Sustainable, Safe & Reliable On-Site Utilities Powering Automation

COMPRESSED AIR | CHILLER & COOLING BEST PRACTICES®

airbestpractices.com

coolingbestpractices.com

September 2025

Codes & Standards

Clean Air. Zero Compromise.

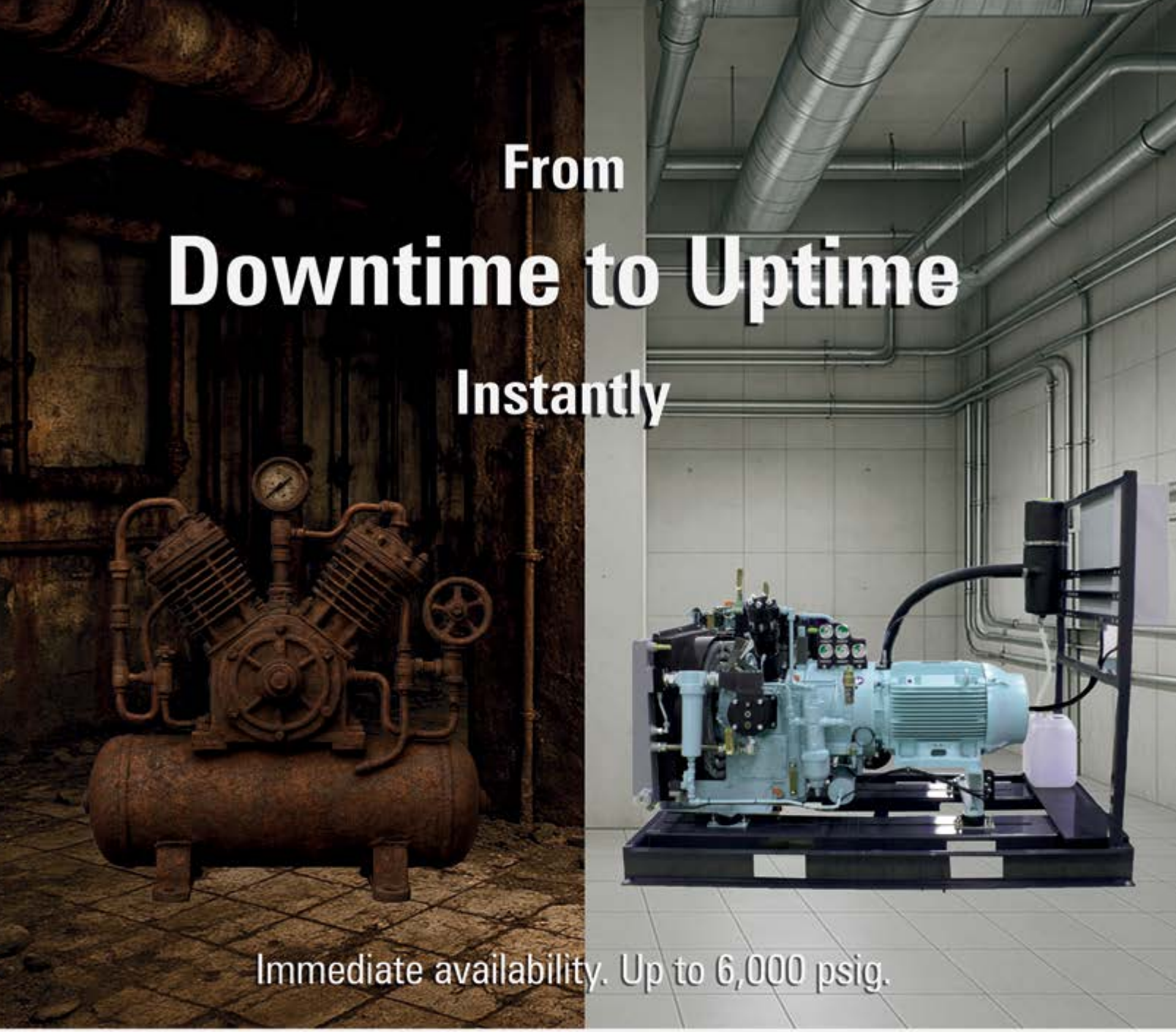
When oil-free really means oil-free.

Our oil-free air compressors are ISO 8573-1 CLASS 0 certified—guaranteeing 100% clean, contaminant-free air. Whether you're in food and beverage, pharmaceuticals, electronics, or automotive, you can count on us to protect your production and your reputation.

Backed by decades of innovation and trusted worldwide, Atlas Copco delivers sustainable performance with zero risk of oil contamination.

Whether you're protecting sensitive equipment, ensuring compliance, or maintaining product integrity, our oil-free technology is proven, reliable, and ready for your toughest challenges.

Atlas Copco Compressors
300 Technology Center Way, Suite 550
Rock Hill, SC 29730
Phone: 866-546-3588
Level up your experience at *atlascopco.com*



From Downtime to Uptime Instantly

Immediate availability. Up to 6,000 psig.

Sauer Compressors USA

Rent with us and meet the team behind your success

Contact Us:

410-604-3142

sales@sauerusa.com

www.sauerusa.com

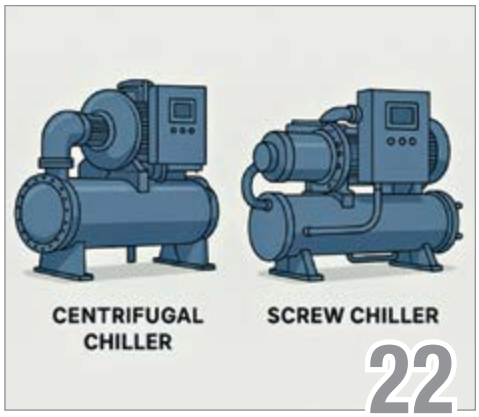
Chuck Westhofen

Jeff Swearingen

Kyle Ricks

COMPRESSED AIR SYSTEM FEATURES

18



22

26

COOLING SYSTEM FEATURES

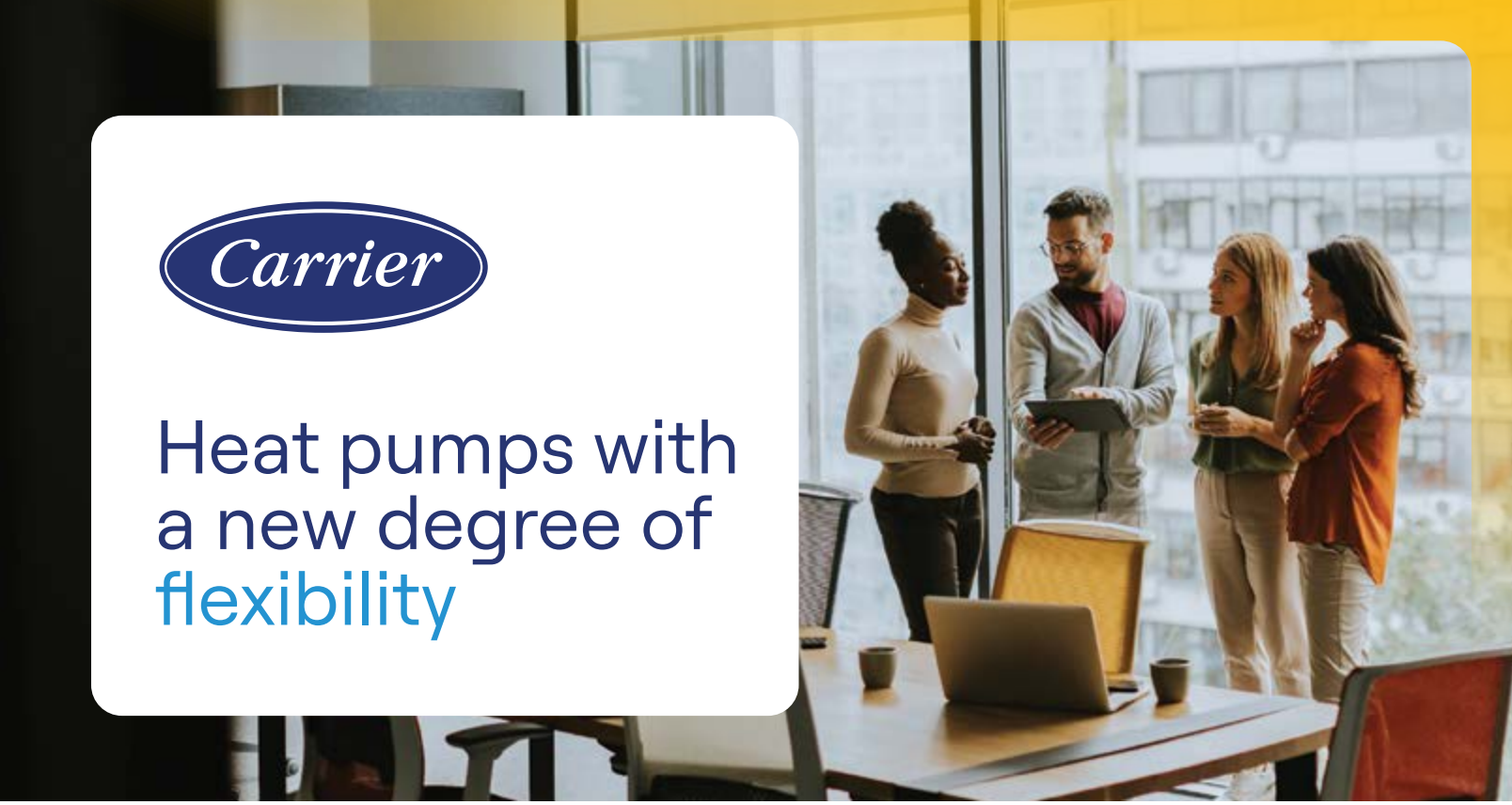
LATEST NEWS

EVERY ISSUE


32


36

Compressed Air Best Practices® (USPS# 17130) is published monthly except January-February combined by Smith Onandia Communications LLC, 37 McMurray Rd., Suite 104, Pittsburgh, PA 15241. Periodicals postage paid at Pittsburgh, PA and additional mailing offices. POSTMASTER: Send address changes to: Compressed Air Best Practices®, 37 McMurray Rd, Suite 104, Pittsburgh, PA 15241.



Heat pumps with a new degree of flexibility

30RQM Modular Air-Sourced Reversible Heat Pump

Modern heating calls for heat pump technologies that improve efficiency and sustainability in all types of buildings. Discover how Carrier is making it happen by taking a modular approach to heating and sustainability with the AquaSnap® 30RQM Modular Air-Sourced Reversible Heat Pump.

- **Operates efficiently at low ambient temperatures** by incorporating variable-speed rotary compressors and fans
- **Adapts to the unique needs of your building** with a compact, expandable design with support for up to 16 modules
- **Supports your sustainability goals** by reducing reliance on boiler systems and using R-454B refrigerant with lower GWP*
- **Makes management and service easy** with remote connectivity and our advanced touchscreen SmartVu™ Controls interface

greenspeed AQUASNAP

Cooling Capacity: 20–320 Tons (70–1,125 kW) 20 Tons per Module
Heating Capacity: 263–4,222 MBH (77–1,237 kW) 263 MBH per Module

Visit carrier.com/30RQM or contact your local Carrier expert today.

*According to the IPCC's Fourth Assessment Report (AR4) of 2007, R-454B has a 466 GWP100. GWP is a measure of a substance's climate warming impact compared to CO_2.

FROM THE EDITOR

Going In-Depth on Codes and Standards

It's time for our annual standards issue, and I predict you're going to hold onto this one. We've packed in a lot of practical information.

Start with a look at the CAGI Performance Verification Program, penned by Jayme Leonard of Atlas Copco Compressors. The program builds trust by using third-party testing to verify that participating manufacturers' published performance data, including energy consumption, flow rate and efficiency, are accurate. The program covers lubricated and oil-free rotary air compressors (fixed speed or variable frequency drive) and refrigerated cycling and non-cycling compressed air dryers.

As limits on high-global warming potential (GWP) refrigerants grow stricter, plant owners need to be on top of upcoming requirements to better plan their purchases. Nick Mislak of Danfoss provides a thorough overview. New York recently set sub-20 GWP limits that could go into effect as early as 2030 to 2034, depending on the chiller type and whether or not it's used as a heat pump. That will greatly limit refrigerant options.

Two articles look at ISO 8573-1's purity classes. Frequent contributor Ron Marshall explains what ISO 8573-1 does and doesn't cover, such as bacteria and mold. Food processing plants need to be aware they can achieve ISO 1.1.1 purity and still be at risk for microbial contamination. Simon Gleissner of SUTO iTEC explains why the correct approach to measuring dew point is often misunderstood. Values must be converted if readings aren't taken at reference conditions of 68°F (20°C) and 58 psig (4 barg).

Industrial and commercial cooling professionals have to know a variety of performance and efficiency codes. A detailed article from Troy Reineck and Matt Sniezek of EVAPCO helps them navigate ASHRAE's efficiency mandates, California's stringent Title 24, the structural integrity dictated by IBC and ASCE 7, the specialized resilience demanded by FBC and HCAI and the transparent performance verified by CTI.

Finally, we're running the second part of our interview with CIS Industries of Louisiana. This installment focuses on energy conservation projects, heat pump chillers and ASHRAE Guideline 36, with excellent specific advice from Keith Earhart.

TROY DREIER
Senior Editor
tel: 412-409-9151
troy@airbestpractices.com

BEST PRACTICES

2025 EXPO OCTOBER 21-23 KANSAS CITY

COMPRESSED AIR / VACUUM / COOLING

Sustainable, Safe & Reliable
ON-SITE UTILITIES
Powering Automation

SPONSORS

CAGI Compressed Air & Gas Institute

CTI Cooling Technology Institute

Train Your Team at Best Practices 2025 EXPO & Conference

Win Up to $20,000 in Compressed Air Equipment!

Five NEW EXPO Pavilions

Leak Detection – Learn to use different types of leak detectors and discover leak audit best practices. Enter the raffle for a LeakCam 600 Kit, valued at $16,990.

SPONSORED BY CS INSTRUMENTS

Piping – Get hands-on experience installing aluminum compressed air piping systems. Enter the raffle to win one of three Do-It-Yourself Unipipe Aluminum Piping Kits, valued between $1,092 and $2,347.

SPONSORED BY unipipe

Technology – 16 Leading Global OEMs present their latest innovations.

Food Safety – Engineer, maintain and verify compliance with FSMA/SQF/BRC/ISO Quality Systems.

SPONSORED BY TRACE Analytics

Maintenance – Maintenance tips from air compressor, air dryer, chiller, cooling tower, blower, vacuum pump Global OEMs.

Get access to all of these pavilions for just $55 with an EXPO Pass!

Three NEW Conference Workshops

Hard Hat Compressed Air Maintenance Workshop – This interactive workshop features fully operational table-top compressed air labs with pneumatic circuits. Led by experts from SMC, Ardagh Glass, The Analysts, UE Systems and Gentex.

SPONSORED BY SMC

Industrial Cooling Workshop – Learn how to maximize energy and water savings. Led by experts from EVAPCO, Integrated Services Group, SPX Cooling Tech and 3M.

SPONSORED BY RWI

Sales Engineering Workshop – Improve the performance of cooling or compressed air technology sales engineers. Led by Mark Allen Roberts, CEO, OTB Solutions.

All of these workshops are included with a Conference Pass. Check out our Early Bird Discounts!

DIAMOND SPONSORS

BEKO

mikropor

REGISTER TODAY!

CABPEXPO.COM/KS-2025

Early Bird Rate Ends 9/30

PLATINUM SPONSORS

KAESER COMPRESSORS — Built for a lifetime.

Sauer Compressors USA

FS-CURTIS | FS-ELLIOTT

BAUER COMPRESSORS — Quality. Our DNA

GVA GLOBALVAC & AIR

SMC

CS INSTRUMENTS

prevost

tamsan-usa COMPRESSORS

GOLD SPONSORS

Sullivan Palatek

BOGE COMPRESSED AIR SYSTEMS

SUTO

WALKER FILTRATION

South-Tek Systems

KSI

unipipe ALUMINUM PIPING SYSTEM

Subscribers 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!

June's inaugural Industrial Sustainability Best Practices EXPO & Conference in Barcelona, Spain, drew an impressive mix of manufacturers, distributors, engineering firms and OEMs. Flanking Compressed Air Best Practices® Magazine Publisher Roderick M. Smith are Carlos Capilla Camacho (left) and Eric Baronnet (right) of Nestlé Waters & Premium Beverages. Camacho delivered an excellent presentation on his company's compressed air management strategy. Visit https://www.nestle.com.

Also in attendance at the Industrial Sustainability Best Practices EXPO & Conference were Juan Garrido, Albert Garrido, Ivan Garrido and Yosel Céspedes Pérez of SerfriAir, a Barcelona-based company that sells compressed air treatment equipment, chillers and industrial gas generators. It's active in the metal fabrication, pharmaceutical, electronics, food and beverage, automotive and chemical industries. Visit https://serfriair.es.

We were wondering how Greg Olson (center) of the Minneapolis district energy system felt about appearing on the cover of our June issue. Luckily, he seems to be all smiles. Here, he poses with Marcus Beer (left) and Steve Heaton (right) in the main plant's control room. The Minneapolis district energy system provides heating and cooling to over 100 buildings in the city's downtown. Visit https://cordiaenergy.com/our-networks/minneapolis/.

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 with a note describing the team and company to Troy Dreier at troy@airbestpractices.com.

In our July issue, Logan Kelly of Cardinal Glass in Casa Grande, AZ, told us how he worked with Arizona Pneumatic Systems to improve his refrigerated compressed air dryers' performance and remove moisture from pneumatic cylinders in glass transfer, seaming and cleaning equipment. This month, he's back – and he's brought the whole team. Visit https://www.cardinalcorp.com.

Marvin van Hout of ANTS Technology & Consulting in Belfeld, The Netherlands, holds a unique honor: He's the first person to appear in Subscribers From Around the World and Real-World Installations and Maintenance in the same issue. Turn to p.48 to see a mis-installed flow sensor he discovered. ANTS Technology & Consulting has been optimizing compressed air systems for nearly 20 years. Visit https://ants-perslucht.nl.

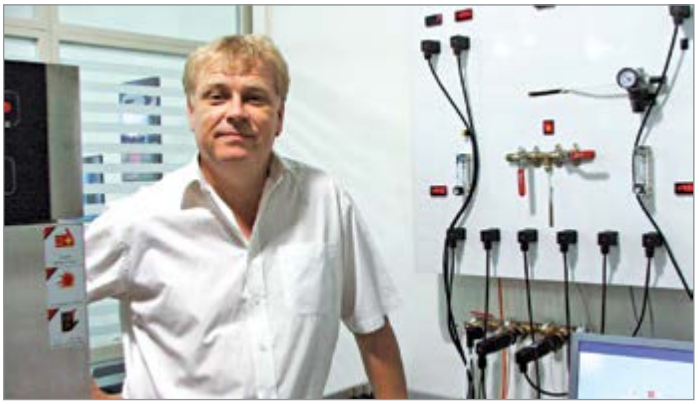
NEWS Compressed Air Industry & Technology

SUTO iTEC Celebrates 20th Anniversary

In 2025, SUTO iTEC proudly celebrates 20 years of delivering cutting-edge measurement and monitoring solutions for compressed air and gases. The company was founded in 2005 by CEO Thomas Fischer and has grown from a pioneering start-up into a global leader and trusted partner for industries around the world.

With over 165 employees, more than 1,250 customers in over 100 countries and a strong focus on innovation, SUTO iTEC stands at the forefront of measurement technology. The company's solutions are known for their precision, reliability and user-friendly design, supporting industries in achieving energy efficiency, system reliability and compliance with international standards.

Over the past two decades, SUTO iTEC has introduced numerous innovations to the industry, such as the S600, the first portable compressed air purity analyzer; the first complete series of compressed air monitoring devices, including seamlessly integrated flow meters, dew point sensors, displays and data loggers and QCM sensor elements for accurate dew point readings down to -148°F (-100°C) Td (temperature dew point).



Thomas Fischer, Founder and CEO, next to the first dew point testing facilities at SUTO iTEC in 2005. The company now works in over 100 countries.

"We are investing heavily in R&D, digitalization and sustainability," said Fischer. "The next 20 years will be about smarter solutions, better data integration and helping industries worldwide operate more efficiently and responsibly." For more information, visit https://www.suto-itec.com.

Yaskawa America Announce North American Headquarters Relocation

Governor Tony Evers, together with Wisconsin Economic Development Corporation and company officials, announced Yaskawa America will invest at least $180 million and create more than 700 new high-paying jobs in Wisconsin.

Yaskawa America is experiencing significant growth driven by innovation in robotics, motion control, AC drives and solar inverters. The company's newest investment in Wisconsin will consolidate its Illinois and Wisconsin facilities into one campus in Franklin, WI, over the next eight to 10 years. The project includes relocating its North American headquarters and training facility from Waukegan, IL.

Mike Knapek, CEO, Yaskawa America, speaking at the expansion and relocation announcement event.

This expansion marks a significant milestone as Yaskawa Electric Corporation celebrates its 110th anniversary globally and Yaskawa America celebrates 58 years of sales, innovation, manufacturing and service in the United States. With this expansion, the company will begin manufacturing robots in Franklin that will be shipped directly to customers or integrated into production lines at its Ohio facility.

"We take pride in our cutting-edge technology, our commitment to quality and our world-class manufacturing, and we look forward to a strong future of growth and innovation in Franklin," said Mike Knapek, CEO, Yaskawa America.

The new campus will include a headquarters, training and lab building, manufacturing and packaging facilities and robotics and semiconductor production operations. It will encompass over 800,000 square feet, strengthening Wisconsin's position in advanced manufacturing. For more information, visit https://www.yaskawa.com.

Ingersoll Rand Acquires Termomeccanica Industrial Compressors and Adicomp

Ingersoll Rand has acquired Termomeccanica Industrial Compressors (TMIC) and its subsidiary Adicomp with a purchase price of approximately $188 million (€160 million).

TMIC is an international leader in the design and production of air and gas compressors with over 100 years of experience and innovation. Its subsidiary Adicomp provides engineered-to-order solutions in the renewable natural gas (RNG) industry. TMIC and Adicomp are based in Italy, with an existing presence in North America and recent expansion into Brazil and India. The businesses will join the Industrial Technologies and Services segment.

"TMIC and Adicomp are leading businesses in their respective industries, and today we welcome them to Ingersoll Rand," said Vicente Reynal, Chairman and Chief Executive Officer, Ingersoll Rand. "These companies strengthen our core capabilities and broaden our service offerings, enabling us to deliver greater value to our customers while advancing our long-term growth strategy for shareholders. Additionally, these companies reflect the strength of our M&A flywheel and reaffirm our ability to partner with family-owned businesses on a proprietary basis." For more information, visit https://www.irco.com.

South-Tek Systems Expands into Comprehensive Compressed Air Solutions with Air Compressors, Dryers and Filters

South-Tek Systems announced the expansion of its product line to include a full suite of South Tek-branded compressed air solutions, including air compressors, dryers and filters. This strategic move marks a significant shift for South-Tek, broadening its focus from nitrogen generation to encompass a comprehensive range of compressed air and gas solutions.

With this expansion, South-Tek Systems now offers a one-stop solution for industrial end-users, distributors and original equipment manufacturers seeking reliable and high-performance compressed air systems. The addition of air compressors, compressed air dryers and filters complements South-Tek's existing nitrogen generators, providing customers with a complete solution for their compressed air and gas needs.

South-Tek Systems' new line of air compressors is designed for maximum efficiency and durability, offering reliable performance and low maintenance costs. The addition of compressed air dryers and filters ensures clean, dry air, protecting equipment and optimizing system performance.

A South-Tek Systems rotary screw air compressor

"This launch marks a significant step in our mission to provide unmatched control, performance and expertise," said Jens Bolleyer, CEO, South-Tek Systems. "As a leading single-source provider of gas generation and compressed air solutions, we now offer a comprehensive product suite under one brand, giving our customers the confidence of relying on one vendor and exceptional support for all their needs."

"We are thrilled to expand our product offerings and provide our customers with a comprehensive compressed air solution," said Dustin Parscal, National Sales Manager, South-Tek Systems. "This expansion allows us to better serve our customers and streamline their operations by offering a single source for all their mission-critical compressed air and gas requirements." For more information, visit https://www.southteksystems.com.


NEWS Compressed Air Industry & Technology

Win Up to $20,000 in Compressed Air Equipment at Best Practices 2025 EXPO & Conference Pavilions

The Best Practices 2025 EXPO & Conference is expanding the exhibit hall this year and introducing five new EXPO pavilions. With a $55 EXPO pass, attendees can connect with over 80 world-class equipment manufacturers and access the pavilions. Also new for this year, there will be raffles to win up to $20,000 in compressed air equipment – including a leak detector camera and DIY aluminum piping kits. The show is in Kansas City, Oct. 21-23.

Leak Detection Pavilion

In a system where electricity costs $0.10 per kilowatt hour, even a tiny leak just 1/16 of an inch wide can waste over $1,000 in electricity annually! At the Leak Detection Pavilion, get hands-on practice with real leak detector technology and learn best practices for planning and conducting leak assessments.

Pavilion sponsor CS Instruments will give away the new LeakCam 600 Kit, a $16,990 value. The full kit includes the LeakCam 600, protective case, two battery packs, holster strap, 100 leak tags and more.

Piping Pavilion

At the Piping Pavilion, gain practical experience installing aluminum compressed air piping and learn how better piping can improve airflow, cut costs and keep your facility running smoothly.

Pavilion sponsor Unipipe will raffle three Do-It-Yourself Aluminum Piping Kits valued between $1,092 and $2,347. Prizes include 8-Drop, 5-Drop and 3-Drop DIY Kits.

Attendees can enter to win CS Instruments' new LeakCam 600 Kit at the Leak Detection Pavilion.

Technology Pavilion

Discover new technologies and innovations from 16 leading global manufacturers of oil-free and lubricated air compressors, compressed air dryers, filters, condensate drains and measurement instruments, nitrogen generators, chillers, cooling towers, pumps, pneumatics, vacuum pumps and blowers. Solve issues with your systems by speaking directly with exhibitors in the Technology Pavilion.

Food Safety Pavilion

Compressed air, vacuum, blower and cooling water systems enter into direct and indirect contact with manufactured food and beverage products. Is your plant at risk of exposing your food products to airborne and waterborne diseases like Listeria and Legionella or simply oil originating from your systems? The Food Safety Pavilion, sponsored by Trace Analytics, will host 16 presentations providing guidance to food and beverage manufacturers.

Maintenance Pavilion

At the Maintenance Pavilion, learn maintenance and service insights from 16 leading manufacturers of air compressors, compressed air treatment, vacuum pumps, cooling towers and chillers.

In addition to the pavilion giveaways, eligible attendees can enter the Daily EXPO $1,000 Energy Treasure Hunt Raffle. To participate, attendees need to collect a stamp from at least 10 Energy Treasure Hunt sponsor booths. Each day of the EXPO, two $250 prizes and one $500 prize will be given away. For more information or to register, visit https://cabpexpo.com/ks-2025.

ABC Compressors Introduces PET Bottling Technology Including the X-PET High-Pressure Air Compressor

ABC Compressors introduced two defining milestones in the evolution of PET bottling technology. The first is the official launch of X-PET, a fully-integrated, oil-free, high-pressure air compressor engineered to meet the rigorous demands of modern blow molding operations. The second is a sneak preview of the next-generation Horizon Synchro, ABC's flagship integrated blowing and filling system.

ABC Compressors' X-PET

Engineered as a true plug-and-play system, the X-PET is delivered as a self-contained, air-cooled package, mounted on a single frame for rapid deployment and minimal installation complexity. It requires no auxiliary components, reducing footprint and downtime while streamlining maintenance operations. The system is available in two models: X-PET 200 (250 m³/h, 45 kW/60 hp) and X-PET 400 (350 m³/h, 75 kW/101 hp).

Both units operate at pressures of up to 580 psig (40 barg) and comply with high-level standards, ensuring global compatibility and reliability. A built-in frequency converter manages start-up peaks and adjusts performance in real time, resulting in optimized energy consumption tailored to actual demand.

While the X-PET sets new standards in compressed air technology, ABC Compressors is gearing up for another major unveiling: the launch of a next-generation Horizon Synchro. This new launch is poised to make waves across the PET industry. Though details remain under wraps until the reveal, one thing is clear: this isn't just an evolution. It's a redefinition. "We're not just unveiling a new machine," said the ABC team. "We're introducing a new chapter in PET bottling industry, one that will challenge how the industry thinks about efficiency, sustainability and system intelligence." For more information, visit https://www.abc-compressors.com.

VPInstruments Launches VP Leak Detector for Proactive Maintenance

VPInstruments announced the addition of the VP Leak Detector to its comprehensive product portfolio. This intuitive ultrasonic inspection tool is designed to help maintenance professionals easily detect compressed air, gas and vacuum leaks and troubleshoot mechanical systems. It supports sustainable operations and helps reduce energy costs.

The VP Leak Detector is a practical and cost-effective solution ideal for both beginners in ultrasonic inspection and seasoned professionals. With its user-friendly design and minimal training requirements, the device empowers technicians to quickly identify leaks. These leaks might otherwise result in wasted energy, increased operational costs or equipment failure.

"Compressed air leaks are often the hidden cause behind skyrocketing energy bills," said Pascal van Putten, CEO, VPInstruments. "With the VP Leak Detector, we give our customers a simple and effective tool for real-time leak detection. It supports their journey toward better energy efficiency and operational reliability."

The VP Leak Detector includes an integrated LED bar graph meter, 8-position sensitivity selector, scanning module, rubber focusing, deluxe headphones and soft nylon carrying case. It features a rugged ABS hand-held design and stainless steel sensor enclosures, and has a peak ultrasonic response, operating in the 36-44 kHz frequency range. Weighing only 11 oz (0.3 kg), the VP Leak Detector is lightweight and portable, making it ideal for energy audits and routine facility inspections.

The VP Leak Detector is a powerful tool designed to support a wide range of maintenance and energy management tasks. Its precision and ease of use make it ideal for daily operations, as well as long-term efficiency strategies. Applications include compressed air, gas and vacuum leak detection, mechanical troubleshooting preventive maintenance programs and energy audits and assessments.

"Compressed air leaks are often the hidden cause behind skyrocketing energy bills," said Pascal van Putten, CEO, VPInstruments.

The VP Leak Detector

"With the VP Leak Detector, we give our customers a simple and effective tool for real-time leak detection. It supports their journey toward better energy efficiency and operational reliability." For more information, visit https://www.vpinstruments.com.

Hitachi Invests in Company Developing Air Energy Storage Solutions

Hitachi Industrial Equipment Systems (HIES) is investing in Innovatium, a U.K. company developing the PRISMA liquid air energy storage (LAES) solution.

There is an increasing need for efficient, cost-effective methods to store energy. This is driven by the growing reliance on renewable energy sources, which have fluctuating supply levels.

Innovatium's PRISMA solution stores compressed air generated from renewable energy by cooling and liquefying it, and then converts it back into compressed air. It offers advantages such as low environmental impact, minimal waste emissions and a longer lifespan compared to current mainstream lithium-ion batteries.

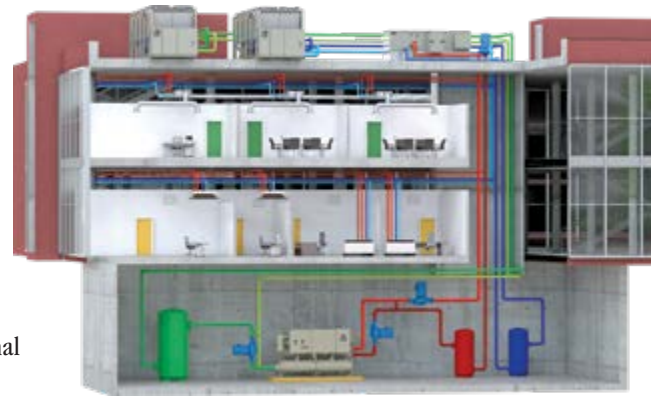
HIES will sell air compressors for PRISMA and expand sales of the PRISMA system through its Hitachi Global Air Power and HIES Europe sales channels. It will expand sales channels for air compressors in markets with high growth potential with the aim of further growing its business. For more information, visit https://www.hitachi-ies.com and https://www.innovatium.co.uk.

NEWS Chiller & Cooling Industry & Technology

Trane Introduces Solutions to Address Electrification, Retrofits and Intelligent Building Management

Trane® – by Trane Technologies is launching a suite of new products and updates designed to empower commercial facility owners and operators to help achieve their sustainability goals, enhance building performance and simplify operations. These innovations address thermal management of electrification of heat, existing building upgrades and essential needs for mission-critical environments.

"Our innovative heat pump systems enable cost-effective electrification for retrofits, while our advanced chiller solutions facilitate seamless upgrades for existing buildings. Additionally, our intelligent building management systems provide the tools needed to make buildings smarter and enhance operational performance," said Oakley Roberts, Vice President of Product Management, Commercial HVAC Americas, Trane.



Trane's Air-to-Water Cascade Heat Pump System operating inside a building

Trane's Agility® magnetic bearing centrifugal chiller has been expanded to 500 tons. It's ideal for retrofit projects due to its energy-efficient operation, high-performance capability and space-saving design. The Agility chiller features an oil-free, two-stage, semi-hermetic centrifugal, refrigerant compressor with a permanent magnet motor, delivering stable operation across various conditions. With full-load and integrated part load values that outperform the ASHRAE® 90.1-2022 standard, the Agility chiller helps reduce electrical consumption and demand charges, lowering operating expenses. Its compact footprint allows it to fit through standard double doors fully assembled or through a single door when disassembled into two sections, reducing structural modifications and cutting installation time and costs.

Trane's Air-to-Water Cascade Heat Pump System is revolutionizing electrified heating, providing a highly efficient alternative to traditional boilers. This system achieves significantly higher temperatures than air-to-water heat pumps alone and is three times more energy efficient than traditional heating. For more information, visit https://www.trane.com and https://www.tranetechnologies.com.

Industrial Cooling Water Workshop Debuting at the Best Practices 2025 EXPO & Conference in Kansas City

For the first time, Best Practices 2025 EXPO & Conference will host the Industrial Cooling Water Workshop. It's one of the three new conference workshops being introduced at the conference this year.

This advanced workshop, tailored for modern industrial cooling water system operators, EPC design engineers and heat rejection equipment sales engineers, will provide brand-neutral best practices for optimizing energy and water savings through lecture, classroom exercises and expert insights from top equipment operators, manufacturers and design engineers. The show is in Kansas City, Oct. 21-23.

The Industrial Cooling Water Workshop is one of the three new conference workshops being introduced at the Best Practices 2025 EXPO & Conference.

The Industrial Cooling Water Workshop is happening on Oct. 22, 8 a.m. to 1 p.m. Attendees can earn four professional development hours.

Session 1: Best Practices for Saving Water & Energy in Cooling Tower Systems

Exercise 1: Choosing the Right Cooling Tower *Led by Mark Pfeifer, P.E., LEED AP BD+C, Sr. Manager – Technical Services, SPX Cooling Tech*

Session 2: Qualitative and Quantitative Comparison of Technologies

Exercise 2: Challenging Conditions Requiring Unique Solutions *Led by Troy Reineck, Business Development Manager and Professor, EVAPCO*

Session 3: Evaluating Heat Loads and Temperature Requirements

Exercise 3: Expanding into Multi-cell Systems *Led by Clayton Penhallegon, Jr., P.E., Principal Engineer, Integrated Services Group*

Session 4: Holistic Design Considerations for Heat Rejection Equipment Specification

Exercise 4: Integrating Dry or Adiabatic Fluid Coolers into Evaporative Systems *Led by Ryan Schmidt, P.E., CEM, Mechanical Engineering Specialist, Chilled Water & Compressed Air Systems Specialist, 3M*

The Industrial Cooling Water Workshop is sponsored by RWI Enhanced Evaporation. For more information or to register, visit https://cabpexpo.com/ks-2025.

ASHRAE Announces 2025-26 President, Officers and Directors

ASHRAE has installed its 2025-26 Society President, along with newly-elected officers and directors.

ASHRAE's 2025-26 officers and directors

Bill McQuade, P.E., CDP, Fellow ASHRAE, LEED AP, will serve as the 2025-26 Society President. In his inaugural presidential address, McQuade introduced the theme for the 2025-26 society year, "Healthy Buildings: Designing for Life." The theme emphasizes the critical role of indoor environmental quality in reducing environmental impacts to the built environment while supporting healthier, more resilient communities.

"Today, shelter is more than just a roof over one's head," said McQuade. "Shelter encompasses the hospitals we are born in, the homes where we find comfort, the schools where we learn and the buildings we work in. A well-designed shelter prioritizes indoor environmental quality, ensuring good air quality, proper lighting, thermal comfort, acoustics and access to safe water, all essential for health and comfort. Providing safe, stable and sustainable shelter is not just a basic human need, it is a fundamental pillar of societal advancement and long-term development."

McQuade is Vice President for Government Affairs and Global Sustainability at Baltimore Aircoil Company in Jessup, MD.

Elected officers who will serve one-year terms are as follows:

- President-Elect: Sarah E. Maston, P.E., BCxP, Member ASHRAE, Director, Colliers Project Leaders, Hudson, MA
- Treasurer: Ashish Rakheja, B.E., M.Tech, Fellow ASHRAE, Director/Chief Operating Officer, AEON, Uttar Pradesh, India

For more information, visit https://www.ashrae.org.

Delta Cooling Towers Launches TMX Series with HDPE Design

Delta Cooling Towers unveiled the latest and largest addition to its innovative lineup. It has launched the TMX series featuring a high-density polyethylene (HDPE) design.

At the heart of this series is a massive 20-foot-long sump molded from a single, seamless piece of engineered plastic. This design eliminates the joints, seams and welds typically prone to leaks and maintenance issues, ensuring long-lasting, trouble-free operation.

The TMX series also meets the stringent ASHRAE 90.1 energy efficiency standards across all models, ranging from 300 to 3,250 cooling tons. Its corrosion-free engineered plastic casing, backed by a 20-year warranty, provides exceptional durability and reliability, making it an ideal choice for a wide range of industrial cooling and commercial HVAC applications.

With direct-drive motor fans, the TMX series provides an environmentally friendly solution. In addition, customers can choose to add antimicrobial resin to combat the growth of pathogens like Legionella, further enhancing safety and hygiene.

"The TMX series is a game-changer delivering greater capacity along with all the benefits of engineered plastic cooling tower technology," said John Flaherty, President, Delta Cooling Towers. "Its seamless design, energy efficiency and customization options make it the most advanced and reliable cooling solution we've ever developed. With this launch, we're setting a new standard for performance, durability and sustainability in the market." For more information, visit https://deltacooling.com.

Delta Cooling Towers' TMX Series

NEWS Industrial Energy & Water Conservation

CalPortland Company Achieves the U.S. EPA's ENERGY STAR® Challenge for Industry at Six Plants

CalPortland announced six plants achieved the U.S. EPA's ENERGY STAR Challenge for Industry, which recognizes plants that achieve a 10% reduction in energy intensity within five years. The average energy intensity reduction for all six CalPortland plants was 33.2%.

National City terminal, National City, CA – 70.7% in five years.
The National City terminal switched from pneumatic rail cars to gravity rail cars which require less energy to operate and lowered air compressor pressure from 125 psi (8.6 bar) to 100 psi (6.9 bar).

Stockton West Cement terminal in California

Stockton West Cement terminal, Stockton, CA – 10% in three years.
The Stockton terminal overhauled an old and inefficient dust collector and upgraded the old truck loadout system, replacing the inefficient equipment with new, energy-efficient motors and more efficient pipe routing.

White River Aggregate plant, Enumclaw, WA – 49.3% in five years.
The aggregate and ready mix plants implemented continual LED lighting modifications, repaired compressed air leaks, replaced air compressors with more efficient air compressors and replaced water chilling systems with more efficient water chillers.

In addition, the Diablo Aggregate plant in Coolidge, AZ, achieved a 33.7% reduction in three years, the East Gate Ready Mix plant in Henderson, NV, achieved a 10.5% reduction in three years and the Newberg Ready Mix plant in Newberg, OR, achieved a 24.9% reduction in three years.

"Achieving the ENERGY STAR Challenge for Industry recognizes the ongoing dedication of our plants to improve energy efficiency," said Allen Hamblen, President and CEO, CalPortland. "We are honored to be recognized by the EPA for our commitment to protecting the environment and the community." For more information, visit https://www.calportland.com.

Marelli's Decarbonization Targets Approved by the SBTi, Commits to Overall Net-Zero Target by 2045

Marelli, a global mobility technology supplier to the automotive sector, has received approval from the Science Based Targets initiative (SBTi) for its net-zero target by 2045, as well as its science-based near and long-term carbon emissions reduction targets.

Marelli has committed to three specific targets validated by the SBTi. Its near-term target is to reduce greenhouse gas (GHG) emissions 42% by 2030 across Scope 1, 2 and 3, from a 2022 base year. Its long-term target is to reduce GHG emissions 90% by 2045 across Scope 1, 2 and 3, from a 2022 base year. Its overall net-zero target is to reach net-zero GHG emissions across the value chain by 2045.

The SBTi is a corporate climate action organization that enables companies and financial institutions worldwide to play their part in combating the climate crisis. It develops standards, tools and guidance which allow companies to set greenhouse gas emissions reduction targets in line with science and with what is needed to keep global heating below catastrophic levels and reach net-zero by 2050 at the latest.

"We are proud of this achievement, which marks a significant milestone in the company's commitment to support global emission reduction efforts," said Denise Lana, Head of Sustainability, Marelli. "The Science Based Target initiative validation is invaluable in building customer trust in our commitments. It also sends a strong message within our company, confirming our commitments and business autonomy despite the recent changes in regulatory frameworks." For more information, visit https://www.marelli.com.

Entrance of Marelli's headquarters in Southfield, MI

Steelcase 2024 Impact Report Spotlights New Net-Zero Commitment, Building Community and Belonging

Steelcase, a manufacturer of furniture, case goods, seating and storage, announced the release of its 2024 impact report, "Our Work Toward Better Futures." The report shares recent goals and progress to build community and belonging in the workplace, as well as the company's new commitment to reduce carbon emissions to net zero by 2050.

"This report reflects our commitment to the well-being of people and the planet. It shares data about our progress toward our goals, and it also represents all the hard work our employees do to create better futures," said Kim Dabbs, Vice President of Impact, Steelcase. "We are proud of the cross-functional collaboration that reflects the collective action needed to make a difference in the world we share."

Steelcase is working toward a better future for the planet by reducing its carbon footprint, designing for circularity and choosing and using materials responsibly. Earlier this year, Steelcase announced its commitment to a net-zero future. The company's plan is to reduce carbon emissions over 90%* throughout its entire value chain by 2050.

Additional progress includes being on track to reach its goal of reducing carbon emissions in its operations 50% by 2030*. Over four years, Steelcase has already achieved a 30% carbon emissions reduction in its operations. The company is partnering with suppliers to set their own science-based carbon emissions reduction targets, thereby leading the industry through supplier engagement. For more information, visit https://www.steelcase.com.

*Reductions are measured from a FY2020 base year.

Steelcase's Learning and Innovation Center in Grand Rapids, MI

West Fraser Timber Releases 2024 Sustainability Report

West Fraser Timber Co., a diversified wood products company with more than 50 facilities in Canada, the United States, the United Kingdom and Europe, released its 2024 Sustainability Report, "Building Together: People and Partnerships." The report highlights the company's sustainability performance across a variety of environmental, social and governance goals and disclosed targets.

West Fraser is advancing its carbon reduction strategy. Its manufacturing operations were powered by 75% renewable energy. At the same time, 100% of the company's mills progressed on their energy reduction road maps to materially reduce the carbon footprint by 2030 using Scope 1, 2 and 3 emission reduction targets, validated through the Science Based Targets initiative (SBTi).

A key highlight was a 22% reduction in West Fraser's Scope 1 and 2 emissions compared to 2019 baseline levels, along with a 13% reduction in its Scope 3 emissions compared to a 2020 baseline. These reductions are on track to meet the company's 2030 GHG reduction targets. For more information, visit https://www.westfraser.com.

Trust Through Testing: Inside the CAGI Performance Verification Program

By Jayme Leonard, Digital Marketing Specialist, Atlas Copco Compressors

If you're involved with compressed air systems, chances are you've come across the name CAGI and for good reason. The Compressed Air and Gas Institute has been part of the compressed air industry since 1915, representing leading manufacturers of air compressors, compressed air dryers, industrial blowers, compressed air system filters and other essential components.

But CAGI isn't only a trade association. It's behind many of the standards and practices that keep the compressed air and gas world running safely and efficiently. Its work includes promoting energy efficiency and system reliability, as well as shaping best practices used across facilities worldwide.

At its core, the organization exists to help compressed air users and manufacturers alike make smarter, more informed decisions. Through its commitment to education, standardization and advocacy, CAGI continues to elevate the compressed air industry, setting the bar for performance, trust and transparency.

What is the CAGI Performance Verification Program?

To further support transparency and confidence in compressed air system equipment performance, CAGI established the Performance Verification Program. This third-party testing initiative verifies that participating manufacturers' published performance data, such as energy consumption, flow rate and efficiency, are accurate and consistent with industry standards.

By choosing compressed air products that have been certified through this program, end-users can trust they're getting the performance they expect, supporting better system design, lowering operating costs and making smarter sustainability investments. It's a powerful tool for building trust between manufacturers, distributors and customers in the compressed air and gas marketplace.

Compliant participants in the CAGI Performance Verification Program earn the right to display the CAGI Performance Verification Seal, signaling to customers that their equipment meets verified performance standards.

In the compressed air industry, accurate and consistent performance data is essential for ensuring system efficiency, reliability and cost-effectiveness. Recognizing this need, CAGI has taken a leading role in promoting standardization and transparency through its Performance Verification Program.

Collaboration with Global Standards Organizations

CAGI works in close partnership with global organizations such as ISO (International Organization for Standardization) and Pneurop (the European association of manufacturers of air compressors, vacuum pumps and pneumatic tools). Together, they help develop and refine globally recognized standards for measuring and reporting compressed air system performance. These collaborations ensure that CAGI's initiatives align with the latest technological and environmental requirements worldwide, while also matching performance expectations across markets.

Simplified Test Codes and Standardized Data Sheets

One of the key challenges in the compressed air industry has been the lack of consistent and comparable performance data. To address this, CAGI introduced simplified test codes and standardized data sheets for lubricated and oil-free rotary air compressors (fixed speed or variable frequency drive) and refrigerated cycling and non-cycling compressed air dryers. These tools make it easier for buyers to compare different models side by side – based on verified data – without needing to decipher complex technical specifications. Standardized data fosters fair competition and better decision-making for compressed air system designers, facility managers and procurement teams.

Above: A VFD air compressor installation showcasing a compact, energy-efficient design.

Compressed Air System Energy Costs and Total Cost of Ownership

Perhaps the most compelling reason for the Performance Verification Program is the significant impact of energy consumption on the total cost of ownership. While the initial purchase price of an air compressor is important, energy costs over the lifetime of the equipment can exceed the purchase price many times over. In fact, energy consumption can account for up to 70-80% of an air compressor's lifetime costs. By providing verified energy efficiency data, the program empowers customers to select compressed air equipment that minimizes operating costs and maximizes long-term value.

This compressed air system controller is integrated in an air compressor room for centralized compressed air system management. Energy consumption can account for up to 70-80% of an air compressor's lifetime costs.

CAGI Performance Verification Program Overview

The CAGI Performance Verification Program is a third-party testing initiative designed to validate the accuracy of published performance data for compressed air equipment. Testing is conducted independently by Intertek, a globally recognized certification and testing organization.

The program includes verification testing for lubricated and oil-free rotary air compressors (fixed speed or variable frequency drive) ranging from 5-200 horsepower (hp) and refrigerated compressed air dryers with capacities from 50-1,000 standard cubic feet per minute (scfm). Participation in the program is voluntary and open to all compressed air manufacturers in the industry, promoting a level playing field and greater transparency for buyers. The key standards used are ISO 1217 for rotary air compressor performance testing and ISO 7183 for refrigerated compressed air dryer performance testing.

By participating, manufacturers demonstrate a commitment to quality, accuracy and customer trust through compliance with globally recognized standards.

Performance Verification Process Overview

The CAGI Performance Verification Program ensures accuracy and transparency through a rigorous, standardized testing process. With the program's random sampling, each participating manufacturer has two units tested annually, which are selected at random from production to ensure real-world performance. Independent testing by Intertek compares the units' actual performance against the manufacturer's published data sheets, verifying key metrics including airflow, power consumption and efficiency. If a unit fails, the manufacturer must retest or re-rate the product within 30 days. A second failure in two years results in visible penalties that could include expulsion from the program, protecting the integrity of the verification process.

Compliant participants earn the right to display the CAGI Performance Verification Seal, signaling to customers that their equipment meets verified performance standards. This

Trust Through Testing: Inside the CAGI Performance Verification Program

process builds trust, supports informed decision-making and promotes higher performance standards across the industry.

CAGI Data Sheets and Performance Metrics

The CAGI Performance Verification Program uses standardized data sheets that provide clear, consistent and comparable performance information for air compressors and refrigerated compressed air dryers.

All participating manufacturers use the same CAGI-approved format for their data sheets, making it easy for end-users to compare products side-by-side across brands. The specific power rating (kW/100 cfm) indicates how efficiently an air compressor produces compressed air. Lower values mean greater efficiency. The isentropic efficiency rating measures thermodynamic efficiency, offering deeper insight into air compressor performance and design quality. By standardizing how performance is reported, CAGI empowers buyers to prioritize efficiency and long-term value in their equipment choices.

These VFD air compressors are part of a clean, modern air compressor room setup for optimized performance and energy efficiency. CAGI performance verification empowers buyers to prioritize efficiency and long-term value.

Benefits for End Users and the Compressed Air Industry

The CAGI Performance Verification Program delivers meaningful value to both compressed air equipment users and manufacturers by promoting integrity, efficiency and transparency across the compressed air market.

- Reliability: End users gain confidence knowing that published performance data has been independently verified by a third party, ensuring the equipment performs as advertised.

- Transparency: With public listings and searchable directories available on CAGI's website, buyers can easily access verified data to support their decision-making.
- Informed Purchasing: Standardized performance metrics allow users to compare energy usage, efficiency and long-term operating costs, leading to smarter investments and lower total cost of ownership.
- Brand Trust: For manufacturers, participation in the program enhances credibility and provides a competitive edge by demonstrating a commitment to performance, honesty and customer satisfaction.

Outlook for Compressed Air Performance Verification

As the compressed air industry evolves, the CAGI Performance Verification Program may expand to cover additional equipment types including nitrogen gas generators, nitrogen gas filters, vacuum pumps and industrial blowers.

Energy efficiency regulations are shifting to reflect more accurate performance metrics, such as isentropic efficiency, increasing the relevance and importance of verified data in both U.S. and global standards.

The future of compressed air system verification may include alignment with Department of Energy (DOE) initiatives, as well as deeper integration with connected systems, enabling real-time monitoring, predictive maintenance and smart analytics to further validate and optimize compressed air system performance.

Verified performance data is important in today's compressed air and gas systems. With energy costs making up the largest portion of total ownership expenses, accuracy, transparency and trust are more important than ever.

Facility managers, industrial engineers and procurement teams are strongly encouraged to prioritize equipment backed by the CAGI Performance Verification Program. Look for the CAGI Verified Data Sheets and Performance Verification Seal when evaluating air compressors and compressed air dryers.

Investing in verified performance is an investment in long-term value, operational reliability and environmental responsibility. BP

This article was prepared with invaluable assistance from CAGI. All photos courtesy of Atlas Copco Compressors.

About the Author

Jayme Leonard is a marketing communications professional at Atlas Copco Compressors, specializing in strategic planning, graphic design, website management and social media. She has developed a wide range of materials including marketing plans, brochures, newsletters and digital content.

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. For more information, visit https://www.atlascopcogroup.com/en.

About CAGI

For more than 100 years, the Compressed Air and Gas Institute has been the leading source on all matters related to compressed air. As the united voice of the industry, CAGI's activities include the development and organization of educational material, including compressed air system training programs to benefit the users of compressed air systems. For more information, visit https://www.cagi.org. For list of participants in the CAGI Performance Verification Program, visit https://www.cagi.org/performance-verification?ap4=1_4.

To read more ***CAGI Standards*** articles, visit https://www.airbestpractices.com/standards/iso-cagi.

For expert presentations on ***CAGI Standards***, visit our webinar archive section at https://www.airbestpractices.com/webinars.

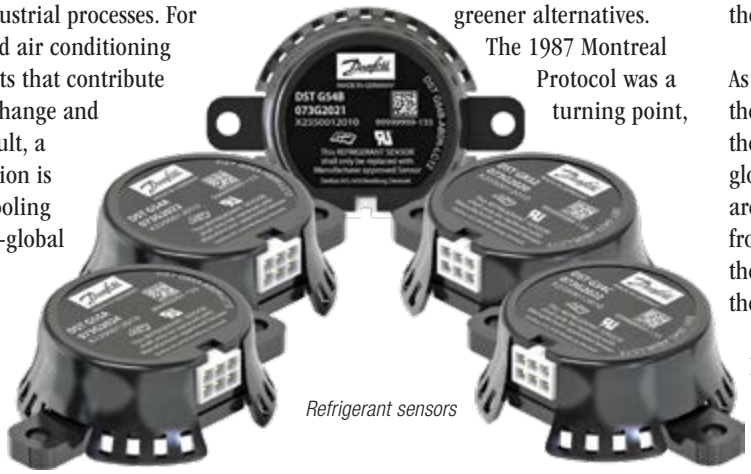
Navigating the Refrigerant Transition: Toward a Sustainable Future

By Nick Mislak, Regional Segment Marketing Director – HVAC, Danfoss

Few technologies are as vital as refrigeration and air conditioning in today's society. These systems underpin modern life, ensuring food safety, comfort at home and at work and cooling for industrial processes. For decades, refrigeration and air conditioning have relied on refrigerants that contribute significantly to climate change and ozone depletion. As a result, a global refrigerant transition is underway, shifting the cooling industry away from high-global warming potential (GWP) substances to environmentally friendlier alternatives. This transition, driven by international agreements, evolving technologies and regulatory mandates, marks one of the most impactful environmental efforts in industrial history.

The Regulatory Landscape for Refrigerants

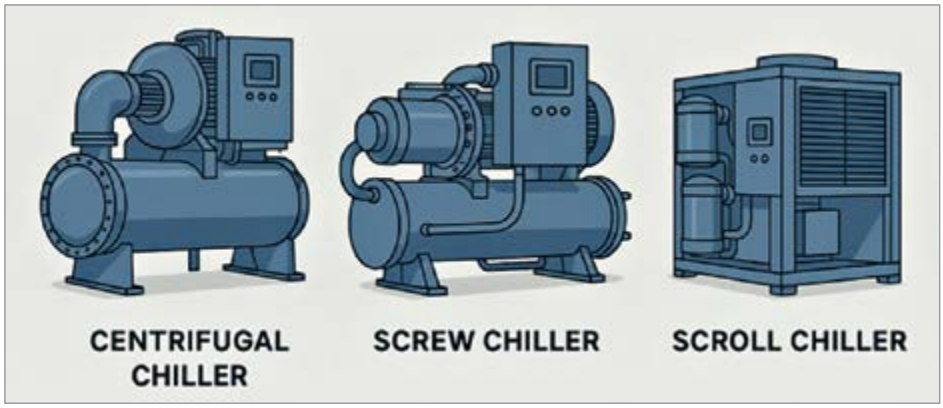
Historically, substances like chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) were widely used in cooling because of their chemical stability, efficiency and non-flammability. However, CFCs and HCFCs were found to be potent ozone-depleting substances (ODS) once released into the atmosphere, so regulations were enacted to transition the cooling industry toward greener alternatives. The 1987 Montreal Protocol was a turning point, mandating a global phaseout of CFCs and, later, HCFCs. In their place, hydrofluorocarbons (HFCs) were introduced. These are compounds that do not deplete the ozone layer but have a high GWP.



Refrigerant sensors

As climate science advanced, attention turned to the GWP of HFCs. Although they're ozone-safe, their emissions significantly contribute to global warming. Several regulatory bodies are driving the refrigerant transition away from HFCs, with the Kigali Amendment to the Montreal Protocol, signed in 2016, as the centerpiece of the global commitment.

In the United States, the American Innovation and Manufacturing (AIM) Act, passed in 2020, empowers the Environmental Protection Agency (EPA)



Above: Danfoss Turbocor headquarters, Tallahassee, FL

Types of chillers

to phase down HFCs through quotas on production and consumption, with the goal of a 40% reduction by 2024 and an 85% reduction by 2036. Individual states, as well as those in the California Air Resources Board (CARB) Alliance, have also proposed or enacted their own GWP restrictions and timing, which vary by application and equipment type. In the European Union, the F-Gas regulation is similarly ambitious, tightening controls on high-GWP refrigerants and promoting low-GWP alternatives.

Low-GWP Refrigerant Alternatives

Chillers play a critical role in this GWP reduction as they are essential equipment in many different applications. Types include centrifugal, screw and scroll compressor chillers. These chillers employ refrigerants that are most suitable to their operating ranges, while also complying with regulatory requirements for energy efficiency and GWP limits. In the U.S., the EPA GWP reduction to refrigerants with a GWP of under 700 was completed in 2025 for most comfort cooling and heating chillers. In 2027, this reduction will also be enforced for equipment used in data centers.

Depending on the chiller type, R-32 (GWP 675) and R-454B (GWP 467) were chosen for the majority of the rotary scroll chiller equipment that traditionally used R-410A (GWP 2088). R-454B is a zeotropic blend composed of R-32 (68.9%) and R-1234yf (31.1%), while R-32 is considered a pure fluid as it's not blended with other refrigerants in its composition. Many manufacturers chose to transition from R-410A to R-454B as its system performance and capacity are almost identical. This facilitated the transition by requiring fewer design changes.

Equipment using R-32 required more extensive redesign but also offered the potential to optimize the cooling system by taking advantage of R-32's higher efficiency and capacity compared to R-410A. Both R-32 and R-454B are ASHRAE Class A2L refrigerants that are mildly flammable and may require additional safety features such as leak detection and mitigation systems to be integrated into equipment and building design. A2L leak detection sensors play a critical role in detecting leaks and taking action to mitigate potential hazards. They're an essential part of HVAC/R systems using A2L refrigerants.

Equipment using R-32 required a more extensive redesign.

In the future, as GWP limits are further decreased, either globally, federally or on a state-by-state basis, manufacturers will need to consider other alternative refrigerants for these applications. New York recently set new sub-20 GWP limits that could go into effect as early as 2030 to 2034, depending on the chiller type and whether or not it's used as a heat pump. A sub-20 GWP requirement greatly limits the refrigerant options

Navigating the Refrigerant Transition: Toward a Sustainable Future

manufacturers can consider for future designs, underscoring the impact natural refrigerants could play in future equipment design.

Making the Refrigerant Transition: Planning Ahead

Currently, there's no ideal replacement that is a drop-in substitute for R-32 or R-454B. All commercially available refrigerants will require a system redesign. The decision on which future refrigerant to select will also depend on future GWP limits. If the requirement is a sub-150 GWP, then R-454C could be an option as it has a GWP of 148. R-454C is also an A2L refrigerant, but it also has moderate temperature glide due to its composition. This makes system design more complex to optimize.

Equipment manufacturers will need to invest in R&D and re-certification processes to meet efficiency targets and safety considerations for A2L or A3 refrigerants.

In Europe, rotary scroll chiller manufacturers are choosing R-454C as either an interim refrigerant or when R-290 cannot be used due to refrigerant charge limitations or safety reasons. R-290 is an ASHRAE Class A3 refrigerant, which means it is highly flammable, so codes and standards need to be updated to allow it to be used safely. It is also a natural refrigerant, so it has no negative impact on the environment. Its strong thermodynamic properties make it an excellent choice for rotary scroll chiller operation in both cooling and heating modes.

Centrifugal and rotary screw chillers are transitioning from R-134a (GWP 1430) and other low-pressure refrigerants to alternatives including R-513A (GWP 573), R-515B (GWP 293), R-1234ze (GWP 7) and R-1233zd (GWP 1). R-513A and R-515B are popular choices as both refrigerants are ASHRAE Class A1 and are not flammable. As such, they don't require the additional safety features that are needed with A2L or A3 refrigerants.

If future GWP limits are decreased to under 150 GWP, then both of these refrigerants will no longer be allowed for use in new equipment. R-1234ze is also a popular choice since it's an A2L refrigerant with a low GWP. It has a relatively high boiling point which makes it not suitable for air-to-water chillers used for heating in cold ambient temperatures

Choosing Low-GWP Cooling Products

There are many factors to consider when choosing which low-GWP refrigerant to adopt. Your current system, application, ease of retrofit and the logistics of your facility and human resources all should be taken into account.

- **Flammability and Safety Compliance.** A2L refrigerants are mildly flammable (with a lower flammability than A3s, such as hydrocarbons, but still a risk). Proper risk assessments, leak detection, ventilation and safety controls are mandatory. Systems must comply with updated building codes (including ASHRAE 15 and UL 60335-2-40), as well as local fire regulations.
- **Equipment Compatibility and Design Changes.** Existing equipment often can't be retrofitted, so transitioning to a new refrigerant may require new equipment, or a complete design change in order to manage flammability zones and charge limits. Consider refrigerant compressors, heat exchangers, cooling system piping, valves and seals that are compatible with the new refrigerant's pressure and chemical properties.
- **Technician Training and Certification.** Service procedures, leak detection practices and recovery requirements for A2L and A3 refrigerants differ from those for A1 refrigerants. Technicians need updated training on handling A2Ls safely. Certification bodies and manufacturers often provide training courses.
- **Regulatory and Environmental Impact.** Consider the full lifecycle of any equipment purchased. Evaluate the total lifecycle climate performance of the refrigerant chosen and consider all implications. For example, A2Ls can help meet low-GWP goals, but must be installed and maintained properly to avoid leaks. Plan for long-term supply, serviceability and end-of-life recovery. Most importantly, verify compliance with phase-down laws, such as the AIM Act in the U.S. and the Kigali Amendment.

Examples of refrigerants

where the evaporating temperature is low. For high-temperature heat pump applications (including boiler replacements and industrial process heating), R-1234ze is also a good choice. R-600a is a good choice, as well, since it's a natural refrigerant, but it's class A3.

Another consideration that may have implications for future refrigerant transitions is the impact of PFAS (perfluoroalkyl and polyfluoroalkyl substances) regulations. PFAS, often called "forever chemicals," do not degrade in the environment. TFA (Trifluoroacetic) is a breakdown product of many PFAS and is considered a contaminant that's potentially harmful to humans and other life. There is, however, an ongoing debate on the actual definition of PFAS and whether or not refrigerants should be included. This is also made more complex by the varying definitions and interpretations used in individual states. California recently proposed Senate Bill 682, initiated by CARB, which would ban or restrict PFAS in commercial and industrial uses, including in refrigerants, as early as 2040. This could restrict the use of refrigerants including R-1234yf and R-454B or others where R-1234yf is a large component of the blend. R-1234yf is believed to degrade nearly completely into TFA, but the overall environmental impact is still under evaluation.

The refrigerant transition is not without growing pains. Equipment manufacturers will need to continue investing heavily in R&D and re-certification processes to meet unit efficiency targets and additional safety considerations for A2L or A3 refrigerants. Technicians will need additional training to safely work on equipment with new refrigerants, particularly those that are flammable or require specialized procedures. Supply chains will need to adapt to new materials, refrigerant cylinders and safety protocols. Equipment designed for new refrigerants may also have higher upfront costs as refrigerant prices increase from current levels and incorporate the cost of leak detection and mitigation. The regulatory landscape will continue to evolve as new requirements are developed and enforced locally and federally. Energy efficiency, environmental safety and sustainability will continue to be top priorities as the HVAC/R industry adapts to new developments. BP

About the Author

Nick Mislak is the Regional Segment Marketing Director for HVAC at Danfoss. He holds Bachelor's and Master's Degrees in Mechanical Engineering and has over 15 years of experience in HVAC engineering and product management.

About Danfoss

Danfoss engineers solutions that increase machine productivity, lower energy consumption, enable electrification and reduce emissions. Its innovative engineering dates back to 1933. Danfoss is family-owned and employs over 39,000 people. It serves customers in more than 100 countries with a global footprint of around 100 factories. For more information, visit https://www.danfoss.us.

For similar articles on ***Refrigeration Compressors,*** please visit https://coolingbestpractices.com/technology/refrigeration-compressors.

Visit our Webinar Archives to listen to expert presentations on ***Refrigeration Compressors*** at https://coolingbestpractices.com/magazine/webinars.

Meeting ISO 8573-1 Compressed Air Quality Specifications

By Ron Marshall, Chief Auditor, Marshall Compressed Air Consulting

➤ In many manufacturing plants, compressed air is a vital utility – powering tools, conveying materials and, in some cases, coming into direct contact with products or packaging. When compressed air is used this way, its quality isn't just a maintenance issue: It becomes a product safety and quality concern, and could even put the company into legal jeopardy. That's why ISO 8573-1 was developed: to provide standardized classes for compressed air purity in terms of particles, water and oil to drive the planning and design of compressed air systems in order to deliver the quality desired or required.

Despite the importance of this standard, many facilities make a critical mistake: They assume that simply installing the right filters guarantees compliance. The thinking goes, "We've got the right equipment in place; therefore, our air must be clean." But, without ongoing measurement and verification, this assumption can lead to serious oversights. Filters can degrade, components within systems can accumulate hidden contamination and piping can introduce impurities that bypass even the best equipment.

This article explores why testing compressed air quality is as essential as choosing the right filtration, discusses real-world experiences, illustrates the risks of assuming things are right and explains the value of compressed air measurement.

Above: Food and beverage plants often demand higher purity levels, as compressed air directly impacts product safety and quality.

The ISO 8573-1 Standard Explained

To understand whether or not a compressed air system is delivering clean air, we need to start with a clear definition of what "clean" means. That's where ISO 8573-1 comes in. This widely-known international standard outlines purity classes for compressed air based on three types of contaminants: solid particles, water (humidity or liquid) and oil (aerosol, vapor and liquid).

Each category is rated on a numerical scale. The lower the number, the cleaner the air. For example, Class 1 for oil means the air contains no more than 0.01 mg/m³ of total oil content, while Class 4 allows up to 5 mg/m³. A designation of ISO 8573-1 Class 4.4.4 means the air must meet Class 4 limits for particles, moisture and oil, a level commonly used for applications where compressed air only comes into incidental contact with packaging or non-critical product surfaces.

Industries such as food and beverage, pharmaceuticals, cosmetics and electronics often demand higher purity levels because

This mess came from a compressed air valve adjacent to a location that made direct contact with food. There were no filters between the compressed air valve and the food. The engineering manager said the facility used food-grade oil in the air compressor.

ISO 8573-1:2010 Compressed Air Quality Classes

Class	Max. Particle Size		Pressure dewpoint		Max Oil Content
	(µm)	(mg/m^3)	(°C/°F)	(g/m^3)	(mg/m^3)
0	Specified by the equipment manufacturer/supplier and greater than class 1				
1	0.1	0.1	-70/-94	0.003	0.01
2	1	1	-40/-40	0.12	0.1
3	5	5	-20/-4	0.88	1
4	15	8	3/37	6	5
5	40	10	7/45	7.8	25
6	--	--	10/50	9.4	--
7	--	--	Not Specified		--

Note: the Class 0 certification was created in response to industry needs for oil-free air. Stating Class 0 without an agreed specification will mean it is not in accordance with the standard. Class 0 air purity is best achieved at the point of use to minimize cost.

ISO 8573-1 levels (Source: Compressed Air Challenge)

compressed air can directly impact product safety and quality. However, even in less regulated sectors, maintaining clean compressed air helps reduce maintenance costs, prevent downtime and prolong the life of pneumatic equipment.

It's important to note that ISO 8573-1 doesn't dictate how to achieve these levels. It simply defines the targets. The responsibility falls upon each facility to select appropriate air compressors, compressed air dryers, compressed air filters, and compressed air testing protocols to meet and maintain the required class. This flexibility is beneficial, but it also introduces risk: If a facility relies solely on equipment specifications without validating actual performance, the compressed air system might fall far short of the intended quality.

While ISO 8573-1 is the global benchmark for assessing compressed air quality, defining limits for particles, water and oil, it's important to recognize it does not cover microbial contamination. For manufacturers in industries where compressed air may come into direct or indirect contact with sterile or ingestible products, this is a significant gap.

Bacteria, mold spores and other microorganisms are not measured or regulated under ISO 8573, which means a compressed air system can be fully compliant with Class 1.1.1 purity and still be a risk for microbial contamination. This is especially concerning in applications involving packaging, filling or cleaning where compressed air is used in a high-contact environment.

To mitigate this risk, these facilities must take additional steps beyond ISO standards, including:

- **Sterile-grade filtration:** Install bacterial-retentive filters, typically membrane or high-efficiency pleated filters with 0.01 micron or better retention at the point of use. These filters are verified to remove bacteria and other microorganisms from the air stream.
- **Frequent sterilization or filter replacement:** In critical applications, filters may need to be steam-sterilized or replaced on a fixed schedule, especially in cleanrooms or aseptic zones.
- **Routine microbial monitoring:** Compressed air systems in hygienic environments should undergo periodic microbial testing using specialized air samplers or contact plates at the point of use to ensure no live organisms are present.
- **System design and materials:** Smooth, corrosion-resistant piping materials like stainless steel or aluminum, along with drainage-friendly layouts, help prevent moisture pooling and microbial growth inside distribution systems.
- **Moisture control:** Because bacteria thrive in wet environments, ensuring extremely low dew points, often -40°F (-40°C) or lower, is essential to inhibiting microbial proliferation.

Meeting ISO 8573-1 Compressed Air Quality Specifications

Testing Is Essential for Maintaining Compressed Air Quality

In compressed air systems, perception often doesn't match reality. Many plant personnel assume that by installing the right filters, often based on supplier recommendations or catalog specs, they're automatically producing compressed air that meets ISO 8573-1 requirements. But without air quality testing, there's no way to confirm whether or not the system delivers the required purity.

Compressed air systems are dynamic. Filters degrade over time, compressed air dryers can malfunction and compressed air piping, especially in older compressed air systems, may contain years of built-up contamination. Even a perfectly designed compressed air system can experience fluctuating performance due to changes in operating conditions, unexpected oil carryover or poor maintenance practices. These issues often remain hidden until product quality problems arise, or a third-party audit uncovers the gap.

Testing provides critical visibility. With the use of portable compressed air analyzers, plant operators can measure oil content, particulate levels and dew point at various locations in the compressed air system to determine whether or not air quality is consistent and within specifications. This should be a routine part of compressed air system maintenance, particularly in industries with product contact or regulatory requirements.

Without compressed air system testing, even the most expensive filtration systems may fall short. In many real-world cases, they do.

Case Study: Cosmetics Manufacturer Fails the Test

A mid-sized cosmetics manufacturer supplying products to a large multi-national company was confident its compressed air system was

Benchmarking of Compressed Air GMPs

Good Manufacturing Practices - Compressed Air in Food Plant	Dew Point	Oil Removal	Particulate Removal (includes microbiological particles)	Efficiency	Location of Filtration
FDA Code of Federal Regulations Title 21CFR, Part 110.40 (g)[1]		Compressed air or other gases mechanically introduced into food or used to clean food-contact surfaces or equipment shall be treated in such a way that food is not contaminated with unlawful indirect food additives.			
FDA Guidance RTE foods[2]			0.3 Micron		Point of use
FDA and the FSMA[12] (Food Safety Modernization Act)		The FSMA does not introduce any specific regulations related to compressed air. It primarily requires companies under FDA jurisdiction to employ a risk-based (HACCP-like) food safety management scheme.			
3-A Standard 604-05-3A[3] Section: D6.6.1		Point of Use-Contact (sterile air): 99.999%[10] All other: 99%[10]			
Britsh Compressed Air Society (BCAS)[4] Section 6	-40° F/C	< 0.01 mg/m³	0.1 - 0.5 Micron		
British Retail Consortium (BRC)[9]		Compressed air used directly in contact with the product shall be filtered.			
Safe Quality Foods (SQF) 7th edition[5]. Section(s): 9.5.7; 10.5.7; 11.5.7; 13.5.4		Compressed air used in the manufacturing process shall be clean and present no risk to food safety.			
International Featured Standards (IFS) version 6[6]. Section 4.9.10.2		Compressed air shall not pose a risk of contamination.			
Global Red Meat Standard (GRMS)[7]		Hazards relevant to food safety shall be controlled in critical control points (CCP) and/or by GMP measures.			
ISO 22000:2005[8] + Prerequisite Program (PRP) (like BSI PAS 220:2008[11])	ISO22000:2005 := Prerequisite Programs should be in place to address supplies of air (Section 7.2.3.C) BSI PAS 220:2008 Section 6.5 := (Summarized) Compressed air systems shall be constructed and maintained so as to prevent contamination. Requirments for filtration, microbilogy, and humidity (RH%) shall be specified. Filtration of the air should be as close to the point of use as is practicable.				
Most discriminating filtration standard:		**< 0.01 mg/m³**	**0.1 - 0.5 Micron**	**Point of Use-Contact: 99.999%**	**Point of use**

= Not Specified
= Most critical standard

Various other standards cover microbial content, often varying by locality. (Source: "Compressed Air GMPs for GFSI Food Safety Compliance," Compressed Air Best Practices Magazine®, Lee Scott, Parker Hannifin, January 2016)"

up to par. After all, it had compressed air filtration installed and never encountered issues serious enough to raise alarms. But then, a client required verification that its compressed air met ISO 8573-1 Class 4.4.4.

When compressed air quality measurements were first taken, they were far worse than expected. The compressed air system wasn't just failing to meet Class 4.4.4; it didn't even qualify for the lowest standard, Class 5.5.5. Oil content, particulate matter and moisture levels were all significantly above acceptable thresholds. This was obvious from visual inspections.

"I didn't expect the initial readings to skyrocket," said Francisco Lara, Manager, Airtec Global, the service provider. "All the particulates were up to the highest values. Hydrocarbons were off the charts. The required maximum value was 5.0 mg/m³, but the instrument measured above this two seconds after connecting it. It was so bad, I had to disconnect the meter to avoid damage."

It turned out the plant relied on lubricated air compressors and had only basic filtration in place. This is acceptable for general applications, but is nowhere near sufficient when compressed air makes direct contact with bottles used in product packaging.

The first step was upgrading the compressed air supply-side filtration. Technicians installed a more robust filtration system that included coalescing filters, activated carbon filters and fine particulate filters, all sized correctly. While this significantly reduced some contaminants, follow-up measurements revealed that oil vapor levels remained too high to meet Class 4.4.4 standards.

This led to the discovery of a deeper problem: oil saturation in the plant's compressed air piping. Over more than a decade of operation, airborne oil from the lubricated air compressors had accumulated along the inner surfaces of the pipes. Now, even with clean compressed air entering the system, residual contamination was bleeding back into the airflow.

Full compressed air piping replacement wasn't feasible due to budget constraints. However, only three of the plant's seven production lines were used to supply the client. This allowed the team to focus their efforts where they mattered most.

A measurement device ensured the compressed system met ISO 8573-1 Class 4.4.4. (Source: SUTO iTEC)

Meeting ISO 8573-1 Compressed Air Quality Specifications

The final reading showing compliance with ISO 8573-1 Class 4.4.4. (Source: SUTO iTEC)

High-efficiency point-of-use filtration consisting of coalescing, activated carbon and particulate elements was installed on each of the three critical compressed air lines. After this localized treatment was implemented, another round of compressed air testing showed excellent results. The air quality not only met, but exceeded the Class 4.4.4 requirement.

"There is definitely a need for this newly developed type of testing instrument. I know of companies that could have saved millions of dollars, literally, in environmental fines, if only they had a monitoring solution for their compressed air quality." Lara said.

Case Study: Milk Products Plant Has Reliability Issues

A milk products production facility aiming to meet corporate Class 0 compressed air standards had unexpected water and oil contamination impact its operations.

Despite having a large oil-free air compressor and desiccant compressed air dryer on-site, moisture was found in the compressed air piping, and air quality issues began to interfere with production reliability.

A closer inspection revealed that while the oil-free air compressor was intended to serve as the sole source of compressed air, system demand frequently exceeded capacity. As a result, an older lubricated air compressor was routinely brought online, unintentionally introducing the risk of oil aerosol into the compressed air system.

Meanwhile, the desiccant compressed air dryer, although technically capable, was operating inefficiently. Improper check valve configuration and a fixed purge cycle meant that its drying performance was inconsistent, especially during light loads. The main air compressor was also forced into rapid cycling, reducing stability and increasing the chance for contaminants to slip through.

To make matters worse, a failed condensate drain on the lubricated air compressor's receiver allowed water to collect and intermittently flow into the compressed air system. Attempts to compensate with a cracked manual drain elsewhere failed to prevent free water from entering the compressed air distribution network.

Despite good intentions and investments in high-quality equipment, a combination of system integration issues and aging infrastructure undermined the plant's compressed air quality goals. This case study highlights the importance of aligning system design, component coordination and air quality testing, especially when producing food-grade products.

Follow-Up Monitoring and Maintenance Planning

To ensure their solutions weren't short-term fixes, each customer was advised to schedule a six-month follow-up audit. This helped determine whether or not serious problems remained, and helped technicians plan the optimal maintenance and replacement schedule for ongoing ISO 8573-1 compliance.

Testing and monitoring were conducted using portable compressed air analyzers, allowing the service provider to present clear, data-backed evidence of system performance before and after the intervention.

These case studies illustrate a lesson that applies broadly across manufacturing: Compressed air quality cannot be assumed; it must be verified. Even when the right equipment is in place, unseen factors, including residual contamination or inadequate maintenance, can undermine compressed air system performance and product integrity.

Secondary filters were required due to contamination from lubricated air compressors.

Remember:

- **Filtration is not a guarantee.** Installing standard compressed air filters without understanding compressed air system history or usage conditions can lead to a false sense of security. Compressed air system filtration must be matched to both the application and contaminants present.
- **Compressed air system piping history matters.** As shown here, the long-term use of lubricated air compressors can lead to internal buildup in compressed air piping that continues to release oil into the air stream. Upgrading filters at the air compressor won't solve the problem if the compressed air piping is saturated with contamination.
- **Point-of-use filtration can be a smart workaround.** When system-wide remediation is not financially viable, localized treatment at critical production lines can deliver the required compressed air quality. This is a focused, cost-effective way to protect product integrity where it matters most.
- **Routine testing is essential.** Portable analyzers provide real-time visibility into compressed air quality. By regularly testing at various points, facilities can confirm compliance, detect emerging issues early and plan compressed air filter maintenance based on actual saturation rates rather than guesswork.
- **Compliance is an ongoing process.** Meeting ISO 8573-1 standards isn't a one-time achievement. It requires continuous monitoring, testing and adjustment. Compressed air quality can drift over time, especially when filters degrade or operations change.

Conclusion: Achieving Desired Levels Requires Diligence

In manufacturing environments where compressed air comes into contact with products, packaging or sensitive equipment, compressed air quality is not optional; it's essential. Standards like ISO 8573-1 exist to help protect product integrity, consumer safety and brand reputation. Achieving the desired standard requires more than simply installing compressed air filters and trusting they'll work.

As these case studies show, assumptions can lead to costly oversights. Hidden contamination, inadequate compressed air system design and lack of testing can all result in non-compliance, even when compressed air systems appear to be properly configured. The only way to ensure compressed air purity is through regular, strategic testing backed by data and expertise.

Manufacturers should treat compressed air as a critical control point, one that deserves the same level of oversight and verification as any other process affecting product quality. Whether through full-system audits or targeted point-of-use solutions, a well-documented testing program provides confidence, protects customers and safeguards supplier relationships.

In the end, clean compressed air isn't just a best practice, it's a business imperative. BP

About the Author

Ron Marshall is a seasoned compressed air expert and Chief Auditor at Marshall Compressed Air Consulting. With extensive experience conducting compressed air system assessments, he specializes in optimizing air compressor efficiency and reducing energy consumption. He is a Certified Engineering Technologist (C.E.T.), Certified Industrial Manager (C.I.M.) and Certified Compressed Air System Specialist.

About Marshall Compressed Air Consulting

Marshall Compressed Air Consulting is an independent firm specializing in industrial compressed air system assessments, energy efficiency optimization and training.

To read articles on ***ISO Standards***, visit https://www.airbestpractices.com/standards/iso-cagi.

For expert presentations, visit our Webinar Archive Section dedicated to ***ISO Standards*** at https://www.airbestpractices.com/webinars.

Pressure Dew Point Monitoring The Key to ISO 8573-1 Compliance

By Simon Gleissner, Managing Director, SUTO iTEC

➤ In compressed air systems, maintaining clean, dry air is essential. It ensures regulatory compliance, protects product quality and supports reliable system performance.

The ISO 8573-1 standard defines clear limits for various compressed air quality parameters. This helps users classify their systems consistently, compare results across applications and set the right requirements for specific processes.

Above: SUTO iTEC's calibration and production facilities are based in Heitersheim, Germany.

One important parameter is the pressure dew point. However, the correct approach to measuring and classifying dew point is often misunderstood. This confusion arises because the ISO 8573-1 classification table does not explain the full measurement process.

This article explains the key points of the ISO 8573 standard and guides you through the correct way to measure and classify pressure dew point for compliance.

ISO 8573-1 Limits and Pressure Dew Point

Chapter 5.3 of ISO 8573-1 defines the dew point limits for each purity class. To classify a compressed air system correctly, measurements must follow the procedures outlined in Part 3 of the standard.

In many cases, users only refer to the classification table and are not familiar with the complete standard. However, Part

ISO 8573-1:2010 Pressure Dew Point

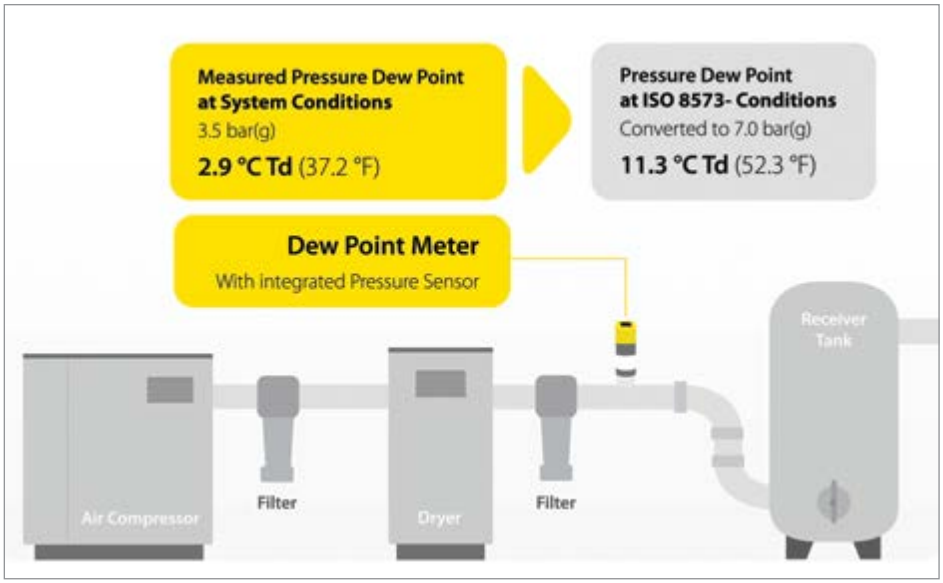
Converted to Reference Conditions of 20 °C (68 °F) and 7 bar(g)

Class	Pressure Dew Point °C (°F)
0	As specified by the equipment user or supplier and more stringent than class 1
1	≤ -70 (94.0)
2	≤ -40 (-40.0)
3	≤ -20 (-4.0)
4	≤ +3 (+37.4)
5	≤ +7 (+45.6)
6	≤ +10 (+50.0)

Hint: The classes and values shown are the 7 bar(g) converted values, not the actual measured pressure dew point.

Pressure dew points converted to reference conditions

A dew point sensor for compressed air and gases



It's important to measure pressure and dew point simultaneously.

3 explains the correct test methods and measurement conditions for humidity, which are essential for reliable and compliant results.

Measurement Standards and Required Conversions

According to Chapter 8, Article 8.1 of ISO 8573-3, all pressure dew point measurements must be converted to reference conditions of 68°F (20°C) and 102 psig (7 barg). This conversion is essential because dew point depends on pressure.

A dew point measurement taken at the system's actual pressure cannot be used directly for classification unless the system operates exactly at 102 psig (7 barg). In all other cases, the measured pressure dew point must be converted to the standard reference conditions.

For example, a dew point reading of 37°F (3°C) at 58 psig (4 barg) might seem to meet the limits of Class 4. However, when converted to the reference conditions of 102 psi (7 barg), the dew point becomes 50°F (9.8°C) dewpoint temperature (Td) and falls into Class 6.

This is a critical consideration. A system designed for Class 4 may appear compliant based on the raw measurement, but after conversion, it does not meet the required class.

If the system pressure is close to 102 psig (7 barg), the difference between the measured and converted values remains small. In low-pressure systems, however, this difference can be significant. Therefore, accurate conversion is particularly important when classifying systems operating at lower pressures.

The Importance of Measuring Pressure Alongside Dew Point

To classify a compressed air system correctly according to ISO 8573-1, it's essential to measure pressure and dew point simultaneously. This approach ensures that the pressure dew point of the system is accurately determined.

Without pressure measurement, the dew point reading does not reflect the actual moisture content of the compressed air

This portable dew point meter includes built-in pressure measurement for direct ISO class indication without external conversion.

Pressure Dew Point Monitoring: The Key to ISO 8573-1 Compliance

under the reference conditions of 102 psig (7 barg). This can lead to incorrect or misleading classifications.

ISO 8573-1 classification requires the following:

- Instruments capable of measuring both dew point and system pressure in parallel
- Conversion of dew point values to the reference conditions of 68°F (20°C) and 102 psig (7 barg)
- Compliance with ISO 8573-3 test methods and documentation standards
- Clear reporting of both the measured and converted dew point values
- Documentation of the system pressure during measurement

Using devices that integrate both pressure and dew point measurement simplifies this process. These instruments eliminate the need for manual calculations, minimize audit risks and support classification in line with the standard.

Many dew point sensors and measurement devices do not include a built-in pressure sensor. While this may be sufficient for basic dew point monitoring, it is essential for ISO 8573-1 classification to use a device that includes integrated pressure measurement.

Some manufacturers offer dew point sensors with integrated pressure measurement and automatic conversion to standard conditions.

A dew point measurement at system pressure with conversion to ISO 8573 reference conditions.

These solutions provide ready-to-use outputs for ISO-compliant classification and make it easier for auditors to verify compliance with the requirements of ISO 8573 Part 3.

Special Considerations for Low-Pressure Systems

Low-pressure compressed air systems often face a higher risk of classification errors. A dew point that meets operational expectations at low pressure may appear non-compliant after conversion to the ISO reference conditions.

This occurs because compressed air at lower pressure can hold more moisture, making the dew point seem compliant with the required class. However, when recalculated at 102 psig (7 barg), the dew point shifts upward and may exceed the threshold for the intended ISO class.

Even if the system performs adequately in daily operations, it may fail an audit if this conversion is not applied. For this reason, pressure-compensated dew point monitoring is particularly important in low-pressure compressed air systems, especially those using refrigerated compressed air dryers.

Building Confidence in Compressed Air System Compliance

Compressed air systems require precise monitoring to maintain compliance and operational reliability. Regular reviews of measurement practices help ensure systems meet ISO 8573 standards.

Key questions to evaluate include:

- Are dew point readings converted to ISO reference conditions?
- Are the instruments compliant with ISO 8573-3 measurement methods?
- Does the measurement process account for system operating pressure?
- Can the reporting withstand the requirements of an external audit?

Using dedicated and well-selected dew point monitoring systems helps minimize audit risks and improves the long-term reliability and efficiency of compressed air operations.

Measurement results

System / Measurement conditions

Medium Temperature [°C]:	31.0	Gas Type:	Air
Medium Pressure [bar]:	5.62	Particle counter flow rate:	2.83 l/min +/- 0.05 l/min

Declared Pressure dew point in °C [referring to actual and reference conditions 20 °C; 7 bar(g)] [*B]

Reference conditions	Limit value	Measured value	Evaluation	ISO 8573-1 Class measured
actual conditions	N.S.[*B]	-24.6	N.S.[*B]	3
20°C / 7 bar(g)	≤ -20.0	-22.7	passed	

This air quality report shows both the system pressure dew point and the ISO 8573-1 converted dew point.

Key Takeaways

To sum up the key points covered in this article, the following aspects are critical for achieving accurate classification and maintaining compliance with ISO 8573-1.

- ISO 8573-1 classification requires converting dew point values to 68°F (20°C) and 102 psig (7 barg).
- Pressure and dew point must be measured together for accurate classification.
- Low-pressure systems are more likely to be misclassified due to pressure effects on dew point.
- Integrated pressure sensors simplify audits and reduce errors.
- ISO-compliant dew point sensors with built-in pressure measurement support continuous, reliable monitoring.

Together, these practices form a reliable foundation for maintaining compressed air purity, ensuring regulatory compliance and optimizing system performance in industrial environments. BP

All images courtesy of SUTO iTEC.

About the Author

Simon Gleissner has over a decade of experience in measurement technology for compressed air and gases. He is the Product Manager for in-house software developments, as well as Product Manager for compressed air quality and purity measurement tools. He is also responsible for the German operations of SUTO iTEC, acting as Managing Director since 2019.

About SUTO iTEC

SUTO iTEC is a global leader in the field of compressed air and gas measurement technology. With over 20 years of experience and a product portfolio that includes dew point sensors, flow meters, particle counters and smart data platforms, SUTO iTEC serves industries across more than 100 countries. Known for precision engineering and customer-focused innovation, SUTO iTEC helps industrial operations meet the highest standards of energy efficiency, quality control and ISO compliance. For more information, visit https://www.suto-itec.com.

To read articles on ***Compressed Air Instrumentation***, visit https://www.airbestpractices.com/technology/instrumentation.

For expert presentations, visit our Webinar Archive Section dedicated to ***Compressed Air Instrumentation*** at https://www.airbestpractices.com/webinars.

Industrial and Commercial Cooling Codes: Why They Matter to Cooling System Stakeholders

By Troy Reineck, Business Development Manager, and
Matt Sniezek, Global Product Manager – Cooling Towers, EVAPCO

In the world of industrial and commercial cooling, performance is only part of the equation. Facility managers, engineers and operations professionals must also navigate an intricate web of codes – regulatory frameworks that govern elements such as structural integrity and thermal efficiency.

Understanding what these codes are, where they apply and how they affect your projects isn't just a matter of compliance – it's about protecting your assets, ensuring operational uptime and making sound investments.

This article breaks down the most critical codes affecting cooling towers, closed-circuit coolers, evaporative condensers and related equipment, explaining why they matter to the professionals responsible for selecting, installing and maintaining them.

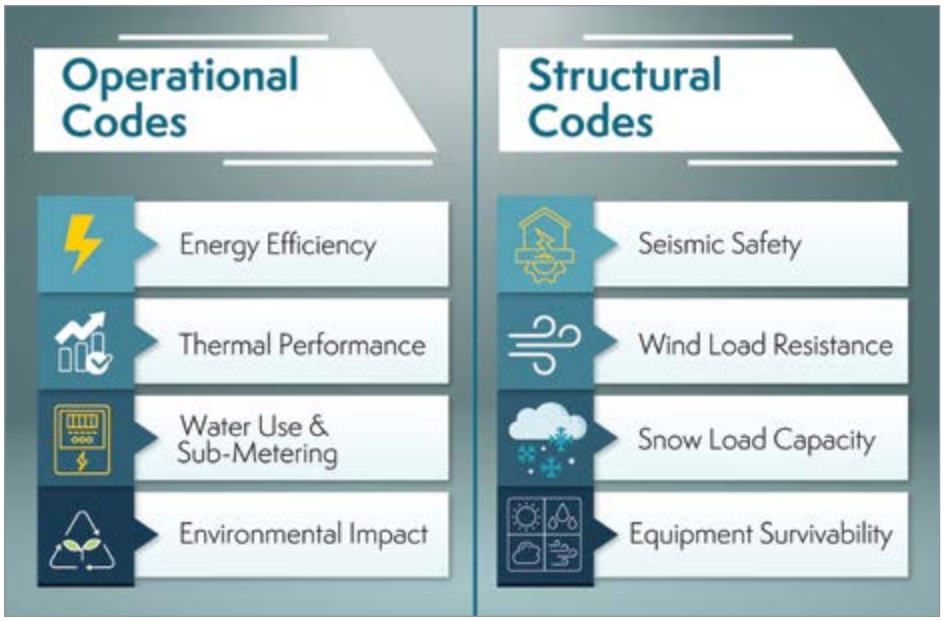
The Basics of Industrial and Commercial Cooling Codes

Codes refer to legally binding regulations or standards that govern design, performance, safety and energy efficiency. They're developed by federal and state agencies, international organizations and independent certification bodies.

Above: Cooling towers installed on an elevated steel platform, delivering high-capacity heat rejection for a large-scale industrial facility.

Unlike guidelines or best practices, codes carry sufficient weight to be enforceable; noncompliance can lead to severe consequences. These might include failed inspections, costly project delays, significant legal liability and even issues with insurance coverage that could leave your organization exposed in the event of equipment failure or an incident.

The development of cooling system codes is a rigorous process, often involving extensive research, public review and consensus-building among experts from various fields, including engineering, manufacturing, academia and regulatory bodies. This ensures the codes are not arbitrary, but are based on sound scientific principles, industry best practices and lessons learned from past incidents. Their purpose is to establish a baseline of safety, performance and environmental responsibility, protecting not only the equipment itself but also the personnel who operate and maintain it, the surrounding environment and the financial interests of the facility owner.



Codes generally fall into two major categories, each addressing a critical aspect of cooling system deployment and operation:

Performance and Efficiency Codes: These are primarily concerned with the ongoing efficiency and environmental impact of cooling systems. This includes giving meticulous attention to energy efficiency, ensuring systems consume minimal power to achieve desired cooling loads, thereby reducing operational costs and carbon footprints. They also cover thermal performance, guaranteeing equipment delivers its specified cooling capacity reliably. These codes often include mandates or guidelines related to water use, promoting conservation through efficient makeup water strategies and effective blowdown management, and sometimes even requiring sub-metering to track consumption.

Structural Codes: These address the fundamental physical safety, resilience and survivability of equipment when subjected to various adverse environmental conditions. This includes designing and installing systems to withstand seismic events (earthquakes), extreme wind loads (hurricanes, tornadoes) and heavy snow accumulations. Beyond merely preventing collapse, structural codes often dictate requirements for equipment to remain operational, or at least safely secured, after such events, particularly for critical infrastructure.

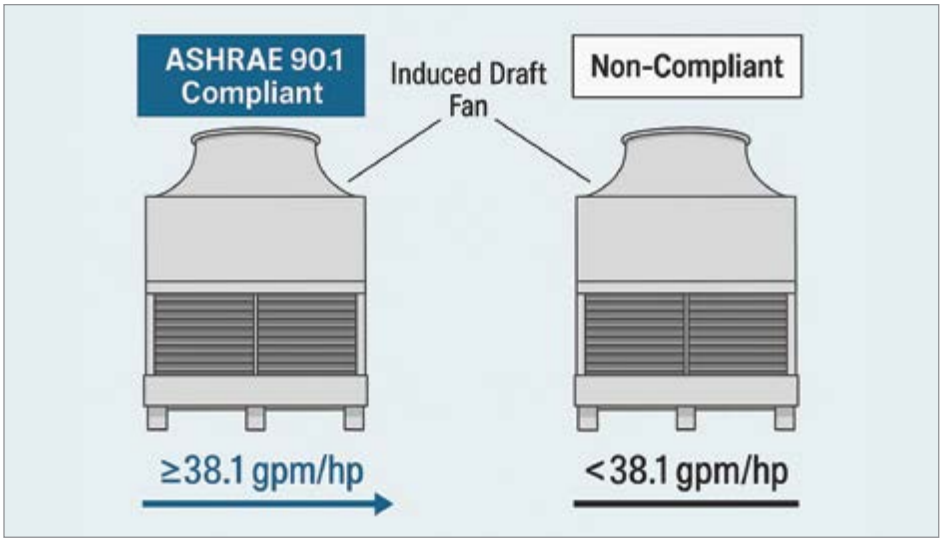
The Indispensable Role of Cooling System Code Compliance

For professionals in the field, codes aren't just bureaucratic checklists to be grudgingly satisfied. They are fundamental guardrails touching every phase of a cooling system's lifecycle, from initial conceptualization to eventual replacement. Understanding and adhering to these codes isn't just about avoiding penalties; it's about strategic asset management, risk mitigation and long-term operational success.

Here's a deeper dive into how codes impact each critical phase:

- **Design:** The initial design phase is where code compliance is either built in or overlooked. There can be consequences.
- **Installation:** This is where the theoretical aspects of design meet the practical realities of construction. Non-compliant mounting, inadequate anchoring or structural components not meeting specified performance criteria can lead to immediate and serious repercussions.
- **Operation:** Once a system is operational, codes continue to play a role, particularly concerning efficiency. Energy and water inefficiencies, often a direct result of poor compliance with operational codes, directly translate to higher operating costs.
- **Maintenance and Upgrade:** Even existing systems aren't immune to code requirements. When planning for replacement cycles, significant upgrades or major repairs, existing systems often must be brought up to current prevailing codes. This means an older, grandfathered system might require more robust structural reinforcement or an efficiency upgrade that wasn't necessary when it was originally installed.

Industrial and Commercial Cooling Codes: Why They Matter to Cooling System Stakeholders



Ultimately, failure to comply can lead to devastating consequences, including operational shutdowns that cripple production, rejected inspections that halt progress, hefty fines that impact budgets or, in the worst-case scenario, systems that catastrophically fail during high wind or seismic events, endangering personnel and causing immense property damage.

Operational Codes You Must Know

Operational codes are the backbone of sustainable and cost-effective cooling system management. They ensure equipment not only performs its primary function, but also does so with minimal environmental impact and optimized resource consumption.

ASHRAE 90.1 (2022) – the Energy Efficiency Standard for Buildings

ASHRAE 90.1, the "Energy Standard for Buildings Except Low-Rise Residential Buildings," is arguably the most widely adopted and influential benchmark for building energy performance across the United States and beyond.

Developed by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), this standard sets minimum efficiency requirements for a broad spectrum of building systems, including HVAC, lighting and, crucially, large cooling equipment, including cooling towers, closed-circuit coolers and evaporative condensers. For cooling systems, ASHRAE 90.1 specifies minimum performance thresholds typically measured in gallons per minute per horsepower (gpm/hp), reflecting the cooling capacity achieved per unit of energy consumed by the fan motor. Each type of cooling equipment (e.g., induced draft, forced draft, cooling tower, closed circuit cooler) has different minimum gpm/hp requirements; see examples below:

- **Induced Draft Cooling Towers:** The standard typically mandates a minimum efficiency of ≥40.2 gpm/hp when operating at ASHRAE 90.1 pre-determined conditions (e.g., 95°F/35°C entering water temperature, 85°F/29°C leaving water temperature, and 75°F/24°C wet-bulb temperature). This metric is a direct indicator of how efficiently the tower uses fan energy to reject heat. Higher gpm/hp values signify greater efficiency.

- **Forced Draft Closed Circuit Coolers:** For these systems, which cool a process fluid indirectly without exposing it to the atmosphere, the efficiency threshold is typically ≥7.0 gpm/hp at ASHRAE 90.1 pre-determined conditions (e.g., 102°F/39°C entering process fluid, 90°F/32°C leaving process fluid, 75°F/24°C wet-bulb temperature).

Why it Matters to You

- **Qualifying for Incentives:** Adherence to ASHRAE 90.1 is often a prerequisite for various financial incentives. This includes earning points towards LEED (Leadership in Energy and Environmental Design) certification, a globally recognized symbol of sustainability achievement. Many utility companies offer significant rebates for installing equipment that exceeds minimum efficiency standards, directly reducing the capital expenditure of new projects.

- **Reducing Operating Costs:** Perhaps the most tangible benefit for facility managers is the direct reduction in operational energy use. In process cooling environments, where cooling systems often run continuously, the cumulative savings from even a slight increase in efficiency can be enormous.

- **Permitting and Interconnections:** In many jurisdictions, compliance with ASHRAE 90.1 (or a local energy code that adopts or references it) is a mandatory requirement for obtaining building permits and utility interconnections. Non-compliance can lead to delays in project commissioning, costly redesigns or even outright rejection of a project until it meets the necessary energy performance criteria.

Title 24 – California's Energy Code

California's Title 24, officially known as the California Building Standards Code, Part 6: California Energy Code, is renowned for its

A crossflow cooling tower rigged and assembled on-site, highlighting the precision and teamwork required for proper installation.

progressive and often more stringent energy efficiency requirements compared to national standards. While it incorporates many aspects of ASHRAE 90.1, it frequently exceeds them, particularly concerning energy and water conservation, reflecting California's aggressive climate goals and water scarcity challenges.

For cooling systems, Title 24's specific requirements include:

- **Enhanced Efficiency for Induced Draft Cooling Towers:** Title 24 often sets a higher bar for cooling tower efficiency, for example, mandating ≥42.1 gpm/hp, which is more stringent than ASHRAE 90.1's baseline. This pushes manufacturers to innovate and produce even more efficient equipment.

- **Mandatory Water Metering:** A distinctive feature of Title 24, especially for larger cooling systems, is the requirement for mandatory water metering of both makeup and blowdown water. This isn't just about tracking; it's about enabling facilities to monitor their water consumption closely, identify leaks or inefficiencies and implement water-saving strategies. It provides valuable data for water management and can be crucial for compliance during drought conditions.

Why it Matters to You

Even if a facility isn't located in California, understanding Title 24 is highly beneficial. Many leading equipment manufacturers, due to the sheer size and influence of the California market, design and build their standard products to meet or exceed Title 24 standards. This means that a "Title 24 compliant" cooling system often represents the cutting edge of energy and water efficiency, offering benefits that extend beyond California's borders.

For those outside California, specifying equipment that meets Title 24 can proactively future-proof installations against evolving national or regional energy codes and signify a commitment to advanced sustainability practices.

Structural Codes You Must Know

Beyond efficient operation, cooling systems must demonstrate the fundamental ability to withstand the forces of nature and other potential hazards. Structural codes address these critical aspects, ensuring the physical safety, resilience and survivability of equipment under adverse conditions. For facilities in high-risk zones, understanding and adhering to these codes is paramount to protecting both personnel and valuable assets.

IBC – International Building Code

The International Building Code (IBC) is a widely adopted model building code in the United States, providing comprehensive regulations for structural safety, fire safety and accessibility, among other things. For large mechanical equipment, including cooling systems, the IBC dictates how these massive structures must be designed and anchored to ensure they remain secure and functional, particularly under external loads.

Key aspects of IBC for cooling systems include:

- **Importance Factor (I_p):** This crucial factor determines the level of seismic and wind resistance required for a structure or component based on its occupancy category and potential risk to public safety.
  - **I_p = 1.0 (Standard Facilities):** For typical commercial and industrial facilities, an Importance Factor of 1.0 applies. This generally means the equipment must be designed and anchored to remain attached to the building structure during a prescribed seismic event or extreme wind load, preventing it from becoming a hazard. While operational integrity is desirable, the primary concern is preventing collapse or detachment.
  - **I_p = 1.5 (Critical Facilities):** For essential facilities where continued operation after an event is critical for public welfare or safety, an Importance Factor of 1.5 is mandated. This includes hospitals, emergency response centers, power plants and facilities housing hazardous materials (e.g., ammonia refrigeration plants). For these applications, cooling systems must be engineered not only to remain attached but also to remain operational after a seismic event or extreme weather,

Industrial and Commercial Cooling Codes: Why They Matter to Cooling System Stakeholders

allowing the critical facility to continue its function. This makes it necessary for manufacturers to invest time and resources to test more robust structural designs, specialized seismic restraints and verified resilience.

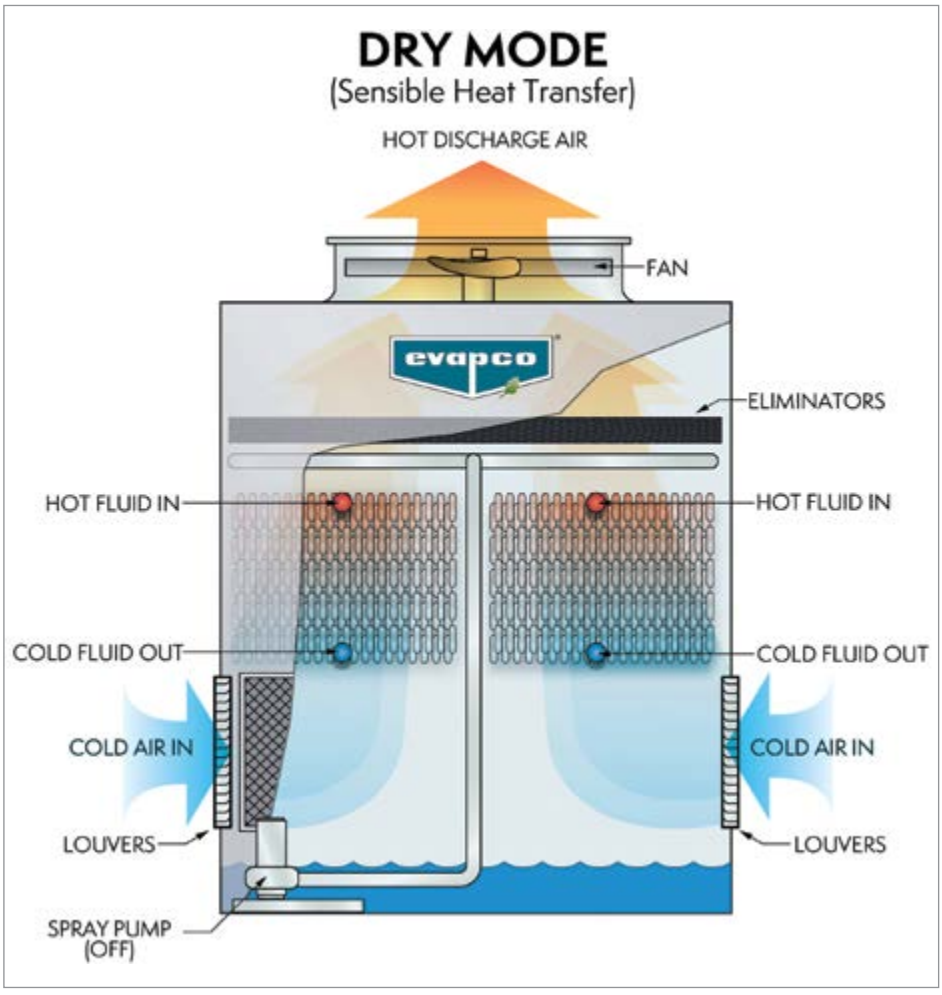
- **Seismic Design Specification (S_{DS}):** This specifies the required seismic forces for a given location and site. S_{DS} values are derived from detailed site-specific geologic data, including soil conditions and proximity to fault lines. A higher S_{DS} indicates a greater anticipated ground motion and, consequently, more robust structural requirements for the equipment and its anchorage. Engineers use S_{DS} values to calculate the lateral forces the cooling system must withstand.
- **Wind load (P):** Based on the wind maps provided in ASCE 7 (discussed later), the IBC specifies how wind pressures are calculated and applied to structures. This is particularly critical in hurricane-prone regions, including Florida, the Gulf Coast and coastal Texas, where cooling towers are exposed to significant uplift and lateral forces. Manufacturers must design cooling tower casings, fan decks and internal structures to resist these forces. Installation must include appropriate anchoring.

ASCE 7 – Load Calculation Standard

ASCE 7, "Minimum Design Loads and Associated Criteria for Buildings and Other Structures," published by the American Society of Civil Engineers, is a pivotal standard that complements the IBC. It provides detailed methodologies and data for calculating various types of loads that buildings and their components, including large cooling systems, must be designed to withstand. While engineers perform the complex calculations based on ASCE 7, facility managers must understand its implications to ensure they specify equipment capable of meeting site-specific loads.

ASCE 7 provides precise calculations for:

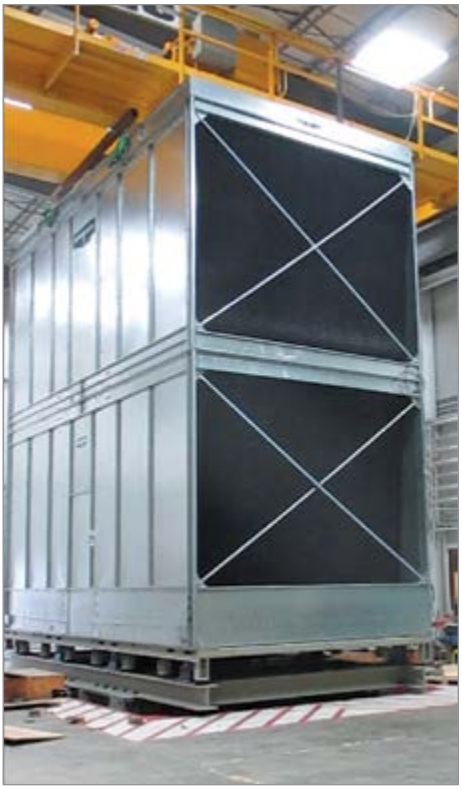
- **Seismic Activity Zones:** It defines seismic design categories for different geographic regions, along with ground motion parameters, allowing engineers to calculate the inertial forces equipment will experience during an earthquake.
- **Wind Speeds by Geography:** ASCE 7 includes detailed wind speed maps, providing basic wind speeds for various locations across the U.S. These maps are crucial for calculating the design wind pressures on structures and equipment, accounting for factors like terrain exposure and building height.
- **Snow Loads:** In northern climates, ASCE 7 specifies methods for calculating snow loads on roofs and elevated equipment, ensuring the structure can support the weight of accumulated snow without failure. While less common for standalone cooling towers unless located on rooftops, it's a factor for accessory structures or platforms.



This closed-circuit cooler operates in dry mode by directing airflow over the coil surface to reject heat without using water, maximizing energy efficiency in suitable conditions.

Why it Matters to You

While facility managers typically don't perform these complex calculations, a fundamental understanding of ASCE 7's role is crucial. When purchasing or designing a cooling system, you should be able to communicate your site's specific requirements (e.g., location, importance factor, exposure category) to your engineers and equipment suppliers. This ensures the chosen cooling system is properly rated and designed to withstand the actual environmental forces it will encounter, preventing costly damage or catastrophic failure. Always request documentation from manufacturers demonstrating compliance with ASCE 7 for specified site conditions.



A crossflow cooling tower undergoing seismic shake table testing to validate structural integrity and performance under dynamic conditions.

FBC – Florida Building Code

The Florida Building Code (FBC) represents a significant enhancement over the national IBC and ASCE 7 standards, specifically tailored to address the unique challenges posed by Florida's severe hurricane climate. Given the frequent and intense tropical storms, the FBC incorporates more stringent requirements to ensure buildings and their components can withstand extreme wind loads, impacts from flying debris and prolonged exposure to harsh environmental conditions.

For cooling systems installed in Florida, the FBC often dictates:

- **Enhanced Anchoring Requirements:** Beyond standard IBC anchoring, FBC specifies more robust and detailed requirements for how equipment must be anchored to supporting structure. This includes prescriptive fastener types, spacing and connection methods designed to resist extreme uplift and lateral forces during high winds.

- **Impact Resistance:** In certain "high-velocity hurricane zones" (HVHZ), equipment or its enclosures may need to demonstrate resistance to impact from wind-borne debris. While less common for the primary structure of a large cooling tower, this might apply to access panels, louvers or associated components.

- **Fastener Requirements:** The FBC provides specific criteria for the type, material and corrosion resistance of fasteners used in equipment construction and installation, particularly given Florida's humid, corrosive environment.

When procuring cooling systems for Florida installations, it's critical to verify equipment is approved by the FBC. Many manufacturers (including EVAPCO) offer models that specifically comply with FBC. Insist on documentation, such as a Florida Product Approval (FL#), which indicates that the product has undergone rigorous testing and review to meet the FBC's stringent criteria. Without this, your project could face significant delays, rework or outright rejection by building inspectors.

OSHPD/HCAI – California's Healthcare Requirements

In California, the Office of Statewide Health Planning and Development (OSHPD), now known as the California Health Care Access and Information (HCAI) agency, sets some of the most rigorous seismic requirements in the world for healthcare infrastructure. Given the critical nature of hospitals and other healthcare facilities – which must remain operational during and after a major earthquake to provide emergency services – HCAI regulations go far beyond typical building codes.

Manufacturers of cooling towers and other essential equipment are required to renew HCAI approval every six years. The approval process requires:

- **Shake-table Testing:** A unique and stringent requirement is that critical equipment, including cooling towers, must pass independent shake-table testing. This involves physically mounting the equipment on a large platform that simulates the ground motions of a severe earthquake. The equipment must not only remain structurally intact, but also demonstrate functional integrity after the simulated seismic event. This rigorous testing provides a high level of assurance regarding the equipment's resilience.

- **Applicability:** These stringent requirements apply directly to cooling towers and other HVAC components serving hospitals, skilled nursing facilities and other critical care environments where uninterrupted operation is literally a matter of life and death.

- **Importance Factor ($I_p = 1.5$) Rated Equipment:** As mentioned under IBC, all equipment for HCAI-regulated facilities must meet the $I_p = 1.5$ rating, signifying it is designed to remain fully operational after a seismic event.

Why it Matters to You

For those managing or specifying equipment for healthcare facilities in California, understanding HCAI requirements is non-negotiable. Only manufacturers that have invested in the necessary engineering, testing and documentation can provide HCAI-compliant equipment. Specifying such equipment ensures patient safety, avoids regulatory roadblocks and protects the facility's ability to respond to emergencies.

Performance Verification: The Indispensable Role of CTI Certification

While codes mandate minimum efficiency and structural integrity, how can facility professionals be sure that the cooling equipment they purchase will perform as advertised? This is where third-party certification bodies, including the Cooling Technology Institute (CTI), play a vital role. CTI certification provides an independent, unbiased verification of thermal performance, giving end-users confidence in their investment.

CTI STD-201 and ATC-105: The Gold Standard for Thermal Performance

The CTI is a non-profit organization dedicated to advancing cooling tower technology. Its certification programs are recognized globally as the gold standard for verifying the thermal performance of evaporative cooling equipment.

CTI STD-201 (Standard for Certification of Cooling Towers): This standard defines the requirements for participating in the CTI Product Certification Program. It outlines the procedures for submitting product data, the scope of the certification and the ongoing obligations of manufacturers, including regular audits and performance verification.

Industrial and Commercial Cooling Codes: Why They Matter to Cooling System Stakeholders

CTI ATC-105 (Acceptance Test Code for Water Cooling Towers): This code provides detailed methodology and procedures for conducting thermal performance tests on cooling towers. It specifies measurement points, instrumentation, calculation methods and acceptable tolerances. When a cooling tower undergoes a CTI-certified test, it is conducted under the strict guidelines of ATC-105 to ensure accuracy and repeatability.

How Certification Works

For a cooling tower model to achieve CTI certification, it must undergo a rigorous process that typically includes:

Initial Performance Verification: A randomly selected production unit of the specific model is tested either in a CTI-approved laboratory or under controlled field conditions according to ATC-105. The test results must demonstrate the tower meets or exceeds its published thermal performance ratings.

Annual Performance Verification: To maintain certification, manufacturers are subject to annual, unannounced performance verification tests on randomly selected units from their production lines. This ensures ongoing adherence to certified ratings.

Transparent Data Publication: CTI publishes a directory of certified models, making it easy for specifiers and purchasers to verify a product's certified status.

Manufacturing Audits: CTI also conducts audits of manufacturing facilities to ensure that quality control processes are in place to consistently produce equipment that meets the certified design.

Why CTI Certification Matters to You

Validates Thermal Performance: The most significant benefit is the assurance the cooling system will deliver its rated thermal capacity under specified conditions. Without CTI certification, you're relying solely on manufacturer claims, which may or may not be accurate in real-world applications. CTI certification eliminates the need for expensive and time-consuming field performance testing (unless a specific acceptance test is required by contract), saving you significant commissioning costs and potential disputes.

Simplifies Code Compliance and Rebate Eligibility: Many energy codes (e.g., ASHRAE 90.1) and utility rebate programs explicitly reference CTI certification as a means of verifying equipment efficiency. Opting for a CTI-certified unit streamlines the compliance process and makes it easier to qualify for financial incentives, accelerating your ROI.

Avoids Over- or Under-Sizing: Knowing the true performance capabilities of a cooling system prevents costly mistakes. An undersized system will fail to meet cooling loads, leading to process disruptions or reduced product quality. An oversized system represents unnecessary capital expenditure and potentially higher operating costs due to inefficient partial load operation. CTI certification ensures you get the right size for the job.

Shields Specifying Engineers and Contractors from Liability: For consulting engineers and contractors, specifying CTI-certified equipment provides a critical layer of protection. If a system fails to meet performance expectations, the responsibility typically falls on the manufacturer, as its product has been independently verified. This reduces professional liability and builds confidence in the specification process.

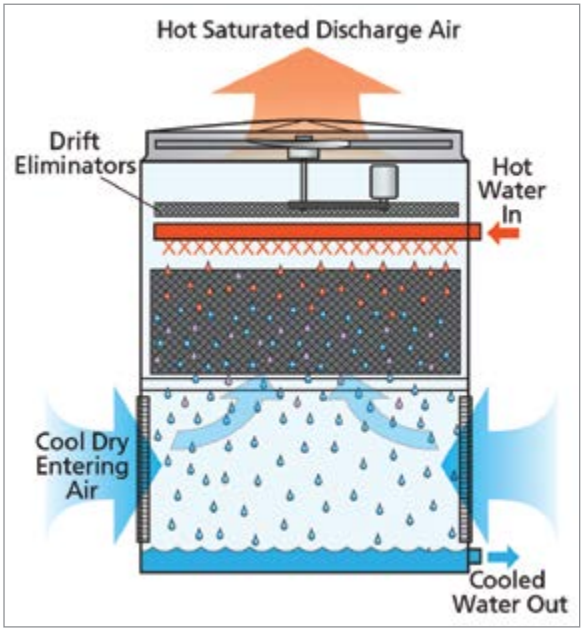
Building Codes Aren't Static – They Evolve

The world of building codes and standards isn't stagnant; it's a dynamic environment driven by technological advancements, lessons learned from past events and societal concerns (such as climate change and water scarcity).

At-a-Glance: Common Codes by Application

Here's a concise overview of the key codes and standards discussed, highlighting their primary focus, where they generally apply and their direct impact on cooling system stakeholders:

Code/Standard	Covers	Applies	Stakeholder Impact
ASHRAE 90.1	Energy efficiency	National	Energy modeling, utility rebates, building code compliance
Title 24	Energy and water efficiency	California	Equipment selection, mandatory water tracking, advanced efficiency
IBC	Structural integrity	National (model code)	Anchoring specifications, seismic and wind design inputs
ASCE 7	Load calculations (seismic, wind, snow)	National	Provides design inputs for engineers (forces, pressures)
FBC	Enhanced wind/hurricane safety	Florida	Requires structural upgrades, specialized anchoring, product approval
HCAI/OSHPD	Seismic resilience in healthcare	California (for healthcare facilities)	Requires shake-table testing, IP=1.5 rating, critical uptime
CTI STD-201/ ATC-105	Thermal performance verification	International	Certifies real-world efficiency, ensures delivered capacity, reduces liability



This induced draft, counterflow cooling tower cools water by combining airflow and evaporation, releasing warm air out the top while recirculating cooled water back into the system.

Codes like ASHRAE 90.1 and Title 24 typically undergo comprehensive revision cycles every three to four years. Similarly, the IBC and ASCE 7 are periodically updated to incorporate new scientific understanding of natural hazards and improved engineering practices.

Staying current with these revisions isn't just a best practice – it's crucial for several reasons:

- **Bidding New Projects:** When bidding on new construction or major renovation projects, the applicable codes are always the most current adopted versions by the local jurisdiction. Bidding based on outdated code knowledge can lead to non-compliant proposals, wasted effort and project rejections.
- **Upgrading Old Systems:** As discussed earlier, major upgrades or replacements of existing systems often trigger the requirement to bring the entire system (or the upgraded components) up to current code standards, even if the original installation was grandfathered. This impacts design, material selection and installation.
- **Seeking Incentives:** Utility rebates and tax incentives are frequently tied to compliance with the latest versions of energy efficiency codes. Failing to meet the most recent standard can mean missing out on significant financial benefits.
- **Navigating Re-permitting or Audits:** Any change of occupancy, significant modification or routine regulatory audit may require re-permitting, which will necessitate compliance with current codes. Being prepared for these eventualities is key to avoiding delays and penalties.

Facility managers and engineers should actively engage with industry associations, subscribe to updates from relevant code bodies and maintain relationships with knowledgeable consultants and equipment manufacturers who stay abreast of these changes.

Codes Safeguard Your Cooling System Investment

In the dynamic arena of industrial and commercial facility management, every major equipment decision carries significant implications for capital expenditure, operational costs and long-term reliability.

When it comes to large cooling systems, the realm of codes and standards emerges not as a mere compliance checkbox, but as a powerful value driver directly impacting ROI.

These essential regulations – ASHRAE's efficiency mandates, California's stringent Title 24, the structural integrity dictated by IBC and ASCE 7, the specialized resilience demanded by FBC and HCAI and the transparent performance verified by CTI – collectively ensure cooling assets are:

- **Maximized for Efficiency:** Translating directly into lower utility bills and a reduced environmental footprint.
- **Engineered for Durability:** Protecting against costly damage and ensuring business continuity during adverse events.
- **De-risked for Performance:** Providing independent assurance the system will deliver its promised capacity.
- **Qualified for Incentives:** Unlocking access to rebates and tax benefits that enhance project viability.

By understanding and applying these codes, facility and plant managers aren't just meeting minimum requirements; they're making informed decisions that safeguard operations, optimize financial performance and position their organizations for sustained success. Investing in code-compliant cooling is not an expense; it's an intelligent investment in operational stability, cost predictability and future resilience.

Additional Resources:

- ASHRAE 90.1 Overview: https://www.ashrae.org/technical-resources/standards-and-guidelines/read-only-versions-of-ashrae-standards
- California Title 24 Resources (California Energy Commission): https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards
- Cooling Technology Institute: https://www.cti.org
- International Code Council (ICC): https://www.iccsafe.org
- Florida Building Code (Florida Department of Community Affairs): https://floridabuilding.org BP

All images courtesy of EVAPCO.

About the Authors

Troy Reineck has been with EVAPCO since 2007 and is currently Business Development Manager. He has also held positions in open cooling towers, closed circuit coolers and, most recently, as the EVAPCO Professor. He has sales experience with an HVAC sales and service representative firm, and also held design, manufacturing and sales engineering positions in the automotive industry. He earned a BSME from GMI Engineering & Management Institute.

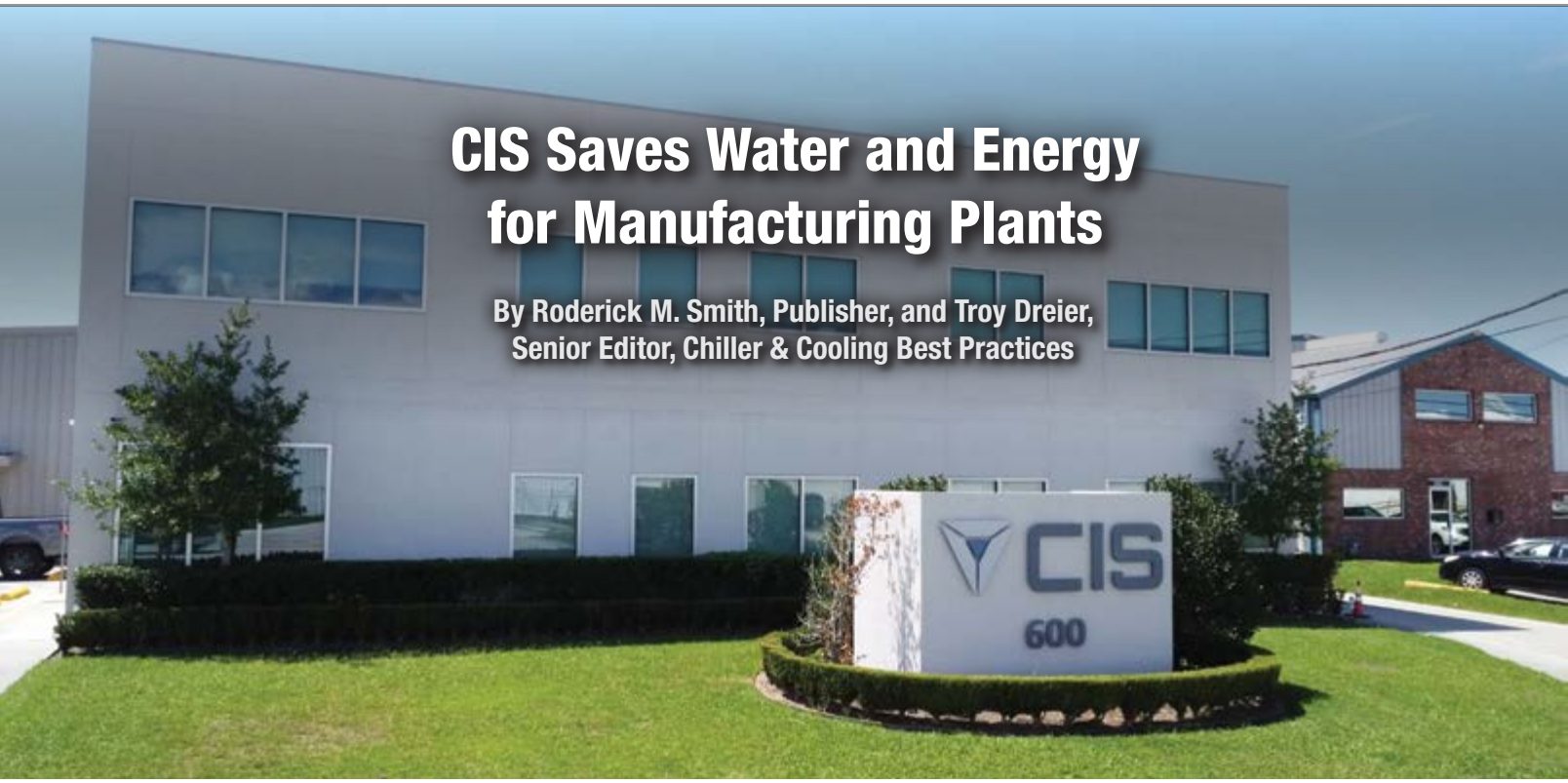
Matt Sniezek is EVAPCO's Global Product Manager – Cooling Towers. He has been with EVAPCO since 2019. He joined the company after graduating from the University of Maryland with a BS in Mechanical Engineering. Matt has filled multiple application engineering roles for closed-circuit coolers and open cooling towers.

About EVAPCO

EVAPCO provides a full spectrum of global product solutions for the commercial HVAC, industrial refrigeration, power generation and industrial process markets with 78 active patents on the market today. Headquartered in Taneytown, MD, the company's products are engineered and manufactured in 25 locations in 10 countries and supplied through a sales network of more than 170 offices. For more information, visit https://www.evapco.com.

To read articles about ***Cooling Tower Technology***, visit https://coolingbestpractices.com/technology/cooling-towers.

For expert presentations, visit our Webinar Archive Section on ***Cooling Tower Technology*** at https://coolingbestpractices.com/magazine/webinars.



CIS Saves Water and Energy for Manufacturing Plants

By Roderick M. Smith, Publisher, and Troy Dreier, Senior Editor, Chiller & Cooling Best Practices

In April 2025, we presented an interview with CIS Industries, a supplier of industrial and commercial HVAC solutions and technologies based in New Orleans, LA, that detailed how the engineering firm helps central utility plants withstand extreme weather events, such as hurricanes. Our interview uncovered so much valuable information we decided to create a second part. Keith Earhart is Senior Vice President, Engineered Sales and Strategic Accounts, for CIS.

Best Practices: What are some of the most common water conservation projects for industrial applications you encounter with water-cooled or air-cooled chillers?

Keith Earhart: That depends on whether we're trying to conserve water because we can't get enough to the site or because it's expensive. We have a couple of approaches. If we can increase the cycles of concentration on a cooling tower, we're blowing less water down. To do that, we have to have a good handle on what's going on in the tower, from proper water treatment to ideally filtered and treated makeup water. We're not just taking well water and dumping it in there. We're potentially running it through a reverse osmosis generator or using nano filtration or we're using a separator.

Above: CIS Industries headquarters in New Orleans, LA

Once we evaporate water, we're left with a certain amount of solids. How do we get them out? Do we blow them down or do we provide a sweeper system that concentrates the amount of particles into a separator and blows that down, therefore increasing our cycles of concentration?

Or do we look at a hybrid adiabatic approach where, at certain times of the year, we can turn off the evaporative portion and run on a pure dry coil? Water conservation becomes tricky depending on the area and the demand to the site.

Keith Earhart, Senior Vice President, Engineered Sales and Strategic Accounts

If we're trying to save energy, what is the most cost-effective solution? Do we want to spend $90,000 on a reverse osmosis system, or do we want to spend $20,000 on a separator that gets us close enough for this scenario? Often, it's a combination of the two.

Best Practices: We have a longtime reader who is responsible for 10 major manufacturing plants. He said, "We're evaporating four million gallons a day just in this plant. Any advice?" I told him, "I know you need to look at makeup water." You just touched on that. Any other things you would say to him, because he'll read this?

Keith Earhart: Certainly. In addition to the makeup water, the cycles of concentration and the basin sweepers and separators – which are all good things – chances are he's changed his towers' fill more than a few times.

Often, we'll see RFPs go out saying, "Change the fill in my cooling tower." Nothing more associated with it. One of our larger customers came to us to advise on the fill for a light industrial cooling tower. When they replaced the fill previously, they left out specifications

on the exact peripheries. In fact, they even left out new requirements for drift eliminators overall. You go to this beautiful little campus next to an iconic stadium, and you see drift from this tower billowing out over the whole campus because somebody wanted to save a few dollars, or it wasn't clearly specified.

I would focus on getting quality components for that fill and making sure your specifications are tight to get exactly what you want with a specifiable drift rate, specifiable performance, specifiable thickness and wind loading associated with that.

It's common that in a fill change, if the customer says, "Give me the best price," they'll go in there with chainsaws and cut out all the fill hangers and the fill, then throw in block fill. Block fill sits on the floor and offers much lower performance. It becomes a nightmare from a cleaning perspective. All the mud just sits on the bottom of this fill and the bottom of the cooling tower. That's not what you envisioned when you spent your money on a fill change, especially with a big light industrial cooling tower. Now, you've taken this high-performance machine and you've put a bottom-line engine in it. Is it an engine? Yeah. Does it work? Yeah. Does it work like it's supposed to? No.

"The fill and drift eliminators are interesting because you pay for them twice. If you use lower-performance fill, your net result might be one degree more of approach on that cooling curve, resulting in one degree hotter condenser water. You have to pay for that twice. You're running hotter water overall, your fans are working harder to get there, but now your chillers have to use significantly more energy to the tune of 11-12% for one degree of approach."

— Keith Earhart

Best Practices: How much impact do quality drift eliminators and fill have on water consumption?

Keith Earhart: Drift is completely wasted water and energy. The water lost serves little to no useful purpose. High-performance drift eliminators boast drift rates of .001% down to .0005%. That's an exponential difference in water conserved when compared to the original drift rates of some large industrial towers that shipped with .01%.

In general, the fill and drift eliminators are interesting because you pay for them twice. If you use lower-performance fill, your net result might be one degree more of approach on that cooling curve, resulting in one degree hotter condenser water. You have to pay for that twice. You're running hotter water overall, your fans are working harder to get there, but now your chillers have to use significantly more energy to the tune of 11-12% for one degree of approach. Now you're rejecting more heat, burning more energy and have overall higher heat rejection, which means you have higher evaporation.

Best Practices: It's like having a bad heat exchanger.

CIS Saves Water and Energy for Manufacturing Plants

Keith Earhart: Exactly. You have to work that much harder to do the same amount of work. Now we have this massive lift, and we really have no need for that. It can make a significant difference overall. Back-of-the-envelope math says every degree of tower water approach is about 11-12% capacity, with the energy usage rising to the cube. That can be significant overall water usage. I would focus on what you're putting back in these towers. Make sure it's OEM grade. Believe me, that matters.

One other thing that can save water is a heat pump chiller. Manufacturers have been putting these out since the 1970s and the oil crisis. They're not recent. While certain parts of the country have embraced them in large central plant loops, other parts of the country have pushed back based on previous experiences with poor designs and maintenance plans. We've done a lot of them, and the key to success is to keep them simple. Run it and size it like a boiler that also happens to make free chilled water.

Imagine if, instead of rejecting the heat from the chillers to the cooling tower, I then redirect it for, say, a hospital, and I use it as useful heat at 140°F (60°C) in my process. That's that much less water I'm evaporating. That's also that much less energy I'm using. I'm not paying for it twice. I'm putting chilled water over here and I'm putting hot water over there exactly where it needs to go. That has led to significant financial as well as environmental savings for a lot of our customers. In fact, nearly all of our energy-to-service and energy-saving projects have a heat pump chiller at their core. The ROI is significant.

Best Practices: I've never thought of a heat pump chiller as a technique to reduce water consumption in a cooling tower. It makes sense.

Keith Earhart: If we don't have to reject it, that's more water savings overall. Of course, we have the added benefit of creating hot water for about half the price. Obviously, natural gas is cheaper per kilowatt than energy, but when we're running a heat pump chiller, we're running on the heating side alone, running a coefficient of performance (COP) of four, which means we're making hot water for half the cost. By the way, you have all that 40-42°F (4-6°C) water on your chilled water side that you're getting for free, as well. The actual integrated COP is significant and it's a win-win. We were on the voting committee for energy codes in Louisiana. We made it known that we have fully embraced heat pump chillers in all our sites.

If you don't want to do an air-side economizer and water-side economizer, a heat pump chiller for a hospital application can be a good approach. Not only that, but we've actually made it code-mandated on hospital facilities over a certain size that you'll have 7% of your capacity come from a heat pump chiller.

"ASHRAE Guideline 36 is basically a high-performance sequence of operations for large buildings, such as large manufacturing plants, hospitals and hotels. The core concept is to have our load dictate what we do, not the other way around."

— Keith Earhart

Best Practices: It's like they're trim units in a way?

Keith Earhart: Yes. Basically, they respond like another stage of the boiler, ideally the first stage of the boiler. First on, last off. If you need additional hot water, you bring another boiler on. If you need additional chilled water, you bring an additional chiller on. You produce as much chilled water as you can, but you respond to the hot water demand load.

ASHRAE Guideline 36 is a high-performance sequence of operations that ASHRAE sponsors. Automatic Logic Corporation (ALC), a Carrier subsidiary, was involved, along with Taylor Engineering. We've developed a high-performance sequence of operations, not just from the air handler perspective, but from the central plant perspective. It's exactly what you're describing: how to bring these chillers on, how to not have it where we're not meeting set point for five minutes, then bringing another chiller on. That means you had one chiller running 100% when you could have easily brought another one on when you hit 80%. If you dig into some of that, it's been pretty good for us. We've implemented it across multiple campuses with great success, because it provides standardized sequences of operations that manufacturers have to certify they're going to hit. You can have a mixture: We can have a constant speed centrifugal chiller that hasn't been replaced. Maybe it's used as a backup. We can have a positive displacement chiller. We can have VFD centrifugal chillers. Based on that combination, we're going to create a grid saying this is how we sequence everything to optimize it. It's based on our need for a set amount of chilled water, differential pressure or cold temperature.

Best Practices: Can you describe ASHRAE Guideline 36? What is it and how do you deploy it?

Keith Earhart: ASHRAE Guideline 36 is basically a high-performance sequence of operations for large buildings, such as large manufacturing plants, hospitals and hotels. The core concept is to have our load dictate what we do, not the other way around. If the process can handle X amount of chilled water temperature, then we will reset to that. If an air-cooled/distribution process like an AHU can handle X amount of differential pressure, then we'll reset down to that point accordingly. We let the load dictate to the plant. From there, based on your need for 20,000 tons of chilled water at this degree and wet bulb temperature, how do we achieve this? The concept is that we have a standard set of sequences that all manufacturers can code, and ASHRAE has the guideline. All manufacturers will go back and say, "We have tested to this guideline, and we certify these programs comply." It takes the burden off the engineer and puts it on the manufacturer.

For more information on CIS Industries, visit https://cisindustries.com. BP

To read similar ***Chiller Technology*** articles, visit https://coolingbestpractices.com/technology/chillers.

Visit our Webinar Archives to listen to expert presentations on ***Chiller Technology*** at https://coolingbestpractices.com/magazine/webinars.

SALES ENGINEERING SKILLS

Precision Prospecting: The Art of Identifying and Closing New Revenue

By Mark Allen Roberts, CEO, OTB Solutions

Sales prospecting is more difficult than ever. Winning new customers hinges on precision, specifically precision prospecting. Gone are the days of casting wide nets. Today, sales pros need to be snipers honing in on ideal targets with pinpoint accuracy.

Salespeople in the compressed air and cooling industry know they need to prospect continuously; however, only the top performers do. The rest make cold-call drop-ins at plants near current customers. Sometimes these drop-ins work and the salesperson is invited inside, but often they don't.

Precision prospecting is the rigorous and methodical process of identifying and reaching out to ideal potential customers who have a genuine need for your product or service and are also able to make purchasing decisions. Precision prospecting means addressing needs, sharing industry best practices and creating lasting, value-rich partnerships.

Mark Allen Roberts will conduct a Sales Engineering Workshop at the Best Practices 2025 EXPO & Conference in Kansas City. Visit https://cabpexpo.com/sales-engineering-workshop/.

Getting Started with Precision Prospecting

Begin by defining your ideal customers. What industries are they in? What locations? How many employees do they have? Who is involved in the buying decisions?

To make connections and start conversations that lead to new revenue, it's important to speak the language of decision makers. Common decision makers for compressed air and cooling products and services include:

- Purchasing managers
- Plant managers
- Maintenance managers
- Maintenance technicians
- Industrial engineers
- CFOs (particularly for large purchase orders)

Compressed air and cooling sales engineers must quickly connect the dots between what they sell and how it impacts the decision maker's needs. Develop and practice value-based messaging for different decision makers.

For example, what do plant managers care about? What's important to them? How do they measure success? Plant managers' main areas of focus are production efficiency, improving throughput, production quality, empowering managers to make data-driven decisions and improving manufacturing costs.

When contacting plant managers at targeted accounts, never assume the person has a problem, but speak their language in the form of a question. For example:

When we help other plant managers with large laser-cutting operations like yours, they want to reduce their cost of nitrogen gas while improving their operation's efficiency. Is this important to you?

I recently helped another plant manager in the automotive parts industry reduce their energy costs while also reducing their downtime. Are these issues you'd like to improve?

We often find compressed air dryers fail in summer months with high humidity. Would you like us to audit your dryers to ensure you don't experience unexpected downtime this summer?

By the nature of your questions, you demonstrate value and build trust.

Precision prospecting is more than a sales strategy. In today's complex, uncertain and competitive business landscape, precision is power. Take a moment to reflect on who your ideal customers are, who makes decisions and what your language will be to improve your prospecting results. BP

About the Author

Mark Allen Roberts is the CEO of OTB Solutions, which provides professional training and coaching. Visit https://www.nosmokeandmirrors.com.

To read about the ***Compressed Air Industry***, please visit https://www.airbestpractices.com

Visit our Webinar Archives to listen to expert presentations on ***Cooling System Technology*** at https://www.airbestpractices.com/webinars.

Real-World Installations & Maintenance

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

There's much we can learn from real-world compressed air, blower, vacuum, chiller and cooling tower installations. This column asks readers to share lessons learned from system installations and maintenance practices they encounter in the real world.

Woodworking in the Vatican City

The Analysts takes a holistic approach to compressed air system optimization, examining every part of a compressed air system to create a tailored plan that improves performance and roots out inefficiencies. Visit https://www.the-analysts.com.

While on a work and pleasure trip to Italy, The Analysts Co-Founder Josh Wamser discovered this cabinet-enclosed reciprocating air compressor in the Vatican City. Walking by a small woodworking shop full of artistic treasures, Wamser said, "I heard the unmistakable sound of a piston air compressor shutting off and venting head pressure. I remember thinking, please do not let compressed air touch any of those paintings! Can you imagine if a small compressed air leak with some water and oil in it accidentally got on a priceless work of art?"

This cabinet-enclosed reciprocating air compressor powers a woodworking shop in the Vatican City.

A Sensor that Doesn't Go With the Flow

Based in Belfeld, The Netherlands, ANTS Technology & Consulting provides energy-saving compressed air services including leak surveys, on-site repairs and consulting. It specializes in helping plants comply with ISO 8573-1 and EN 12021 standards. Visit https://ants-compressed-air.com.

While working at a raw materials processing plant, Marvin van Hout, Commercial Technical Advisor, came across this incorrectly installed thermal mass flow sensor. The sensor should have been mounted on the ball valve with its shaft inserted into the center of the pipe. The elbow fitting is unnecessary. Van Hout notes the use of bayonet couplings makes this installation not only ineffective, but also a safety hazard.

Using sensors to monitor compressed air system flow only works if the sensors are installed correctly.

Submission Guidelines

We invite subscribers to share stories and photos of remarkable system installations they've come across. Email Troy Dreier at troy@airbestpractices.com. Please send a high-resolution image as a JPG or GIF file and a note describing the installation.

THE MARKETPLACE

TECHNOLOGY & JOBS

Job & Product Marketplace Advertising Information

Reach 16,200+ readers of Compressed Air Best Practices® Magazine with Marketplace Ads every month!

Prices are $625 per Job or Product Marketplace Ad ($440 if 6 or more ads are placed).

Contact Erik Klingerman at erik@airbestpractices.com to schedule your Marketplace Ads.

COMPRESSED AIR BEST PRACTICES®
www.airbestpractices.com

ADVERTISER INDEX

Advertising/Editorial Rod Smith • rod@airbestpractices.com • Tel: 412-980-9901
Subscriptions Administration Patricia Smith • patricia@airbestpractices.com • Tel: 412-980-9902

A Publication of Smith Onandia Communications LLC
37 McMurray Rd., Suite 104, Pittsburgh, PA 15241

THE MARKETPLACE

TECHNOLOGY & JOBS

BEKOMAT®

Condensate is a by-product of the air compression process and can be aggressive, pollutant-loaded, and/or contain oil. It exists in every compressed air application and is something that must be continuously managed. Condensate drains remove the liquids and are an often overlooked component of the compressed air chain, yet when left unchecked can cause poor part quality, machine damage, and even bodily injury to employees. Drainage points are also one of the system areas where energy waste is highest.

BEKO

Energy Savings

Maximum energy savings is achieved from the patented operation that guarantees true zero air loss.

Intelligence

The electronic control board and sensor ensure intelligent operation at all times with the ability to automatically clear clogs and debris.

Maintenance

Maintenance time and costs are kept to an absolute minimum with a quick and easy procedure consisting of just one part.

Reliability

An integrated sieve eliminates concerns about dirt, Y-strainers, and extra maintenance giving you the highest level of reliability.

+1 (800) 235-6797
www.bekousa.com

Condensate Drains

Truth in Compressed Air

Reliable | Efficient | Innovative

What's your Plan B for Compressed Air?

During outages, business expansions, or periods of limited capacity, dependable backup air keeps operations running smoothly. Just like a generator provides backup power, KAESER portable compressors are designed for maximum flexibility and on-site reliability.

Don't get caught unprepared.

Introducing the M480 – your reliable solution for industrial backup air. Need oil-free air? We've got you covered with the M500.

KAESER COMPRESSORS®

us.kaeser.com ● 866-516-6888