the NASCAR Cup Series and the trucks it enters in the NASCAR Gander RV & Outdoors Truck Series.

"We have an employee base that's really committed to trying to win on the racetrack and a committed owner who invests a lot of resources and his own time in the company," said FRM New Business Manager Andrew Green, adding how the company's philosophy led to the recent installation of a highly reliable compressed air system at its car and truck fabrication shop.

"We're always looking forward to how we can better ourselves and get closer to the victory lane in everything we do."

## Small Team Wins Big

Located in Mooresville, North Carolina, FRM employees 75 people who work to race two Ford Mustang cars, one of which is the No. 34 car for Michael McDowell and the No. 38 car for Anthony Alfredo. McDowell won the 2021 Daytona 500. In the truck series, the team fields the No. 38 Ford F-150 truck for Todd Gilliland.

FRM is considered a young and small company in the sport of stock car racing. The company, which is owned by Robert "Bob" Jenkins, began running full time in the Cup Series in 2009.

"In 12 years, we've really built the company into something to be proud of and something that continues to grow and continues to improve," Green said. "There are big teams with as many as 500 employees and more resources. There are also teams that have tried for many years to win the Daytona 500 and never won it. But one of the things that makes us unique is that we are overachievers who put in our full effort into making the program as best as possible."

The goal of winning, combined with growth, created the need for FRM to move into its current production facility in late 2018. It also drove the need to replace an existing compressed air system to help the team take the fabrication of vehicles to a higher level.

## Building Precision Racing Machines

At FRM's 35,000-square-foot race shop, team members work five days a week and more when needed to convert new-build and refurbished cars and trucks into precision racing machines engineered and customized to not only meet strict racing regulations, but to also give drivers every opportunity to win.

When it comes to new-build cars, FRM fabricates its own bodies from sheet metal and other materials, while its technical partner Roush-Fenway supplies the shop with prefabricated steel chassis. The bodies and chassis are separately prepared and painted with primer before being bonded together. After a car is assembled, the body is sanded and modified to meet exacting NASCAR guidelines. In a final step, the team hand-applies a vinyl wrap to the car to give it the final color, as well as a variety of graphics such as logos of vehicle sponsors.

Preparation of the body and the chassis include a thorough cleaning process, which is followed by the application of an epoxy sealer. The components are then baked in a pressurized cure booth for a short period at 140°F (60°C) before being painted. Once the car body is fused to the chassis, the epoxy sealer is then applied only to the seams of the assembled car.

The preparation process for the body of a refurbished car is much the same as a new-build car. More often than not, FRM replaces the body of a car even if it receives only minor damage in a race. The process for trucks is the same, with a few variations on the theme. In all, the teams at FRM work on as many as 30 vehicles throughout the season. The cars and trucks are rotated in and out of the shop and compressed air is used in virtually every phase of production.

## Intermittent Compressed Air Demand

When FRM moved into its current facility in Mooresville, it wasn't long before the team decided the existing compressed air system needed serious attention. The 25-year-old rotary screw air compressor had simply outlived its useful life. Additionally, the team needed a system to meet the critical need for stable air at all times, despite the intermittent and typically large demand for air throughout any given day.

FRM subsequently partnered with Chicago Pneumatic Compressors (www.cpcompressors.com) to select an air compressor best matched to its requirements. FRM then partnered with the Charlotte, North Carolina, branch of Universal Air & Gas Products Corporation

## Front Row Motorsports Takes the Checkered Flag with Clean, Dry Compressed Air

*At FRM, the body of stock car is primed and ready for a vinyl wrap to give the car its final color and graphic treatment.*

(UAPC) to install the air compressor. UAPC (www.uapc.com) provides local compressed air service support for Chicago Pneumatic Compressors.

The decision regarding the air compressor best suited for FRM included an assessment of the shop's compressed air applications. Among the top priorities was a system capable of efficiently and cost-effectively providing an ample supply of stable, clean, and dry compressed air without fail, despite intermittent demand and virtually non-stop use by as many as 10 FRM team members at any given time. The system also needed to accommodate future growth in compressed air demand, and Chicago Pneumatic Compressors

was able to supply a 30-horsepower (hp) unit that met and exceeded the team's needs.

At the paint booths, FRM team members typically use conventional High-Volume Low-Pressure (HVLP) paint sprayers to prime the chassis and car bodies. Paint pressure pots (also called paint tanks) feed paint to the paint sprayers. The compressed air system supplies air to the paint pots at a steady 65 psi. The tanks regulate air output for the sprayers at 12 to 15 psi in order to deliver the precise amount of paint to a given chassis or car body.

Another primary use of compressed air includes power for dual-action sanders. The team uses the sanders to sand paint and other materials, such as body putty. The sanders require a precise flow of air to provide both rotational and the orbital action necessary for careful edging, feathering, and finishing work. The shop also uses a host of three-inch, air-powered grinders for a variety of tasks, such as grinding seams of bonded body parts to ensure a seamless surface. Hand-held, variable-flow air guns are also used to dry off chassis after they've been cleaned. The range of applications at the shop is wide.

"We have air hoses in each of our two paint booths, which are in constant use, and there is an air tool running probably every minute of every day we're at the shop," said Doug Needham, FRM Paint and Body Manager.

## Air Compressor Setup Matches Specific Needs

After evaluating FRM's operation, Chicago Pneumatic Compressors recommended replacing the existing air compressor with a gear-drive, lubricated CBPg 29-D rotary screw air compressor rated to deliver up to 130 scfm at 125 psi.

Packaged in a sound-attenuated enclosure, the air compressor includes an integrated refrigerated dryer rated to provide 145 scfm of air at a pressure dew point of 39°F (4°C). Chicago Pneumatic Compressors also provided FRM with a base-mounted, 500-gallon dry receiver tank. Chicago Pneumatic Product Marketing Manager Daran Van Koevering said the large tank met FRM's specific request for an efficient and stable supply of compressed air today and well into the future.

"In general, you can never really have too much air storage," Van Koevering said, noting how efficiency equates to energy cost savings. "It keeps the air compressor starts and stops to a minimum. With an air compressor, the cost to run it far outweighs the initial air compressor itself. If there is anywhere you can cut those energy costs it will definitely help you get the most out of your investment."

Additionally, the sizeable tank virtually eliminates the potential for pressure drop, said Eric Pressley, Service Lead at UAPC.

"What they didn't want to happen is pressure drop, especially when painting," Pressley said. "They wanted enough storage to ensure nothing happened during mid-paint because the paint has to be flawless."

## Front Row Motorsports Takes the Checkered Flag with Clean, Dry Compressed Air

UAPC installed the air compressor on a concrete pad outside the facility and within a few feet of the paint shop. FRM subsequently built a small metal building around the air compressor with ample venting to protect it against the elements, while allowing for sufficient airflow.

The air compressor provides dry air to the stand-alone storage tank. From there, air is

*FRM team members use High-Volume Low-Pressure (HVLP) paint sprayers to prime its car bodies.*

*A Chicago Pneumatic CBPg 29-D rotary screw air compressor satisfies FRM's need for stable and clean, dry air.*

routed to an existing regenerative desiccant dryer located directly inside the facility. The dryer provides an even higher level of clean, dry air given the pressure dew point setting of -80°F (-62.2°C) and Relative Humidity down to .01% RH. The tank-mounted dryer features a water-separator, as well as oil coalescing filters rated to capture particulates down to .01 micron and aerosols down to .008 parts per million (ppm). The dryer is also equipped with automatic condensate drain, as is the storage tank as an extra precaution.

The existing compressed air system also includes two-inch, galvanized steel piping loop with one-inch piping feeding air to 15 drops, including two dedicated to the paint booths. The system supplies air to the tools at 90 psi.

## Winning is the Goal

At FRM, the production schedule is planned out months in advance. The reliability of the new air compressor provides the shop with confidence it will always deliver shiny, super-streamlined cars and trucks that are more than ready for race day.

"When we do a new build, for example, it's very critical we dry the chassis off as quickly as possible with the handheld blowers," said Needham. "I have never seen that application pull down the air compressor while we're painting, and I have other guys running grinders and sanders. That's why I'm very pleased with it."

Losing air pressure, Needham said, would create a problem that needs to be avoided at all costs. As would oil, water or contaminants in compressed air.

"What we want is to start and finish without any problems," he said, noting another example of how painters cannot stop painting once the process starts until the job is finished. "We don't want anything to hold us up or make us go back and redo something. We cannot have moisture in our air tools whatsoever. We depend on clean, dry air just like we do for lunch each and every day."

The new air compressor and FRM's relationship with Chicago Pneumatic Compressors and UAPC, said Green, align with the team's goals of winning.

"It's about, 'How can we put ourselves in the best position to win in NASCAR and compete for more milestones?' That's what we will continue to look to do," said Green. BP

*All photos courtesy of Front Row Motorsports.*

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# Cleaning Products Plant Innovates and Saves

By Ron Marshall, Marshall Compressed Air Consulting and Greg Good, EcoPlant

➤ As part of its ongoing corporate initiative to find ways to reduce its energy bills, and the costly impact on the bottom line, a cleaning products plant, located southwest of Chicago, recently focused on improving their compressed air system operation. This company is a global leader in water, hygiene and infection prevention solutions and services, and ranks eighth on the 2021 Best Corporate Citizens list, according to Corporate Responsibility (CR) Magazine. This article discussed their efforts to improve the operation of their compressed air system by implementing an innovative compressed air monitoring and control system.

## Operating Blindly

The compressed air system consists of two 200 HP oil-flooded/water-cooled rotary screw compressors and one 300 HP rotary screw unit with variable capacity control. A wet receiver tank, two refrigerated dryers with pre- and post-filtration, and a dry receiver condition the air before feeding three separate production areas. Desiccant dryers for two for these areas lower the dewpoint to minus 40˚F (-40˚C). The plant compressors are nearing the end of useful life, and as a result, the plant was suffering from various issues, such as frequent pressure drops, causing costly production interruptions due to compressor shutdowns, and high costs to bring in rental compressors.

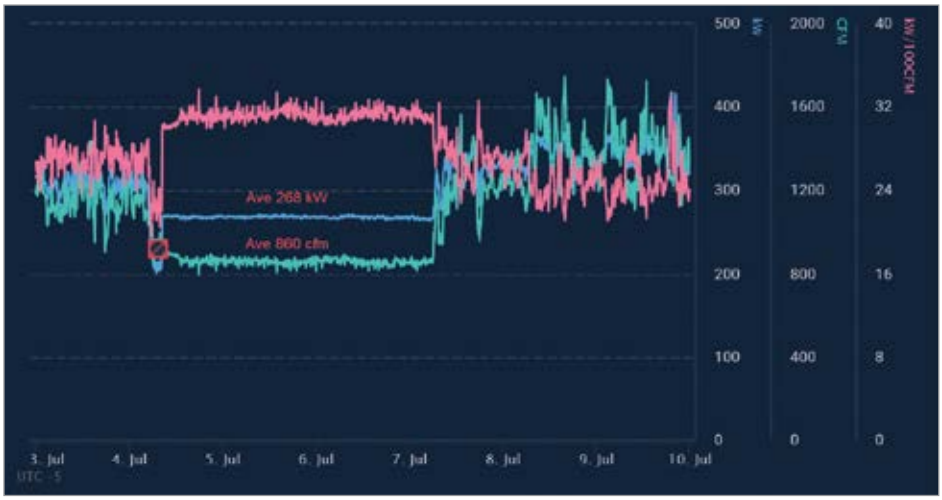
Other than the typical pressure and temperature gauges installed at various points in the system, the compressed air system key operating parameters were previously not monitored in any organized way, and the electrical operating costs were unknown. This made the local operators blind to any energy or flow related problems in the system. A compressed air assessment done by a local vendor, however, identified efficiency problems with the way they ran their compressors and


*System P&ID screen showing complete system with measured parameters (Source: Ecoplant.co)*

operated the air dryers, this was the impetus that started the ball rolling on the compressed air improvement efforts.

## Key Measurements Establish System Baseline

Plant personnel decided the first step in their improvement efforts was to establish a baseline of pressure, flow and energy to see where they stood. They called on a company called Ecoplant to provide the hardware and software needed to gather this information and to organize it in an understandable way. The chosen system is very unique to the industry and consists of inexpensive and advanced input/output devices called Ecoboxes that connect to each measurement instrument in the compressed air system, and to each compressor's local controller. The Ecoboxes have the ability to "talk" the many communications protocols used among various compressor manufacturers. Strategically placed IoT sensors gather critical data such as kW consumption, specific power (kW/100 CFM), airflow, pressure and dew point. The data is gathered and aggregated, then sent via a private cellular network to the cloud for viewing and analysis.




*During non-production times the system consumed 860 cfm, almost as much as a fully loaded 200 hp compressor. About 400 cfm of this flow is estimated to be leaks. (Source: Ecoplant.co)*

## Data Collection Reveals Issues

Almost immediately the analysis of the collected data revealed some efficiency challenges:

- The plant's average specific power (SP) required to generate compressed air averaged 25 kW/100 cfm, about 30 percent higher than a typical optimized level of 18 kW/100 cfm.
- The compressed air system was at its most inefficient during low production periods, this is typical of poorly controlled compressors and was caused by the large 300 hp compressor operating during light system air flow

## Cleaning Products Plant Innovates and Saves

when the smaller compressors could more efficiently carry the load.

- One of the compressors was operating in a degraded fashion, reaching only 80% of rated flow during critical peak demand periods.
- Many random pressure drops were noted. This was caused by control problems with one the compressors and overheating shutdown.
- Annual kilowatt hour consumption was measured at about 3 million kWh, for an annual utility cost of $183,000
- Air leakage was estimated at about 400 cfm, and the annual cost "to feed the leaks" was calculated at $52,000

### Plan for Improvement

Based on the data analysis a plan for improvement was developed:

- The plant could reduce an average of 510 kilowatts, resulting in about 17 percent reduction and $32,000 in electrical savings annually, simply by operating the compressed air system at optimal efficiency if utilizing dynamic controls provided by the monitoring system. This would achieve a reduction in $CO_2$ emissions of 245 metric tons.
- Repairs were to be undertaken to improve the conditions and correct the settings of some problematic compressors.
- The data constantly collected from the compressor controllers would be used to warn against impending failures of the compressors, such as overheating conditions. Due to the many shutdowns occurring due to limited condition monitoring, it was estimated that the factory could avoid over $100,000 per year in productivity loss.
- The monitoring and control system would provide maintenance

management by showing a broader picture of the factory's overall compressed air health using some easy-to-understand web-based status screens.

## The Value of System Measurement and Control

This case study shows the value of performing baseline measurement of a compressed air system. Many unanticipated discoveries were made during this assessment and during the ongoing monitoring. The plant was suffering from unreliable pressure and poor system inefficiency.

Air compressor loading was higher due to a significant level of non-productive load, including leakage. Compressor capacity was


*Figure 3: The specific power (pink line) profile taken during the assessment showed shows the efficiency of the system drops off substantially as the flow reduces. This is typical of a poorly controlled system. (Source: Ecoplant.co)*

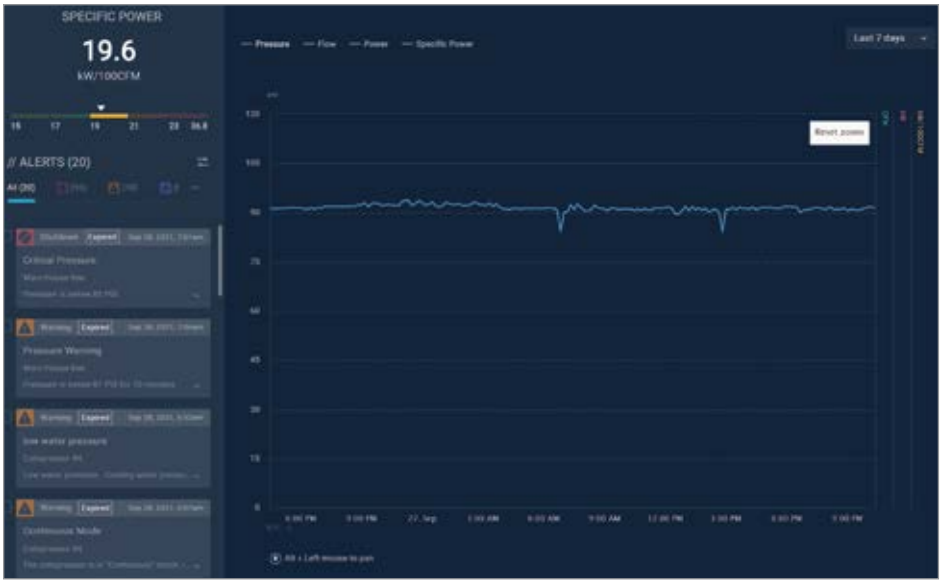



*Figure 4: Pressure events such as this one can be detected, and the root cause easily determined by reviewing recorded alarms and warnings because the monitoring system is hooked up to each compressor controller. (Source: Ecoplant.co)*

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*"We used to think of energy efficiency primarily as a means to save money, but that's changed. We believe there are a lot of benefits beyond that and it's become part of our identity."*

— Sharon Nolen, Manager of Global Natural Resource Management, Eastman

*"As an example, we were using higher pressure air compressors for an application that didn't need that amount of pressure so we installed a blower rated to deliver air at 15 psi, which saved $30,000 a year."*

— Nick Waibel, Global Energy Lead, Tate & Lyle

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

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— Lora Gans, Environmental Health & Safety Manager, Stanley Black & Decker

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## Cleaning Products Plant Innovates and Saves

lower due to incorrect adjustment, something that was not obvious until readings were taken. Many of these items were not previously known by plant management.

Because the control system talks directly to the compressors in the correct native language, long term tracking and trending of machine conditions could be done by harvesting available data. When adjustments are required to switch the order of compressors, for more efficient operation, the control system, using pre-programmed algorithms and artificial intelligence, simply writes new pressure setpoints to optimize operation and save energy.

The plant engineering staff is now working hard to address the system improvement recommendations made by the technical support from Ecoplant, with an improvement in pressure, and significant reduction in operating costs on the horizon.

**TABLE 1**

| | |
|---|---|
| **ENERGY AND SUSTAINABILITY IMPROVEMENT** | |
| Energy reduction | **$55,000** savings |
| Air leak reduction | **$52,000** savings |
| $CO_2$ emissions reduction | **331 metric tons** (based on 23% reduction) |
| Cooling water reduction | **> 15%** |
| **EQUIPMENT & MAINTENANCE OPTIMIZATION** | |
| Professional consulting | **$10,000** value/cost avoidance |
| Infrastructure optimization | **$50,000** value/cost avoidance |
| Quarterly air audits | **$20,000** value/cost avoidance |
| Redirected in-house labor | **400 hours** (8 hours/week) |
| **Production Risk Reduction** | **$120,000** (based on over 60 critical system alerts) |
| **TOTAL ANNUAL VALUE** | **$297,000** |

To summarize, the plant, through the deployment of the Ecoplant cloud-based software-as-a-service (SaaS) solution, has already benefited from cost savings, cost avoidance and risk reduction estimated as shown in Table 1. BP

*Ron Marshall is an experienced technical writer, trainer and compressed air auditor, owner of Marshall Compressed Air Consulting. Contact him at, tel: 204-806-2085, email: ronm@mts.net.*

*Greg Good is Technical Account Manager for Ecoplant. He has spent over 16 years in the compressed air industry working with an OEM distributorship prior to joining the team at Ecoplant. Contact him at: greg.good@ecoplant.co*

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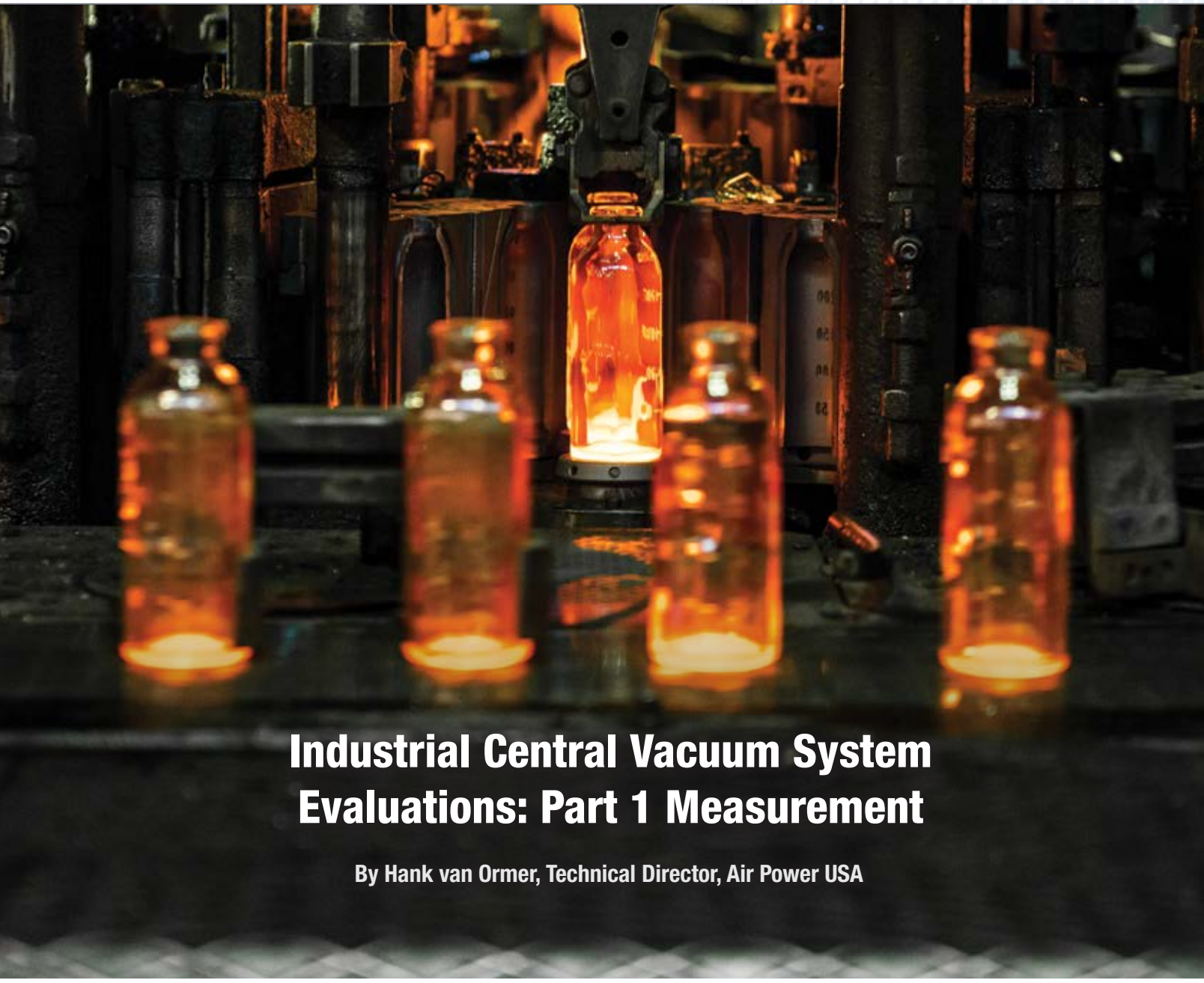

# Industrial Central Vacuum System Evaluations: Part 1 Measurement

By Hank van Ormer, Technical Director, Air Power USA

## ➤ Atmospheric Pressure (ATM)

What is vacuum as used in the manufacturing/industrial sector? The clearest answer is – a contained space with gaseous pressures much less than surrounding atmospheric pressure.

Atmospheric pressure (ATM) is expressed in many units of measure. At room temperature a cubic foot of contained air at sea level – the random movement and molecular impact on the walls of the containment vessel equal a force of 14.7 psia for every square inch of the walls.

Some of the most common units of measurement are:

- HgAbs – Inches of mercury absolute with a nominal 30" (29.92) column of air = 1 ATM
- Torr – the 30" nominal column of air is set at 760mm- 760 Torr = 1 ATM
- A common counterpart with these:
  - 1 ATM (Atmosphere) = 29.92" HgAbs
  - 760 Torr = 14.7 psia

HgAbs (inches of mercury absolute) is a very reliable and accurate measurement. However, the measurement range is relatively narrow. If a wider range is needed, Torr offers more increments of measure for high vacuum. Note: "high" vacuum equals a lower vacuum reading!

Micron measurement (and some others) are used for ultra-high vacuum, deep space, etc. where there are fewer measurement increments.

## Vacuum Levels by Class and Typical Applications

Vacuum applications are often loosely classified into different levels using terms like low, medium, high and ultra-high vacuum. Here are some definitions and common applications.

- **Low Vacuum –** generally applied to such commercial products as vacuum cleaners.
- **Medium Vacuum –** typically achieved by a single stage vacuum pump and measured with basic equipment – generally HgAbs or Torr. Medium to lower high vacuum serve many industrial markets such as:
  - Glass Container Manufacturing
  - Material Conveying (bulk and production lines)
  - Production Furnace (processes such as heat treatment and procedures)
  - Printing, paper, rubber, and plastic procedures
  - Food processing, meat packaging, electrical, pharmaceutical
- **High Vacuum –** usually requires multi-stage pumps. There are some single stage positive displacement pumps that serve significant sectors to this class.
- **Ultra-High Vacuum (UHV) –** usually requires heating or a chamber to remove trace gases and other special procedures. Most standards recognize this to a level of $10^{-7}$ Torr and beyond.

## Evaluating Pressure Drop in a Vacuum System

When a vacuum system is first selected and set up, much energy and attention is spent selecting the pump to achieve and continue to supply the correct target vacuum levels required.

The operating system accessories and connectors to equipment not purposely selected or applied can generate vacuum leaks (outside air enters the system or the demand side) that unchecked can destroy its performance.

**TABLE 1: ATMOSPHERIC AIR COMPOSITION**

| Air Composition at 50% Relative Humidity | |
|---|---|
| **Gas** | **Percent** |
| $N_2$ | 78.08 |
| $O_2$ | 20.95 |
| Ar | 0.93 |
| $CO_2$ | 0.033 |
| Ne | $1.8 \times 10^{-3}$ |
| $CH_4$ | $2.0 \times 10^{-4}$ |
| He | $5.24 \times 10^{-4}$ |
| Kr | $1.0 \times 10^{-4}$ |
| $H_2$ | $5.0 \times 10^{-5}$ |
| $N_2O$ | $5.0 \times 10^{-5}$ |
| Xe | $8.7 \times 10^{-6}$ |
| $H_2O$ | 1.57 |

**TABLE 2: UNITS OF VACUUM MEASURE**

| Units of Vacuum Measurement | | | |
|---|---|---|---|
| **Units** | **inHg (abs.)** | **Torr** | **Microns** |
| 1 inHg | 1 | 25.4 | $2.54 \times 10^4$ |
| 1 Torr | $3.937 \times 10^{-2}$ | 1 | 1000 |
| 1 Micron | $3.937 \times 10^{-5}$ | $1 \times 10^{-3}$ | 1 |

**TABLE 3: VACUUM LEVELS BY CLASS AND USERS**

$10^{-7}$ Torr refers to 0.0000010Torr where 1 Torr is 1mm of Hg (mercury) of pressure

| Term | Vacuum Levels |
|---|---|
| Rough Vacuum | 760Torr to 1Torr |
| Medium Vacuum | 1Torr to $10^{-3}$Torr |
| High Vacuum | $10^{-3}$Torr to $10^{-7}$Torr |
| Ultra-High Vacuum (UHV) | $10^{-7}$Torr and beyond |

**TABLE 4: COMMON UNITS OF MEASURE IN LOW TO LOWER-MEDIUM PRESSURE VACUUM SYSTEM**

| Inches HgV | Torr | Millibar | Bar | Inches HgAbs | PSIA |
|---|---|---|---|---|---|
| 0 | 760 | 1,013 | 1.01 | 29.92 | 14.7 |
| 2 | 709 | 946 | 0.95 | 27.92 | 13.7 |
| 5 | 633 | 844 | 0.84 | 24.92 | 12.2 |
| 10 | 506 | 675 | 0.67 | 19.92 | 9.8 |
| 15 | 376 | 505 | 0.51 | 14.92 | 7.3 |
| 18 | 303 | 404 | 0.4 | 11.92 | 5.9 |
| 20 | 252 | 336 | 0.34 | 9.92 | 4.9 |
| 22 | 201 | 268 | 0.27 | 7.92 | 3.9 |
| 25 | 125 | 167 | 0.17 | 4.92 | 2.4 |
| 28 | 49 | 65 | 0.07 | 1.92 | 0.9 |
| 29 | 23 | 31 | 0.03 | 0.92 | 0.5 |
| 29.92 | 0 | 0 | 0 | 0 | 0 |

# Industrial Central Vacuum System Evaluations: Part 1 Measurement

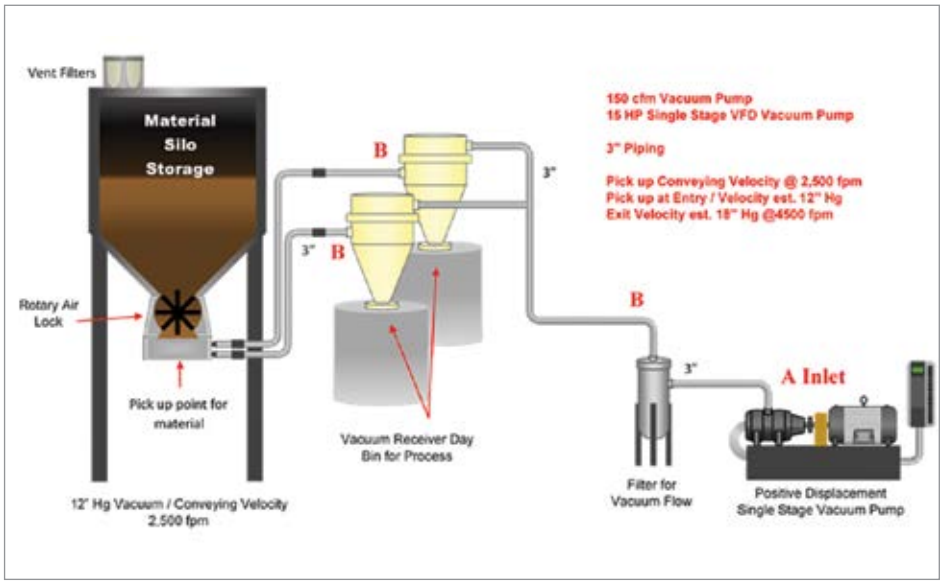


*Figure 1: Typical Vacuum Dilute Phase Conveying System for Particle Material*

Often in industrial applications the term "High Vacuum" is desired but may or may not be required. Accordingly, be sure of what vacuum level is the "True Target Pressure."

Vacuum pumps must operate at the higher level of vacuum to compensate for unplanned excessive pressure loss in the system. Too small or restrictive piping configuration will compound this issue due to "pressure drop" in the flow.

Pressure Drop is the difference in system operating pressure from the pump supply to the point(s) of use. It is very common in the vacuum industrial system to measure the required points in inches of mercury/absolute (HgAbs.). Refer to Table 4 that covers the range of various common units of measure from atmosphere to nominal "Perfect Vacuum".

## Measuring for System Pressure Drop

When a compressed air system has higher positive pressure than is required at the process, it creates increased air flow with no improvement in quality or productivity and is referred to as "artificial demand." The same is true in a vacuum system; excessive pressure drop will make the pump work harder to achieve the same productivity and quality, production hence "Artificial Demand." As the system vacuum falls below the "True Target", there is need for a higher vacuum at the pump requiring the system to compensate for the loss. Depending on the type of pump and the operating curve, this may well be an increase in operating energy cost.

If the total loss is significant enough to demand extra flow capacity to allow the operating system to hold true target pressure, it may require another pump to produce the needed acfm. There will be an increase in operating cost along with the ancillary cost of the ownership operating units.

Figure 1 provides an example of where to measure to understand operating pressure drop. Measure the vacuum at the inlet to the vacuum pump (A) and using the same gauge measure the vacuum at the point(s) of use (B).

The difference is the total system operating pressure drop. This can range from a fraction of inches of mercury to about 15 inches. High pressure drop requires increased volumetric flow (ACFM) to compensate.

Generally, as the vacuum level increases, ambient air entering the system expands proportionately, which alters the vacuum level. The higher the vacuum level, the greater the expansion This is called the "Expansion Ratio." To maintain the target vacuum level, more pump volumetric capacity is required (ACFM). At some point, if left unchecked, additional pump capacity will be required, increasing the operating energy cost and can associate ownership costs. BP

*For more information contact Hank van Ormer, Technical Director, Air Power USA at tel: 740.862.4112, email: support@airpowerusainc.com or https://www.airpowerusainc.com/contact/*

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# COMPRESSED AIR INDUSTRY & TECHNOLOGY NEWS

## Sulzer HSR High-Speed Turbocompressor

The uniquely designed HSR high-speed turbocompressor is manufactured in Finland. Not a single drop of oil is present in the machine, making it truly oil-free. The variable speed, direct-driven technology of the HSR turbocompressor delivers a wide turndown of flow from the gearless direct drive. Titanium impellers supported by active magnetic bearings make the HSR an energy-efficient and environmentally friendly compressor. And as if that were not enough, the machine can also recover up to 93% of its generated heat, which can then be utilized in the industrial process. One key benefit of this outstanding technology is the minimal life cycle and maintenance cost. For most, if not all compressors, a life cycle of over 15 years normally equates to 3.6 times the investment cost of the machine, but with the HSR, the maintenance costs are hugely reduced. Why? Because parts that don't touch don't wear, and parts that don't wear don't fail.

*Sulzer, www.sulzer.com*

## Edgetech Instruments DewMaster Precision Hygrometer

The American made, rackmount DewMaster precision hygrometer with stainless steel X3F sensor from Edgetech Instruments Inc. is well known in the industry for its high value and performance. In 19-inch rackmount configuration with its corrosion resistant, primary method, chilled mirror sensor remotely mounted on a connecting cable typically 10 feet long, it is a drop-in replacement for products by other manufacturers. Edgetech Instruments features quick delivery and fast annual recertification turnaround to avoid unnecessary downtime at your facility. There is no need to wait long periods for equipment replacements or services. The DewMaster is a laboratory grade, high precision, field proven instrument with multiple available sensor configurations and wide applicability to fit all budgets. Available sensors can be air, fan or liquid cooled to fit the required dew/frost point range.

*Edgetech Instruments, www.edgetechinstruments.com*

## Pneumatech Medical Gas Solutions Integrates with BeaconMedaes

Pneumatech Medical Gas solutions announced its integration into the BeaconMedaes brand. By joining forces under one brand, we will provide clarity for our external partners and regulatory bodies about the distinction between the two brands, both of which are distributed in the United Kingdom by Atlas Copco Medical Ltd. The integration will enable us to simplify our go-to-market processes and internal systems, resulting in accelerated production and response times. The combined effort of two brands will give us the resources to further strengthen our focus on developing innovative products and tailored solutions that suit our customers and their patients even better. The integration also benefits our partners and customers, giving them access to an expanded product range through a single, well-established brand that offers best in class service and support globally and locally, throughout the entire product lifecycle.

*BeaconMedaes, www.beaconmedaes.com*

## Midwest Control Brass Ball Valves

Midwest Control, a premier supplier of air compressor and pneumatic system components, has introduced a new line of M600 Male X Female Brass Ball Valves. Constructed of high strength forged brass, the M600 line is available with fully open or close design built for trouble-free use in the most rugged industrial applications. The M600 line provides a working pressure of 600 PSI WOG and is safety tested at 1.5X working pressure. Versatile ball valves can be used safely with a variety of liquids. Full port design provides the highest flow performance possible. It includes a high precision chrome-plated ball with PTFE seat for leak-proof service and chrome-plated steel lever handle with blue vinyl grip. Valves can be used at temperatures ranging from 0°F - 365°F, also suitable for vacuum service to 29.9" Hg.

*Midwest Control, www.midwest-control.com*

# COMPRESSED AIR INDUSTRY & TECHNOLOGY NEWS

## Automation24 Offers Endress+Hauser Measurement Devices

Automation24, an online shop for industrial automation technology, announced it has added Endress+Hauser process control measurement devices to its growing product offering. Endress+Hauser process instruments and components deliver impeccable accuracy, allowing plant operators in industries like food and beverage, water and wastewater, oil and gas and pharmaceutical to reduce operating costs and enhance the quality of their end products. Highlights from this product offering include: cerabar pressure transducers and transmitters, ceraphant pressure switches, Picomag and Promag flowmeters, minicap capacitive level detectors, prosonic ultrasonic level detectors, TH Series thermometers, ecograph data loggers, RIA 14/15/16 loop-powered process indicators, measuring devices for hazardous areas and other demanding applications. "We are very excited to add Endress+Hauser products to our online shop," said Ron Baysinger, Vice President.

*Automation24, www.automation24.com*

## Atlas Copco Acquires French Distributor

Atlas Copco has acquired AEP, a French distributor of compressors and provider of service. The company has a strong market presence in Paris and the Île-de-France region. AEP is a privately owned company and has 8 employees. The company is located south of Paris, in Saint-Michel-sur-Orge. The company serves a diverse group of small to medium-sized customers in industries such as manufacturing, food and beverage, and automotive. "AEP has highly qualified service technicians, and the company has for many years been a distributor of Atlas Copco," said Vagner Rego, Business Area President Compressor Technique. "By this acquisition we will reinforce our commitment to better serve our customers and strengthen our capabilities for the growing market of small- and medium-size companies." The company will become part of the Service division within the Compressor Technique Business Area.

*Atlas Copco, www.atlascopcogroup.com*

## Siemens Matched Motor/Drive Combination Package

Siemens Industry, Inc. announced the release of combination motor/drive packages, allowing an OEM or end-user the option to select the optimum solution for a variety of heavy-duty industrial motion control applications from a single source, backed by a full three-year warranty. Choosing from a pre-determined list of motor/drive combinations, the customer simply makes the selection best suited to the application. The motor and drive are packaged on a single pallet, shipped and invoiced together. The motor and drive combinations are power-matched for 480V high-overload operation through a 20 hp range, with I2T protection from thermal damage provided as a standard in both the motor and the drive components. The Siemens Intelligent Operator Panel is included with these packages, allowing easy step-by-step drive start-up.

*Siemens, www.usa.siemens.com*

## Prevost Expands PPS1 Line

Prevost Corporation announced its Prevost Piping System 100% aluminum line has expanded to include a new 4" diameter size. Like the existing line, the 4" range boasts an extensive selection of fittings and accessories making it the most complete range by any single manufacturer. We designed the 4" fittings to facilitate installation while maintaining the same reliable performance customers have grown to trust. The double lobe O-ring in our fittings, guarantees the system, leak free for 10 years. New products include flanges for drilling under pressure, the new Compact Connector Concept fittings for compressor rooms, innovative installation tools and pneumatic safety valves. The entire system is fully customizable and designed to accommodate any facility configuration. We meet numerous worldwide certifications though our rigorous Research & Development design process, stringent manufacturing operations and thorough quality inspections.

*Prevost, www.prevostusa.com*

# COMPRESSED AIR INDUSTRY & TECHNOLOGY NEWS

## Emerson's New Emissions Monitoring System

Emerson announced the new Rosemount XE10 Continuous Emissions Monitoring System, which is designed to help industrial plants meet increasingly stringent environmental regulations and evolving sustainability demands. With its built-in performance analytics and automated validation capabilities, the new system ensures accurate emissions monitoring and reporting to help plant operators reduce the risk of non-compliance shutdowns and penalties. Designed for rapid deployment, the new system is a compact and standardized solution certified to the European standards EN 14181 and EN 15267, which govern the quality assurance requirements for automated measurement systems of stationary source emissions. The system also complies with the emissions reporting requirements of the U.S. Environmental Protection Agency. "Real-time data reporting and quality assurance are critical to regulatory compliance," said Iain Howieson, vice president and general manager for Emerson's gas analysis business.

*Emerson, www.emerson.com*

# COMPRESSED AIR INDUSTRY & TECHNOLOGY NEWS

## Exair No Drip Siphon Fed Spray Nozzle

EXAIR's new 1/2 NPT siphon fed air atomizing spray nozzle atomizes a variety of fluids in a round spray pattern where no liquid pressure is available and heavy application of liquid is needed. This corrosion resistant type 303SS nozzle draws liquid into the airstream and mixes it internally while providing up to 24" of suction height. Liquid can be easily adjusted to meet the needs of your application using the adjustment valve. The patented No Drip design ensures conservation of precious liquids and protects surface finishes from drips. The 1/2 NPT spray nozzle provides high liquid flow up to 68 GPH in a 6" diameter round pattern. With EXAIR's wide variety of air atomizing spray nozzles, you can coat, cool, treat and paint a variety of products using compressed air and liquids with a viscosity of up to 300 centipoise.

*Exair, www.exair.com*

## Vaisala Indigo510 Transmitter

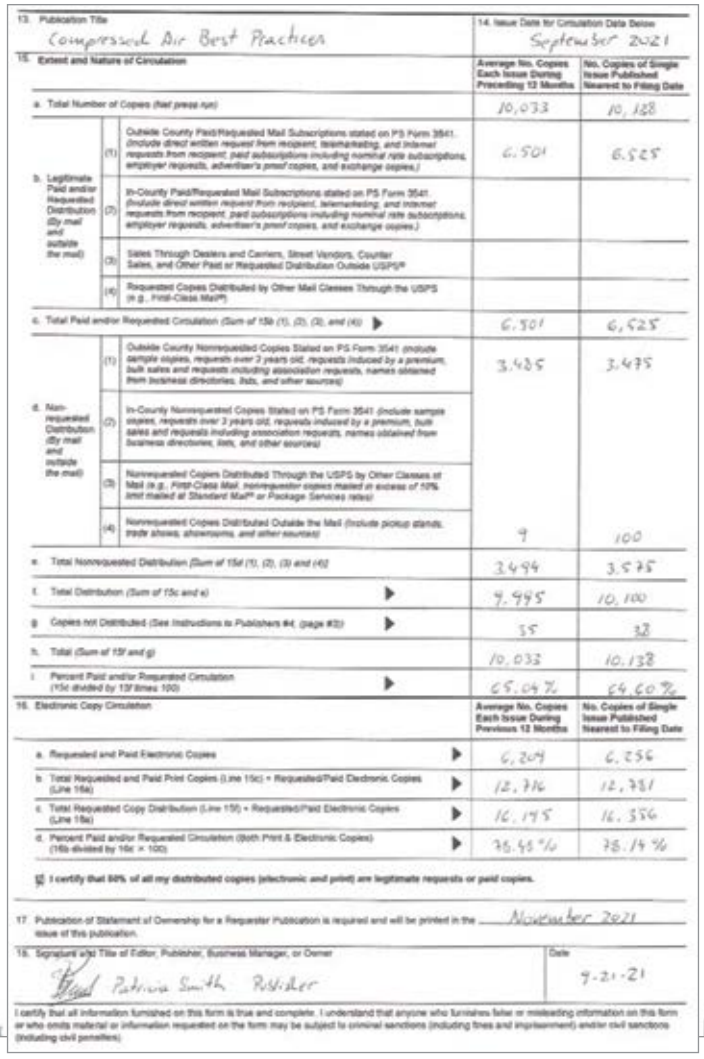
The new Indigo510 is the latest addition to Vaisala's top-of-the-line Indigo transmitter family, all of which are compatible with Vaisala's industry-leading Indigo measurement probes. The Indigo510 builds on the same modular platform and includes the same metal casing, software, and display as the flagship Vaisala Indigo520 Transmitter. Indigo510 is available also without a display. The Vaisala Indigo510 Transmitter is an ideal choice for demanding industrial applications where precise and accurate measurements are needed for a single parameter at a time. Its rugged IP66 and NEMA4-rated metal enclosure ensures reliable performance in the toughest environments. The streamlined transmitter has been designed to meet customer demands. Attaching any Indigo-compatible measurement probe to the Indigo510 transmitter is easy and convenient. The Indigo510 transmitter extends the options for data visualization, connectivity, supply voltage, and wiring compared to using a stand-alone probe.

*Vaisala, www.vaisala.com*

## Parker Executive Leadership Changes

Parker Hannifin Corporation announced that Lee C. Banks, currently President and Chief Operating Officer, has been elected by the Board of Directors to a new role as Vice Chairman and President. The Board also has elected Jennifer A. Parmentier, currently Vice President and President – Motion Systems Group, to the role of Chief Operating Officer, reporting to Banks. Berend Bracht, currently Vice President of Operations – Engineered Materials Group, has been elected to succeed Parmentier as Vice President and President – Motion Systems Group. "Our strategic approach to succession planning across our leadership team allows our executives to build the experiences and skills necessary to continue the transformation of our company," said Tom Williams, Chairman and Chief Executive Officer.

*Parker Hannifin, www.parker.com*



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All **BEKO TECHNOLOGIES** equipment is designed and tested to meet the strict quality guidelines of our company. There are no compromises to the quality or reliability of any of our products.

**BEKO TECHNOLOGIES** is your single source of supply for all your compressed air treatment and monitoring needs with the expertise and know-how you've come to rely on.

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## *Turnkey compressor, blower, and vacuum systems*

**Expanding production and need more air in a hurry?**

Custom engineered solutions from Kaeser Compressors are air systems built to specification for the most demanding and challenging applications. Available as skids or custom weatherproof enclosures, these complete systems are designed for exceptional reliability, simple maintenance, and superior energy efficiency.

- Eliminate construction/renovation time costs
- Faster installation and commissioning
- Move compressed air to a better environment
- Make space for production equipment
- Easy remote monitoring
- Eliminate Class 1, Div 1 constraints
- Sigma Air Utility option (air as utility)

See how they eliminate space, weather, and accessibility constraints and greatly reduce construction and installation time. Visit **us.kaeser.com/cabp**.

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